Robotics and On Farm Technology Adoption in the EU

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Agenda

- Introduction
- Short Overview of European Dairy Industry (focus on Germany)
- Technology Adoption in Feeding
- Smart technology around parlors
European Dairy Industry

- EU 28 in total 23 million dairy cows
- Annual production of 152 million tons
- 6 countries produce 70% of the EU milk

http://ec.europa.eu/agriculture/milk/index_de.htm
EU 28 Milk Production 2013

Figure 1: EU Cows' Milk Collected - 2013 (million litres)

- Germany: 30,301 million litres
- France: 23,971 million litres
- United Kingdom: 13,687 million litres
- Netherlands: 12,213 million litres
- Poland: 9,921 million litres
- Italy: 9,657 million litres
- Spain: 5,981 million litres
- Ireland: 5,581 million litres
- Denmark: 5,025 million litres
- Belgium: 3,474 million litres
- Austria: 2,933 million litres
- Sweden: 2,868 million litres
- Czech Republic: 2,382 million litres
- Finland: 2,287 million litres
- Portugal: 1,777 million litres
- Hungary: 1,364 million litres
- Lithuania: 1,339 million litres
- Romania: 879 million litres
- Slovakia: 827 million litres
- Latvia: 736 million litres
- Estonia: 706 million litres
- Greece: 652 million litres
- Slovenia: 517 million litres
- Croatia: 504 million litres
- Bulgaria: 495 million litres
- Luxembourg: 287 million litres
- Cyprus: 157 million litres
- Malta: -
German Dairy Industry

- 2013: 4.27 M cows, 31 M tons production
- 2013: 77869 farms, average 55 cows/farm
- Prediction 2020: 4.4 M cows, 33 M tons production, 50000 farms

Milchpraxis 3/2014
German Dairy Industry

Prediction 2020:
4.4 M cows
33 M metric tons production
Distribution of farms in Germany

- Total 77,869 farms
- 9,481 farms > 100 cows
- 1,909 farms > 200 – 499 cows
- 446 farms > 500 cows (average of 800 cows each)
- more than 150 farms > 1000 cows
- Benchmark is 4% BF and 3.4% protein
Distribution of Milk Production DE

- 2013: 9500 farms > 100 cows (12% of all cows) produced 50% of the milk
- 2010: 15000 farms > 100 cows (15% of all cows) will produce 65% of the milk

Milchpraxis 3/2014
Technology Adoption in Feeding

- Robotic Feeding Systems
- Robotic Push Up Systems
- Self Propelled Mixer Wagons
Robotic Feeding System
Robotic Feeding Systems

- 16 different manufacturers
- Different systems of storage for forages
- Different mixing systems
- Different delivery systems (feed chart, TMR mixer, belt systems)
Manufacturer and systems of feeding robots

- **stationär**
  - "Futterband" System
    - Cornmell
    - Pellon
    - Rovibec
    - GEA
  - "Schiene mit stationärem Mischer und Verteilwagen" System
    - DeLaval
    - GEA
    - Pellon

- **mobil**
  - "Schiene mit Misch- und Verteilwagen" System
    - GEA
    - Hetwin
    - L. Fullwood
    - One2Feed
    - Pellon
    - Rovibec
    - Schauer
    - Trioliet
    - TKS
    - Wasserbauer

  - "Futtermischwagen" (selbst fahrend) System
    - Cornmell
    - Schuie-makker
    - Lely
    - Jeantil
Robotic Feeding Systems

- Costs between different systems
- Saving in barn (narrower feedbunk)
- Time savings ?
- Feed hygiene in feeding center ?
- Loading accuracy (take out human error)
- Consistency of TMR (mixing quality) ?
- Advantage of 8 or more feedings/ day ?
Narrow feed bunk (Milchpraxis 4/2015 page 24)
Feeding frequency greater than 2x/day?  
(Slide from Rick Grant, Miner Institute)

<table>
<thead>
<tr>
<th>Reference</th>
<th>FF /d</th>
<th>Eating time %</th>
<th>DMI %</th>
<th>Milk %</th>
<th>Rest %</th>
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<tr>
<td>DeVries et al. (2005)</td>
<td>1 vs 2x</td>
<td>+3.5</td>
<td>-2.0</td>
<td>NR</td>
<td>-0.8</td>
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<tr>
<td></td>
<td>2 vs 4x</td>
<td>+4.6</td>
<td>-3.0</td>
<td>NR</td>
<td>0</td>
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<tr>
<td>Mantysaari et al. (2006)</td>
<td>1 vs 5x</td>
<td>+7.0</td>
<td>-4.8</td>
<td>-1.0</td>
<td>-12.1</td>
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<tr>
<td>Phillips and Rind (2001)</td>
<td>1 vs 4x</td>
<td>+11.0</td>
<td>-6.3</td>
<td>-4.7</td>
<td>-8.6</td>
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<td>Nikkhah et al. (2011)</td>
<td>1 vs 4x</td>
<td>NS</td>
<td>-5.2</td>
<td>-2.5</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Cows laid down more quickly with increased FF.

Increased TMR feeding frequency improves efficiency: Is it desirable long-term if it reduces resting time?
Take Home Message Feeding Robots

- Advantage of different rations (you only have to fill the forage bunkers)
- Costs are higher than conventional systems (acquisition, running)
- Consistency of TMR tbd
- Time savings
- Production benefit?

→ Probably solution for smaller and mid size farms
Robotic feed Push Up
Effect of empty-bunk time (Matzke and Grant, 2003)

Compared 0 vs 6 h/d functionally empty bunk (midnight to 6:00 am)

- +7.9 lb/d milk yield
- 1.8x greater lying in stalls
- 2x greater feeding at bunk
- Less restless
Feed push-up (Armstrong et al., 2008)

- 1 to 2 hours post-feeding is most competitive; most displacements
- Push-up each ½ hour for first 2 hours versus once per hour
  - Fed 3x/day

<table>
<thead>
<tr>
<th>Item</th>
<th>1x/h</th>
<th>2x/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, lb/d</td>
<td>41.4</td>
<td>40.1</td>
</tr>
<tr>
<td>Milk, lb/d</td>
<td>61.3(^b)</td>
<td>65.3(^a)</td>
</tr>
<tr>
<td>Milk/DMI, lb/lb</td>
<td>1.48(^b)</td>
<td>1.63(^a)</td>
</tr>
<tr>
<td>Lying in stall, % of cows</td>
<td>45.3</td>
<td>43.8</td>
</tr>
</tbody>
</table>
Robotic Feed Push Up
Calculation profit with feed push up robot

- Feed costs lb dry matter: 11 cents
- Milk price: $16 per cwt
- Calculation 1: cows 1 hour off feed
- Calculation 2: cows 2 hours off feed
- Push ups per group: 16 per day
- One robot serves 280 cows
- Only off feed time is calculated, no other effects
Net profit

- Annual costs of robot: $6,060 incl. invest, depreciation, installation, operating costs, interest, maintenance
- 1 hour off feed before, now: +1.31 lb milk, +0.655 lb DM-intake,
  net profit for 280 cows: $8,060 annually
- 2 hours off feed before: + 2.63 lb milk, +1.315 lb DM-intake,
  net profit: $22,000 annually

Calculation available on request
Self propelled mixer wagons
Self propelled mixer wagons

- Very common on larger dairies in Germany
- Experience:
  fast, accurate loads are possible (proven by TMR audits), excellent silage face, no loose feed, good work place for feeder, no reduction in particle size
Self propelled mixer wagons

+ speed of consistent feed delivery
+ feed flow at loading (feed is fluffy in machine -> easier mixing)
+ less driving distances as with loader
+ labor and fuel savings (up to 50% according to a company that is selling both systems)
+ very often only short mixing time after last ingredient (sometimes less than 3 minutes, proven by TMR audits)
Self propelled mixer wagons

+ only one operating machine (instead of tractor/truck and loader)
+ NIRS dry matter measurement possible
- Max capacity at the moment 30m³ (about 1060 cubic ft.)
- max height defacing 6.5m
- No mixing of defaced material
- Higher investment if loader and tractor are already on farm
- One key machine (breakdown scenario)
Self propelled mixer wagons

Good experience with mixing accuracy
There are machines that serve more than 1,500 cows and youngstock with 1 feeder in 1 shift.

Maintenance is key to success. Machines with more than 20,000 hours!

Investment and savings (time, fuel..) have to be calculated per farm – no general statements possible.
The next step....? (picture Schuitemaker website)

STRAIGHT FROM SILAGE CLAMP >
The next step...... ?

Autonomus driving self propelled mixer wagons:


- Hirl (Germany): [http://www.hirl-technik.de/](http://www.hirl-technik.de/)
Smart technology around the parlor

- DeLaval TSR
- DeLaval BCS camera
- SCC data, conductivity
- GEA Dairy ProQ
Teat Spray Robot (DeLaval TSR)

- Robotic arm that is able to spray-dip up to 400 cows/hour
- Independent of rotary (stand alone operation, could serve rotaries from other companies)
- Accurate spray (on the farms that I visited)
- Minimum 6ml/milking (teat end covered) up to 10ml (whole teat covered)
TSR (picture: DeLaval)
TSR Calculation

- See spreadsheet
- Breakeven at 3,000 milkings per day (400/hour) compared to manual dip (same amount of teat dip)

- What else could this person do (check cows...)?
- What technology is necessary if there is no person at the end of the rotary (sort gate, milk weights...)?
BCS camera

- 3D camera that is able to measure the BCS while the cow is passing a sort gate (cow needs to be identified)
- Acquisition Costs: €4,500 then €3–5/cow/year
BCS camera
**BCS camera**

Usefull tool for:

- BCS change after calving (determining CR), ideal is combination with scale (less than 4% bw losses between day 2 and day 21 -> better fertility)

- Avoid cows with too high BCS (identify animals for maintenance group)

- Ration decisions long-term

- Not for incidences like ketosis, acidosis… (here rumination time is better tool)
SCC measurement, conductivity

- DCC
- SCC measurement in parlors or robots or stand alone version
- SCC is changing quickly between milkings and days
Conductivity in parlors, robots

- Conductivity is measured of:
  1. forestrip milk (robots)
  2. during the whole milking (for some Robots, AMR, DairyPro Q per quarter)

- Milk is checked for abnormal color (blood) in robots, AMR, DairyProQ, conventional parlors

  Good tool for detection of health issues at udder level if used together with milk weights
Discussion SCC, conductivity

- How to interpret the results?
- When to intervene? DeLaval: at least >115% of conductivity the last two days, milk weights <90%, question of sensitivity of the system
- 5,000ppm blood: not able to detect by human eyes
- What is the quality of monthly DHI data on SCC?
Fully Automated Rotary: GEA DairyProQ
Information Dairy ProQ

https://www.youtube.com/watch?v=Z1ooALds_Fc
Conclusions

- A lot of smart technology is installed
- What is beneficial?
- What is used?

Different ways lead to success.
At the end always people are responsible for success.
Thanks to:

- DeLaval, Germany
- GEA, Germany
- RMH, Netherlands
- Wasserbauer, Austria

For a lot of good information and for contributing to this presentation
Thanks for you attention!!!!