



# Animal Genetic Resources

How to preserve genetic diversity for the future



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*Farm animals are animals kept for food production. These can be cattle, but also horses or ducks. Many farm animal breeds have become rare over the past 50 years. There has also been a decline in genetic diversity within breeds. The Centre for Genetic Resources, the Netherlands (CGN) supports the preservation of breeds and traits and conserves genetic material in the gene bank.*

# Why do we need genetic diversity in farm animals?

The Netherlands has a rich heritage of different types of farm animal breeds, created through many decades of breeding. Because these animals are used for a specific purpose, they have continuously been selected for certain desirable traits, with the emphasis on the efficient production of, for example, milk, meat or eggs.

Consequently, breeds less optimised for high efficiency food production and certain valuable genetic traits have come under pressure. Not only are breeds such as the Veluwe Heath Sheep, Dutch Red and White Friesians or the Dutch Hookbill Duck at risk of disappearing, but genetic diversity within breeds is also declining. Genetic diversity is essential to ensure we can continue to respond to changes in livestock farming. For example, the transition to circular agriculture requires resilient animal breeds that can perform well under a wide range of conditions.

The Centre for Genetic Resources, the Netherlands (CGN), part of Wageningen University & Research, supports the preservation of breeds and conserves genetic material in its gene bank. In Wageningen, genetic material (mainly semen) from more than 140 breeds of different animal species is stored. The species concerned are cattle, pigs, horses, sheep, goats, dogs, ducks, geese, pigeons, rabbits and poultry - both rare breeds and more common commercial ones.

## What is a Dutch breed?

A Dutch breed is a breed that has been bred and kept in the Netherlands for at least 40 years and six generations and is bred as a (stand-alone) 'Dutch' population.

A breed is represented by a breeding society or an organised network of breeders in the Netherlands that is registered with the Chamber of Commerce.



Deep Red cattle

# Animal genetic resources gene bank

The aims of the animal genetic resources gene bank are:

- To secure genetic diversity in rare and more common breeds
- To insure against emergencies such as the loss of breeds due to animal disease outbreaks or serious hereditary defects
- To use genetic material to support rare breed breeding programmes
- To provide material for research and genetic characterisation.



Straws of frozen sperm in a tank of liquid nitrogen

Breeding societies, animal owners and knowledge institutes that want to store or use genetic material can contact the CGN via the website.

## *Donations of genetic material*

The CGN regularly collects doses of genetic material through agreements with artificial insemination (AI) organisations, breeding societies and breed registers. The CGN secures genetic diversity within a breed by means of targeted selection of donor animals. We select as many unrelated animals as possible based on ancestry or DNA data.

## *Requests for genetic material*

Each request for genetic material from the gene bank is checked against various issue criteria. For example, we assess whether the request supports the maintenance of a breed or is necessary in order to achieve specific breeding objectives. We always discuss requests with the relevant breed society.

## *Cryopreservation: store at -196°C*

Storing genetic material in liquid nitrogen at a temperature of -196°C stops all biological, chemical and physical processes. This enables the material to be stored almost indefinitely. In order to ultimately retain as many living sperm cells as possible, it is important to consider the optimal methods for collecting, diluting, freezing and thawing sperm from each animal species.

The CGN continuously researches innovative techniques for cryopreservation of genetic material with a view to developing and optimising freezing protocols for each animal species.

# Risk status of Dutch breeds

Of the more than 140 Dutch farm animal breeds, about 90 percent have rare (critical, endangered or vulnerable) status. The CGN determines the risk status of the breeds annually based on numbers and internationally applicable criteria. These criteria were drawn up by the United Nations Food and Agriculture Organization (FAO). You will find the most recent [breed list](#) on our website.

When monitoring the status of breeds regarding their risk of extinction, we work closely with the Netherlands Enterprise Agency (RVO), the Dutch Rare Breed Survival Trust, breeding societies and breed registers.

A number of Dutch breeds are of great international importance. Pure-bred pig lines and Dutch sporthorses are two examples of these. The CGN keeps track of these populations as well.



Gelder stallion Danser in the equestrian sport

## Criteria for risk classification of breeds (FAO 2013. In vivo conservation of animal genetic resources)

Endangerment risk category	Number of adult female animals		Increase in inbreeding per generation	
	High <sup>1</sup>	Low <sup>2</sup>	%	
<b>Critical</b>	<100	<300	> 1%	Too high
<b>Endangered</b>	<1000	<3000	0.5-1%	High
<b>Vulnerable</b>	<2000	<6000	0.25-0.5%	Moderate
<b>Normal</b>			<0.25%	Low
<b>Unknown</b>				Unknown

1 Animal species with high reproductive capability: dog, pig, rabbit, poultry

2 Animal species with low reproductive capability: cow, horse, sheep, goat

# Sustainable breeding programmes: advice and expertise

The CGN advises breeding societies on the development of sustainable breeding programmes and the preservation of sufficient diversity within the breed. We carry out population analyses using available pedigree or DNA data. Based on these analyses, breeding societies and individual breeders can further develop their breeding policies and we can select suitable animals for the gene bank.

The CGN also facilitates knowledge transfer to breeding societies through lectures, theme days and webinars. One example of this is our 'Breeding Wisely' webinar series, which covers topics such as setting breeding goals, animal registration and dealing with hereditary defects.



Dutch Pied goats



Researchers Mira and Rita discuss the infographic on the risks of inbreeding

## The European Union Reference Centre for Endangered Animal Breeds (EURC-EAB)

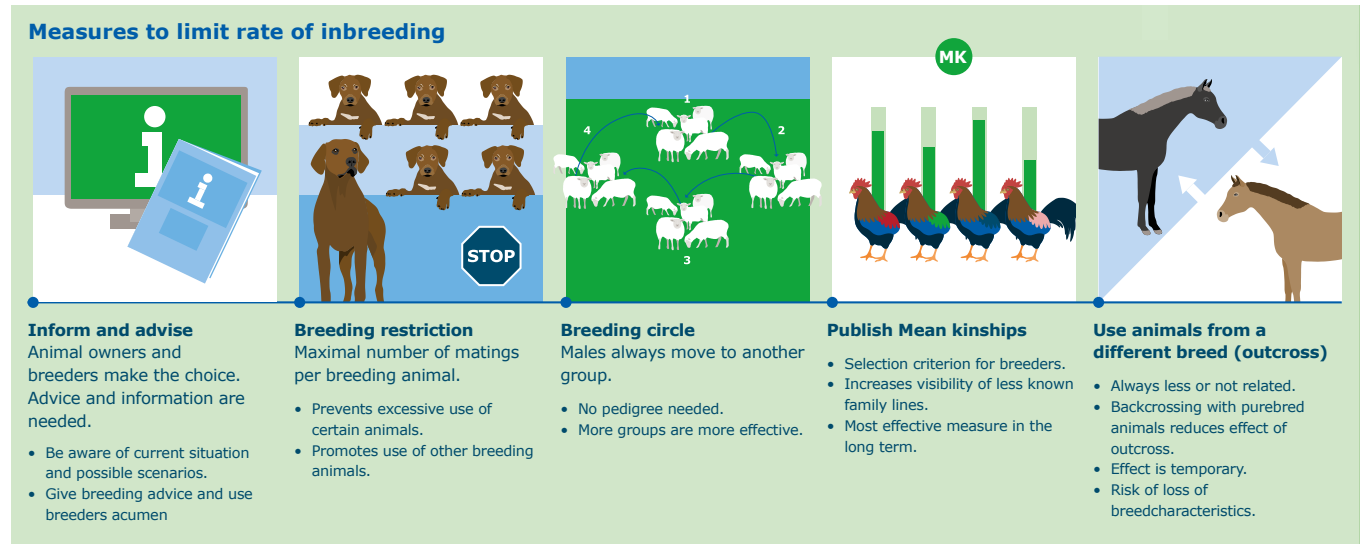
Experts from Wageningen University & Research (WUR) work together with IDÈLE (France) and BLE (Germany) in the [EURC-EAB](#). Its objective is to advise the European Commission, national governments and breeding societies on sustainable breeding programmes for rare farm animal breeds. The EURC-EAB also advises on the implementation and further development of European breeding regulations. In addition, the EURC-EAB works closely with the European Regional Focal Point for Animal Genetic Resources (ERFP).

Sipke Joost Hiemstra is head of CGN and director of the EURC-EAB: *"Effective breeding programmes are very important for maintaining the variety of rare farm animal breeds in Europe. This is how we maintain genetic diversity within the breeds and thus ensure that these breeds remain usable in the future."*

# Why high kinship between parent animals is undesirable

A gene is a piece of DNA on which genetic information is stored. Each animal receives two variants of each gene (alleles) when it is conceived: one from the father and one from the mother. Sometimes a change, or mutation, takes place in an allele, creating new diversity.

This is not necessarily problematic. If it concerns a recessive hereditary disease, the animal itself will not notice anything. It only becomes a problem when an offspring receives a harmful variant from both its father and its mother, and that likelihood becomes greater when the father and mother are related. This is because they may both have inherited the same harmful allele from their common ancestor, which they then both pass on to their offspring.



## High kinship in dog breeds successfully reduced

The Saarloos wolfdog and the Wetterhoun have small populations. Fifteen years ago, both breeds had health problems such as reduced fertility due to a high increase in inbreeding.

One of the CGN recommendations to the breeding societies was to introduce new blood by crossing dogs with unrelated dogs of another breed (*outcrossing*), based on certain conditions and agreements. The idea behind this is

that traits such as conformation and character are preserved, while the mean kinship decreases. In addition, genetic management is needed to lower the mean kinship of a breeding animal with all other breeding animals.

The results show that this approach works. Thanks to these recommendations, the rise in inbreeding has slowed and these breeds are doing better. More puppies are being born per litter, indicating an improvement in fertility.

## Centre for Genetic Resources, the Netherlands

The Centre for Genetic Resources, the Netherlands (CGN) carries out statutory research tasks (WOT) on the preservation and promotion of the sustainable use of genetic resources on behalf of the Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN). Genetic resources have value for food production, agriculture and forestry, both now and in the future. The CGN is engaged in the preservation of genetic resources of crops, farm animals and trees.

## Contact

Are you interested in collaborating with the CGN or finding out more about animal genetic resources?

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