INBREEDING INFOGRAPHICS

What is inbreeding and why can it be problematic? Most people can answer this question, albeit with some difficulty. But calculating a kinship or inbreeding coefficient? Understanding why a homozygous gene pair (i.e. a gene pair with two identical genes) can have both advantages and disadvantages in breeding? Or knowing under what conditions an inbred animal can still produce genetically healthy offspring? Not all breeders have this kind of knowledge at their fingertips, regarding relatively rare breeds, for example.

To help breeders, breed organizations and studbook publishers make the right breeding policy decisions, the Netherlands Centre for Genetic Resources (CGN) developed three infographics on inbreeding. CGN is WUR's programme unit for statutory research tasks (WOT) on genetic sources and the genetic diversity of crops, farm animals and aquatic species, trees and shrubs. *Resource* has permission to publish one of those infographics here; the entire set is available (in Dutch and English; French and Spanish versions are in the works) at fokkenmetverstand.nl.

Text Marieke Enter ◆
Infographic Illustration-ink
(©CGN/ERFP; cgn.dier@wur.nl)

Managing inbreeding and relationship in a breed

Inbreeding (F) can cause genetic defects and affect health. When breeding related animals the offspring will be inbred. Inbreeding itself is not heritable.

When breeding an animal, it is important that breeders can choose from a sufficient number of weakly related animals with low relationship for breeding.

Population
Rate of inbreeding (ΔF): difference (in %) between the average inbreeding in a population and the average inbreeding at an earlier stage.

Rate of inbreeding per generation
Rate of inbreeding adjusted for generation interval, used for risk assessment between breeds and species.

For a healthy population

More animals for breeding

Higher genetic diversity

Lower rate of inbreeding

Evaluate the effect of measures.
Start again at 1 and 2.

Inform and advise breeders.

Mean Kinships (MK)
Average kinship of an animal to all other breeding animals (♂+♀) in the population.

| Publish MK to assist selection of breeding animals. | Offspring increases the MK of their relatives. | Use animals with a low MK for breeding. | MK adjusts every generation for animal use. |

Measures to limit rate of inbreeding

STOP

Inform and advise
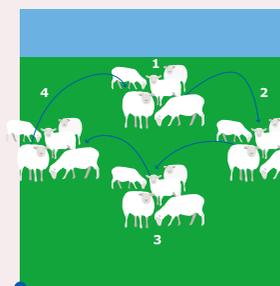Animal owners and breeders make the choice. Advice and information are needed.

- Be aware of current situation and possible scenarios.
- Give breeding advice and use breeders' acumen.
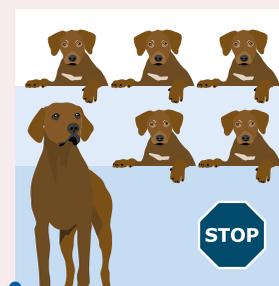
Breeding restriction
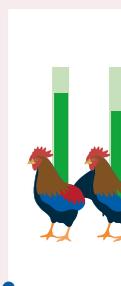Maximal number of matings per breeding animal.

- Prevents excessive use of certain animals.
- Promotes use of other breeding animals.
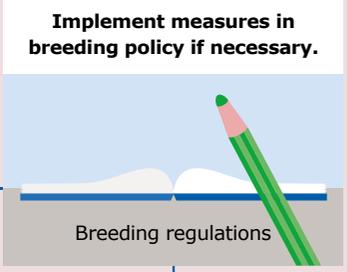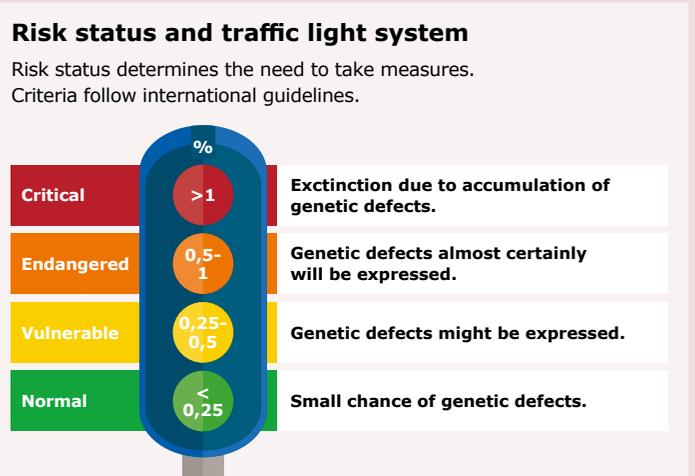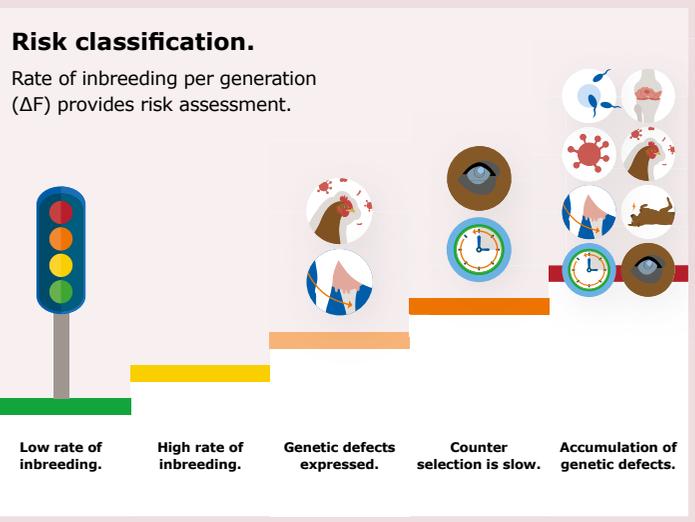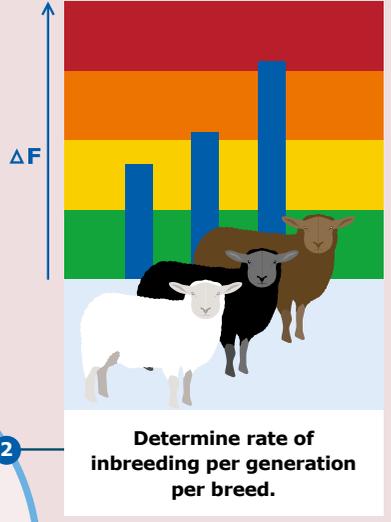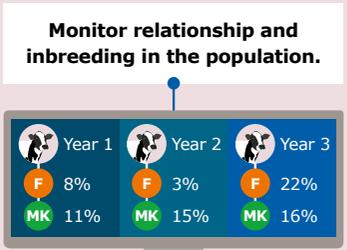
Breeding circle
Males always move to another group.

- No pedigree needed.
- More groups are more effective.

Publish Mean

- Selection criter
- Increases visib family lines.
- Most effective long term.

Monitor relationship and inbreeding in the population.

	Year 1		Year 2		Year 3
F	8%	F	3%	F	22%
MK	11%	MK	15%	MK	16%

ΔF

1

6

2

Inbreeding in the breeding programme

Breeders select breeding animals. Breeding organisations are responsible for the breeding policy supporting the breeding goal.

5

3

4

Implement measures in breeding policy if necessary.

Breeding regulations

Determine rate of inbreeding per generation per breed.

Risk classification.

Rate of inbreeding per generation (ΔF) provides risk assessment.

Low rate of inbreeding.	High rate of inbreeding.	Genetic defects expressed.	Counter selection is slow.	Accumulation of genetic defects.

Evaluate risk factors.

Risk factors

Few or uneven use of breeding animals.

Risk status and traffic light system

Risk status determines the need to take measures.
Criteria follow international guidelines.

%

Critical	>1	Exctinction due to accumulation of genetic defects.
Endangered	0,5-1	Genetic defects almost certainly will be expressed.
Vulnerable	0,25-0,5	Genetic defects might be expressed.
Normal	<0,25	Small chance of genetic defects.

MK

Kinships

ion for breeders.
ility of less known

measure in the

Use animals from a different breed (outcross)

- Always less or not related.
- Backcrossing with purebred animals reduces effect of outcross.
- Effect is temporary.
- Risk of loss of breed characteristics.
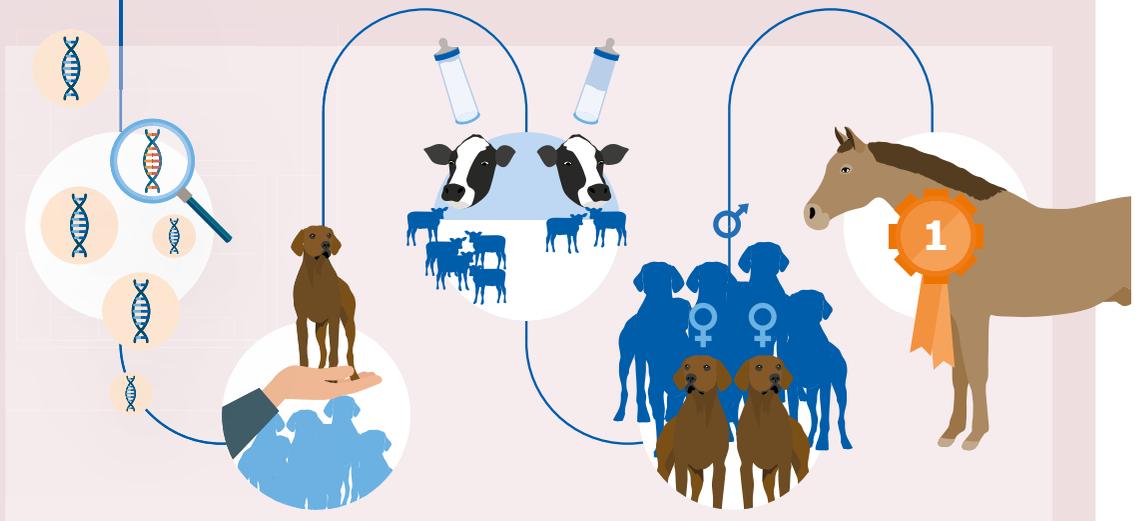
Small, closed populations quickly run out of unrelated animals.

Not all potential breeding animals are used for breeding.

Few, related animals are used due to high selection pressure on heritable traits.

Male biased sex ratio in breeding animals.

Champions are more popular and produce dispro-portionate numbers of offspring.

1