

# Deep-frozen? Alive and kicking?

## Different approaches to the conservation of farm animal diversity



The Nguni cattle of South Africa are a model example of the *ex situ in vivo* conservation of an indigenous breed: they were conserved on government farms and, once their numbers had been increased by breeding, they were made available for commercial production.

Photo: Wolfgang Bayer

The contribution made by animal husbandry to food security is now widely recognised. It has also become evident that smallholder livestock-keeping and pastoral systems can be ecologically benign. Indeed, pastoralism is often the only sustainable form of agriculture possible in arid and semi-arid regions. Smallholder and pastoral systems rely on animals adapted to the local conditions. Large-scale, industrialised systems require more uniform animals. Production-oriented projects often aim to improve “unproductive” indigenous breeds, for example by cross-breeding. However, breeds with high production potential are not adapted to the harsh and variable environments in which many smallholders and pastoralists live. Moreover, the social and cultural value of indigenous animals is often overlooked by policy-makers and development experts alike.

Yet for industrial livestock producers, too, it is essential to have a genetic basis that is as broad as possible, as high-performance breeds also need genetic diversity.

In the Holstein Friesian dairy cattle breed, one of the most popular dairy breeds around the world, artificial insemination and selection have resulted in greatly increased milk output. At the same time, however, this has caused such a narrowing of genetic diversity that breeders are now thinking about crossing Holstein Friesian with other dairy cattle breeds such as the Danish Red, the Brown Mountain or the Jersey in order to reduce inbreeding.

### Key terms

The term “farm animal genetic resources” (FAnGR) covers the entire genetic make-up of farm animals, which are usually classified according to their various breeds.

A breed is

- a) a homogenous group of animals with defined and identifiable characteristics that distinguish them from other groups within a species; or
- b) a group which has come to be regarded as an independent breed as a result of geographical separation from other groups with similar traits. The definition of a breed is relatively arbitrary.

In situ conservation is the conservation of a breed in its area of origin and within an existing farming system.

Ex situ conservation is the conservation of a breed outside its area of origin, either *in vivo*, for example in zoos or on government farms, or *in vitro* in the form of sperm, embryos, oocytes or somatic cells, including stem cells.

### The key question: Who decides what is to be conserved?

Is it really necessary to conserve all traits or the entire spectrum of farm animal genetic resources worldwide? Not all animal traits are desirable – one has only to think of the aggressivity of bulls. Moreover, breeding may create new and better traits. The traits required in animals differ according to the needs of the keeper. Conservation decisions are also influenced by different interpretations of the concept of ownership of genetic resources. Are animals and their genetic resources private property, or are they owned by a community or by a nation, or are they part of a global heritage? Do FAnGR serve only the purpose of production, meaning that they can be manipulated at will? Or are livestock-keepers custodians of gifts from Nature?



Cryo-conservation in northern India.

Photo: Wolfgang Bayer

Views on these questions differ greatly between different stakeholders. Breed societies and nature conservationists nevertheless agree that some conservation must be carried out in order to protect us against future risks and because our current knowledge of FAnGR is far from complete.

An assessment of the genetic distance between animal breeds or types can help identify situations in which investment in conservation will be most effective.

In developing countries the genetic diversity of farm animals has not as yet been much studied. Many farmers know the genealogy of their animals – especially of larger animals such as cattle, camels or horses – or classify their animals by phenotype, but the genetic base and the relationships between animals are seldom known. Moreover, formal science has a poor understanding of the genetic basis of disease resistance, adaptation to low-quality feed and to climate, and of the genetics of animal behaviour.

## In situ has priority

Conservation of FAnGR within the area of origin and the farming system there does not mean that animals are kept in a museum. Farming systems change and require animals to change also. This means that there are genetic trends within animal populations. Animals being conserved *in situ* also adapt physiologically to their environment.

Local communities can manage *in situ* conservation themselves, with little outside support. Farmers can then continue to own the genetic resources that their forebears have developed over centuries.

Breed societies can play a useful role in *in situ* conservation, provided that they use a clear definition of breed characteristics and have a sufficiently large active breeding population. However, such societies need reliable documentation of what is happening in the field, especially regarding sire lines. A minimum of between about four and six sire lines should be maintained to avoid inbreeding. Tools which breed societies can use to promote and main-

## Basotho ponies on the increase

Horses appeared in Lesotho as war booty during the first half of the 19th century and were quickly integrated into the local culture, mainly for riding. Around 1850 they were for the first time described as a breed – one which was easy to train, hardy, sure-footed and noted for its stamina. During the Boer War the armies on both sides used Basotho ponies. Later, ponies were exported to Kenya. A combination of disease, crossbreeding with “better” animals and the notion that the Basotho pony was “old-fashioned” almost led to its extinction. In the mid-1970s a government stud farm and a breed society were set up in order to conserve these ponies that were so well adapted to the mountainous environment. Animals from Ireland and Egypt were used to re-establish the breed. Today there are around 100,000 Basotho ponies; they serve as draught animals, for local transport and as trekking animals for tourists.

tain breeds include sire licensing, herdbooks and animal shows, often at agricultural fairs. Breed societies need a firm legal base, for example national laws for animal breeding. An example of *in situ* conservation through a breed society is the Basotho pony in Lesotho.

*In situ* conservation of local breeds requires an enabling national policy. Many countries still have national policies that focus on high production. Nevertheless, there are hopeful signs, such as government support for local breeds – even though this may need outside support, e.g. Through FAO, regional and international breeding societies and major donors.

Possible support measures include:

- providing information to farmers about the advantages and disadvantages of particular breeds,
- promoting local and adapted breeds in rural development programmes,
- marketing special products for niche markets.

Direct financial support may be justified in some cases, for example when short-term gains favour the keeping of an exotic breed but long-term considerations make it desirable to maintain a particular local breed. However, such subsidies require intensive administration and close contact between agricultural administrators and livestock-keepers; they are rare in developing countries.

## Ex situ: Successful with wild forms

A distinction is made between *ex situ in vivo* and *ex situ in vitro* conservation. *Ex situ in vivo* means that animals of a

## Pig in luck

Small, black, pot-bellied, very fertile, yet completely undemanding, robust and resistant to parasites – that's the I pig. It is indigenous to the Nam Ha province in the north of Viet Nam. Traditionally, local breeds such as the I pig were the backbone of smallholder livestock husbandry.

With increasing commercialisation of pig production, local breeds have been displaced more and more and now only make up about one-fourth of the total pig stocks in Viet Nam. I pigs are kept almost exclusively in remote, rural areas in the upland parts of the country. Of the 14 indigenous breeds still existing, seven are endangered and three faced with extinction – including the I pig.

Up to 1970 this was the most frequently kept pig breed in the north of Viet Nam. Scarcely twenty years later, it had almost entirely disappeared. In 1989 the National Institute of Animal Husbandry (NIAH) launched a conservation programme to save the I pig, working together with smallholders. GTZ provided support to the programme. The stock of I pigs has grown slowly but steadily in recent years.

particular breed are kept in zoos or on government or special farms in order to ensure the survival of rare breeds. In such an approach it is usually only possible to keep a few animals and the low numbers make it difficult to maintain different sire lines. The *ex situ in vivo* approach has been used to conserve wild breeds; the animals are later returned to the wild. Examples of this are the Mendes antelope in Tunisia and the Przewalski horse in Mongolia. In South Africa, Nguni cattle from government farms were used to introduce Nguni cattle to commercial farms.

## **In vitro : Straightforward, economical, but very limited in scope**

There is increasing discussion of *in vitro* methods of FAnGR conservation, usually involving cryo-conservation (deep-freezing) of sperm, egg cells, embryos or somatic (body) cells. Cryo-conservation can be used with mammals, but not with birds. It has the advantage that extinct breeds can be reconstituted if sperm or embryos have been previously stored. Implanting somatic cells (cloning) has had such a high rate of failure that it cannot currently be seen as a viable option. The implantation of deep-frozen egg cells (oocytes) is also prone to failure.

The use of deep-frozen semen or the implantation of embryos has proved successful in several mammalian species, including humans. These methods are most widely used in cattle. Using deep-frozen sperm, a breed can be reconstituted within 45 generations. Where embryos are used, the process is immediate.

## Cryo-conservation: Still novel

Cryo-conservation requires reliable access to liquid nitrogen. In theory semen or embryos could be stored in this way for hundreds of years. If liquid nitrogen is available, the costs of conserving a breed are minimal: about 600 euros per year. However, collecting the material can pose a problem, because sperm and embryos are difficult to collect under smallholder conditions. Animals of the breeds to be conserved need to be kept close to appropriate facilities and must be used to being handled in a particular way.

Cryo-conservation has not so far been widely used. Even in Europe semen or embryos from only about half the endangered farm animal breeds are being stored, and only in the case of very few breeds is enough material stored to conserve the breed in its documented diversity. Many breeds or animal populations with specific characteristics are not well characterised. One of the few breeds which has been re-established from cryo-conserved material is the Harz Red cattle.

## Nguni cattle now a popular source of meat

The Nguni cow in South Africa is an example of successful re-establishment of an indigenous cattle breed from – partially – *ex situ* conservation. This breed, kept for centuries by Zulu people, was used for many purposes (milk, meat, draught) and was central to Zulu culture. When the Europeans arrived in South Africa, they regarded the Nguni as “scrub”, because the animals were fairly small, heterogeneous in horn shape and coat colour – and they were culturally important. For more than a century the indigenous farmers were told that Nguni were unproductive and should be replaced by larger breeds, preferably of European origin. This resulted in cross-breeding that was completely unsystematic. The hoped-for increase in production did not materialise and instead the animals needed treatment for ticks and worms. Now the Nguni cattle are fully rehabilitated. Twenty years ago a breed society was established. There are now 20,000 dams and 4,000 sires registered in the herdbook, and the Nguni breed takes seventh place among the beef breeds used in commercial cattle farming in South Africa. A number of development programmes are now under way to encourage small-scale farmers to keep Nguni cattle.



The Harz Red cow from Germany is an example of the successful cryo-conservation and rehabilitation of a breed that was believed to have been lost. Photo: Wolfgang Bayer

## Importance for development cooperation

In development cooperation work the conservation of animal genetic resources forms part of the support offered to animal-keeping smallholders and pastoralists. The goal is the adaptation of animal-keeping to local conditions, and not the reverse. This paradigm shift was introduced some time ago, but it has not yet been taken on board by all stakeholders. Priority should be given to *in situ* conservation within the existing farming system. This can be achieved by, for example, promoting the marketing of special products.

### The Issue Paper series “People, Food and Biodiversity” aims to:

- stimulate an interest in the conservation and sustainable use of biological diversity,
- present quickly and clearly concrete actions and experiences,
- explain new concepts and issues relating to the topic of biological diversity,
- encourage and stimulate the mainstreaming of this topic within development cooperation projects and programmes.

**We look forward to your suggestions and experiences so as to enable us to improve this series.**

## Saving the Harz Red cattle

The Harz Mountains in central Germany were formerly a mining area. To attract mineworkers the local duke granted them the right to graze cattle in the ducal forest. The miners kept a typical multipurpose cattle breed: the Harz Red. When smallholder cattle-keeping declined in the second half of the twentieth century, the Harz Red – a type of Rotes Höhenvieh, or red highland cattle – disappeared. The last Harz Red bull was slaughtered in 1970. When some of the remaining farmers wanted to once again keep the traditional cattle, they were told that all sperm had been destroyed. In 1984, however, 60 straws of sperm from a Red Highland bull were “discovered” in an insemination station; the staff had forgotten to destroy them. Cows with a high percentage of Harz Red cattle pedigree were inseminated, and the male offspring were used for breeding. It was, however, necessary to use some related and also endangered Red Highland cattle from neighbouring areas. Over the last 20 years the number of Red Highland cattle in the Harz has slowly but surely increased. Traditional events such as the start of the grazing season are now popular tourist attractions in the region.

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Text: Dr. Wolfgang Bayer  
Editor: Beate Wörner  
Contact: Annette von Lossau,  
Dr. Marlis Lindecke  
E-mail: annette.lossau-von@giz.de,  
marlis.lindecke@giz.de  
Website: <http://www.giz.de>