Challenges and new developments in dairy cattle nutrition

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Gert van Duinkerken & Roselinde Goselink
NO MILK QUOTA
The post quota scene (I)

- **Global dairy production**
  - Global dairy production will grow about 2% per year (FAO, OECD)
  - Majority of extra production will come from developing countries

- **Farm profitability highly dependent of**
  - Input prices (e.g. feed)
  - Output prices (milk)
  - To a lesser extent: farm scale

- **Milk prices will be volatile**
  - Mean milk price level will slightly decrease, compared to quota era

- **Feed prices will be volatile**
  - Mean feed price will increase
Price volatility

- Price volatility
- Milk
- Feed
- Feed use & nutrient use efficiency
Price volatility

Trend 1: Precision Livestock Feeding
The post quota scene (II)

- Dairy production limited by scarce resources, e.g.
  - Water; arable land in developing countries; know-how

- Growing dairy production
  - Increasing feed demands
  - Increasing feed protein demands
Increasing feed demands

Available feeds

versus

Lactating herd

Young stock
Increasing feed demands

Available feeds

versus

Lactating herd

Young stock

Longevity & health
Increasing feed demands

Available feeds

Lactating herd

versus

Young stock

Longevity & health

Trend 2: more focus on longevity & health
Increasing feed protein demands

Feed protein demand
Increasing feed protein demands

Feed protein demand

Grass & forage management
Increasing feed protein demands

- Novel feed materials
- Low protein diets
- Grass & forage management
Increasing feed protein demands

Feed protein demand

- Novel feed materials
- Low protein diets
- Grass & forage management
- GMO-free diets
- Local feeds
Increasing feed protein demands

Feed protein demand

- Novel feed materials
- GMO-free diets
- Local feeds
- Grass & forage management
- Low protein diets

Trend 3: renewed views on feed proteins
Outline of this presentation: 3 trends

1. Precision livestock feeding

2. More focus on longevity & health

3. Renewed views on feed proteins
Precision Livestock Feeding
Precision feeding

- Taking into account:
  - Individual variation
  - Temporal variation
Hypothetic variation in efficiency
Individual differences in apparent efficiency

Mean lactation FPCM yield (kg/day)

NEL (kJ/kg FPCM)

Source: Meijer et al.

Difference in apparent efficiency

3170 kJ NEL/kg FPCM

Source: Meijer et al.
Temporal variation: efficiency differs within a cow between days

Concentrate intake can be increased

Concentrate intake can be lowered
Precision feeding

- Taking into account:
  - Individual variation
  - Temporal variation

- Using:
  - New data collection technology
  - Smart models → enable interpretation and application
New data collection: phenotypes

- Increasing amount of (real time) phenotypical data
- Measure individual as well as temporal variation
- Examples:
  - Automated body weight recording
  - Individual feed intake
  - Technology for body condition scoring
  - Monitoring of rumen conditions
  - Rumination activity
- Combine with genotype
  \(\rightarrow\) New breeding characteristics
  \(\rightarrow\) Nutrition x genetics
Milk yield

Real Time Process data
Individual animal records

Adaptive Model

Parameter estimates
Warnings

Prior informatie
Intervention
Discount factors
Limits

Goals
Limits
Prices...

Control Algorithm

Optimal settings

Notifications...

Automatic concentrate feeding

Output

André et al, 2007
Precision feeding

- Taking into account:
  - Individual variation
  - Temporal variation

- Using:
  - New data collection technology
  - Smart models → enable interpretation and application

- Why?
  - Early warning systems → enable interventions
  - Increase nutrient use efficiency
  - Prevent health disorders
  - Increase gross margin & profitability
Dynamic feeding concept: variation in efficiency is used to optimise gross margin

- input constant
- input based on efficiency

**Graph:**
- X-axis: Individual efficiency (%)
- Y-axis: Gross margin (€)
- Two curves:
  - One for input constant
  - One for input based on efficiency
- Increase of profit
- Reduction of loss
More focus on longevity & health
Lifetime production and lifespan (Case: the Netherlands)

Source: CRV
Replacement rates dairy cattle

- Ireland: 23%  
  Maher et al., 2008
- USA: 32%  
  Pinedo et al., 2010
- The Netherlands: 23 - 28%  
  Nor et al., 2014
- Canada: 32 - 38%  
  CanWest DHI, 2011
86% of replacement is involuntary (Case: Canada)

Source: CanWest DHI & Valacta
Calculations by AAFC-AID, Dairy Section
Farmers are eager to reduce health disorders

Health → performance

Resource efficiency

Reduce antibiotic treatment

Image dairy chain
Incidence of disease

- Mastitis
- Lameness
- Cystic ovaries
- Ketosis

Astrid Koeck et al., 2012
Transition period in dairy cattle = top priority
Metabolic adaptation during early lactation: key to cow health, longevity and a sustainable dairy production chain

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**Abstract**

Enhancing longevity by reducing involuntary culling and consequently increasing productive life and lifetime production of dairy cows is not only a strategy to improve a farm’s profit, but is also
Research challenges transition cows

- Scientists and industry R&D will develop more in-depth knowledge on role of:
  - Specific nutrients (e.g. glucogenic, lipogenic)
  - Feed additives
  - (Feeding) behaviour
  - Gene-nutrient interactions
  - Stressors and immune responses
  - ... 

- Translation into customised nutrition and management strategies for (individual) cows
Renewed views on feed proteins
Increasing feed protein demands

Feed protein demand

- Novel feed materials
- Low protein diets
- Grass & forage management
- GMO-free diets
- Local feeds

Trend 3: renewed views on feed proteins
Price development of feed ingredients

- *Price soybean meal: from 2000 – 2014 doubled*
- *Since 2009: increasing contrast between price soybean meal and wheat*

Scarcity of protein sources for feed?
# Protein balance in EU-27 (2012-2013)

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<tr>
<th>Category</th>
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<th>EU-consumption (x 1000 ton protein eq.)</th>
<th>Rate of self sufficiency (%)</th>
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<tr>
<td>Soybeans</td>
<td>344</td>
<td>14.280</td>
<td>2%</td>
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<tr>
<td>Rapeseed/Sunflowerseed</td>
<td>5.022</td>
<td>6.795</td>
<td>74%</td>
</tr>
<tr>
<td>Legumes</td>
<td>424</td>
<td>450</td>
<td>94%</td>
</tr>
<tr>
<td>Total all proteins</td>
<td>7.391</td>
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<td>31%</td>
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(Fefac, 2015)
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(Fefac, 2015)

**Policy to reduce feed protein imports**
Increasing interest in non-GMO diets

- Non-GMO labels increasingly relevant in European dairy production
- Non-GMO feed
  - Replace GM soy products by non-GM alternatives
  - Rape seed, peas, beans, lupins, sunflower seeds
- Trend towards the use of local feed materials
  - Grass based production
  - Protein crops
- Critical: availability, amino acid composition, price, ...
Compound feed costs: simulation study

- 3 compound feeds: standard, medium, high protein
- 2 scenarios:
  - All feed materials may be included
  - No Latin American soy products
- Compound feed costs compared for these 3 x 2 = 6 cases
- Raw material prices: average July 2014 - June 2015
  - €/100 kg; delivered to feed company; excl. VAT
  - Least cost formulation (Bestmix)
# Compound feeds costs per scenario

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<th>Scenario</th>
<th>Protein level (g DVE/kg)</th>
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<td><strong>Scenario</strong></td>
<td><strong>90</strong></td>
</tr>
<tr>
<td>1 Standard situation</td>
<td>15.35</td>
</tr>
<tr>
<td>2 Without soy bean products</td>
<td>15.66</td>
</tr>
<tr>
<td>Extra costs scenario 2</td>
<td><strong>0.31</strong></td>
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*DVE = Dutch standard for ileal digestible protein*
Challenges

- Reduce the use of non-EU proteins
- Improve use of grass, forages, protein crops, crop residues
- Low protein diets
- Novel feed proteins
  - By-products from food & biofuel industry
  - By-products from new biorefinery technologies
  - Aquatic proteins
  - ...
- Amino acid based diet formulation
Conclusions
Major trends in dairy cattle nutrition, post-quota

- Precision Livestock Feeding concepts
- More focus on longevity & health
- Renewed views on feed proteins
Thank you for your attention!