Access and Benefit-sharing of Animal Genetic Resources

Using the Nagoya Protocol as a Framework for the Conservation and Sustainable Use of Locally Adapted Livestock Breeds

by

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Abbreviations

AnGR	Animal Genetic Resources
BCP	Biocultural Community Protocol
CBD	Convention on Biological Diversity
CGRFA	Commission on Genetic Resources for Food and Agriculture
COP	Conference of the Parties
EFFAB	European Federation of Farm Animal Breeders
FAnGR	Farm Animal Genetic Resources
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
ITWG-AnGR	Intergovernmental Technical Working Group on Animal Genetic Resources

Executive summary

Animal genetic resources are an important subset of biological diversity, composed of the breeds and strains of domesticated animals that humankind has developed out of some 40 wild species over the last 10,000 years. They form the foundation of an industry valued at USD 1.4 trillion and are essential to the livelihoods of 1.3 billion people, including 600 million poor. Animal genetic resources fall under the purview of the Convention on Biological Diversity as well as the Nagoya Protocol

This study seeks to investigate the cornerstones of an international access and benefit-sharing regime for animal genetic resources that would be fair and equitable as well as workable, considering the distinctive features of animal genetic resources, as well as the urgent need for maintaining and conserving domestic animal diversity for future generations.

The sector is characterized by a large diversity of breeding systems. These range from communal systems placing a premium on adaptation traits to corporately owned operations aimed at providing high performance animals that function in industrial systems. While the former depend on traditional knowledge and are basically open access, the latter involve sophisticated scientific knowledge and are protected by various forms of Intellectual Property Rights. Because of the large differential in performance, there is currently little interdependence of these systems, although this may change, due to emerging consumer preferences, resource shortages, climate change, the need to decrease use of antibiotics, and other factors.

Some of the distinctive features of animal genetic resources include the need for in-situ conservation (as ex-situ conservation is proving difficult), the linkages between communities and specific breeds, the patterns and direction of exchange which are currently mostly North-North, North-South and to some extent South-South, but with limited movements South-North. Important for the design of an international regime on ABS is the current lack of industry interest in genetics from developing countries, as well as the potential of local breeds to significantly contribute to rural development in-situ if the right types of support are provided.

The hurdles to conservation and sustainable use include the promotion of cross-breeds and exotic breeds, the lack of data and documentation of local production systems and breeds, as well as subsidies for industrial systems and the prevailing "efficiency paradigm". By contrast, bio-piracy is of limited significance.

The various stakeholder groups have different opinions on Access and Benefit-Sharing. Governments are mostly concerned with developing the right kind of material transfer agreements and preventing any disruption in the flow of animal genetic resources. They also see the need for addressing Livestock keepers' Rights and support (Biocultural) Community protocols, as stipulated by the Nagoya protocol. Among scientists, some are worried that their access to research materials may be jeopardized; others warn about the deleterious impact of the indiscriminate export of exotics into developing countries threatening the integrity of local breeds. Indigenous and local livestock keepers have been advocating for fair and equitable benefit-sharing since 2003, requesting for their breeds to be recognized as product of their traditional knowledge and as community property.

While the Global Plan of Action for Animal Genetic Resources provides a comprehensive framework for the management of AnGR, the Nagoya protocol adds important dimensions. By mandating prior informed consent and mutually agreed terms not only by provider countries but also by local and indigenous communities it enforces Strategic Priority 5 of the GPA to support indigenous and local production systems and associated knowledge systems of importance to the maintenance and sustainable use of animal genetic resources.

Based on these considerations, the components of a specific International Regime for AnGR are suggested, including the need for the decoupling of benefits from specific cases to sharing and managing benefits on a collective basis. The "International Regime" would include support for community protocols by communities that conserve specific breeds and agro-ecosystems, creation of a "Community breed repository" (in analogy to the Global Seed Vault), enactment of Livestock Keepers Rights and the establishment of a benefit-sharing fund. Provisions would have to be made to protect Traditional Knowledge with respect to animal genetic resources to put it on an even footing with scientific knowledge and give it protection. Recommended is also the regular (or mandatory?) use of genetic impact assessments as well as a monitoring mechanism.

Introduction

State sovereignty over genetic resources and benefit-sharing are core principle of the United Nations Convention on Biological Diversity (CBD). Art. 15 states that access to genetic resources is subject to national legislation and that parties to the CBD shall also create measures with the aim of sharing in a fair and equitable way the results of research and development and the benefits arising from the commercial and other utilization of genetic resources.

Enacting these principles into practice has been fraught with difficulties; hence in 2010, during the tenth meeting of the Conference of the Parties (COP 10) to the Convention on Biological Diversity, held in Nagoya, countries adopted the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization* (Nagoya Protocol). This protocol mandates an Access and Benefit-Sharing (ABS) regime that regulates the access and benefit-sharing of genetic resources and associated traditional knowledge at national, regional and international level (Welch et al. 2012).

The CBD was created with wild biodiversity in mind, especially medicinal plants where the source of a particular genetic resource and associated traditional knowledge can often be established easily. The situation is different with respect to genetic resources for food and agriculture, including crops and livestock, as humans have modified these in an incremental manner and in many different geographical locations far from where they were originally domesticated. In recognition of this situation, a special instrument has been developed for access to crop genetic resources, the International Treaty on Plant Genetic Resources for Food and Agriculture. This treaty establishes a multi-lateral ABS-system for a common pool of 64 of the most important food crops and forage crops which are held in ex-situ collections worldwide (Santilli 2012).

For AnGR, an equivalent instrument is absent. The impending and on-going implementation of the Nagoya Protocol at national levels therefore creates some urgency for the animal genetic resource sector to engage with these questions. Unless a separate legal framework is established for AnGR, the provisions of the Nagoya Protocol will apply for this sector as well.

The purpose of this study is to investigate the cornerstones of an international ABS-regime for AnGR that would not only be fair and equitable but, in the true spirit of the CBD, also make a substantial contribution to the conservation and sustainable use of domestic animal diversity for future generations.

The Nagoya Protocol: Content and Status of Implementation

The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity* is an international agreement which aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding, thereby contributing to the conservation of biological diversity and the sustainable use of its components. It was adopted by the Conference of the Parties to the Convention on Biological Diversity at its tenth meeting on 29 October 2010 in Nagoya, Japan. It entered into force in October 2014, 90 days after the 50th ratification. Creation and adaption of national ABS-systems are ongoing, but as of today (November 2014) only few of the 51 Members and other countries have fully implemented the Nagoya Protocol.

Animal genetic resources: significance and status

Definition and importance

Animal genetic resources (AnGR) encompass all the animal species, breeds and strains that are used – now, as well as in the past and in the future - by humans for the purpose of food production and agriculture. The existing domestic AnGR have been developed out of some 40 wild species over the last 10,000 years; they are continuously changing and in flux. Often they have been moved and mixed many times between different countries and continents before being consolidated into distinct breeds. In many cases, this makes it virtually impossible to pinpoint their place of origin and to track their transboundary movements (Mathias 2003, Valle Zarate et al. 2005).

AnGR form the basis and the building blocks of the global livestock economy, a sector that is currently valued at USD 1.4 trillion, employs at least 1.3 billion people and is essential to the livelihoods of at least 600 million poor small-scale livestock keepers (Thornton 2010). The sector is critical to world food security, accounting for 40 percent of global agricultural GDP, providing 26 percent of global protein consumption (Tekola 2013) and providing 17 percent to kilocalorie consumption. With an annual growth rate ranging between 3 and 5 percent, its significance is set to increase even further (Rosegrant et al. 2009).

Animal genetic resources are the result of human interventions and the current populations are genetically very distant from their wild progenitors. New breeds developed each time people introduced livestock populations into new environments and new territories, or when they selected them for new use patterns. Developing out of the interplay between biological and cultural factors, domestic animal diversity is a reflection of both cultural and ecological diversity: it represents biocultural heritage. Since livestock breeds have historically been exchanged across borders and been continents, livestock keepers and breeders in many parts of the world have contributed to the development of the existing breeds, and livestock production in most regions depends on AnGR that originated or were developed elsewhere.

This situation is formally acknowledged in the *Interlaken Declaration* that was adopted by 109 country delegations at the International Technical Conference on Animal Genetic Resources, held in Interlaken, Switzerland, from 3 to 7 September 2007.

Box 1. Interlaken Declaration:

"We recognize that the genetic resources of animal species most critical to food security, sustainable livelihoods and human well-being are the result of both natural selection, and directed selection by smallholders, farmers, pastoralists and breeders, throughout the world, over generations. The result is a wide variety of livestock breeds that provide a diverse stream of benefits to the environment, humanity and its cultural heritage. "(Interlaken Declaration, FAO, 2007).

The majority of AnGR are kept in the form of live animals by farmers and livestock keepers and globally only a limited amount is stored ex situ in the form of frozen semen, embryos, gametes and somatic cells (Gibson et al. 2005). In Europe and developed countries, as well as such countries as China and India efforts are made to systematically create gene banks, but in many of the developing countries where much of the remaining diversity is to be found, such endeavours do not exist or are in their infancy.

Box 2. Interlaken Declaration:

"We recognize the enormous contribution that the local and indigenous communities and farmers, pastoralists and animal breeders of all regions of the world have made, and will continue to make for the sustainable use, development and conservation of animal genetic resources for food and agriculture. We further recognize the historic and relevant contribution of all persons engaged in animal husbandry, who have moulded animal genetic resources to meet societal needs. It is their ownership and management of the genetic resources of their livestock that has enabled them to make important contributions in the past. It is this ownership and management that should be ensured for future societal benefits. We affirm that they should participate in the fair and equitable sharing of benefits arising from the utilization of animal genetic resources for food and agriculture. We affirm the desirability, as appropriate, subject to national legislation, of respecting, preserving and maintaining traditional knowledge relevant to animal breeding and production as a contribution to sustainable livelihoods, and the need for the participation of all stakeholders in making decisions, at the national level, on matters related to the sustainable use".
(Interlaken Declaration, FAO 2007)

Number and status of animal genetic resources

Food production from livestock relies on a small group of species. Although more than 40 mammalian and bird species have been domesticated, only three species (cattle, chickens and pigs) account for about 88 percent of the world's annual meat production from livestock, while two species (cattle and buffaloes) produce 96 percent of milk and just one species (chickens) provides 92 percent of eggs (FAOSTAT 2011).

Each species is composed of different types of populations which can include wild and feral populations, landraces and primary populations, standardized breeds, selected lines, and any conserved genetic material.

Although the term "breed" is fraught with difficulties, the number of breeds conventionally serves as a yardstick for assessing and monitoring diversity.

Box 3. Definition of a breed

Either a subspecific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species or a group for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity (FAO 1999).

For practical purposes, breeds are either classified as "locally adapted" or as "exotic". Locally Adapted Breeds are defined as those which have been in the country for a sufficient time to be genetically adapted to one or more of the traditional production systems or environments in the country. Exotic Breeds are those which are maintained in a different area from the one they were developed. They can be further subdivided into Recently Introduced Breeds and Continually Imported Breeds. Another important category from the perspective of implementing the Nagoya Protocol is Transboundary Breeds referring to breeds that occur in more than one country. An additional distinction is made between International Transboundary Breeds and Regional Transboundary Breeds (Scherf and Schwabenbauer 2012).

The FAO records information for 18 mammalian species and 16 avian species. It has currently recorded some 8,300 livestock breeds in its database. Of these 22 percent are classified as at risk of extinction, and 8 percent have already become extinct (FAO 2012a). For ca. one third of all breeds, no population data are available, so their risk status cannot be assessed (FAO 2013b).

Box 4. Definitions of risk status

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 to five; or the overall population size is close to, but slightly above 100 and decreasing, and the percentage of pure-bred females is below 80 percent.

Endangered breed: A breed where the total number of breeding females is between 100 and 1000 or the total number of breeding males is less than or equal to 20 and greater than five; or the overall population size is close to, but slightly above 100 and increasing and the percentage of pure-bred females is above 80 percent; or the overall population size is close to, but slightly above 1 000 and decreasing and the percentage of pure-bred females is below 80 percent.

Critical–maintained breed and endangered–maintained breed: Critical or endangered breeds that are being maintained by an active public conservation programme or within a commercial or research facility (FAO 2007).

Diversity of breeding systems

The global livestock sector is characterized by a large diversity of production systems, ranging from low input and extremely extensive to high input and industrial. These go along with a similar diversity in breeding systems varying in their emphasis on adaptive or production traits exposure to natural conditions, are characterised by different impacts on the environment and ruled by different systems of ownership and intellectual property regimes.

Breeding systems range between two extremes, with many intermediate forms.

Local Breeding systems with emphasis on Adaptation traits

At one end of the spectrum are breeding and production systems in which animals are kept in “natural” environments and exposed to a large degree of natural selection imposed by the elements. Such systems are prevalent in ecologically marginal areas and typically practiced by pastoralists for whom adaptation traits are more crucial than production traits. Selection is for adaptation to climatic extremes, for the ability to forage on local biomass and to cope with seasonal feed shortages. Selection for social behaviour – within a herd or in the interaction with humans – also plays a major role. Reproduction is natural. Male animals for breeding are specifically selected based on the attributes of their maternal lines, as well as a number of other criteria, which may include beauty, behaviour, size, colour, ability to walk and many others. In certain societies it is still customary to interbreed with wild or feral male animals in order to ensure vitality and robustness.

Female animals are passed on within the family or the community from one generation to the next and herds are structured into female lineages. There can be restrictions on selling female animals, as these are needed to regenerate the herd, and females are only exchanged as dowry or bride wealth between families. These practices are the reason why many breeds are associated with specific ethnic or social groups and named after them.

The emphasis in these systems which place a premium on resilience is less on the individual animal, but on having a functional herd in which a range of traits are represented, so as to be prepared for any eventuality. Intergenerational learning is important in these herds – young animals learn from their mothers which plants to feed on, where to graze and where not to graze.

These systems are coupled with a high degree of biodiversity, on several levels. First of all, there is high intra-breed genetic diversity, as herders strive to have herds with differently endowed animals and lineages, so be able to respond to changing scenarios, especially with respect to droughts and climatic fluctuations. Secondly, each pastoralist group tends to have its own historically grown breed; breed diversity is high in pastoralist areas (Hall and Ruan 1993). The production environments themselves also exhibit extremely high degree of biodiversity, as they often are not cultivated and animals forage on naturally available plants. Pastoralism is highly compatible with conservation of wildlife and eco-systems (Mc Gahey et al. 2008, Nelson 2012, Notenbaert et al. 2012). This is one of the reasons why pastoralist areas often are targeted to be turned into conservation areas, such as national parks.

In traditional pastoralist breeding systems, ownership straddles or straddled the line between private and communal. While individual animals have a specific owner, there are societal obligations to share female animals with other members of the community. Furthermore, it is difficult to restrict access to desired male animals, as it is not considered appropriate to refuse requests for use by other community members.

Box 5: Linkage between communities and specific breeds

A distinctive feature of AnGR that sets them apart from crop genetic resources is their frequent association with specific social or ethnic groups. Many breeds are named after livestock keeping or pastoralist communities. Examples include the “Red Maasai sheep”, the Kakar sheep breed in Pakistan, the Boran cattle in Kenya, and many more. In other cases they are named after certain well demarcated geographical areas. This makes it much easier than with plant genetic resources to identify the stewards of certain breeds, and the specific people and breeders networks who could take up in-situ conservation and to whom benefit-sharing agreements should be directed (LPPS and Koehler-Rollefson 2005; Koehler-Rollefson and LIFE Network 2007).

Breeding systems for industrial production

Globally, a rapidly increasing proportion of livestock is grown in vertically integrated systems in which one company controls the whole or large parts of the value chain, including supply of animals and feed, slaughter, processing and marketing. Currently, 90 percent of poultry, 69percent of hogs, and 29 percent of cattle are contractually produced through vertical integration. In these systems farmers are growers, not breeders; they are either employed by companies or act as contract growers.

The animals raised in such systems are provided by a small and decreasing number of specialized genetics companies. The last decades have seen an enormous consolidation in this sector (Gura 2007). In the poultry sector, only two companies, EW Group and Hendrix Genetics, supply genetics for layer hens for the world market at a global scale, down from 10 companies in 1989. In the broiler genetics business, there were four companies that provided these in 2006 - Aviagen, Cobb-Vantress, Hendrix Genetics, and Nutreco. Currently, these seem to have consolidated to only two companies, as Nutreco sold its animal breeding operations to Hendrix Genetics, which is collaborating with Cobb-Vantress, a subsidiary of Tyson Foods (Chemnitz et al. 2014).

"*From each pure line, 80 GPS (grandparent stock), 6.800 PS (parent stock) (85 per PS *80 GPS), and 680.000 laying hens (100 per PS * 6.800 PS) can be produced. Each laying hen currently produces around 368 eggs, which implies that each pure line bird is accountable for approximately 250 million commercial eggs*" (ISA, n.d.).

The hold of these companies is also expanding beyond strains for industrial systems, as they have bought or built partnerships with smaller companies such as Sasso ("Label Rouge") in France and Kabir International that specialize in coloured genetics, local free-range chickens and niche markets.

In the industrial pig sector, the number of breeding companies is larger, but is taking rapid steps towards consolidation. A handful of specialized genetic companies including PIC/Genus, TOPIGS, Danbred, Newsham, and Hypoer control more than 35 percent of the market (Merks 2010). More than 15 percent is in the hands of integrators, such as Smithfield Foods, Sadia and the Charoen Pokphand Group that have their own breeding operations (Merks 2010). Smithfield Foods Inc. was acquired in 2013 by Shuanghui, China's largest meat processor, which subsequently changed its name to WH Group and is incorporated in the Cayman Islands.

ABS-PIC recently acquired Génétiporc from Aliments Breton Foods in Canada, the largest producer and processor of organic and natural pork in North America. The transferred assets include intellectual property, genetic nucleus herds of approximately 3,200 pure line sows and customer contracts (London Stock Exchange 2013).

The rest is provided by smaller companies and individual breeders. The general pattern of these companies is to produce purebred dam and sire lines that provide the grandparent or great grandparent stock which is sold under licensing agreements.

In the cattle breeding sector, breeding has more input from government agencies. Here too, superior genetics are distributed globally mainly through frozen semen and embryos, and consolidation is progressing. For instance, Genus (U.K.) merged with ABS Genetics (USA) into GENUS ABS which supplies both dairy and beef genetics to more than 70 countries (Nimbkar and Arendonk 2011). GENUS ABS has bovine studs in around 7 countries from which it collects 13 million doses of semen which are deep frozen and sold throughout the world. GENUS ABS is part of the same company as Genus PIC, the international leader in providing genetically superior pig breeding stock and technical support for maximising genetic potential to commercial pork producers.

In sheep breeding too, tiered breeding structures are making inroads for the purpose of providing fast growing lambs.

These scientific breeding programmes with their emphasis on improving performance in controlled environments have yielded impressive results. Dairy cows on average now provide more than 8200 kg milk annually. Layers provide around 300 eggs/year; broilers have daily weight gains of 60 g, turkeys of 150 g, and pigs of around 780 grams.

But one-sided emphasis on performance has also been accompanied by a loss of vitality and disease resistance. The lifespans of dairy cows, sows and layers have been significantly reduced, due to fertility problems and lameness (Hörning 2014). Lately there is more emphasis on improving adaptation traits, for instance in pigs the ability to digest roughage (EFFAB 2014). In order to address such sustainability issues, EFFAB introduced EFABAR, a voluntary code of good practice for animal breeding and reproduction organisations (Code EFABAR 2014).

In general there is an association between high performance breeds and monocultures of feed crops, especially corn and soy. Many of the genetics companies are owned by or linked up with feed companies. Although feed conversion rates have been increased significantly in industrial poultry and pig strains, these genotypes are no longer able to forage and thrive on low quality roughage and feed stuff in the manner of locally adapted breeds. By opting for the large-scale adoption of industrial breeds and production systems, countries often become dependent on imports of animal feed, as the case of China illustrates. Similar reservations are being expressed by experts in the Indian livestock sector who are concerned about the resources required to sustain the country's projected growth in the dairy sector.

Intermediate Systems

Between the two extremes, there is a range of intermediate systems. In developing countries, there are village-based smallholder breeding systems using communally owned male breeding animals. In Europe and the US there are classical breed organisations which are run by a "community" of farmer breeders that register their animals in a herd book. Many such organisations also exist for rare and threatened breeds and have prevented their extinction. They utilize traditional line breeding techniques, assisted by knowledge that prevents or minimizes inbreeding (Sponenberg and Bixby 2007).

In developing countries, there is also much unplanned breeding or mere reproduction, as community institutions that earlier ensured the integrity of breeds are unravelling. One of the most worrying trends is the indiscriminate distribution of exotic or cross-bred animals which leads to the dilution of previously distinct local breeds. This is regarded as one of the major threats to the conservation of local livestock breeds (Ramesha 2011). Scientists in countries such as India are raising their voice against these practices (e.g. Bharananganam declaration, below).

Traditional knowledge (TK) versus scientific knowledge

The two types of breeding systems at each end of the spectrum are basically associated with two types of knowledge, although the transition is of course sliding.

Traditional/Indigenous Knowledge

Extensive systems of pastoralists are based on a large body of indigenous or traditional knowledge that is transmitted orally from one generation to the next. This knowledge, also referred to as Indigenous knowledge about animal breeding (IK-AB) is crucial for the conservation of breeds and livestock genetic diversity, as well as for the continued management of the eco-systems of which they are a component (Lokhit Pashu-Palak Sansthan et al. 2005).

It encompasses the following components:

1. Knowledge about production and reproduction characteristics of breeds under field conditions
2. Knowledge about undocumented breeds (Example Banni buffalo, Nari cattle, Malvi camel breed in India)
3. Knowledge about susceptibility or resistance of breeds and individual animals/lineages to diseases
4. Identification of maternal lineages with desirable characteristics
5. Knowledge about the "pedigree" and family history of individual animals (including possibly negative traits)
6. Knowledge about the special challenges of the production environment

Unfortunately, as only isolated examples of these systems were studied, they have remained largely invisible. Some of the pioneering studies have been among such groups as the Bororo in Niger (Krätli 2009), the Rendille and Somali in Kenya (Huelsebusch et al. 2002) and the Raika in India (Köhler-Rollefson and Rathore 2000). Although no systematic corroborating data are available, there are indications that traditional systems are rapidly unravelling, as modernization and declining grazing areas make herding as less attractive occupation for the new generation.

Scientific Knowledge

Scientific knowledge about animal breeding is based on phenotypic recording large populations and calculating estimated breeding values for particular traits such as growth rate and production of eggs, meat, milk and wool with complex statistical programmes. More recently, the field of molecular genomics has provided the opportunity to sequence entire genomes and is eliminating the need for offspring testing. The number of genetic markers has increased rapidly from a couple of hundred micro satellites to 800,000 single-nucleotide polymorphism (SNP)s which allows to estimate Direct Genomic Values based on Estimated Breeding Values from large reference populations (Moser at al. 2010).

Most of the techniques used in scientific animal breeding are deemed proprietary and are protected by patents or trade secrets. This includes statistical methods for genetic improvement, DNA markers for genetic improvement, transgenic and cloned animals and methods to produce them, new methods to measure traits, methods to identify animals, computer software and other written materials (Rothschild 2002). Examples of patents having been granted include genetic markers for superior milk products or superior milk production, sex identification, double muscling in mammals; even entire lines of pigs and chickens have been patented (WIPO/FAO 2014).

Scientific knowledge about animal breeding is remunerative and much in demand; nevertheless there is a shortage of quantitative geneticists.

Table 1. Comparison of breeding in production systems

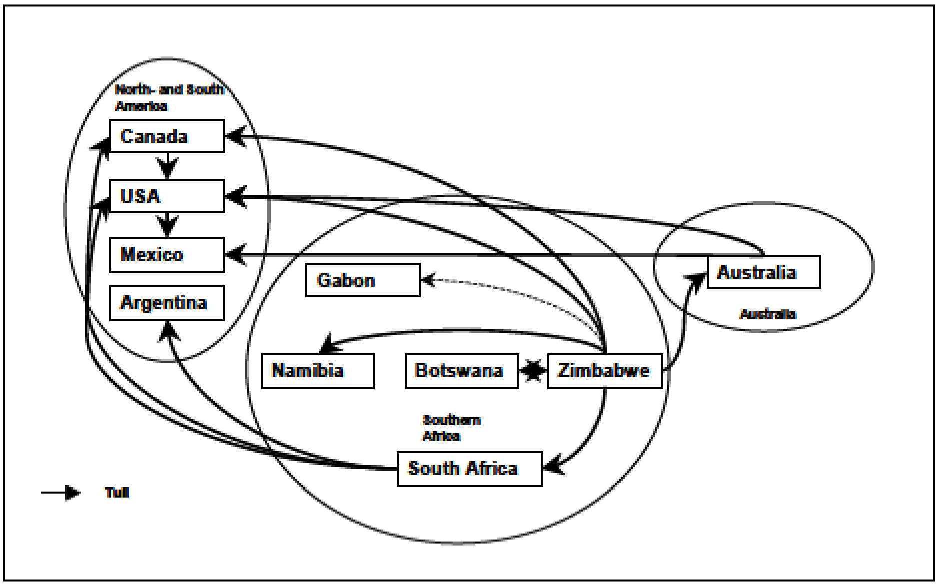
Attributes of breeding systems	Extensive/pastoralist	Intensive/industrial
Natural selection	Strong	Minimal
Number of selection traits	Many	Few
Selection for productivity traits	Secondary to adaptive traits	Prime selection criteria
Selection for social behaviour	Strong	Minimal/none, although increasing in group pen animals (pigs, chicken for welfare reasons
Selection for feeding	Foraging ability	Feed conversion rate
Property system for AnGR	Private and communal	Private
Exchange of AnGR	Based on societal norms and reciprocity	Contractual, market

Patterns and directions of exchange

Animal genetic resources have been traded between countries and all over the world for centuries. New breeds are developed through crossing of two or three existing ones; existing breeds are developed or diversified into separate strains, a process that occurs automatically every time nucleus populations are introduced into new environments. All breeds benefit from the occasional infusion of "fresh blood". In principle it is in the interest of upholding diversity and of further development of AnGR to ensure that genetic material can be exchanged and moved around the globe without impediment, although there are also certain caveats, as will be detailed below. The procedures for the exchange of genetic material across borders are well established. Trade is regulated by the transfer of private ownership (through contracts under private law). The current major hurdle to the exchange of genetic resources is posed by the strict zoo-sanitary regulations of some countries as mandated by the OIE Terrestrial Animal Health Code.

Most exchanges take place between developed countries ("North to North"), although the exchange from developed to developing countries ("North to South") has also been important, with results that are regarded as mixed. Exchange between developing countries ("South to South") also exists, but movements from developing countries to developed countries ("South to North") are relatively rare, but they do occur (Mathias and Mundy 2005, Valle Zarate et al. 2005). A case documented in detail is the export of Tuli embryos from Africa to Australia and then from there to the United States (Mpofu 2002).

Movements of Tuli cattle (source: Homann et al. 2006)



Another case concerns the introduction of genetics of the Meishan pig from China with the intent of improving litter size. Pigs from China have been imported for this purpose To Europe and elsewhere since several hundred years, but recently a new dam line "meidam" which is derived from the Meishan pigs was registered. It has a 30 percent higher litter size (ACMC n.d.).

There is very little, if any, transfer of genetic material from "traditional" to "industrial" systems, as the performance differential is too huge. However, there is significant transfer of industrial genetics to traditional systems, usually in the context of development and aid programmes. This is one of the major causes for erosion of distinct breeds.

Ownership of animal genetic resources

An individual animal represents both a biological and a genetic resource. Physical ownership of the animal traditionally included ownership of the embedded genetic material and the price of the animal reflected its genetic value. This is the system that is still in place in the pastoralist and farming societies that steward much of the remaining livestock genetic diversity. Some traditional communities placed customary restrictions on the sale of female animals and allowed them only to be transferred within the society from one generation to the next or through marriage arrangements. On the other hand there could be moral obligations to make studs available for breeding to all other community members.

In an effort to flag their association with certain breeds and traditional knowledge, about half a dozen local and 'traditional' livestock keepers have developed Biocultural or Community Protocols to put their ownership on record and to claim status as indigenous or local community stewarding biodiversity under paragraph 8j of the CBD on record (Köhler-Rollefson et al. 2012).

Table 2. Overview of Biocultural Community Protocols developed by livestock keepers

Community	Country	Year
Raika	India	2009
Samburu	Kenya	2010
Banni buffalo breeders	India	2010
Pashtoon	Pakistan	2010
Kutchi camel breeders	India	2011
Bargur cattle breeders	India	2010
Jaisalmer camel breeders	India	In progress
Golla	India	In progress
Deccani shepherds	India	In progress
Kangayam cattle breeders and Korangadu eco-system	India	In progress
Bakkarwal nomads	India	In progress

Breeding companies have found ways and means of protecting the investment they have made in the pure breeding lines, which form their main assets. Ownership or physical possession of an animal by farmers does not automatically include the option or right of using it as a genetic resource. In the poultry and pig sectors, use of their animals for breeding is prevented through secrecy and hybridisation (Temmerman 2011). As hybrids do not reproduce in a stable manner, farmers always need to buy new animals from the company controlling the original pure-bred lines. In the pig sector, purchasers have to sign contracts prohibiting the use of animals for breeding, or committing to on-farm use only without the option of selling to third parties.

With the advent of genomics and genetic markers, information about the genome of specific animals is also becoming an issue and a marketable high value resource. For instance, the company Topigs has established a proprietary database that contains data from more than 20 million breeding pigs. Two other companies, Cargill, Inc. and Branhaven LLC, recently licensed their patented genomics tools that can identify animals best suited to optimize weight gain, beef marbling, tenderness, red meat yield, rib eye quality and other important characteristics to Neogen Corporation (Cargill 2014).

Impact of selection on genetic diversity

With only two companies providing layer hen genetics and four providing those for broilers, substantial shares of the world's egg and broiler production depend on a small number of breeding lines which are designed to meet the needs of the industrial production. There is an enormous performance differential between these hybrids and even the more productive breeds.

As a consequence, even organic chicken producers have to resort to the same hybrid chicken - although they meet neither the philosophy nor the needs of organic production. Due to trade secret law, which does not exempt genetic resources, the actual diversity is unknown. FAO assumes that most commercial strains are based on four breeds.

Industrial pig production is dominated by only five breeds: Large White, Duroc, Landrace, Hampshire, and Pietrain. Some 66 percent of the mothers of pigs fattened in Europe are hybrids between 'Large White' and 'Landrace' breeds. But the genetic diversity within these breeds has become very small with effective population size[1] of the Duroc being only 61 animals, and that of Hampshire 74 animals.

In dairy cattle, selection has focused on a small number of traits, such as amount of milk, fat content and, more recently, on feed efficiency under optimal production conditions. Although there are more than 3.7 million Holstein cows in the USA, their effective population size in 2004 was only 60 animals. The effective population sizes of Jerseys and Brown Swiss in the USA were even less, amounting to 31 and 32 animals respectively (Hansen 2006). Worldwide only a few thousand bulls are annually tested, and of these far less are selected. Embryo transfer and cloning technologies are other interventions that are further eroding genetic heterogeneity (Scientific Advisory Board on Biodiversity and Genetic Resources at the Federal Ministry of Food, Agriculture and Consumer Protection 2011).

An international project that seeks to make information about the bovine genome available through an open source system has confirmed a rapid recent decline in bovine genetic diversity and considers this as a reason for concern (The Bovine hap-map consortium 2009).

Key points

1. Animal genetic resources underpin the global livestock industry, a sector that is valued at $ 1.4 trillion, employs at least 1.3 billion people and is essential to the livelihoods of at least 600 million poor small-scale livestock keepers.
2. Small-scale livestock keepers which act as "keepers of genes" and guardians of biological diversity keeping and breeding animals by exposing them to environmental stresses and feeding them with locally available resources are under increasing pressure mainly due to loss of their resource base and forces of "modernization".
3. An increasing share of AnGR is managed by professional breeding companies that are rapidly consolidating into a small number of globally represented corporate entities, often together with feed and input companies.
4. There have been enormous advances in livestock performance under controlled conditions, although this is dependent on the availability of high quality feed grown in monocultures.

[1] Effective population size is the number of individuals in a population who contribute offspring to the next generation.

Threats to the sustainable use and problems of conservation

Livestock genetic diversity has to be upheld for the broader goal of adapting to future scenarios, as without variability there is no scope for evolution and adaptation to changing conditions in the natural and economic environment. For the continued existence of every species the possession of genetic variability is necessary (Falconer 1960). However, the hurdles to the sustainable use of livestock genetic diversity and to the conservation of indigenous and locally adapted livestock breeds are numerous.

Unravelling of traditional systems

Many of the diversity conserving pastoralist and smallholder systems are under threat, due to a variety of factors, including loss of grazing areas (land-grabbing, urban sprawl, conversion to crop cultivation), underestimation of their productivity, education, and availability of alternative livelihood support systems. Lack of respect by society at large is in many cases leading to the discontinuation of transmission of traditional knowledge systems that form the basis for pastoralist systems.

On the other hand, industrial systems are rapidly expanding, especially in countries with emerging economies, such as China, Vietnam, Russia, Ukraine and Brazil. This is due to subsidies for the establishment of such production units, the availability of easy credits, as well as the desire of policy makers to provide livestock products at cheap prices in the belief that it will help feed people and increase prosperity. The competitive advantage of these systems is that they are landless, i.e. can be transferred to almost anywhere in the world, as long as the supply of feed and other inputs can be guaranteed.

The baance between traditional systems and industrial systems is thus rapidly shifting towards the latter which is one of the main factors responsible for erosion of domestic animal diversity. According to the latest estimates, the number of animals that are raised in industrial systems has rapidly increased: globally, 63 percent of pork, 73 percent of eggs and 79 percent of poultry meat derive from such production units (Hoffmann 2011). Some 43 percent of beef cattle are raised in feedlots (Nierenberg and Garces 2004).

Lack of data and documentation of local production systems and breeds

There is an almost complete dearth of data on the productivity and output of local production systems and local breeds in developing countries. The case of pigs in Papua New-Guinea (see Box 6) is just one case of many and represents a scenario that is repeated around all developing countries and that is reflected in the absence of population data for many breeds listed in DAD-IS. This lack of information about the existing systems based on local breeds is one of the major reasons why policy makers continue to promote cross-breeding and importation of exotic breeds. Absence of recording also makes it impossible to develop genetic improvement programmes by means of intra-breed selection. A recent study of community-based animal genetic resource management by keepers of various sheep breeds in Ethiopia confirmed the value of this approach and that phenotypic mass selection possible (Haile at al. 2013).

Box 6. Erosion of local pig breeds in Papua New Guinea

In Papua New Guinea, more than 100 different ethnic groups raise pigs as a central part of their culture and traditional rural economy. Because of this cultural diversity, the genetic diversity of the 1.8 million pigs kept can be expected to be very high as well. Unfortunately, indiscriminate cross-breeding with exotic breeds is eroding the local breeds (Ayalew et al. 2011). This goes back to colonial times when the Australian government restocked pig populations after World War II, which had eliminated many of the local pigs. This trend continues today, undermining the indigenous pigs which are assumed to be "low producers", although they have never been documented and characterized. Their advantages over hybrid pigs in terms of ability to use a variety of feed, to forage for themselves and to cope with disease pressures are not taken into account although they are of crucial importance for food security and could provide the basis for sustainable rural development on local resources.

Promotion of cross-breeding and exotics

A major problem that continues to prevent and undermine the sustainable use of locally adapted breeds is the importation of exotics and their indiscriminate cross-breeding with local breeds. This continues to be a pre-occupation of governments and aid organisations who believe that they are beneficial for poverty alleviation and rural development and promote and distribute them arbitrarily, often without understanding the benefits and productivity of already existing livestock systems. This results in dilution of local breeds so that they become an amalgam of populations and truly non-descript – a situation that obtains for instance in Kenya and in India.

Current lack of industry interest in developing country genetics

According to a statement by the industry, it is almost totally self-sufficient and does not expect to require access to any external genetic resources for the foreseeable future. The reasons for this are enormous differentials in performance as well as lack of performance recording systems in the South. Despite these assurances, the situation may change over the medium or long-term, especially considering climate change and the shortage of feed for high performance animals. Already there are suggestions that the poultry industry would benefit from the infusion of "native birds" because of reduced genetic diversity (Muir 2007, Muir et al. 2008).

The role of subsidies

Industrial systems are heavily subsidized, especially through subsidies for corn and soybeans – the main ingredients of livestock diets without which the expansion of industrial systems would not have been possible. For instance in the US, farm subsidies, including crop insurance, have amounted to USD 256 billion in the period from 1995 to 2013 (Environmental Working Group 2013). The latest US farm bill passed in 2014 foresees to spend USD 956 Billion over the next ten years (although this also includes a large amount for food stamps).

In Germany, direct payments to subsidize cultivation of feed crops for pig and poultry amounted to 950 million Euros in 2008 and 2009. Furthermore, the construction of industrial fattening units was subsidized with 80 million EUR per year, while there were also export subsidies to the tune of 80 million EUR during the same time period (Benning and de Andrade 2011).

The importation and use of high performance genetics in developing countries is heavily subsidized. This has been studied for Vietnam where subsidies for imported pig genetics amounted to some 19-70 percent of gross margin and were regarded as a significant driver in the process of breed substitution and extinction (Drucker at al. 2006). In China, sow subsidies amounting to 34 million EUR (2.6 billion Yuan) were given in 2011. In addition, subsidies to the insurance for sows and hogs added up to 16 million EUR (1.4 billion Yuan) in 2011. There are also grants for larger hog operations, free mandatory immunizations, a 25 percent corporate income tax waiver on pig operations, besides subsidized loans and a spectrum of other promotional measures (Chen and Wang 2013).

Difficulties of ex-situ conservation

As opposed to the situation with plant genetic resources where seeds can be stored in a relatively uncomplicated manner, AnGR cannot easily be put into cold storage. Ex-situ conservation by deep freezing sperm and embryos, while practiced systematically by such countries as China and the Netherlands, requires extensive infrastructure that has to be upheld over long periods – practically indefinitely. Reconstituting a population from frozen material is difficult due to long generation intervals and low regeneration rates. Frozen populations can neither evolve and adapt to changing disease pressures and climate scenarios nor do they keep up with the rapid productivity gains of scientifically managed populations. In fact, they are used by the breeding industry to measure genetic progress over time (EFFAB 2014). The centralised ex-situ model for conservation of plant genetic resources provided by the Svalbard Seed Vault is thus neither appropriate nor transferrable to AnGR.

The ex-situ conservation of live AnGR on government farms, as attempted for instance in India, while theoretically useful, has often proven difficult to implement. A recent evaluation of Indian government farms revealed that in most cases these were not successful, due to inbreeding and neglect.

In-situ conservation is of the essence

There is wide spread agreement that in-situ conservation by livestock keepers is the method of choice. The approach has been very successful in European countries. For instance in Germany no livestock breed has become extinct in the last decades, due to the dedication and efforts of hobby livestock keepers. In the USA, in Great-Britain and many other countries, hobby breeders have ensured the survival of rare breeds.

Overall, conservation by utilization is regarded as most appropriate approach to conserving AnGR. A well-known example concerns the revival of the Schwäbisch-Hallische Pig in Germany that was close to extinction, but turned into the foundation of a regional specialty meat “industry” (Bäuerliche Erzeugergemeinschaft Schwäbisch Hall w.V. n.d.). There are similar cases from other parts of the world.

Decentralised local in-situ activities appear to be the best bet for conservation and can also increase rural income (LPP et al. 2010).

The role of bio-piracy

The question whether a specific transaction of taking a farm animal across borders constitutes biopiracy or not is complex. Animal genetic resources are usually privately owned, although in local and indigenous communities, they have characteristics of both private and communal goods. Customarily, ownership of an animal meant ownership of its genetic material. If I purchase a cow or a bull or a sow, I can use it for breeding. An animal is both a biological resource and a genetic resource at the same time. Only recently the scenario is changing, for instance in the industrial pig sector where buyers enter into contractual agreements preventing them from using animals for breeding.

There are a handful of cases of breeds from developing countries that are often referred to as examples of bio-piracy. One of them concerns the Tuli cattle from Zimbabwe which was developed by local communities as a source of food and draught power. In 1987, frozen embryos of Tuli cattle were shipped to Australia, ostensibly for research, but eventually animals reached the United States where they became priced for the quality of their beef as well as their ability to perform in harsh environments. No prior informed consent of the Tuli cattle breeders was obtained, neither were benefits derived from utilisation and commercialisation shared.

The attempts to utilize the genetic resistance to endoparasites of the Red Maasai sheep (see above) are also referred to in this context.

In India, the Kerala State Biodiversity Board prevented the planned export of heat adapted Malabari goats to Australia in January 2012, as the shipment did not have the required clearance from the National Biodiversity Board.

At about the same time, the suspected illegal export of genetic material from Ongole cattle breed was highlighted in the Indian media. "Suspecting an international racket in the export of semen of Ongole bull, acclaimed as one of the world's best bovine species available, the State government has sounded an alert at all sea ports and airports in the country to prevent transportation of either the animal or their genetic material." (The Hindu 2012).

But the sale of livestock across borders is an important source of revenue for livestock keepers, in this case the Malabari goat breeders or Ongole breeders. Overseas markets can provide a major incentive to continue breeding and keeping indigenous breeds and it would be unfair to deny this option to poor livestock keepers in developing countries, when breeders from developed countries benefit from exporting their animals. Instead, the south-north exchange of breeds should be promoted to create benefits for livestock keepers and breeders in the South.

At the same time, safeguards must be put into place to ensure that genetic material sourced from such breeds is not patented or put under some other kind of IPR protection in the receiving countries.

Key points

1. The loss of AnGR that is proceeding in developing countries is due to the neglect and deterioration of local livestock production systems that are based on indigenous or locally adapted breeds and associated traditional knowledge.
2. Livestock genetic diversity is further compromised by the expansion of industrial livestock production systems which replace community-based systems of animal breeding and livestock production. This replacement is fuelled by a range of subsidies for industrial systems while community based systems are undermined by loss of their pasture resource bases and lack of attraction for young people.
3. Biopiracy of AnGR has not been a major issue; only a few instances have been discussed.
4. The implications of emerging technologies, such as gene-editing, will need to be explored. They may totally change the scenario. Access to genetic information may become more important than physical access to the genetic resource in form of living animals.

Potential of locally adapted animal genetic resources

Asset of the poor

Local breeds are an important self-replicating asset of almost all rural people in developing countries and fulfil functions that go far beyond the output of products. They serve as insurance and as a savings bank; they are social currency. Often people have owned them for many generations, so they do not need to take a loan to purchase them or invest in infrastructure and inputs, as they would with exotics or hybrids provided by a breeding company (Köhler-Rollefson et al. 2008).

Especially the position of women can be strengthened by projects and support for the development of local breeds. The importance of pastoralist breeds is routinely underestimated, although statistics show their enormous economic significance proof in a large number of African countries (Krätli et al. 2013).

Apart from this livelihood role for their traditional owners, there is indication that their asset value will grow in the near future.

Need for reducing input costs

The costs of providing high performance livestock with high-quality feed can be enormous as feed costs are about 70 percent of overall production costs. Farmers have little or no control over feed related expenditure, as they are largely dependent on the global market for soy and corn. This can lead to situations where production costs exceed the income from livestock raising. In response, farmers and livestock keepers increasingly opt for low-input breeds that can be sustained on pastures and forage. Such lower performing animals are also easier to manage. As a consequence, genetic improvement companies are now trying to breed for better use of low quality feed stuffs in pigs (EFFAB 2014). There is an EU research project that specifically looks into the use of low-input breeds. Yet, in the dairy sector, bulls with a medium performing genetic background are not available (Hörning 2014).

Climate Adaptation

Climate unpredictability is one of the most urgent and vital reason for conserving AnGR that are adapted to various scenarios, including higher ambient temperatures, higher rainfall, and a higher incidence of extreme climatic events such as droughts and flooding. For instance during the floods in Pakistan, it was the local buffalo breeds that were able to cope while dairy cows drowned (Kakar pers. comm). In Africa, camels have moved southwards in recent decades, reflecting their great adaptability to droughts (Hoffmann 2013).

Disease resistance

Routine use of antibiotics and antihelminthics to keep livestock healthy has become a major concern as it leads to resistance of disease causing organisms. There has thus since long been interest in introducing “resistance genes” into commercial breeds. One of the longest on-going efforts concerns the red Maasai sheep which has demonstrated genetic resistance to *Haemonchus contortus* (Barbers pole worm), an endoparasite that sucks blood and can cause death if animals are not treated. Australian sheep producers spend more than 140 million EUR (200 million AUD) each year controlling helminths using monthly chemical drenches, a process that is not only expensive but also environmentally damaging. The drenches also are becoming increasingly ineffective because resistance to the chemicals is building up in the worms. This situation triggered interest and extensive research efforts to investigate the genetic basis for helminth resistance in the red Maasai and other sheep breeds (see below).

Another example of the quest for genetic disease resistance is the on-going effort to identify heritage poultry breeds with natural resistance to salmonellosis. Forty heritage breeds obtained from non-commercial hatcheries in Iowa are assessed for their ability to resist colonization by Salmonella in their intestinal tracts after experimental infection; the genetic traits conferring the resistance are to be identified (Leopold Center for Sustainable Agriculture n.d.)

Despite the desire and vision to introduce such disease resistance genes into high performance, there have been many technological and practical difficulties associated with it. According to EFFAB (2014) "*Any strategy to genetically increase the resistance to (or tolerance of) infectious diseases is complicated because it is always debatable which disease should be targeted. Epidemics such as the recent one of Avian Influenza occur once or twice per decade, and every time it is a different virus. Any livestock breed with genetic resistance to that particular virus would have an extremely high utility value while the disease is prevalent, and virtually no value one or two years later, when the epidemic is over. The logistics of exploiting such a genetic resource (i) worldwide and (ii) very fast, would be very challenging – even assuming that such a breed would actually be identified soon enough and (paradoxically) that the veterinary authorities in the immigrating countries would let the animals in."* Apart from that, no one genetic resource would fit all contexts and environments.

Compliance with animal welfare regulations, organic standards and consumer notions

In developed countries, such as Germany, but also many others in Europe and America, consumers and the general public are increasingly discontented with industrial ways of raising livestock and there is steady coverage in the media about some of the excesses of these production systems. As people have become urbanized and disconnected from their rural roots, they also develop notions of livestock farming which do not match the existing realities. As a consequence, vegetarianism and veganism are on the rise and the demand for eggs from free-ranging chickens and milk from happy cows grazing in lush meadows is increasing. Having been selected mostly for extreme performance under controlled "artificial" conditions, commercial breeds may no longer be able to function in the more natural settings from which consumers would like to derive their products.

The organic sector is already experiencing problems with the availability of genetic resources that can comply with its higher welfare standards. For instance, under its animal welfare standards, the culling of one day old male chicks in layer strains is not accepted; it has recently also been outlawed in the German state of North Rhine-Westphalia. At the same time, there is no dual purpose chicken breed or strain that would make the fattening of male chicks economically viable. There are now efforts to create such a breed by the industry and by organic poultry breeders (Idel 2007).

High Value and Specialty Food

In more affluent societies, but not limited to them, there is considerable and growing demand for livestock products that are especially healthy, please gourmet taste buds or have a heritage connotation. These products can generate significantly higher market prices than those coming out of industrial systems.

Higher nutritional value

Evidence is accumulating that the products from local breeds are nutritionally more valuable than those of commercial breeds. There are a number of studies that support this view. Pasture raised beef has a higher content of linolenic acid than concentrate fed beef (Dhiman et al. 1999). The Mangalitza pig has a lower percentage of saturated fatty acids than hybrid lines (Parunovićet al. 2013).

While such nutritional analyses comparing products from different production systems are expensive and time consuming (Barnes et al. 2012), there are often strong local beliefs in the superiority of local breeds. For instance, eggs from indigenous chickens in India cost several times more than commercial ones. Milk and ghee (butterfat) from local Indian dairy breeds, such as Gir or Tharparkar, are sold at prices than can be 50 percent above those from hybrid cows. Interestingly, local people associate the higher value to the large variety of local forage plants that animals ingest have been shown to have known medicinal value and contain valuable phytomedical substances (Köhler-Rollefson 2013).

More research is required to determine whether nutritional differences are due to genetic factors or due to bio-diverse diets of the animals. Likely it will be a combination of both factors.

Heritage

In developed countries, there are successful endeavours to produce and market "heritage foods" from traditional breeds. One example is the work of the British Pig Association (British Pig Association n.d.)

Heritage Foods USA

Heritage Foods USA was formed in 2001 with the help of Slow Food USA for the purpose of reviving regional cuisines. Through its Heritage Turkey Project, the company increased the number of heritage breeds twofold. Currently it slaughters and processes 200 pasture raised pigs that are antibiotic free per week, as well as 7,500 heritage turkeys for Thanksgiving (Heritage Foods USA n.d.)

Taste

Discerning consumers prefer the taste of livestock products associated with particular agro-ecosystems or cultures. Iberian ham from free-range pigs that roam oak forests (called *dehesas*) along the border between Spain and Portugal, and eat only acornsis a well known case, but examples also exist from developing countries. For instance in Vietnam which owns the largest pig herd in Southeast Asia, indigenous pork is much in demand due to its special flavour and generate 15 percent higher prices (Huong et al. 2009). Specialized supply chains are emerging that connect smallholder farmers keeping indigenous pig breeds such as Mong Chai and Ban in the highlands to affluent consumers in the lowlands.

In India, certain specific dairies are specializing in marketing the milk of desi (indigenous) cows, for instance the Charaka Dairy, near Hyderabad (Charaka n.d.).

Slow food is an international organisation, which promotes food and taste education and connects sustainable producers with consumers. One of their initiatives is the 'Ark of Taste', a repository of food products with distinctive quality in terms of taste. The Ark of Taste is highlighting the special products of an increasing number of threatened livestock breeds, such as cheese from the Tetevan sheep breed in Bulgaria; the Karakachan sheep, horse and dog breeds kept by the Karakachans, a nomadic people of the Balkans, the wool and meat of the Navajo Churro sheep in the US, and meat from the Limpurg Oxen in Germany (Slow Food Foundation n.d.)

Similar efforts are made by the SAVE Foundation that acts as European umbrella organization for the in-situ conservation of endangered breeds and cultivated plant varieties. SAVE has instituted the Arca-Deli® Award for products from their member farmers and established the Heritaste Trademark that identifies products and services provide by indigenous livestock and crops that represent a cultural asset and are produced locally and non-industrially (SAVE 2013)

This is demonstrated by the European experience. Well documented examples include the Schwaebian Haellische pig breed in Germany and several cases of French cheeses which can only be made by specified cattle and sheep breeds, such as the well known Comte cheese which must be made from milk of the Montbeliarde cattle breed. Also in France, the Normande cattle breed is associated with the production of Camembert, Pont-Lévêque and Livarot cheeses (Verrier et al. 2005).

Key points

1. Locally adapted AnGR are major assets of the rural poor, especially women, and often essential to their livelihoods.
2. They have potential for equitable rural development and it is expected that their value will increase substantially in the near future, due to increase in feed prices, need to adapt to climate change, consumer desire for products from healthy animals raised without antibiotics and according to higher animal welfare standards, as well as demand for tasty and healthy livestock products with heritage character.
3. Supporting rural people to secure these assets and capitalize on them could result in a win-win situation in which AnGR are managed sustainably by and for the benefit of rural people while also increasing resilience and adapting to climate change.

The Nagoya Protocol on access and benefit-sharing

Core elements

The aim of the Nagoya Protocol is to ensure benefit sharing and thereby create incentives for the conservation of biological diversity, sustainably use its components, and further enhance the contribution of biological diversity to sustainable development and human well-being. It seeks to achieve this by creating greater transparency and better mechanisms for the utilization of genetic resources and associated traditional knowledge, while also strengthening the opportunities for fair and equitable sharing of benefits.

As long as there is no internationally agreed treaty that covers (certain) AnGR for food and agriculture – comparable to the ITPGRFA with its Annex 1-PGR – and which is recognised by the CBD as specialised ABS agreement, the ABS approach of the Nagoya Protocol and respective national ABS legislation is applicable for any AnGR.

The "utilization of genetic resources" is defined in Article 2 as "to conduct research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology". This means that the provisions of the Nagoya protocol are not applicable to the international trade in farm animals for consumption, for multiplication or for conventional breeding without the use of genomic and molecular methods.

Crucially, for obtaining **access**, the Nagoya Protocol places great emphasis on **prior informed consent** and **mutually agreed terms** not only of the country of origin, but also of **local and indigenous communities** when access to their genetic resources is sought. In Article 5.2 it states that "each Party shall take legislative, administrative or policy measures, as appropriate, with the aim of ensuring that benefits arising from the utilization of genetic resources that are held by indigenous and local communities, in accordance with domestic legislation regarding the established rights of these indigenous and local communities over these genetic resources, are shared in a fair and equitable way with the communities concerned, based on mutually agreed terms." Benefits can be both monetary and non-monetary.

In Article 7, parties are committed to, "in accordance with domestic law, take measures, as appropriate, with the aim of ensuring that **traditional knowledge associated with genetic resources that is held by indigenous and local communities is accessed with the prior and informed consent or approval and involvement of these indigenous and local communities**, and that mutually agreed terms have been established.

In Article 12, parties are urged to, in accordance with domestic law take into consideration **indigenous and local communities' customary laws, community protocols and procedures,** as applicable, with respect to traditional knowledge associated with genetic resources. Furthermore it is stated that "parties shall endeavour to support, as appropriate, the development by indigenous and local communities, including women within these communities, of **Community protocols in relation to access to traditional knowledge associated with genetic resources** and the fair and equitable sharing of benefits arising out of the utilization of such knowledge.

Article 10 of the Protocol provides scope for discussing the needs for and finally developing a global multilateral benefit-sharing mechanism to address the fair and equitable sharing of benefits derived from the utilization of genetic resources and traditional knowledge associated with genetic resources that occur in transboundary situations or for which it is not possible to grant or obtain prior informed consent. This discussion will enter into full steam during the second meetings of the members in 2016.

The Nagoya Protocol obliges its members to take a variety of measures to monitor the utilization of genetic resources after they leave a country including by designating effective checkpoints at any stage of the value-chain: research, development, innovation, pre-commercialization or commercialization.

Implications and meaning of the Nagoya Protocol for animal genetic resources

National level

The responsibility of implementing the provisions of the Nagoya Protocol rests at national levels. It obliges the contracting parties to involve with local and indigenous communities, to share the benefits with them in a fair and equitable way and to respect their customary practices and to support the development of community protocols. These are crucial points as much of the erosion of AnGR has been due to ignorance and lack of respect and support for the animal husbandry production systems of local and indigenous communities in the countries in which they occur. The stipulation to support the development of community protocols, if implemented at scale, has the potential to change this situation and lead to more information and awareness of governments about their existing AnGR, about the traditional knowledge and customary practices that have created and sustain them and about their contribution to local economies and role in sustaining local eco-systems and the net of biodiversity.

In this respect, the Nagoya Protocol corresponds to Strategic Priority No 6 of the Global Plan of Action on Animal Genetic Resources which postulates to "Support indigenous and local production systems and associated knowledge systems of importance to the maintenance and sustainable use of AnGR" through a variety of measures.

The stipulation to **monitor the utilization** of genetic resources after they left a country and the establishment of effective checkpoints at any stage of the value chain means that countries should take safeguards and seek assurances that no biochemical and genetic research is to be undertaken on exported animals without the prior consent of both communities and governments. National governments may decide to develop ABS regimes that go beyond the scope of the Nagoya Protocol. For example, Art. 15 of the CBD containing the basic ABS principles, does not specify what utilisation means. Countries such as India therefore require ABS agreements also for access to genetic resources and associated traditional knowledge for certain commercial uses as the production of ayurvedic medicine without R&D activities being involved. In any case, an ABS agreement will comprise mutually agreed terms (MAT) that specify, inter alia, the kind of utilisation that is allowed, the types of benefit sharing at the different stages of the value chain, and conditions for third party transfer.

Table 3. Applicability of the Nagoya Protocol to the transactions of animal genetic resources

	PIC required from community	PIC required from country	MAT required
Export as commodity for consumption(1)	no	no	no
Export of animals/semen for multiplication(1)	no	no	no
Export of animals for conventional breeding without the application of biochemical and genetic research(1)	no	no	no
Export of animals for research on the biochemical and genetic composition	yes	yes	yes
Sampling and utilisation in provider country	depending on the scope of national ABS regime	depending on the scope of national ABS regime	depending on the scope of national ABS regime

(1) These activities may come under national ABS legislation depending of its scope and definition of utilisation

International/global level

The Nagoya Protocol creates space for developing a specialized legal framework or sui generis system for AnGR, as already exists for plant genetic resources in the form of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The issue of transboundary genetic resources is very relevant for AnGR, as is the problem of granting and obtaining prior informed consent from communities in the absence of community protocols.

Stakeholder Perspectives on Access and Benefit-Sharing and the Nagoya Protocol

Governments

Until the adoption of the Nagoya Protocol, governments had not given more than cursory attention to the question of access and benefit-sharing of AnGR. Shortly after this event, in December, 2010, the Dutch government hosted an international technical expert workshop in Wageningen with the purpose of “Exploring the need for specific measures for access and benefit-sharing of AnGR for food and agriculture”. The workshop was attended by almost all stakeholder groups, including the industry, research organisations, governments and NGOs and participants discussed about the pros and cons of establishing a separate treaty or legal framework for AnGR as it already exists for plant genetic resources for food and agriculture. The results of the workshop were presented in a side-event during CGRFA 13. One of the recommendations of this workshop was to carry out further work in developing and implementing Biocultural Community Protocols, and it was also suggested to better address the issue of Livestock Keepers’ Rights. The arguments for and against a separate legal framework for AnGR were discussed (Martyniuk 2010).

The perspective of governments is reflected in the endorsement during the fourteenth session of the Commission on Genetic Resources for Food and Agriculture (CGRFA 14) of the report of the 7th Session of the Intergovernmental Technical Working group on Animal Genetic Resources (FAO 2013 a). The Working Group emphasized the need for capacity building and technical assistance activities with regard to access and benefit sharing for AnGR. It supported the need for developing model contractual clauses and also endorsed the development of voluntary guidelines at the appropriate level for domestic legislative, administrative and policy measures for access and benefit sharing for AnGR based on regional consultations which would involve all stakeholders. The need to consider community protocols in relation to access to traditional knowledge associated with AnGR was mentioned and the Global Plan of Action for Animal Genetic Resources was recommended as point of reference. The option of using the Funding Strategy for the Implementation of the Global Plan of Action for Animal Genetic Resource as a benefit-sharing instrument was also referred to.

For Europe, the European Regional Focal Point for Animal Genetic Resources (ERFP) has taken up the issue and put up a special ERFP Task Force "Access and Benefit Sharing (ABS)" that is analysing the Nagoya Protocol for its political and practical implications and investigating the possible benefits of common guidelines or recommendations or even a formalised agreement on AnGR (European Regional Focal Point n.d.). In its opinion, “the specific policies and measures which might best constitute components of a specific International Regime for AnGR, need further elaboration” and it also states that “Although the practices for animal genetic resources are very different, it is worth thinking about the political implications and possible benefits of common guidelines or recommendations or even a formalised agreement on AnGR. “

Private sector/industry

The breeding industries cater mostly for industrial systems that can provide optimal environments for high performance livestock. Most of them are based in Europe and supply worldwide, focusing on poultry, pigs and cattle. There are differences with respect to each species, but in general the industry feels that it is not dependent on introduction of genes from the South, as their breeding programmes depend on selection within their existing breeding populations. The diversity within their stocks is believed to be sufficient for adapting to emerging needs. The industry emphasizes that there are very few examples of commercially successful introduction of Southern genes into their breeding lines. One of the problems with genetics from developing countries is the absence of scientific recording schemes. The industry expects much better results from genomic selection that depends on scientific recording of relevant economic and functional traits in different production environments.

The industry argues that it does not fall under the purview of the Nagoya Protocol, as all its genetic resources have been developed internally. This argument is true, as long as access to genetic resources for research and development occurs within a company or between companies in countries that do not provide for specific access regulation. One of their practical worries is that the Nagoya Protocol could lead to lengthier border controls that interfere with the transport of day-old chicks and fresh semen – particularly when the transport is North-South as in the vast majority of cases. Delays at borders would also raise the danger of disease contamination for the animals that are grown under strict bio-security conditions. It is feared that the establishment of the required "competent authorities" might delay North-South transactions lead to additional paperwork and warns that misunderstanding by officials could develop into a technical barrier to trade which leaves the authorities open to legal challenge either at EU or WTO level. They request "the development of internationally acceptable Material Transfer Agreements that cover the needs of North-North, South-South, North-South and hypothetical South-North transactions" (EFFAB pers. comm.). However, if the Nagoya Protocol is properly implemented, these worries should be unfounded, as the animals transferred by the industry go to end users who do not intend to undertake research and development, and they therefore do not fall under the scope of the Nagoya Protocol.

Science/Research

Scientists and researchers at universities also express concern that the Nagoya Protocol might obstruct academic research by constraining the exchange and use of genetic resources (Welch et al. 2013). In a survey of US researchers on non-plant genetic resources, it was revealed that many of them depend on the exchange of genetic resources, although usually only on a very limited scale. This exchange happens informally and is based on reciprocity, rather than payments. Often no material transfer agreements are made, only in the case that IPR outcomes are expected. This practice is based on the traditional academic commitment of researchers to the advancement of science and the existing norms of freely exchanging data, ideas and materials. However, as researchers are now expected to generate commercial results and encouraged to protect their research by means of patenting, patterns are changing (Welch et al. 2013). It is also becoming increasingly difficult to disentangle links between academic researchers and commercial enterprises, as much of the research is funded by such interests and has lost its independent nature. Another issue raised is the impact of genetic drift on developing access and benefit sharing guidelines, using the Meishan pig as an example (Blackburn et al. 2013).

Any future national ABS regime will set up rules that foreign (and maybe also domestic) scientists need to follow if they access genetic resources and associated traditional knowledge for research and development as this is the core of the Nagoya Protocol. Member countries of the Nagoya Protocol are also obliged to establish compliance rules, which apply to domestic research to secure that ABS rules of the country of origin and contractual agreements are followed. In the case of non-commercial research, countries shall develop simplified access rules but will certainly not waive contractual agreements that foresee a certain level of non-monetary benefit-sharing and provisions how to deal with a transition from non-commercial to commercial utilisation.

Some scientists see danger in the continued and unregulated North-South transfer of AnGR, as this causes the dilution of local breeds without leading to improvement in performance.

At a meeting held in Kerala (India), in 2012, the participants, most of them scientists, concluded in the Bharanaganam Declaration (see Appendix 2) that "*five decades of the existing policy of promoting cross-breeding and exotic breeds has led us nowhere in India, while the scenario in other countries does not provide a promising model to follow. We therefore strongly recommend the following actions to be taken for the sake of rural livelihoods and poverty alleviation, for the conservation and sustainable use of biological diversity, as well as for national autonomy and independence from imports*: *Fundamental re-orientation of India's top down breeding policies to community based development of indigenous breeds.*

Similar sentiments have been expressed by scientists working in Kenya, Papua-New Guinea and elsewhere (e.g. Ayalew pers. comm.). With regard to the provisions of the Nagoya Protocol and future national ABS regulations it is not likely that these concerns will be addressed. ABS rules and more important MAT of access agreements can determine the kind of research and methodologies applied to accessed genetic resources; the broader context of research aims and policies related to the further introduction of breeding material will not be element of the access agreements.

Small-scale Livestock Keepers[2]

Small-scale livestock keepers have engaged for more than ten years with questions of access and benefit-sharing of AnGR, going back to the Karen Commitment that was issued by the representatives of pastoralists and indigenous livestock keeping communities in October, 2003 and in which they demand to *benefit equitably from the use of AnGRFA in their own communities and by others* (see Appendix 1). In side-events during CBD COPs 9, 10, and 11, livestock keepers have repeatedly drawn attention to their contribution to animal genetic resource conservation. Making the link between the survival of breeds and the survival of small-scale livestock keepers such as pastoralists, smallholders and family farms in a general policy environment that favours large-scale industrial modes of livestock production, they demand Livestock Keepers' Rights.

The term "Livestock Keepers' Rights" was coined during the World Food Summit in 2002 by civil society attending the Forum for Food Sovereignty to flag the role of livestock keepers in animal genetic resource management. It alluded to "Farmers' Rights" as known from the International Treaty on Plant Genetic Resources for Food and Agriculture that had been recently concluded (Köhler-Rollefson et al. 2010).

Between 2003 and 2007, a large number of grassroots consultations were carried out by and with livestock keeping communities to define the term more closely. These consultations took place in Kenya "Karen Commitment"), India, Italy ("Bellagio Brief") and Ethiopia ("Addis

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[2]Livestock keepers are defined here as either indigenous livestock keepers that have a long-standing cultural association with their livestock and have developed their breeds in interaction with a specific territory or landscape or ecological livestock keepers that sustain their animals and the environments where these animals live, relying largely on natural vegetation or home-grown fodder and crop by-products and without artificial feed additives (LIFE-Network 2012).

Résumé") and involved about 500 representatives of livestock keeping communities from Africa, Asia, Latin America and Europe. They identified 7 cornerstones of "Livestock Keepers' Rights" that would enable livestock keepers to continue playing their role as guardians of biological diversity (Köhler-Rollefson et al. 2010).

During this process, Livestock Keepers' Rights were elaborated into a much more comprehensive concept than Farmers' Rights. Rather than representing legal rights, they correspond to development principles that would help livestock keepers continue to conserve biodiversity.

Principles and Rights

During a workshop with legal experts held in Kalk Bay, South Africa in December 2008, the rights were further refined and subdivided into principles and rights:

Principle 1: *Livestock Keepers are creators of breeds and custodians of animal genetic resources for food and agriculture.*

Principle 2: *Livestock Keepers and the sustainable use of traditional breeds are dependent on the conservation of their respective ecosystems.*

Principle 3: *Traditional breeds represent collective property, products of indigenous knowledge and cultural expression of Livestock Keepers.*

Based on these principles articulated and implicit in existing legal instruments and international agreements, Livestock Keepers from traditional livestock keeping communities and/or adhering to ecological principles of animal production, shall be given the following Livestock Keepers' Rights:

- Livestock Keepers have the right to make breeding decisions and breed the breeds they maintain.
- Livestock Keepers shall have the right to participate in policy formulation and implementation processes on animal genetic resources for food and agriculture.
- Livestock Keepers shall have the right to appropriate training and capacity building and equal access to relevant services enabling and supporting them to raise livestock and to better process and market their products.
- Livestock Keepers shall have the right to participate in the identification of research needs and research design with respect to their genetic resources, as is mandated by the principle of Prior Informed Consent.
- Livestock Keepers shall have the right to effectively access information on issues related to their local breeds and livestock diversity.

Declaration on Rights

The Kalk Bay workshop also resulted in a Declaration on Livestock Keepers Rights that references the individual principles and rights to existing international legal frameworks such as the UN Convention on Biological Diversity, the United Nations Convention to Combat Desertification, the Global Plan of Action for Animal Genetic Resources and the Interlaken

Declaration on Animal Genetic Resources, as well as the Universal Declaration of Human Rights, the International Covenant on Economic, Social and Cultural Rights, the United Nations Declaration on the Rights of Indigenous Peoples, the Convention on the Protection and Promotion of the Diversity of Cultural Expressions, the Convention (No. 169) concerning Indigenous and Tribal Peoples in Independent Countries, the Declaration on the Rights of Persons belonging to National or Ethnic, Religious and Linguistic Minorities, and other pertinent legal agreements (LPP n.d.).

The Declaration on Livestock Keepers' Rights was signed by a large number of individuals and organizations. Subsequently, the participants of the International Technical Expert Workshop on Access and Benefit Sharing in Animal Genetic Resources for Food and Agriculture that was held in Wageningen in the Netherlands from 8–10 December 2010, recommended that "Livestock Keepers' Rights should be better addressed" (FAO 2011).

Biocultural Community Protocols

As there is currently no international process leading towards a legally binding or voluntary agreement in which Livestock Keepers' Rights could be embedded, livestock keeping communities have started developing Biocultural Community Protocols (BCPs) in which they seek to establish their status as an indigenous or local community stewarding genetic resources under Article8j of the CBD. While the methodology still needs to be improved, the BCPs make visible the linkages between breeds and the communities that have developed them and they also establish breeds as the "prior art" of communities and they therefore represent community claims over animal genetic resources.

"BCPs" comply with the notion of community protocols advanced by the Nagoya Protocol which in its Article 12 states that "Parties shall endeavour to support, as appropriate, the development by indigenous and local communities, including women within these communities, of:

"(a) Community protocols in relation to access to traditional knowledge associated with genetic resources and the fair and equitable sharing of benefits arising out of the utilization of such knowledge;

(b) Minimum requirements for mutually agreed terms to secure the fair and equitable sharing of benefits arising from the utilization of traditional knowledge associated with genetic resources; and

(c) Model contractual clauses for benefit-sharing arising from the utilization of traditional knowledge associated with genetic resources."

During a conference about the future of livestock keeping that was held in Bonn on 6-7th September, 2012, one of the working groups discussed "Biocultural Protocols and Approaches to Access and Benefit-Sharing for Animal Genetic Resources" (LPP 2012). This working group noted that livestock in traditional communities has both private and public goods characteristics. As livestock breeds represent specific combinations of genes and are also the result of collective breeding, it concluded that benefits should be shared on one hand, but not be linked to direct access to genes. The working group also regarded BCPs as a useful tool for communities to establish breeds as their "prior art" and as a means of claiming ownership over AnGR and raising awareness about a community' contribution to breed development.

The working group also discussed that small-scale livestock keepers provide a collective service by maintaining breeds and stewarding eco-systems. These services can be rewarded monetarily at national level through payments for environmental services, such as carbon sequestration and biodiversity conservation. Furthermore, they can be rewarded through the provision of an enabling environment that supports them to continue their livelihood and breed conservation activities (livestock keepers rights, grazing rights, services). It recommended establishment of a benefit sharing fund/pool at international level to support communities which maintain and use local breeds.

Conditions for receipt of funds would be that the beneficiaries have a BCP in place. Furthermore, communities should have direct access to the Benefit-sharing fund (no obligatory government involvement).

Key points

1. Prior to the development of the Nagoya Protocol, most stakeholders, including governments and industry did not engage with the concept of access and benefit-sharing, likely because the scenario in the sector is different from other subsets of biodiversity. Flows of AnGR have been mostly North-North or North-South, even South-South, but only rarely South-North, although new needs in the North caused by climate change may alter this scenario.
2. Although the Nagoya Protocol has generated concerns among the livestock industry about interfering with the routine exchange of farm animals as a commodity or for multiplication, these concerns are unfounded, as such transactions are not subject of the Nagoya Protocol. However, as individual farm animals combine aspects of biological and genetic resource, it would be necessary to establish mutually agreed terms when transferring animals that belong to local, indigenous or rare breeds across borders to prevent abuse of the system.
3. The Nagoya Protocol is to be implemented mostly at the national level. With its emphasis on prior informed consent and mutually agreed terms and involvement of indigenous and local communities, it should, if properly implemented, motivate countries to closer collaborate with the stewards of their AnGR and better understand their value, economic contribution, and the eco-system services they provide. Under the Nagoya Protocol, prior informed consent and mutually agreed terms would need to be established if AnGR sourced from indigenous and local communities are utilized for research even within the country.
4. Livestock keepers themselves have initiated the establishment of community protocols to highlight their role as local and indigenous communities stewarding AnGR and traditional knowledge under paragraph 8jof the CBD. These community protocols could be the basis for obtaining “Livestock Keepers Rights” as a mechanism for sharing the benefits from their AnGR.

Conclusions

The concept of access and benefit-sharing, originally developed for wild genetic resources, needs to be tweaked in order to fulfil the third goal of the CBD of sharing the benefits of AnGR with the providers of these resources.

While the industry has developed a number of mechanisms to safeguard the investments that they have made in the development of AnGR (patents, trade secret, hybrid breeding, contracts prohibiting use for breeding), the indigenous and local communities that currently act as stewards of livestock genetic diversity are undergoing developments that undermine their ability to conserve, use sustainably and share the benefits of their genetic resources and traditional knowledge. This is mostly due to neglect and disinterest of governments, as well as due to general trends (scramble for land and resources, disregard for customary practices, changes in values, monetarization of the economy, etc.).

The Nagoya Protocol contains important elements to redress this situation and create a more supportive scenario for the "keepers of genes" by sharing with them monetary and non-monetary benefits, as listed in the annex of the Nagoya Protocol. Non-monetary benefits should include the participation of livestock keepers in policy formulation and implementation processes on AnGR for food and agriculture, training and capacity building, access to services, marketing support, identification of research needs, and access to information, corresponding to the demands made in the widely supported Declaration of Livestock Keepers' Rights (LPP n.d.).

Diligent implementation of the Nagoya Protocol with respect to the provisions that apply to traditional knowledge and local and indigenous communities has the potential to make an important contribution to the conservation and sustainable use of AnGR which, in the long term, will be an important investment by developing enhancing their food security and autonomy, as it will render them less dependent on feed imports.

Although much discussed in the sector, the Nagoya Protocol should not have negative effects on the routine trade in farm animals as a commodity, for multiplication and for conventional breeding without genomic research. However, cases such as the utilization of the Red Maasai sheep for genomic research to understand resistance against endoparasites would necessitate obtaining of prior informed consent under the Nagoya Protocol, even if the research is conducted within the country of origin (in this case, Kenya).

The interest of commercial players in utilizing genetic resources from, including those held by local and indigenous communities has been limited, although a few cases have been reported.

There are certain specific characteristics of AnGR that suggest a separate sui-generis instrument for AnGR could be useful, both directly by countering some of the threats to genetic diversity as well as indirectly by focusing global attention onto the topic.

- The concept of sharing benefits based on access provided to specific AnGR cannot be expected to provide reasonable incentives to the conservation and sustainable use of AnGR, due to the almost total absence of commercial interest in locally adapted breeds that obtains currently.
- In developed countries, the service of in-situ conservation is currently provided by small-scale livestock keepers in marginal areas which are often very poor. In the

interest of fairness and equity, ways and means should be found to reward them for this service to humanity (FAO, 2012a).

- In order to ensure benefit-sharing and to create incentives for the conservation and sustainable sue of AnGR, the option of decoupling the sharing of benefits from specific cases of access should be examined. One option suggested would be to grant “Livestock Keepers’ Rights” to communities that have claimed status as indigenous or local community stewarding genetic resources under Article 8j of the CBD by means of a (biocultural) community protocol. “Livestock Keepers’ Rights” could be an avenue for ensuring in-situ conservation for access in the FUTURE, independent of demand for providing access NOW. Such arrangements would need to be embedded in national legislations, but an international instrument could do much to encourage and support such an approach by emphasizing that this would be the benefit implementing countries and help them adapt to climate change and increase their autonomy from feed imports; i.e. represent an important means towards achieving food security.
- As outlined above, a major threat to the conservation and sustainable use of AnGR is posed by the continuing importation of exotic breeds into developing countries. More emphasis on genetic impact assessments is urgently required.
- The need to monitor and evaluate the implications of rapid technology advances as well as the consolidation of the industry.

Components of an International Regime for Animal Genetic Resources

1. Reference to the Global Plan of Action on Animal Genetic Resources

The Regime would make reference to the Global Plan of Action as a comprehensive framework for the conservation and sustainable use of animal genetic resources that was approved by the FAO Conference.

2. Reference to the Nagoya Protocol on Access and Benefit-Sharing

The regime would summarize the pertinent provisions of the Nagoya protocol, such as:

- The need for establishing prior informed consent and mutually agreed terms with respect to the utilization of animal genetic resources managed and owned by indigenous and local communities.
- The requirement for supporting customary practices as well as the establishment of community protocols with respect to animal genetic resources.
- The need to not restrict the customary use and exchange of animal genetic resources and Traditional Knowledge within and amongst local and indigenous communities.

3. Summary of the distinguishing features of animal genetic resources

- The need to adapt livestock production to the challenges of climate change
- The need for in-situ conservation

- The role of small-scale livestock keepers in upholding a broad genetic base and as guarantors of livestock genetic diversity
- The *current* independence of the industry from access to external genetic resources

4. Need to share benefits with the "Keepers of Genes"

The regime would emphasize the need to share benefits with the indigenous and local communities that currently provide the service of conserving and managing locally adapted animal genetic resources for the purpose of fairness and providing incentives support for community protocols.

5. Support for Community Protocols

In reference to the Nagoya Protocol, the International Regime would confirm the need for the systematic establishment of community protocols by indigenous and local communities stewarding animal genetic resources. This would serve the purpose of making visible the association between certain breeds and certain communities and provide the opportunity for these communities to claim status as under Article 8j of the CBD. This claim could then represent the foundation for receiving non-monetary benefits as detailed in the "Declaration of Livestock Keepers' Rights". Furthermore, community protocols would serve to establish ownership by communities over their genetic resources and Traditional Knowledge and thereby represent protection against possible interference with the customary use and exchange of animal genetic resources.

6. Creation of a "Global Community Breed Repository"

Entitling local and indigenous communities to receive non-monetary benefits for their role in in-situ conservation could eventually lead to a global network of "livestock keepers' biocultural heritage sites" that could represent the decentralised equivalent to the Global Seed Vault in Svalbard. The livestock keeping communities that have established BCPs or community protocols would be eligible for benefits for their active role in conservation and upholding a pool of genetic resources with adaptation characteristics for the future. They would eventually form a network of community based conservation projects or endeavours that conserve both local breeds as well as important agro-ecological ("heritage") systems.

7. Establishment of a Benefit-Sharing Fund

A fund for financing the establishment of such a network of sites would need to be established. The Funding Strategy for the Implementation of the Global Plan of Action for Animal Genetic Resources that was adopted in 2009 by the CGRFA in its first call for proposals already focused on support to community-based conservation of animal genetic resources. Because many non-monetary benefits have the potential to make a contribution to poverty alleviation and rural development, donors focusing on these issues might also be willing to contribute, as well as breeding companies out of a sense of corporate responsibility and to ensure availability of livestock genetic diversity in the future.

8. Need for Genetic Impact Assessments

As taking exotic material from North to South has been identified as a major cause of genetic erosion and disintegration of locally adapted breeds, there needs to be more emphasis on the development of genetic impact assessment to mitigate negative impacts of current exchange practices. The International Regime should consider a more binding approach to involve the approval of an impact assessment by a relevant authority as a prerequisite for exchange.

9. Monitoring

A monitoring mechanism should be instituted that keeps track of the nature and direction of gene flow, so as to adapt measures necessary for fair and equitable benefit-sharing as and when required.

Timeline of discussions with respect to ABS of AnGR

27-30 October, 2003

Conference of Indigenous Livestock Breeding Communities on Animal Genetic Resources, held in Karen, Kenya. Participants issued the Karen Commitment, requesting to have their breeds recognized as products of their communities and indigenous knowledge, and therefore remain in the public domain, as well as benefit equitably from the use of AnGRFA in their own communities and by others.

7-9th September, 2007

International Conference on Animal Genetic Resources for Food and Agriculture held in Interlaken, Switzerland. Countries agreed on the Global Plan of Action for Animal Genetic Resources as a voluntary framework and issued the Interlaken Declaration.

8-10 December, 2010.

International technical expert workshop, Exploring the need for specific measures for Access and Benefit-Sharing (ABS) of Animal Genetic Resources for Food and Agriculture (AnGRFA), held from 8 to 10 December 2010 in Wageningen, the Netherlands. The workshop was attended by 55 participants from over 30 countries. The workshop was made possible through funding from the Ministry of Economic Affairs, Agriculture and Innovation of the Netherlands, the Norwegian Ministry for Agriculture and Food, and the Federal Office for Agriculture of Switzerland.

18-22 July, 2011.

At a side-event during the **13th session of the Commission on Genetic Resources for Food and Agriculture** (CGRFA) held at FAO in Rome, the concept of Livestock Keepers' Rights was introduced and supported by government officials.

6-7 September, 2012

Livestock Futures Conference one of the working groups discussed "Biocultural Protocols and Approaches to Access and Benefit-Sharing for Animal Genetic Resources". Its recommendations were submitted to the first session of the ad hoc technical working group on access and benefit-sharing for genetic resources for food and agriculture.

11-13 September, 2012.

First session of the ad hoc technical working group on access and benefit-sharing for genetic resources for food and agriculture on Longyearbyen (Svalbard), Norway.

24-26th October, 2012

A side-event during the **7th Session of the ITWG-AnGR focused** on Access and Benefit-Sharing of animal genetic resources. It was hosted by the governments of Brazil and The Netherlands and featured presentations by governments, the private sector and an NGO.

15-19 April, 2013.

The FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) met on 15-19 April 2013 to consider activities related to access and benefit sharing (ABS) and, in parallel, possible changes to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Concrete action on access and benefit sharing (ABS) for genetic resources for food and agriculture was deferred until at least early 2015. There was disagreement whether the different types of genetic resources under the FAO's remit should be discussed individually or whether one system should encompass all of them.

August, 2013

Access and benefit sharing Task Force Report by Elżbieta Martyniuk

ERFP Assembly, Nantes, August, 2013

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Appendices

Appendix 1. Karen Commitment

Pastoralist/Indigenous Livestock Keepers' Rights

Leaders of Traditional Livestock and Pastoral Communities, government representatives, Civil Society Organizations with a focus on livestock genetic resources, academics and livestock researchers met in Karen, Kenya from 27 - 30 October, 2003.

They issued a statement as follows:

We call on governments and relevant international bodies to commit themselves to the formal recognition of the historical and current contribution of pastoralists and pastoralism to food and livelihood security, environmental services and domestic animal diversity.

We also demand that they recognise the contributions of pastoralists and other livestock keepers, over millennia, to the conservation and sustainable use of animal genetic resources for food and agriculture including associated species and the genes they contain (AnGRFA).

Furthermore, we insist that there is international legally-binding recognition of inalienable Livestock Keepers' Rights and the Rights of their communities to:

- continue to use their knowledge concerning the conservation and sustainable use of AnGRFA, without fears of its appropriation
- participate democratically in making decisions on matters related to the conservation and sustainable use of AnGRFA
- access, save, use, exchange, sell their AnGRFA, unrestricted by Intellectual Property Rights (IPRs) and [modification through] genetic engineering technologies that we believe will disrupt the integrity of these genetic resources
- have their breeds recognised as products of their communities and Indigenous Knowledge and therefore remain in the public domain
- benefit equitably from the use of AnGRFA in their own communities and by others.

We call on the Food and Agriculture Organisation of the UN (FAO) to start negotiating such a legally binding agreement, without delay, ensuring that it will be in harmony with the Convention on Biological Diversity.

We further call on the FAO to develop a Global Plan for the conservation and sustainable use of AnGRFA by pastoralists, other livestock keeping communities and relevant public institutions.

Finally, we insist that AnGRFA be excluded from Intellectual Property Rights claims and that there should be a moratorium on the release of genetically modified livestock until bio-safety is proven, in accordance with the Precautionary Principle. We call on relevant institutions concerned with food, agriculture, trade, intellectual property and animal research to provide assurances and such legal protection as is necessary to sustain the free flow and integrity of AnGRFA, vital to global food security and the environment.

Appendix 2. Bharananganam Declaration

LIFE Network

Bharananganam Declaration

We, the participants of the Conference "Native livestock breeds for the future of mankind" that was organised on 7th and 8th July, 2012 at Hosanna mount in Bharananganam, Kottayam, Kerala, by the Vechur Cattle Conservation Trust with the support from National Biodiversity Authority Chennai discussed, exchanged information and reviewed trends around indigenous livestock breeds and arrived at the following conclusions:

1. Considering that in India livestock is the main source of livelihood for the rural poor, with marginal farm households (≤1.0h hectare of land) owning more than half of country's cattle and buffalo, and more than 80% of its sheep and goats,
2. Noting that most of the livestock related tasks are performed by women who succinctly express a preference for easy-to-manage and resilient local livestock breeds,
3. Reviewing the evidence from National Sample Surveys which indicates that the average milk yields of native cattle and buffalo breeds is gradually increasing due to livestock keepers' own interventions and without outside support , while those from cross-breeds are hovering at around 6 kg, despite massive financial investments by the government over five decades,
4. Being mindful of the fact that according to recent extensive surveys by the Rainfed Livestock Network, livestock throughout India continues to depend majorly on Common Property Resources (village commons, forest, revenue land) as well as crop by-products, while purchased feed plays a minor role,
5. Becoming aware of the global data about the decrease in fertility, short life-spans, and the high degree of in-breeding in Holstein-Friesians with their effective population size reduced to only 100 animals,
6. Realizing that semen supply is dependent on a small number of global players
7. Observing that according to international forecasts by OECD and FAPRI (Food and Agricultural Policy Research Institute at the University of Iowa, USA), feed price levels are expected to increase by about 50% in the long-term.

We conclude that five decades of the existing policy of promoting cross-breeding and exotic breeds has led us nowhere in India, while the scenario in other countries does not provide a promising model to follow. We therefore strongly recommend the following actions to be taken for the sake of rural livelihoods and poverty alleviation, for the conservation and sustainable use of biological diversity, as well as for national autonomy and independence from imports:

1. Fundamental re-orientation of India's top down breeding policies to community based development of indigenous breeds. While many states now on paper support conservation and use of indigenous breeds, this intention still needs to be operationalized in practice and requires major efforts and investment.

2. Support to the prevailing extensive production systems by providing secure access to grazing resources through community tenure rights and implementation of the Forest Rights Act.
3. Creation of strong incentives for local breed conservation and development - so the breeds that are on the verge of extinction or in rapid decline can be revived.
4. Participatory identification and mapping of indigenous breeds in their respective agro-ecosystems to arrive at a real assessment of India's animal genetic diversity, rather than subsuming 80% under the non-descript label.

Whereas public investments in the livestock sector in developing countries are usually found to be inadequate and breeding programs may even be non-existent, globally the organization of poultry, pig and cattle breeding is increasingly concentrated in a few international breeding corporations.

Selection programs for farm animal improvement are incremental and make use of within and between breed variation. Many species have long generation intervals and low regeneration rates.

Individual animals embodying AnGRFA are in general privately owned, and individual breeding animals exhibit a high value. AnGRFA are mainly under private control and ownership, and cannot generally be considered to be in the public domain. Commercial breeders often protect their investments through 'staying ahead' of competitors and by physically controlling the use of their most valuable breeding animals. Exchange of AnGR between private parties occurs to a large extent under private law agreements. In communal systems, sharing breeding animals is regulated by communal rules. Ownership of an animal or germplasm includes in principle the license to use and sell. At the same time, implementation of the Nagoya protocol, and increasing use of IPR protection (e.g. patents) may have an increasing impact on the (future) exchange of AnGRFA. Finally, AnGRFA can be characterized as being more closely related to human biology and culture compared to other genetic resources for food and agriculture. This notion in particular illustrates the need to take into account the 'total economic value' of ANGRFA in further development of policies and regulations.