Sheep and Goat Breeding in Norway

InterNorden 2014

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The mission of animal breeding is Genetic Improvement

**Genetic improvement**
- Increased income
- Reduced costs
  - Reduced labour
- Improved animal welfare

**Genetic gain per year**
- The breeding plan
  - Breeding goals
  - Breeding programme
  - Expected gain
- Breeding activities
- Estimated genetic gain
- Phenotypic improvements
Breeding goals in Norwegian meat sheep breeding

Centrally operated
- Carcass weight of the lamb
  - Direct effect
  - Maternal effect (milk etc.)
- Carcass quality (EUROP)
  - Meat
  - Fat
- Litter size (total born)
- Lamb survival (0-2 days)
- Wool
  - Quality
  - Fleece weight

Farmers priorities
- Conformation – good looking (Ewe mature size)
- Ewe longevity
  - Mastitis
  - Abdominal hernia
  - Vaginal prolapse
- “Easy care”
- NSG project 2014-2016
  - Lambing ease
  - Lamb vigour
  - Suckling assistance
What really matter is:
- Genetic gain \textit{per year}

Basic science:

\[ \Delta G = \sigma_g \times \frac{A \times I}{L} \]

- \( \Delta G \): Genetic gain per year
- \( \sigma_g \): The standard deviation of the additive genetic variation in the population
- \( A \): The accuracy of selection
- \( I \): The selection intensity (proportion selected for further breeding)
- \( L \): The generation interval

It’s all about the effectiveness of the breeding programme!
The Norwegian sheep breeding programme

1. Sheep recording
2. Breeding value estimation
3. Breeds/populations
4. Selection
5. AI (artificial insemination)
6. Estimated genetic gain
7. Phenotypic gain
The sheep breeding programme (1): 
- Recording

- Sauekontrollen: Operated by Animalia
  - Web programme
  - Central database

- Participation
  - 29% of the sheep farmers
  - 45% of all ewes in Norway

- On farm recordings (web)
  - Identity – pedigree
  - Lambing info
  - Live weights
    - Birth
    - 6 weeks
    - 20 weeks
  - Diseases, losses etc.
  - Directly from the slaughter house to the database
    - Lamb identity (electronic ear tag)
    - Carcass weight
    - Carcass EUROP score
    - Wool quality and weight
The sheep breeding programme (2):
- Estimating breeding values (EBVs)

- Operated by NSG
- Information from the sheep recording
  - 10+ million animals with records
- BLUP method
  - DMU programme (Danish)
  - 4 breeds/populations
  - 13 runs per year
- EBVs fed back to sheep recording database

- EBVs to the farmers
  - Litter size
  - 5 week weight
    - Maternal
  - Carcass weight
    - Direct
    - Maternal
  - Carcass meat score
  - Carcass fat score
- Overall breeding value
  - Weighting of trait EVBs differ among breeds
  - Decided by the NSG breeding board
The sheep breeding programme (3a):
- Breeds/populations

**Norsk spælsau**
≈15% of all sheep in N.
- Composite breed
  - Feral sheep (improved)
  - Icelandic sheep
- Characteristics
  - Flock instinct
  - Short tail
  - White, two character wool
  - Polled (no horns)
  - Fertile
  - Fast growing
  - Large

**Norsk kvit sau (NKS)**
≈ 75% of all sheep in N.
- Composite breed
  - UK imports 18xx
  - Dala
  - Rygja
  - Steigar
  - Texel
  - Finsheep
- Characteristics
  - No flock instinct
  - Long tail
  - White, crossbred wool
  - Polled
  - Fertile
  - Fast growing
  - Large
## The sheep breeding programme (3b):

### - Populations organized by NSG

<table>
<thead>
<tr>
<th>Population</th>
<th>Flocks</th>
<th>Ram circles</th>
<th>Ewes</th>
<th>Rams Natural service</th>
<th>Rams AI</th>
</tr>
</thead>
<tbody>
<tr>
<td>NKS</td>
<td>1000</td>
<td>125</td>
<td>90 000</td>
<td>1 850</td>
<td>20</td>
</tr>
<tr>
<td>Spæl</td>
<td>180</td>
<td>25</td>
<td>12 000</td>
<td>280</td>
<td>8</td>
</tr>
<tr>
<td>Sjeviot</td>
<td>50</td>
<td>4</td>
<td>1 800</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>Pelssau</td>
<td>18</td>
<td>1 200</td>
<td>40</td>
<td>4</td>
<td></td>
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</tbody>
</table>
The sheep breeding programme (4a):
- Selection

Females
- Selection within flock
  - 30-40% selected
- Criteria – farmers choice
  - Overall breeding value
  - Specific traits
  - “Easy care”
  - Likes and dislikes

Males
- Selection within ram circle
  - Test rams (0,5 year)
  - Elite rams (1,5 years)
  - Criteria
    - Overall breeding value
    - Conformation
    - Wool quality
    - Ram circle preferences
- Selection across ram circle
  - AI rams (2,5 years)
  - Criteria
    - Overall breeding value
    - Conformation
    - Wool quality
    - Population inbreeding control
The sheep breeding programme (4b):  
- Selection of rams

<table>
<thead>
<tr>
<th>Population</th>
<th>NKS</th>
<th>Spæl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ram lambs born</td>
<td>90 000</td>
<td>12 000</td>
</tr>
<tr>
<td>Progeny test rams</td>
<td>1 850</td>
<td>280</td>
</tr>
<tr>
<td>Elite rams</td>
<td>350</td>
<td>80</td>
</tr>
<tr>
<td>AI rams</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>- Theory</td>
<td>0,02%</td>
<td>0,07%</td>
</tr>
<tr>
<td>- Practise</td>
<td>1%</td>
<td>3%</td>
</tr>
</tbody>
</table>

80-90 % of the test rams have an AI ram as sire
The sheep breeding programme (5):
- Artificial insemination (AI)

- Two ram AI centres
  - Staur (Hedmark)
  - Særheim (Rogaland)
- 50 rams per year
  - 20 breeds
- 32,400 semen doses sold
  - Frozen semen: 92%
  - Fresh semen: 8%
- The semen dose contains 200+ million sperm cells

- AI technique
  - Natural oestrus
  - Oestrus detection with an intact ram
    - protection necessary 😊
  - “Shot in the dark
    (depositing the semen in the bottom of the vagina)
  - Pregnancy rate: 70%

- Done by the sheep farmer
  - One day course to get the license
The sheep breeding programme (6):
- Carcass weight *genetic gain*, kg;
  maternal, direct and sum

**Diagram:**
- NKS: Avlsframgang slaktevekt (154 dager), alle fødte lam i ring
  - Lam-slaktevekt
  - Mor-slaktevekt
  - Slaktevekt totalt

**Graph:**
- Genetisk endring i slaktevekt, kg
- Years: 2000 to 2013
The sheep breeding programme (7):
- Carcass weight *phenotypic gain*, kg

*2000 – 2013:*
The phenotypic gain in carcass weight is around \( \frac{1}{2} \) of the estimated genetic gain

\[ y = 0.092x + 19.063 \]
An effective breeding programme...

- Based on science
- Centrally financed
- Large breeding (nucleus) population
- Cooperation among the farmers in the nucleus
- Effective recording of relevant traits
- Intensive ram selection
- Extensive use of AI (and/or embryo transfer)

- One main selection criteria
  - the overall breeding value (overall index)
    - Democratically decided (NSG)
    - Obey, or ...
Goat breeding (1)

- Total population of milking goats: 35,000
- Breed (composite)
  - The Norwegian milking goat
  - French Alpine
- Breeding nucleus
  - 60 individual farmers ("buck circles" are history)
  - 6,500 goats
Goat breeding (2)

- **Selection**
  - Goats – within herd selection
  - Bucks
    - 1-2-3 test bucks per herd – within herd selection
    - 5-6 AI progeny tested bucks – across herds selection

- Breeders in the nucleus have to use AI for elite matings
  - Good quality of test bucks
  - Better quality of replacement goats
  - Genetic links between herds
    - Important for unbiased comparison of bucks across herds
Goat breeding (3)

- Breeding goal
  - Milk production (kg per day)
  - Milk content
    - Fat %
    - Protein %
    - Lactose %
  - Free fatty acids
  - Somatic cell count
  - Udder and teat conformation
  - Speed of milking