

The Norwegian model for a sustainable breeding program

"From theory to sustainable animal breeding"

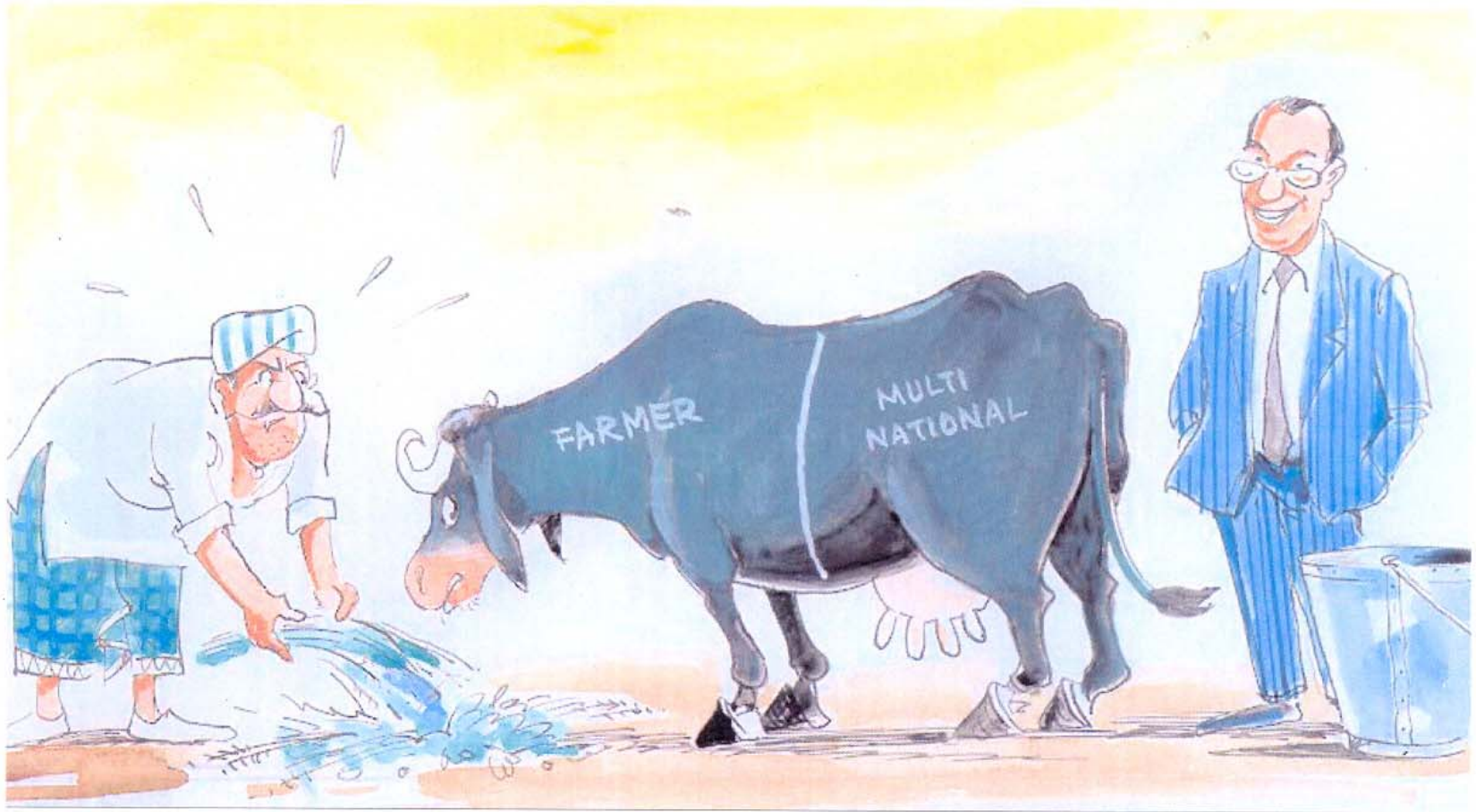
An open seminar to honour dr. Erling Fimland
Ås 12th January, 2009.

Professor Odd Vangen

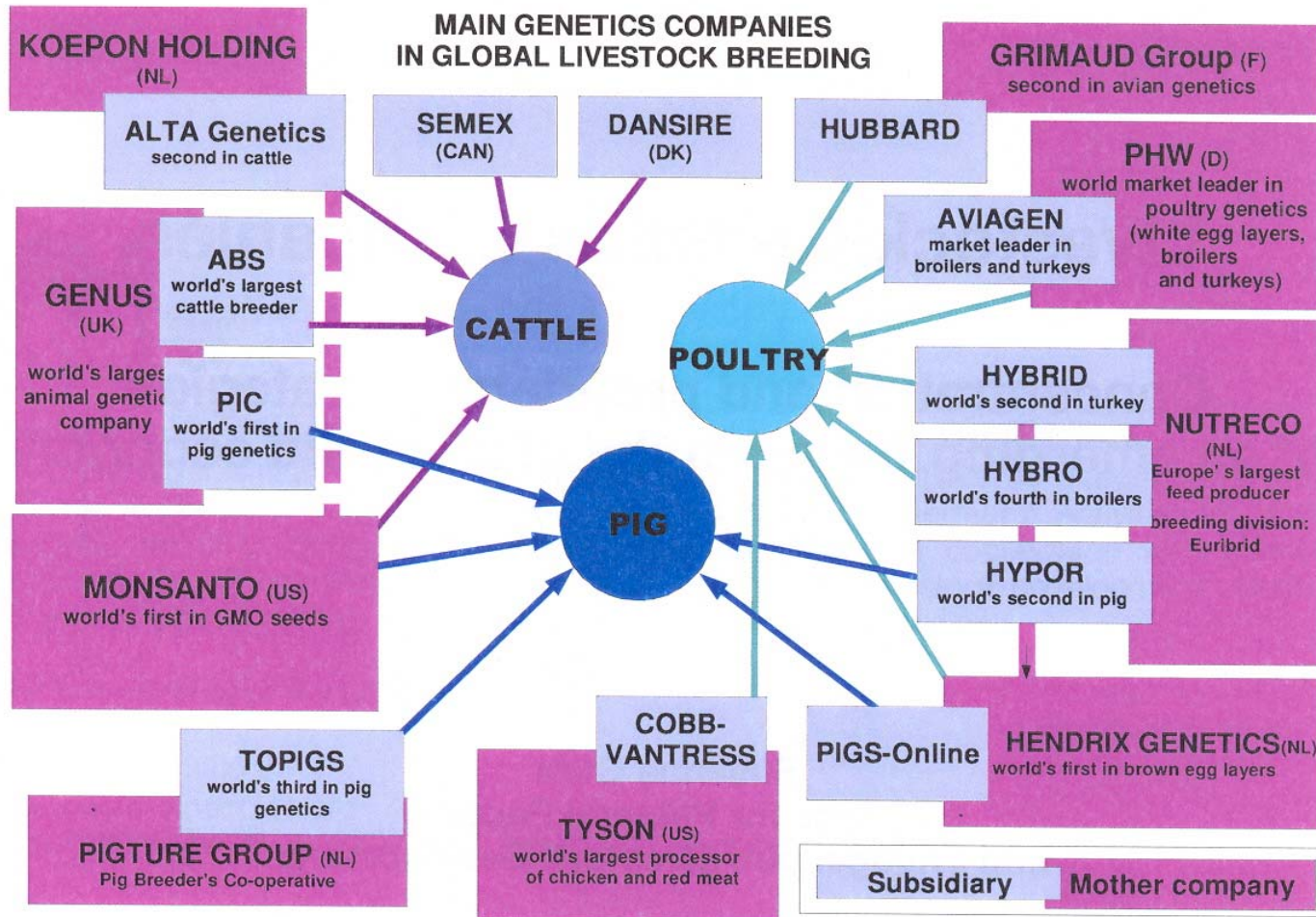
IS THERE- WAS THERE – A NORWEGIAN AND/OR NORDIC MODEL FOR SUSTAINABLE ANIMAL BREEDING?

- Did we have especially clever applied scientists, did we have especially loyal farmers, did we have the optimal economical politics, did we have the optimal size of farm enterprises, or was there other reasons why animal breeding from the 1960's and onwards till today in Norway finally has gained nationwide (and slightly international) attention.

An illustration of some of the changes that have taken place in the animal breeding industry from the start of Erling's scientific career till today.



Concentration of ownership to Animal Genetic Resources!



Changes in the animal breeding industry

- $\frac{3}{4}$ of the world's **chicken** production comes from industrialized breeding lines
- $\frac{2}{3}$ of the world's **milk** production comes from industrialized breeding lines
- $\frac{1}{3}$ of the world's **pig** production comes from industrialized breeding lines
- 4 international companies own and control the commercial **egg and broiler** genetics
- 5 large inter/multi-national companies own and control large parts of the commercial **pig** genetics
- 4-5 main AI companies supply the international **cattle** semen market with genetics

Our scientific discipline has gained renewed international interest (1)

The New York Times (editorial observer), Jan. 23, 2008:

"Closing the barn door after the cows have gotten out".. "anyone who cares about food –its different tastes, textures, and delights- is more interested in diversity than uniformity"..

The New York Times, Jan. 27, 2008:

"A dying breed".....the world's food supply is increasingly dependant on on a small and narrowing list of highly engineered breeds...Holstein, Large White, Rhode Island Red, Leghorn...

....for countries on the equator..the Holstein breed is very poorly suited--- may be the least suited breed...

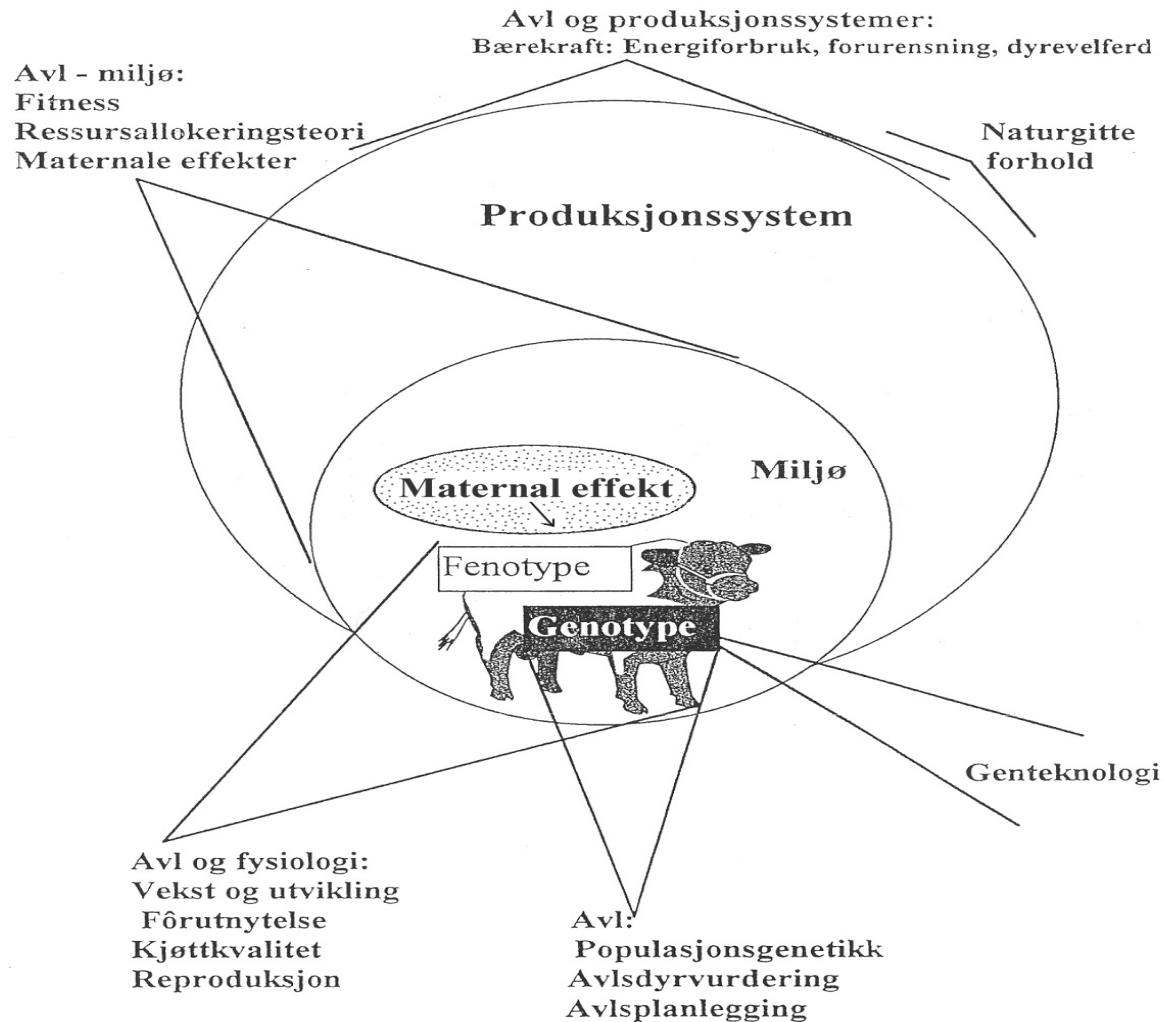
Our scientific discipline has gained renewed international interest (2)

"The world needs more quantitative geneticists"

- a. (Editorial (2007)
in Journal of Animal Breeding and Genetics)**
- b. Stated in the general debate at
1st Int. Technical Conference on Animal Genetic
Resources for Food and Agriculture**

A wider perspective on animal breeding as a part of a production system- genes and environment.

Perspektiver på husdyravl



The “leading stars” for Norwegian Breeding Organizations were formulated around 1960 and were expressed as such:

- **Genetic progress for the many** (*the farmers, heavily involved in recordings for the breeding organisation, have the right to shear a part of the outcome of genetic progress*)
- **The farmer's right to be consulted** (*involvement, ownership*)
- **Utilizing the scientific improvements** (*utilizing new knowledge, bridge between theory and practice*)

The success of a breeding organisation is dependant on the genetic improvement created, and this genetic improvement is dependant on scientific inputs.

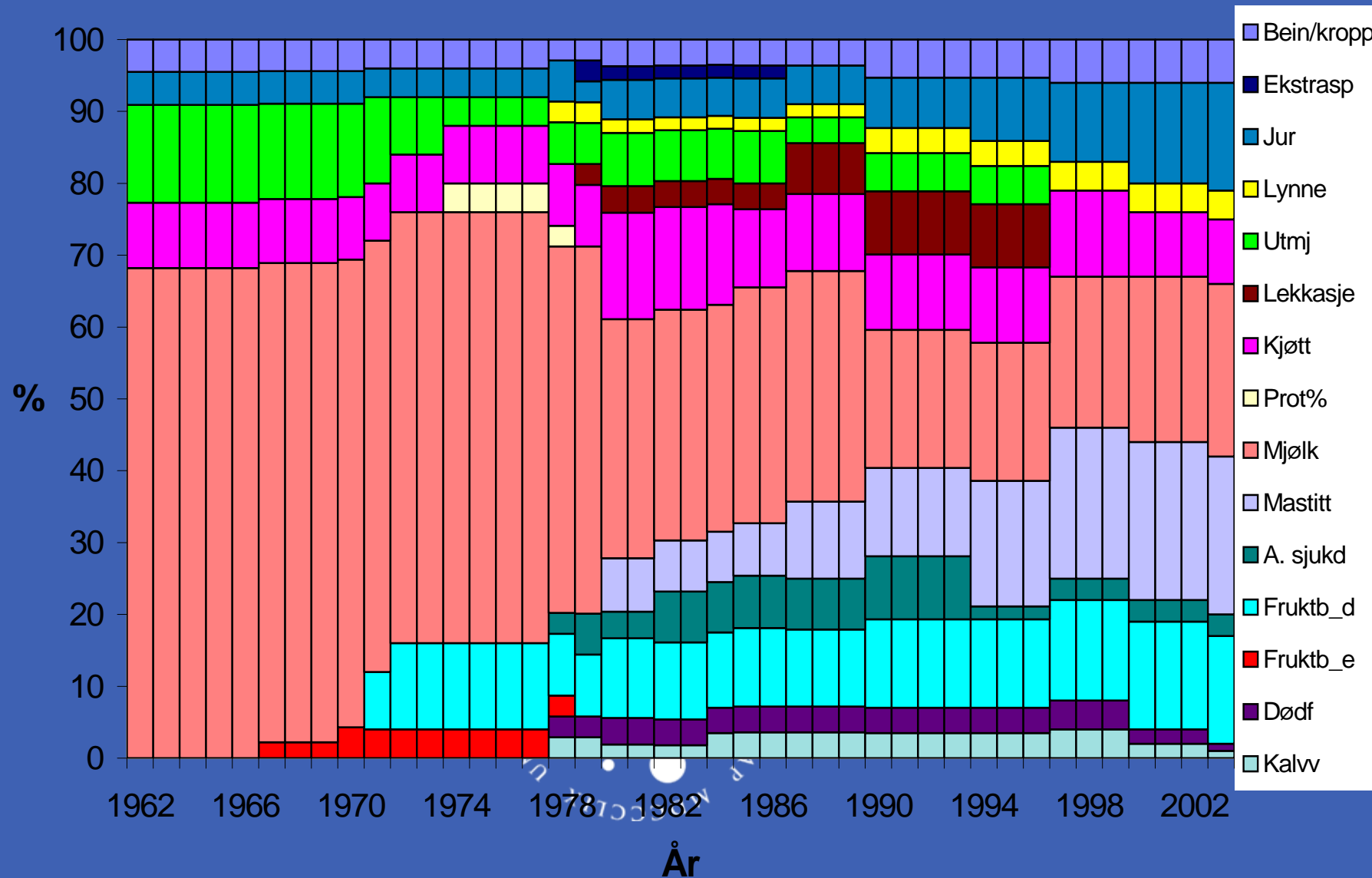
Norwegian breeding organizations have some success on the export market. WHY:

- **Strongly organised**
- **High AI percentage (high selection intensities and efficient use of males)**
- **High health status**
- **Short distance theory-practice**
- **Interested and motivated breeders**
- **Openness of breeding system**
- **Documentation of genetic level**

Key elements

- The present success of Norwegian farm animal breeding nationally and internationally is a result of these leading stars and these investments in animal breeding and genetics from then to present.
- Some of the key elements of this development have been the close links between breeding industry and genetic/breeding research and education. The success of a breeding organisation is dependant on the genetic improvement created, and this genetic improvement is dependant on scientific inputs.
- The success of Norwegian fish farming (especially salmon) was as well developed from the same breeding philosophy and from the same scientific groups linked to our department and to the scientists within the breeding organisations.

Development of the breeding goals for Norwegian Red Cattle





The most striking with these breeding goals:

Many traits

Many low-heritable traits

Many "long perspective" traits

Many health, fertility, labour reducing and consumer related traits

Main challenge for sustainable breeding in Norwegian Red Cattle (NRF) (Sehested, 2006)

- **Minimum inbreeding**
- **Maintaining genetic variance**
- **Genetic gain**

The Norwegian Gene Technology Law (Legislation) (when evaluating genetic modified organisms):

Only in Norway:

- Sustainable development
- Value of the product for the society

Additionally as in EU:

- Ethical considerations
- Environment and health effects

How to maintain these advantages for farmers and society?

Breed for future traits:

- **Maintain production efficiency**
- Maintain strong alliances with the breeders
- **Beware of importance of field recording systems and health status**
- Strengthen breeding for health, longevity and fertility –
in both purebreeding and crossbreeding

Criteria for sustainable breeding (Fimland, 2006)

- Reduced effective number within a population gives increased inbreeding and reduced genetic variation
- Reduced effective number in a population gives lower probability for new genetic variation through mutations

AND

- We will need a certain number of breeds in order to have breeds to select amongst (between breed variation)

Criteria for sustainable breeding (Vangen 2007)

At breed level:

Breeding for more traits simultaneously leads to a better balanced biology of animals

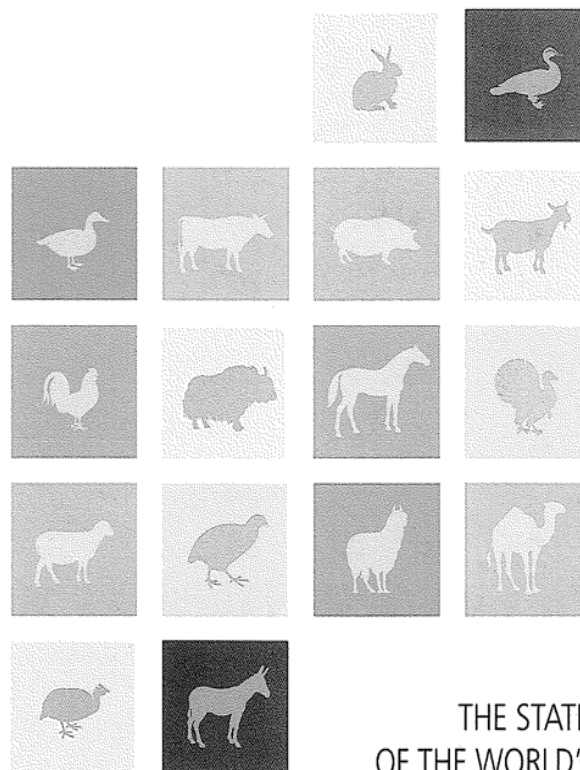
Breeding in a long term perspective leads to a better balanced biology of animals

Registration of traits in their natural environments (in field) increase the possibilities of relevant adaptation to the production environments.

Include knowledge of biological limitations and non-linear correlations between traits

Maintain large enough population size

Balance breeding values with relationship values, summarized to the selection value.



THE STATE
OF THE WORLD'S
**ANIMAL GENETIC RESOURCES FOR
FOOD AND AGRICULTURE**

COMMISSION ON
GENETIC RESOURCES
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AGRICULTURE



Box 83

Norwegian Red Cattle – selection for functional traits

The Norwegian Red (NRF) is a high-producing dairy cattle breed in which fertility and health have been included in a selection index (known as the Total Merit Index) which has been in operation since the 1970s. The case of the NRF provides a practical illustration that production and functional traits can be successfully balanced in a sustainable breeding programme. This achievement has been based on an effective recording system and a willingness to place sufficient weight on the functional traits. The programme is run by GENO, a cooperative owned and managed by Norwegian dairy farmers. Currently, ten traits are included in the Total Merit Index. The following list shows the relative weight given to each:

Milk index	0.24
Mastitis resistance	0.22
Fertility	0.15
Udder	0.15
Beef (growth rate)	0.09
Legs	0.06
Temperament	0.04
Other diseases	0.03
Stillbirths	0.01
Calving ease	0.01

Key features of the programme include the fact that more than 95 percent of herds participate in the recording system and are on a computerized mating plan, 90 percent of matings are carried out using AI, and there is 40 percent use of test bulls. All diagnosis and health registration is carried out by veterinarians, and databases are maintained for pedigree and AI-related information. About 120 young bulls are tested annually with progeny groups of 250 to 300 daughters – thus enabling the inclusion of traits with low heritability (such as mastitis with a heritability of 0.03 and other diseases with 0.01) while still providing a selection index with high accuracy.

Milk production per lactation in the best herds exceeds 10 000 kg, with the top cows producing more than 16 000 kg. The genetic trend is positive with

respect to fertility – the average 60 day non-return rate in the population is 73.4 percent. Between 1999 and 2005 incidence of mastitis in NRF cows was reduced from 28 percent to 21 percent, and it is estimated that of this reduction 0.35 percent per year was the result of genetic improvement. Major calving difficulties are reported in less than 2 percent of calvings, and less than 3 percent of calves are stillborn.

The sustainability of the breeding programme is promoted by a number of factors:

- Both production and function are expressed by many traits, and they are both strongly weighted in the breeding strategy.
- Many different combinations can result in a high total breeding value. This allows for the selection of animals from different breeding lines and, thus, automatically reduces the risk of inbreeding.
- The breeding work is based on data from ordinary dairy herds, which guarantees that the breeding programme produces animals that are well adapted to normal production conditions.

Provided by Erling Fimland.

For further information see: http://www.geno.no/genonet/presentasjonsdel/engelsk/default.asp?menyvalg_id=418



Photo credit: Erling Fimland

Some recent results with use of Norwegian Red in different countries-1

There have been sporadic exports of NRF genes since the 1970s; to begin with, on a more idealistic basis and as export of purebred material to sister populations in Australia, Sweden and the USA. In recent years, however, there has been considerable international interest in the breed, mainly with regard to crossbreeding with various Holstein populations. In the FAO report “The State of the World’s Animal Genetic Resources for Food and Agriculture”, NRF is mentioned as a positive example of breeding for health, fertility and functional traits.

Norwegian Red ABROAD (2) (Vangen, 2008)

- The frequency of mastitis among Holstein cattle in Ireland is 15.3 %, whereas crosses were closer to the figure for NRF, which is 11.2 %. Survival from first to third lactation was 78 % in NRF, compared to 67 % in Holstein. In Canada, the calf mortality rate in first calvers was 11.9 % in Holstein cows, but only 6.3 % in NRF-Holstein crossbreeds. Holstein cows in California had 17.7 % calving difficulties and 14.0 % stillbirths, whereas the figures for crossbred dams (Scandinavian Red x Holstein) were 3.7 % and 5.1 %, respectively.
- Regarding milk yields, there is only slight differences between crossbreeds and purebred Holstein, whereas NRF cows yield 5-8 % less. In a trial with grass-fed dairy cows in Ireland, crossbreeds gave 99 % of the purebred Holstein milk yields, whereas NRF cows under the same conditions gave 95 % of the Holstein yields. Warm-climate testing in California and Madagascar also shows that NRF is more robust and tolerates heat better than Holstein.
- **NEW RESULTS ARE CONTINUEOSLY AVAILABLE, AND THE NORW. RES. COUNCIL HAS RECENTLY FINANCED A PHD POSITION TO STUDY THESE RESULTS**

Final comments

- Erling has been an active scientist with highly acknowledged theoretical background- still he has contributed tremendously to the applied side of animal breeding.
- In his active period animal breeding internationally has changed from national breeding programs with more or less application of theoretical knowledge to international/multinational breeding companies that have control of the genetic resources. Investments in animal breeding is beginning to be a part of international business.
- Within Norway we are still running national programmes (minus poultry (and salmon?)). WE have some natural advantages in running sustainable breeding programmes, however, we have to agree on these advantages. ERLING has told us, among other things, about the important criteria for running sustainable breeding programmes.

Final comment- 2

***MAY BE NORWEGIAN ANIMAL BREEDING
ORGANISATIONS AND SCIENTISTS HAVE JUST
ACTED ACCORDING TO THE BOOK
(ACCORDING TO ANIMAL BREEDING THEORY)***



Thank you- and THANKS Erling!

