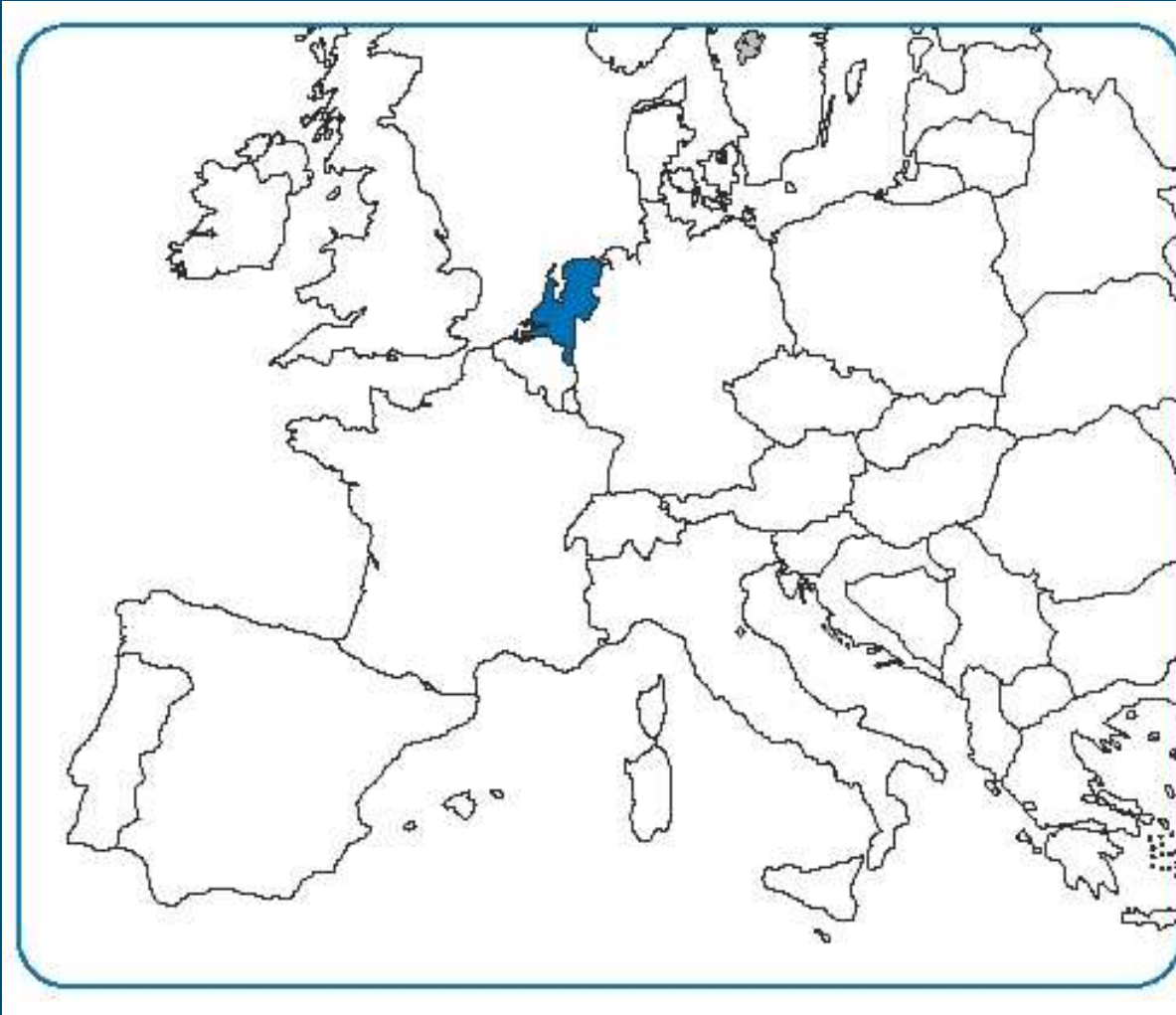


# *Animal breeding, conservation and sustainable use of animal genetic resources in The Netherlands*

Kor Oldenbroek

Centre for Genetic Resources, the Netherlands



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# Curriculum Kor Oldenbroek

- 1968 – 1973: McS Animal Breeding and Genetics, Wageningen University
- 1973 – 1988: Breed comparisons and crossbreeding in dairy cattle
- 1985 – 1988: PhD Feed intake and energy utilization in dairy cows of different breeds
- 1988 – 1992: Effects of biotechnology on breeding and production in cattle
- 1992 – 2000: Conservation of animal genetic resources
- 2000 – 2005: Head research division Animal Sciences Group, Lelystad
- 2005 > CGN, Wageningen: Policies, Education programs, Analysis FAO State of the World

## Interested in:

- Follow up of country reports on AnGR
- Initiatives for *in situ* use of native breeds
- Initiatives to involve AnGR in education, content of courses on AnGR
- Data on exchange of AnGR, exchange practices and viewpoints
- Opportunities for bilateral collaboration

# Content of presentation

- Centre for Genetic Resources, the Netherlands
- Animal breeding and contrasts with plant breeding
- Conservation of AnGR
- Sustainable use of AnGR
- FAO project exchange, conservation and sustainable use

# Management of genetic resources: why?

- farmers developed agro-biodiversity since 10,000 years
- industrialisation of agriculture and habitat loss resulted in uniformity and genetic erosion
- genetic resources remain essential for future food security and sustainable agriculture

# CGN's scope

- Plant Genetic Resources
- Animal Genetic Resources
- Forest Genetic Resources
- Plant Variety Research

# CGN's status

- unit for statutory tasks of Wageningen UR
  - independent from research institutes
  - reporting directly to Ministry of LNV
  - hosted by Plant Research International, Alterra and Animal Sciences Group under Service Level Agreements
- operating under a 5-year implementation agreement with the Ministry of Agriculture, Nature and Food Quality



# CGN's crop collections

- 20 crop collections with over 23,000 accessions
- developed from working collections
- focus on small numbers of high quality
- focus on vegetable crops and potato

# CGN's funders

- Ministry of Agriculture, Nature and Food Quality
- FAO, World Bank
- European Union

# Animal breeding principles

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# Farm animal breeding for (food) production

- Generation of genetic improvement

Selection of parents for next generation

Based on estimated breeding values

>> *Pedigree recording and recording relevant traits*

- Dissemination of superior genetic material

>> *(Artificial) reproduction methods are decisive*

- Food = meat (male and female), milk and eggs (female)

# Genetic improvement

## ■ Accuracy of selection

Heritability of the trait

Number of relatives with performance data

>> *Reproduction (number of offspring per year) important*

## ■ Selection intensity (% animals needed as parents)

>> *Reproduction (number of offspring per year) important*

## ■ Generation interval (age parents at birth offspring)

# Reproduction in farm animals

- Artificial insemination very effective in all species (cryopreserved semen)  
*>> High number of offspring per sire*
- Variation in offspring per female  
Poultry 200; pigs 25; sheep / goat 2-3; cattle / horse 1
- Embryo transplantation: not in poultry
- In vitro culture of embryo's / cloning: cattle  
*>> Artificial reproduction in females only practiced in nucleus breeding schemes and for exchanges between nuclei*

# Practical aspects of animal breeding

1. Description of the production goal
2. Description of the production circumstances
3. Description of the available species and breeds
4. Choice of the appropriate species and breed
5. Definition of the breeding goal
6. Pedigree registration; recording relevant traits
7. Genetic evaluation of potential parents
8. Choice of parents and mating plan (inbreeding!)

# Selection traits in farm animals

- Dairy production: amount of milk, milk components, fertility, udder health, longevity
- Meat production: daily gain, feed conversion, carcass composition, litter size
- Egg production: number of eggs, egg weight, feed conversion, shell quality



# Poultry breeding

- Primary breeding: four lines, creating genetic progress, owned by breeding company
- Multiplication: two crossbreds ( $A \times B$  and  $C \times D$ ), production day-old chicks, owned by breeding company
- Production: four-way crosses (ABCD), owned by farmer

# Pig breeding

- Primary breeding: pure line breeding; 3-4 lines; creating genetic progress; exchange between countries; owned by breeding company
- Secondary breeding: development of sub lines; owned by breeding companies or contracted to farmers
- Multiplication: production of crossbred sows and mating to purebred of crossbred boars; contracted to farmers
- Production: three or four way crosses; owned by farmers

# Dairy / beef cattle breeding

- Primary breeding (advanced): pure breeding; open nucleus schemes; males owned by breeding company; part of females owned by farmers; exchange of embryo's and semen
- Primary breeding (traditional): pure breeding; male owned by breeding companies, females by farmers, exchange of semen
- Production: purebreds owned by farmers; records of performance used by breeding companies

# Sheep and goat breeding

- Primary breeding (advanced / sheep): two or three way crosses; natural mating; owned by farmer
- Primary breeding (traditional): pure breeding; natural mating; owned by farmer
- Production: mostly at farm of birth; owned by farmer

# Investments in breeding programs

- Maintenance, testing and recording of animals
- Artificial reproduction of top animals (exchange)
- Sampling of data and estimation of breeding values
- Incorporation of molecular genetics in selection

# Creating benefit from breeding programs

- Selling one day old chicks in poultry
- Selling gilts and semen in pigs
- Selling semen in cattle
- Selling rams in sheep and bucks in goats

!! Selling semen is open dissemination of genetic progress !!

# Animal versus plant breeding

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# Contrasts between plant and animal breeding

- Breeding is much slower and less flexible in animals
- Animal breeding is cumulative and results in steady gain
- Accuracy of selection lower in animals
  - Less relatives
  - High costs of phenotyping (adaptation, resistance)
  - Sex limited traits
  - Hybridization not fully exploited (herd books instead of synthetics)
- Intensity of selection is lower
  - Many females are used to maintain a herd
- Generation interval is much longer
  - Much often longer than one year (up to 5-6 years in cattle)



# Restrictions in animal breeding methods

- Inbreeding only to limited amount; modern breeding programs aim at optimal genetic gain = maximum gain with a restriction on inbreeding
- Crosses with wild relatives difficult to perform
- Self pollination not possible
- Asexual reproduction not possible
- Genetic modification and cloning only experimental

# Animal breeding and conservation in NL

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# Developments in Dutch agricultural sector

- Specialization and intensification after WW 2
- Focused on export of animal products, strong breeding companies with a global scope
- Environmental policies and quota decreased volumes and restricted further expansion
- Non food production increases: nature and landscape management, recreation, sport and health care farming

# Intensification and specialization in animal production

- Small number of high productive breeds are producing a rising proportion of food
- Native Dutch breeds threatened with extinction (not fashionable!); imports of foreign western breeds in seventies; incorporated in Dutch breeds and lines; import of Meishan from China was a disaster (gap)
- 1976: Rare Breed Foundation: support of breeding programs and stimulation of conservation
- 1993: Gene bank foundation of farm animals; private initiative with public funding and donation of material by industry

# Objectives for conservation

- Future market demands
- Changes in production system
- Socio-economic value
- Opportunity for research
- Cultural-historic reasons
- Ecological value

# Selection criteria (value of breeds)

- Adaptation
- Traits of economic importance
- Unique traits
- Cultural historic value
- Genetic uniqueness

# Activities in Animal Genetic Resources (1)

- *ex situ* conservation
  - genebank semen (and embryo) collections
  
- support for *in situ* management
  - small populations of Dutch origin
  - minimising inbreeding rates
  - use of genebank germplasm

## Activities in Animal Genetic Resources (2)

- policy advice
  - conservation policies in relation to veterinary policies
  - support to FAO's Global Strategy
- supportive research
  - cryo-biology
  - genetic management strategies



# Dutch conservation program AnGR

Co-ordinated by CGN:

- Management of farm animal gene bank
- Policy advice
- Support *in situ* / *on farm* conservation
- Research
  - Cryobiology and reproduction
  - Genetic management and conservation strategies
- Documentation

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# Dutch gene bank collections for farm animals

- Two types of collections:
  - Dutch Gene Bank Foundation for Farm Animals: 'commercial breeds'
  - Centre for Genetic Resources: 'rare and small breeds'
- Management of both genebank collections by CGN
- Duplicate collection at Veterinary Faculty, Utrecht
- Funding from:
  - Ministry of Agriculture
  - Dutch Gene Bank Foundation (private sector)

## Present Dutch gene bank collections

### Semen doses

	# of breeds (or lines)	# of males / breed	# of doses / breed
Cattle	8	2 - 2000	400 - 50000
Sheep	5	12 - 27	1100 - 3000
Pig	16	6 - 34	200 - 800
Poultry	6	10	70 - 600
Horse	3	4 - 8	60 - 100

# Rare breeds and widely used breeds in gene bank

## Cattle

- Groningen White Headed
- Deep Red
- Dutch Friesian Red & White
- Coloursided White-back
- Dutch Friesian Black and White
- Meuse Rhine-Yssel
- Holstein Friesian



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# Dutch objectives cryopreservation 2004-2008

- Conserve genetic material of all endangered/rare domestic animal breeds in the gene bank
- Stimulate breeding industry and breeding associations to conserve a 'back-up' of their – more widely used - breeds
- Short term support for breeding programmes of small populations
- Long term and short term objectives
- Economic and cultural/historical reasons

# Present Dutch gene bank collections

## Sheep

- Drente Heath Sheep
- Schoonebeeker Sheep
- Mergelland Sheep
- Kempen Heath Sheep
- Veluwe Heath Sheep
- Black Blazed Sheep



# From collection from live rams to collection of semen from the epididymus

## Epididymal semen collection:

### ■ Advantages

- Relatively cheap
- Considerable number of doses per ram
- Independent of behavior of ram

### ■ Disadvantages

- Collection from slaughter house: low sanitary status



# Stimulating *in situ* use of native breeds

- Landscape management: Groningen White Headed
- Nature management: Dutch Belted, Heath Sheep
- Organic farming: Dutch poultry breeds
- Health care farming: young animals of all species
- Hobbyists: native poultry and sheep breeds
- Education centre: young animals of all species











# Dark red M.R.IJ. for nature management?



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# Petting farm?



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# Education centre with demofields?



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## Dark Red M.R.IJ. for niche products?



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# FAO project exchange, conservation and use

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# FAO / SOW / exchange, conservation and use

- FAO: enhance global food security
- SOW: stimulation of the conservation and sustainable use of species and breeds with adequate adaptation / resistance
- Access: entrance to resources for breeding and production purposes
- Exchange: improvement of efficiency of local production of food from animals and no loss of local breeds with a potential value in the future
- Benefit sharing: improvement of welfare of local farmers and breeders



# Convention on Biological Diversity: Objectives

- Conservation
- Sustainable use of components
- Fair and equitable benefit sharing arising out of use
- Appropriate access to resources
- Appropriate transfer of technologies
- Including rights resources / technologies / funding

# Convention on Biological Diversity: Principle

## ■ States have:

*Sovereign rights to exploit their own resources pursuant to their own environmental policies*

*and the responsibility to ensure that activities within their jurisdiction or control do not damage to the environment of other States or of areas beyond the limits of national jurisdiction*

# Purpose of our project

- Analysis of all relevant aspects of exchange, conservation and sustainable use of Animal Genetic Resources
- Enable feasibility of different legal regimes
- Implications of these regimes for different user groups

# Stakeholders in exchange, conservation and use

- Governments and NGO's
- Research and education
- Breeding organizations
- Livestock keepers and their representatives

# Dutch stakeholders in farm animal genetics

- Ministry of Agriculture: CBD ratification, follow up and implementation
- Centre for Genetic Resources TN: development of conservation methods and implementation in co-operation with research institutes
- Wageningen University: courses in genetics and in livestock systems
- IP-office: Patents on the use of alleles of genes affecting important traits
- Breeding organisations: management of populations
- Commodity Board: EU regulations, breed and veterinary regulations
- Farmer's organisation (LTO): consequences of changes in regulations for farmers
- Rare Breed and Genebank Foundations: stimulation of the use of native breeds and performing of conservation plans
- Organisations using animals for non food purposes: recreation, education, care farming, nature management

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# Drivers that will affect AnGR

- Biotech: cloning and genetic modification is possible without negative side effects. No ethical restrictions and biotech methods are indeed efficient
- Climate change: global warming results in the abrupt loss of habitats and changes are much faster than the adaptation capacity of the animals can handle
- Globalization and differentiation: uniform bulk production at low prices and a variety of production systems for a diversity of niche local markets?
- Implementation existing law: CBD acting in full force?

***What will be the impact of these drivers on exchange, conservation and sustainable use of AnGR?***

## Developments in animal breeding and exchange (NL)

- Dairy cattle breeding:  
Holstein Friesian is dominating breed (87 % of calves born) developed by CR Delta VRV (85 % of inseminations) and Altapon (7 %); Altapon = private; CR Delta = cooperation

CR Delta and Altapon are multinational companies with open nucleus breeding schemes (CR Delta: NL, Australia, Brazil, USA; Altapon: NL, USA, Canada, UK)

Export > 1.7 million doses of semen (global; East Europe)  
and 31347 heifers (Algeria, Spain, Russia, Poland, Portugal, Greece)

## Developments in animal breeding and exchange (NL)

- Pig breeding (Pigture group; cooperative) 5 female lines and 7 male lines
- Topigs in number 2 (with Danbred) after PIC
- Breeding and multiplication (franchisers producing gilts; 50 % exported)
- Semen and embryo exchange used to synchronize breeding stock in different countries
- Western companies (retailers!) invest in East Europe



# Developments in breeding and exchange (NL)

- Poultry breeding: Nutreco (private company)
- Acting globally with breeding material and within EU with poultry products
- Specialization and intensification
  - 2200 farms with 31 million laying hens
  - 1225 farms with 53 million broilers
  - 138 farms with 1,4 million Turkeys
- Hendrix Poultry breeders 25 % market share
- Hybro 10 % market share globally

# Patents in livestock breeding

- Dairy cattle, pigs and poultry
- MAS for production, quality and fitness traits
- Patent on detection of allele with a positive effect and application in breeding
- Detection in all phases (generations) and application in primary breeding phase
- Aim: improved position in international competition (not extra income in selling a license to a competitor)

## General questions <> exchange, conservation and use

1. Activities and objectives of your organization?
2. Perception of current situation?
3. Current exchange and effect on conservation and use?
4. Current policies and regulations in use?
5. View on future developments and driving forces?
6. Desirable policies or regulatory options?

# Questions governments and ngo's

1. Impression of gene-flows?
2. Zoo-sanitary issues?
3. Ownership of genetic resources? Patents in animal production?
4. Policies in animal production and effect on animal breeding/production?
5. Wishes for regulations facilitating exchange?

# Questions research and education

- View on role of AnGR in research and education (present and future)
- Willingness to develop breeding programs for native breeds with adequate adaptation and resistance
- What are your priorities in research and education for the future?

# Questions breeding organizations

1. Ownership structure in breeding and production?
2. Management of genetic diversity in situ?
3. Conservation program in addition to breeding program?
4. Exchange of genetic material (import / export; intracompany)?
5. Application of biotechnology?
6. Protection of knowledge and its application?

# Questions livestock keepers

1. Production market? Important traits?
2. Source of breeding material?
3. Role of native breeds?
4. Main difficulties in farming with your animals?
5. Role of extension service?
6. Effect of subsidies?
7. Intensification or diversification?

# Thank you for your attention!

- Questions?
- Comments?
- Suggestions?