Sheep Breeding in Norway

Sheep Breeders Round Table 2015

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The Norwegian Association of Sheep and Goat Breeders (NSG)
Outline

- Sheep production in Norway
- Breeds
- Sheep recording
- NSG – the sheep breeding company
- Traits, EBVs and total merit index
- Genetic gain
- R&D
- Genomics
- Key points about sheep breeding in Norway
Sheep production in Norway (1)

- Production per year
  - 24 million kg of meat
  - 4 million kg of wool

- Consumption
  - 5 kg per capita per year
  - Self sufficient
  - Some import
    - Tax protection

- Sheep farmer economy
  - Heavily subsidised - 2/3 of the income
    - Per animal
    - Per hectare
  - Good farmer prices
    - 4-5 £ per kg carcass weight
    - 3 £ per kg of wool
  - Norwegian costs - high (oil related)
  - Net income from sheep
    - Low, but improving
Sheep production in Norway (2)

- **Structure**
  - Farmers: 12 000
  - Ewes (1+ years): 700 000
  - Small flocks:
    - Average 55 ewes
    - Few 300+ ewes

- **Production very seasonal**
  - Indoor lambing April-May
  - Slaughter in August-November
    - Age 160 days
    - Carcass weight 20 kg

- **Housed during winter**
  - Before mating until 1-2 weeks after lambing

- **Intensive care during lambing time**
  - Assist the ewe
  - Assist the lamb
    - Colostrum
  - One lost lamb is one too many
Sheep production in Norway (3)

- Feeding

- Grass silage in the winter
- Spring pasture on farm
  - 2 - 6 weeks
  - Aprile – May – June
- Summer pasture in the woods or the mountains
  (mid June - mid Sept.)

Norway: 3% arable land
Photo: Grethe Ringdal
Sheep production in Norway (3)
- Feeding

- Grass silage in the winter
- Spring pasture on farm
  - 2 - 6 weeks
  - Aprile – May – June
- Summer pasture in the woods or the mountains (mid June - mid Sept.)

- Autumn pasture on farm
  - First group of lambs: Directly to the abattoir – September
  - Second group: October
  - Third group: November
  - The rest: Jan. - Feb.

- Concentrate
  - Ewes
  - Lambs
Breeds

- Norwegian Spælsau – 3 lines: 15 %
  - Most important: Flock instinct
  - Short tail (“spæl”)
  - Fleece: Dual coated wool, white - coloured
  - Polled - Horned

- Norwegian White Sheep (NWS): 75 %
  - Long tail
  - Fleece: Crossbred type, white
  - Polled

- 10-15 other breeds: 10 %
Norwegian Spælsau of today
Norwegian White Sheep
- definitely a composite

NWS: A population, not a proper breed
NWS:
- Sire line or maternal line?

- 90,000 ewes in 950 breeding flocks (2014)
  - Number of lambs born: 2.29
  - Age of slaughter, days: 156
  - Carcass weight, kg: 21.1
  - Carcass conformation: R+ (9.3)

- NWS is a dual purpose breed

- Used as “pure”
  - No appreciable crossbreeding in Norway
Animalia: The Norwegian Sheep Recording System

- Sheep Recording in Norway
  - Sheep producers: 30%
  - Ewes: 43%
  - Slaughtered lambs: 49%

- Central database
  - On farm data
    - Web / Mobile app
  - Abattoir data
    - File transfer

- Output
  - Management tool
  - Benchmarking
  - EBVs
  - R&D
Recording (2)

- Individually recorded
  - Electronic ear tags (EID)
- Birth info
  - Dam and Sire
  - Total born
  - Live born
  - Lambing ease (code)
- Weights of lambs
  - Birth
  - 6 weeks
  - 20 weeks (weaning)
- Disease
  - Mastitis

- Abattoir info
  - Carcass weight
  - EUROP conformation and fat score
  - Fleece weight and quality

- NOT DONE IN NORWAY
  - Ultrasound scanning for meat and fat
  - CT scanning
  - Fecal egg count
The breeding company:
- **NSG** and the Ram Circles (1)

- 80% of sheep farmers are members of NSG (10,000)
- NSG Breeding Council
  - 5 breeders
  - 2 from the abattoirs
  - 1 from the Agr. University
- Central office at Ås
- Breeding and AI is half of the activities in NSG
  - Director: Thor B.
  - 3 geneticists
  - 3 breeding consultants

- NSG budget for breeding: 1.3 mill. £
  - Gov. support: 45%
  - Levy on meat: 15%
  - AI sales: 40%
- Responsible for the breeding programme
- Calculating EBVs
  - 13 runs per year
- AI
- R&D
The breeding company:
- NSG and the Ram Circles (2)

- Ram circle: A small financially independent organization that has breeders as members
  - More than 50 years of good work
- Rams are owned by the ram circle and used among member flocks
- Ewes are owned by the members themselves
- Cooperating with NSG
  - Regulations
  - Guidelines
  - Financial support from NSG
    - 150 £ per test ram that qualifies
**NWS breeding**

- **The breeding population**
  - 150 ram circles
  - 950 members
  - 90,000 ewes

- **Progeny testing of rams**
  - Selection within ram circle
    - Test rams (0.5 y.): 1,800
    - Elite rams (1.5 y.): 300

- **AI**
  - Selection across ram circles
    - 20 rams (2.5 years)
    - 5 rams (3.5 years)

- **Elite matings**
  - 15% of ewes in ram circles are AI’d

- **Sired by an AI ram in ram circle flocks (2014)**
  - Lambs born: 9%
  - Lambs slaughtered: 5%
  - Ewes lambing: 21%

- **AI sires in ram selection**
  - Test rams sired by an AI ram: 85%

**AI: The key to success**
- Selection intensity of rams
- Connectedness among flocks
AI the Norwegian way
- 35,000 semen doses per year

- No synchronisation, no hormone treatment
- Oestrus detection 2-3 times per day
  - Walk the ram; Leach and apron
- Inseminate once 18-24 hours after onset of oestrus
  - Frozen semen – 240 mill. sperm cells
  - Vaginal deposition
  - Done by the farmer
- Non-return: 70%
- Cost: (Rent of shipper + freight + 20 doses)
  - Per semen dose: 23 £

“A shot in the dark”
## Traits in the breeding work - heritabilities and weighting

<table>
<thead>
<tr>
<th>NKS</th>
<th>Heritability $h^2$</th>
<th>Weight in the total merit index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lamb traits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth, carcass weight at 22 w.</td>
<td>0.12</td>
<td>24 %</td>
</tr>
<tr>
<td>EUROP conformation score, at 20 kg</td>
<td>0.19</td>
<td>18 %</td>
</tr>
<tr>
<td>EUROP fat score, at 20 kg</td>
<td>0.19</td>
<td>11 %</td>
</tr>
<tr>
<td>Fleece weight, at 20 kg</td>
<td>0.33</td>
<td>2 %</td>
</tr>
<tr>
<td>Fleece grade, at 20 kg</td>
<td>0.08</td>
<td>0 %</td>
</tr>
<tr>
<td><strong>Ewe traits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal ability, at 6 weeks</td>
<td>0.06</td>
<td>15 %</td>
</tr>
<tr>
<td>Maternal ability, at 22 weeks</td>
<td>0.05</td>
<td>24 %</td>
</tr>
<tr>
<td>Litter size, total born</td>
<td>0.13</td>
<td>6 %</td>
</tr>
</tbody>
</table>
The name of the game (1): Genetic gain – litter size

Number of lambs born

Increase in litter size

Birth year of lamb

Inger Anne presents a poster

Enough is enough!
The name of the game (2): Genetic gain – lamb growth

Goal: Slaughtered straight from the mountains

Jette and Thor presents a poster

Lamb carcass weight at 22 weeks

- Total genetic gain
- Direct
- Maternal

Change in carcass weight, kg

Birth year of lamb
The breeders: Have to do more recording!

- New traits?
  - Early lamb loss
  - Lambing ease (new scoring)
  - Lamb vigour
  - Suckling assistance
  - Udder and teat conformation
  - Mastitis
  - Longevity

- Improved models
  - Adjusting weights for age
  - Adjusting EUROP scoring for age or weight
  - Heterogeneous variances
  - Litter size: Reduce variability
  - Contemporary groups within flock-year

- Genomic information
Genomic selection

- The key equation

\[ \frac{\Delta BV_X}{t} = \frac{r_{BV_X,P^*_X}(i_X)\sigma_{BV_X}}{L} \]

- Genomic tools may allow
  - Increased accuracy (\( \uparrow r_{BV_X,P^*_X} \))
    - Via “Genome-enhanced” EBV
  - Decreased generation interval (\( \downarrow L \))
Opportunities

- Facilitate improvement of otherwise difficult-to-measure traits \( r_{BV_X, P_X^*}; L \)
  - Traits expressed later in an animal’s life
    - Longevity
  - Traits expressed in only one sex
    - Fertility, litter size
  - Traits that are expensive and/or challenging to measure
    - Lamb survival, mastitis, maternal bonding, eating quality
Opportunities

- Facilitate improvement of otherwise difficult-to-measure traits \( r_{BV_X,P_X^*} ; L \)
- Form a better pedigree \( r_{BV_X,P_X^*} \)
Challenges

- Requirement is likely for large reference populations in individual breeds
  - “Large” to capture genetic diversity within a breed
  - “Within breeds” because genomic predictions do not extend well across breeds
    - In many industries, there are lots of breeds
- Validation (training) must be ongoing
  - Accuracies deteriorate as ancestors used to form genomic predictions become more distant

Structure of ram circles likely well suited to form industry-based reference populations
Challenges

- Requirement is likely for large reference populations in individual breeds

To keep “up-to-date”, need to measure about 12.5% new animals per year

(Goddard, 2009; Hayes et al., 2009; van der Werf et al., 2011)
Challenges

- Requirement is likely for large reference populations in individual breeds
- Costs of genotyping
  - Value per animal unit is relatively low in sheep
  - However, the per animal cost of genotyping is nearly the same across species
Benefits vs. costs

- The utility of genomic selection in the Norwegian industry will depend on
  - Gain in accuracy realized
    - Function of the number (diversity) of performance recorded sheep, e.g., 1/4 million Norwegian White ewes
  - Economic importance of traits being considered
  - Cost and thereby industry uptake of genotyping
Norwegian lamb finishing system

- Lambs grazed over-summer on mountain or forest pasture
- Once gathered, drafted on-farm
  - Over-weight & over-finished lambs marketed immediately
  - Target weight & finished lambs also marketed immediately
  - Under weight and/or under-finished lambs retained
    - Grass and/or concentrate fed until achieve a target end-point or end-of-season
Carcass weight by age (2014)
Norwegian lamb finishing system

- What then is the target end-point for adjustment for genetic evaluation?
  - Weight (20-25 kg)?
  - Age (20 weeks)?
  - Finish?
  - A combination of several?

- Given varying drafting strategies, how should contemporary groups be defined?
  - Will (and should) producers provide more delineating contemporary group designations?
## Sheep breeding
- what is unique for Norway?

- **Centrally financed**
  - 1.3 million £

- **Recording**
  - One central database
  - Carcass data transfer

- **Large breeding population**
  - 90,000 ewes
  - 1,800 rams

- **AI**
  - The very best rams
  - Intensively used

- **Substantial genetic and phenotypic gain**

- **The sheep breeders**
  - A strong belief in the breeding theory
  - Confidence in the central breeding management
  - The same breeding goal for all breeders within a breed
  - Collaboration, not competition
    - Within ram circle
    - Across ram circles

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**Making results – together!**
Invitation to
World Championship in Ewe Productivity

Norwegian contestant – Hove 2010-00003

<table>
<thead>
<tr>
<th>Year</th>
<th>Lambs</th>
<th>20 week weight</th>
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<tbody>
<tr>
<td>2011</td>
<td>2</td>
<td>60 + 61</td>
</tr>
<tr>
<td>2012</td>
<td>4</td>
<td>62 + 67 + 64 + 61</td>
</tr>
<tr>
<td>2013</td>
<td>3</td>
<td>63 + 66 + 72</td>
</tr>
<tr>
<td>2014</td>
<td>3</td>
<td>61 + 59 + 60</td>
</tr>
<tr>
<td>2015</td>
<td>2</td>
<td>62 + 57</td>
</tr>
<tr>
<td>Sum</td>
<td>14</td>
<td>875 kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>175 kg per year</td>
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</tbody>
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*Concentrate given to the ewe, not the lambs: • 56 kg per year*

**Progeny for breeding:**
- 6 daughters
- 2 AI rams