The effect of increased production efficiency in beef production

I. Cow population size
II. Greenhouse gas emissions

EAAP Annual Meeting, 2016 Belfast UK

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Introduction

- A simulation study
  - production strategies to meet domestic demand for milk and beef towards 2030

- Background:
  ✓ Domestic milk quotas
  ✓ Import restrictions on milk and beef
  ✓ High annual increase in milk yield/dairy cow from ΔG/E-improvements
    ⇒ decrease in dairy beef production

  ✓ To ensure domestic beef production to meet market demands:
    ⇒ increase in suckler beef production
    ⇒ undesirable due to increased greenhouse gas (GHG) emissions

- Key role: Annual milk yield/dairy cow
The simulation - assumptions

- Time span: 2012-2030
- Annual domestic human population growth rate: +1 % (Statistics Norway, 2015)

- Four scenarios for production goals:
  - A: Milk quota constant - beef + 1% per year (market demand)
  - B: Both milk and beef + 1 % per year
  - C: As B, with restrictions on dairy cow feed rations:
    - min. 60 % roughage on energy basis
    - min. 85 % domestic ingredients in concentrates (⇒ developed two new concentrate types; C1 and C2)
  - D: Change import restrictions:
    - Domestic milk production declines (− 1 % per year)
    - Domestic beef production constant (2012 level)
The simulation - assumptions

- **Four scenarios for production goals:**
  - A: Milk quota constant - beef market demand + 1% /year
  - B: Both milk and beef + 1% /year
  - C: As B, with restrictions on dairy cow feed rations:
    - min. 60% roughage on energy basis
    - min. 85% domestic ingredients in concentrates (⇒ developed two new concentrate types; C1 and C2)
  - D: Change import restrictions:
    - Domestic milk production declines (−1% /year)
    - Domestic beef production constant

- **Within scenario A, B, D:**
  Three prognoses for increase in annual milk yield/dairy cow:
  - 2%
  - 1%
  - 0%

- **Scenario C:** Milk yield set by feed resource restrictions
Assumptions – summarised:

- Four scenarios for production level
- Within each scenario three prognoses for increase in annual milk yield/dairy cow

<table>
<thead>
<tr>
<th>Production goal 2030</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (mill. litres)</td>
<td>1 500</td>
<td>1 770</td>
<td>1 770</td>
<td>1 230</td>
</tr>
<tr>
<td>Beef (tonnes)</td>
<td>110 000</td>
<td>110 000</td>
<td>110 000</td>
<td>80 000</td>
</tr>
<tr>
<td>Feed resource restrictions</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Annual increase in milk yield/dairy cow</td>
<td>2, 1, 0 %</td>
<td>2, 1, 0 %</td>
<td>*)</td>
<td>2, 1, 0 %</td>
</tr>
</tbody>
</table>

*) milk yield are set by feed restrictions

- Production statistics from official and livestock data bases (baseyear 2012)

- 2012 population sizes:  
  - 233 000 dairy cows  
  - 70 000 suckler cows
Analyses:

- How will an increase in milk yield per dairy cow affect the need for cows to meet demands for milk and beef within the given scenarios - when beef production efficiency (kg carcass/cow\*year) is

  1) held constant (2012 level)
  2) or with realistic increases in population means of traits for both dairy and suckler cows respectively, by 2030? (ΔG and/or E-improvements)
Traits and breeds studied

✓ Replacement rate (%)
✓ Calf losses (stillborn & died before 180 d)
✓ Age at 1st calving
✓ Calving interval
✓ Twinning frequency (suckler cows only)
✓ Carcass weight heifers
✓ Carcass weight bulls (and steers)

✓ Breeds:
  • Dairy (Norwegian Red)
  • British (Hereford/Angus)
  • Continental (Charolais, Limousin, Simmental)
Model to describe calf and beef production from dairy/suckler cow herds

R% = Replacement rate (%)
CL= Calf losses (stillborn & died before 180 d)
AFC= Age at 1th calving
Cl= Calving interval
CWH = Carcass weight heifers
CWB = Carcass weight bulls (and steers)
CWC = Carcass weight cow
HL= Herd life of cow
TW = twinning % (suckler cows)

DCS = days from calving-slaughter cow
PYC = production years of cow (= slaughter age – age 1th calving)

Total nb. of weaned calves per cow = TNWC= \(1 + ((\text{HL}-\text{AFC}-\text{DCS}) \times (1-\text{CL}) \times (1+\text{TW})) / \text{CI}\)

Total nb. of heifers for slaughter = TNFS = (TNWC \times 0.5) – 1
Total nb. of bulls for slaughter = TNBS = (TNWC \times 0.5)

Carcass production:
Heifers: TNFS/PYC \times \text{CWH}
Bulls: TNBS/PYC \times \text{CWB}
Cow: R% \times \text{CWC}

Carcass production per cow and year = (TNFS/PYC \times \text{CWH}) + (TNBS/PYC \times \text{CWB}) + (R% \times \text{CWC})

Changed one at a time or in various combinations as deviations from actual population means 2012
Results 1):
Beef production efficiency (kg carcass/cow*year) held constant, 2012 level

- Increased milk/beef production in step with human population growth will require + 100 000 cows (B and C)
- Milk yield level per dairy cow had a strong influence on number of suckler cows
- Dairy cow feed rations with higher contents of domestic feed resources (roughage and grain/low soy %) caused substantial changes in the ratio dairy/suckler cows needed (Scenario C1/C2)
The potential for increased production efficiency in beef production (ΔG and/or E-improvements)

- Effectivity measures:
  - Weaned calves/cow*year
  - *Kg carcass/cow*year

- Measured as:
  - Absolute production level (kg)
  - Production change in % as deviation from a base level (year 2012)

- Calculated as:
  - Improvement in single traits
  - Various combinations of traits
Increased efficiency with realistic assumptions of changes in population means, several traits combined:
- 10 % in the dairy
- 15 % in the suckler cow population, respectively, by 2030
⇒ corresponded to a reduction of 30' – 45' cows ≈ 11.000 tonnes of carcass

Traits with the largest single effect on efficiency were:
- Replacement rate (%)
- Calving interval
- Carcass weight of bulls/steers

- for both dairy and suckler production
Conclusions

- In a system with milk quotas and import restrictions on milk/beef - the annual milk yield per dairy cow has a key role in use of production resources and relative size of the dairy vs. the suckler cow population.

- An increase in milk/beef production in step with human population growth will require a substantial increase in total number of cows.

- Significant improvements in production efficiency may be obtained with realistic changes in population means of beef traits from ΔG/E-improvements.

- Restrictions in composition of dairy cow feed rations – i.e. high share of «local» feed resources; - reduced the milk yield per dairy cow with 25 % and lowered the need for suckler cows - especially with improved beef production efficiency.

- The calculated effects of improvements in beef production efficiency demonstrate the potential for reductions in environmental impacts from ruminants.
Corresponding effects on greenhouse gas (GHG) emissions?

Thank you for the attention!

The project “Strategies in dairy and beef production for meeting the demand of food based on a climate- and cost efficient use of domestic feeds (2013-2015) was financed by:

*The Foundation for Research Levy on Agricultural Products
*The Agricultural Agreement Research Fund
*The farmer cooperative industry partners: TINE SA, Nortura SA, NFK
Results 2):
The effect of increase in beef production efficiency (kg carcass/cow*year)

- With realistic assumptions of improvements:
  - 10 % in the dairy
  - 15 % in the suckler cow population, respectively, by 2030

  \[ \rightarrow \text{corresponded to a reduction of } 30\text{‘} - 45\text{‘ cows} \approx 11,000 \text{ tonnes of carcass} \]

Traits with the largest single effect on efficiency were:
- Replacement rate (%)
- Calving interval
- Carcass weight of bulls/steers

Example-alternative: Realistic changes in population means

**Dairy:**
- Calving interval 12.5 → 12.0 mnd.
- Optimal carcass weights bulls/heifers (+ 10 %)

**Suckler:**
- Calving interval 12.9 → 12.5 mnd.
- Calf losses (8 → 6 %)
- Optimal carcass weights bulls/heifers (+ 6 %)