

Genomics for small breeds

Genetic Forum Cattle Breeders and Dairy Farmers, Poland

8-11-2023, Jack J. Windig



Background

**Centre for Genetic
resources the Netherlands**



- Gene bank
- Support breeding organisations of rare Dutch livestock breeds
- Develop tools and methods for conservation



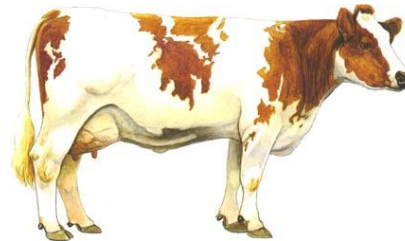
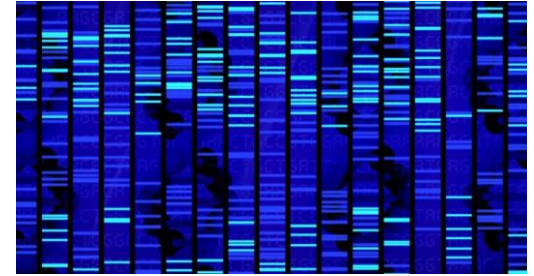
**EUROPEAN
REFERENCE CENTRE FOR
ENDANGERED
ANIMAL BREEDS**

- Scientific and technical advice
- Methods for preservation of endangered livestock breeds
- Conservation of genetic diversity within breeds

This talk

- Rare cattle breeds and use of genomics
- Genomics to identify breeds and breed differences
- Special qualities of rare breeds
- Genomic selection and rare breeds

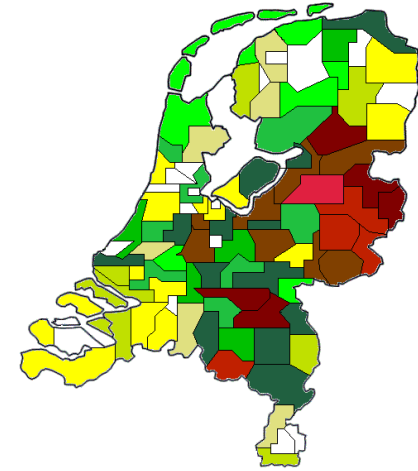
All illustrated with Dutch cattle breeds



Local indigeneous cattle breeds: MRV

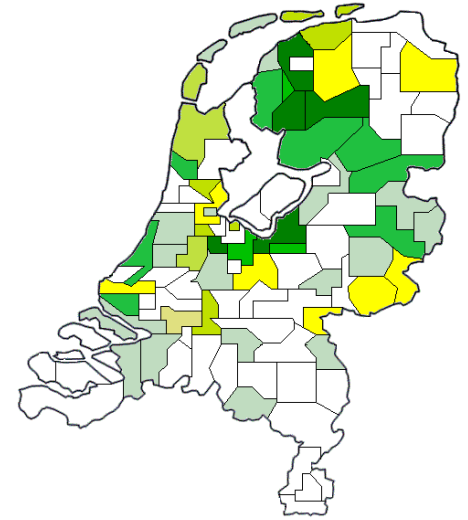


Deep Red variety



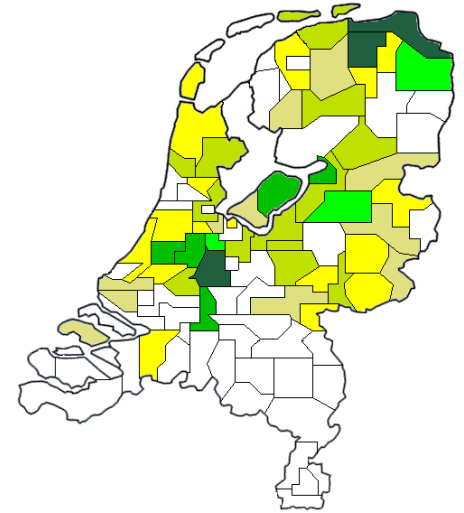
- South and East
- On sandy soils and along rivers

Local cattle breeds: Dutch Friesian



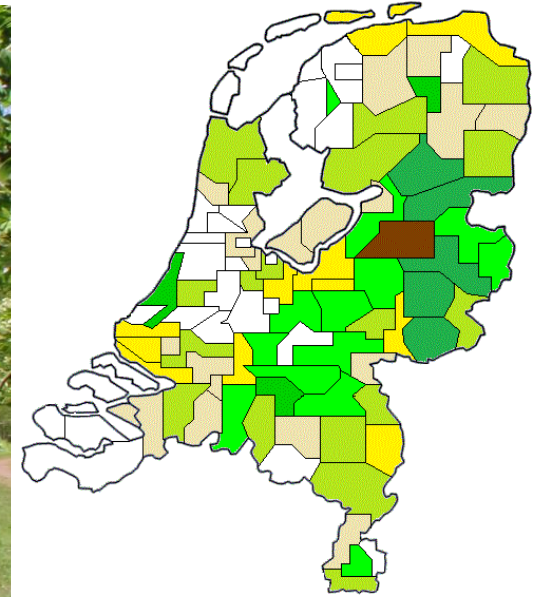
- West North
- Peat and Clay

Local cattle breeds: Groningen White headed



- North-East and Centre West
- Clay and peat

Local cattle breeds: Dutch Belted



- East and South
- Beef (and ornamental)

Development of cattle breeds in the Netherlands

- Number of registered cows

BreedD	1970	2017
MRY	178 973	19 898
Dutch Friesian	629 410	3 153
Groningen White Headed	14 214	2 785
Dutch Belted	380	3 356
Holstein Friesian	0	2 015 132

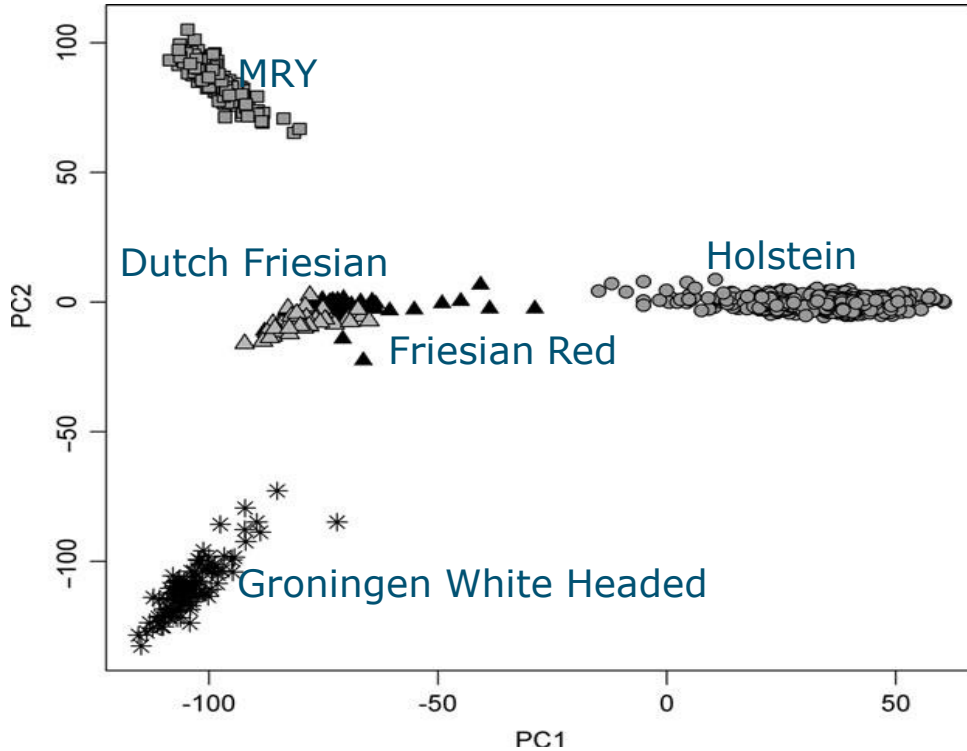
- Local cattle breeds decimated in the past 50 years
 - Replaced by Holstein Friesian
- Since 2017 stable numbers except for MRV (halved)

Genomics to identify breeds and breed differences

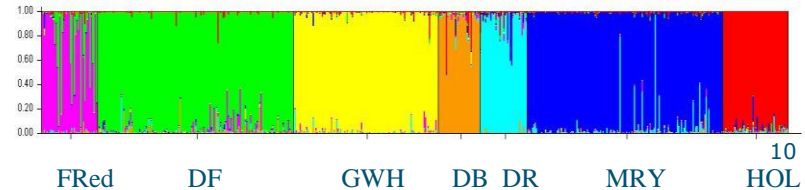
- Dutch Gene bank
 - Samples stored of all Dutch cattle breeds
 - Since the 1970s
 - Cross section of whole population
- Opportunity to investigate genetic variation
 - 50K SNP chip
 - 880 Bulls: Dutch cattle breeds + Holstein
 - 35 025 Markers across the genome



Genomic relationships between breeds



- Test to assign correct breed?
- Search for DNA SNP markers to identify breeds
 - Different between breeds
 - Uniform within breeds
- Selection of 133 Markers sufficient to identify breeds



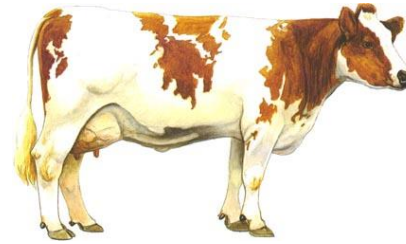
Protocol DNA test



Registration of unregistered animal

1. Check breed characteristics & identification of animal by breeding organisation
2. Take hair sample, fill in a form, sent it to CGN
3. Genotyping by commercial lab, analysis by CGN
4. Registration in herd-book if correct





Special qualities of local breeds?



Dual purpose naturally project



- Public – private cooperation project supported by ministry of agriculture
 - Biodiversity in agriculture
- Hypothesis: Locally adapted indigeneous breeds function better in nature-inclusive agriculture than the high input/high output Holstein Friesian

National bird - Black tailed Godwit



Why do farmers keep local breeds?

Quotes of farmers with local breeds

- Holstein superior in milk production

In this extensive farming system the breed performs well

It is a breed from our own region for hundreds of years and I like that

It is simply a cow that fits in organic farming

The veterinarian hardly has to visit us

These cows take better care of themselves

Their fertility is rather good

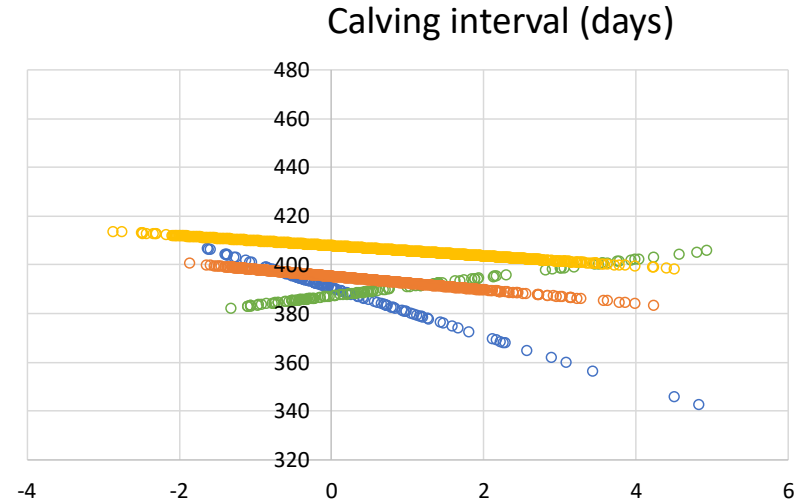
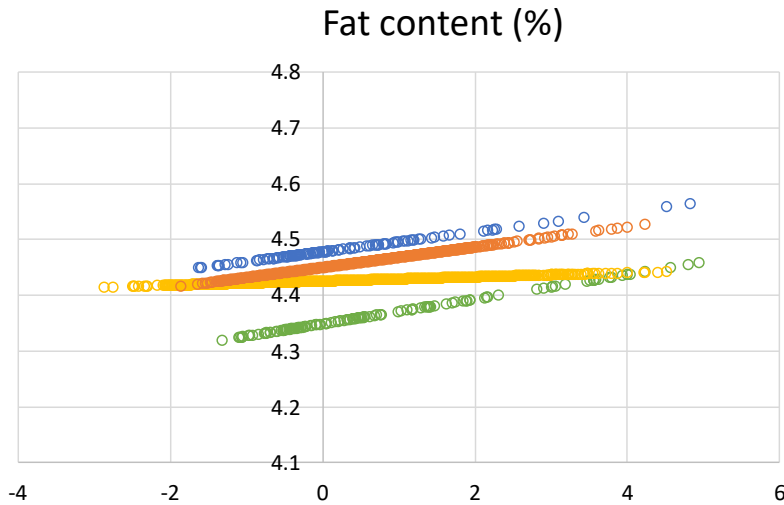
I like flexible cows for a flexible farmer

- Result from interviews
- Local breeds perceived as more robust and self-reliant
- Opportunities for local breeds in less intensive farming systems

It just performs on grass, so I do not need to buy concentrates

- High variation within breeds

Performance breeds in different farming systems



Concentrates →

Agroecology

○ Dutch Friesian

○ Groninger White Headed

Concentrates →

Agroecology

○ Meuse-Rhine-Yssel

○ Holstein Friesian

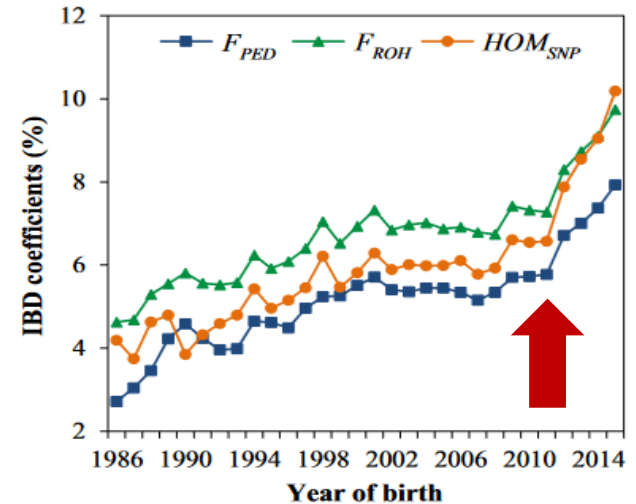
- Holstein stable across environments
- Opportunities for local breeds in agro-ecological farming

Future of local breeds

- Smaller populations
 - Risk of inbreeding and associated problems
- Performance
 - Lower production
 - Opportunities in low input systems / extensive farming / agro-ecological farming
- Adapt breeding goals
- What about genomic selection?

Genomic selection

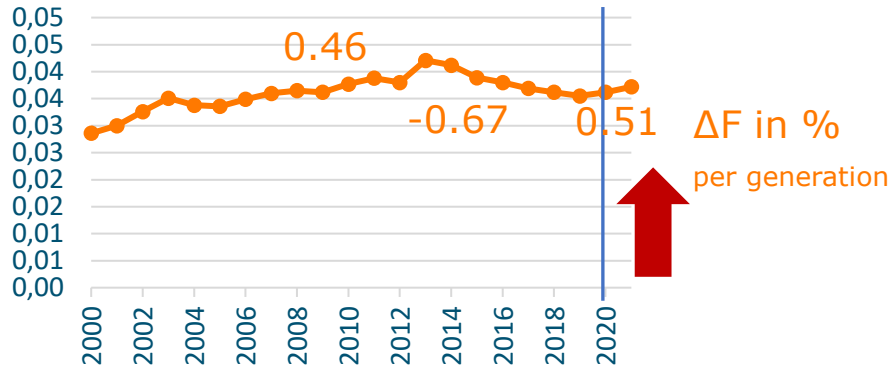
- Reference population
 - Animals with reliable breeding values
 - Determine Relationship DNA profile – breeding value
- Reliable breeding values at birth
 - Acceleration in genetic gain
- Now widely in use especially in Holstein
 - Inbreeding rates have increased in Holstein



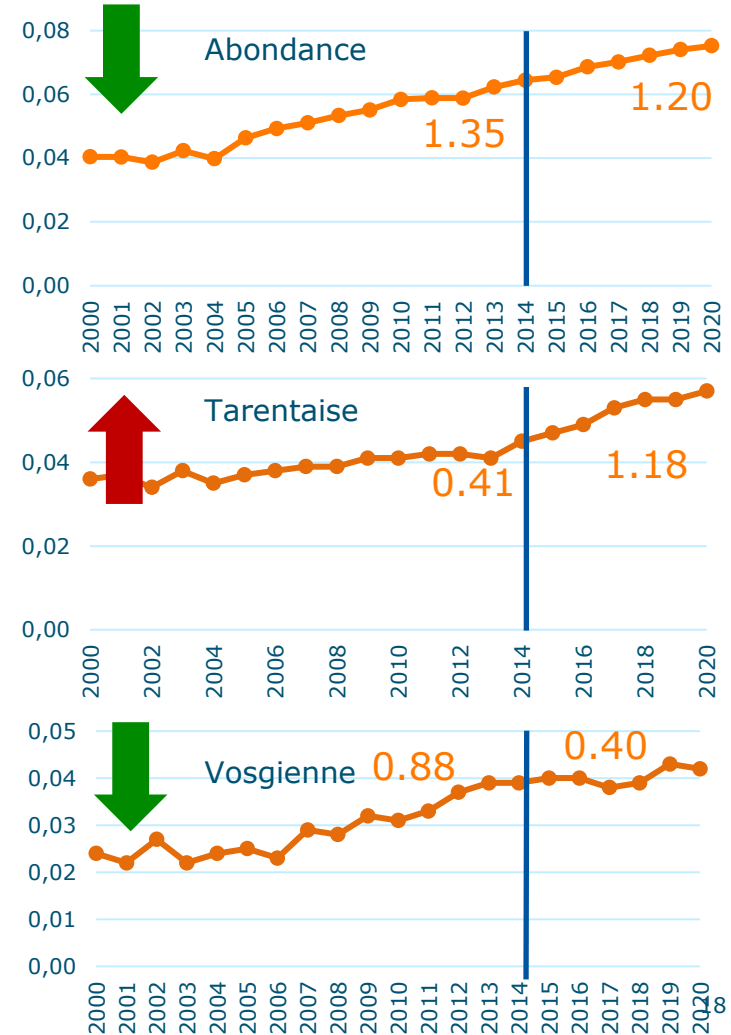
- the Netherlands (Doekes et al. 2018)
- Poland (Topolski and Jagusiak 2020)

Inbreeding rates in local breeds

MRIJ



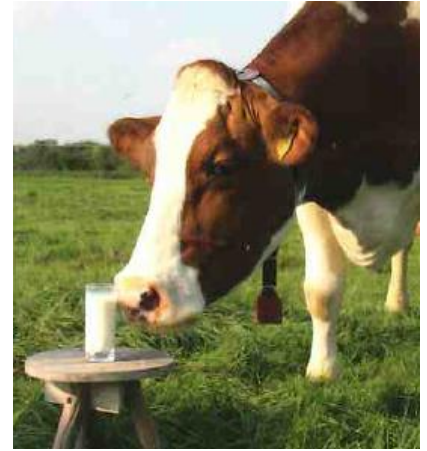
- After introduction Genomic selection
- Can go up or down
- Genetic management is more important than introduction GS per se



Genomic selection in local breeds

- Difficult to establish reference population
 - Few animals
 - Fewer animals with reliable breeding values
- MRIJ
 - Reference population of 40 Bulls
 - Does it increase the reliability of the breeding value of a young bull?
 - Reliability without Genomic Selection 0.30
 - On average 4% increase in reliability
 - 5-10% for production traits
- Even with a small reference population some benefit
 - Start building a genomic database of animals with reliable EBVs for local breeds

Stoop et al. 2017



Genomic selection across local breeds

- Can animals from other breeds help?
 - Animals from other breed have less useful information
 - Need more animals for same effect
- Within Dutch local breeds limited benefit
 - Number of animals needed to increase reliability with same percentage as 1 animal of own breed

	MRY	DpRd	DBelt	DFri	GWH
MRY	1	11	43	48	52
DpRd	24	1	112	97	115
Dbelt	116	133	1	64	128
DFri	78	69	38	1	67
GWH	114	112	104	92	1

Marjanovic et al. 2021



- Look at related foreign breeds
- German Red and White Dual purpose (Rotbunte DoppelNutzung) closely related to MRV
- Now included in reference population

Genomics for small breeds

- Local breeds have special qualities
 - Opportunities in less intensive systems
- Genomics can help to identify breeds
 - Possibility to incorporate non-registered animals
- Genomic selection possible in small breeds
 - Start building a genomic database
 - Cooperate with closely related breeds

