Present and Future
Innovations to improve Milk harvesting

IDF World Dairy Summit
Farming systems in the future
November 25, 2004
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Division: Applied Research

Innovations to improve milk harvesting
- Developments
- Milk harvesting systems
- Automatic Milking Systems
- Experiences in Europe
- Concluding remarks

Number of dairy farms
Developments 1990 - 2001

Farm Size Status 2001
World dairy cost map in 2003

Cost of milk production in US-$ / 100 kg milk

- > 40
- 30 - 40
- 20 - 30
- 15 - 20
- < 15

Structural developments
- Internationalisation and globalisation
- General developments in society
  - From agricultural to industrial to knowledge based
- Cost of production factors land and labour
- Dairy industry developments
  - Requirements
  - Payment systems
- Product quality and food safety
- Concern on animal health

Number of dairy cows per herd (2003)

Average yield per cow (2003)

Average milk production per farm * 1000kg (2003)

Number of dairy farms in The Netherlands
Past decades

- Prices of labour and land increased
- Milk price decreased

Productivity per manhour and per ha has to increase!

Farm size structure (NL)

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt;30</th>
<th>30-70</th>
<th>&gt;70 cows</th>
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<tbody>
<tr>
<td>1996</td>
<td>15k</td>
<td>5k</td>
<td>5k</td>
</tr>
<tr>
<td>2000</td>
<td>12k</td>
<td>7k</td>
<td>15k</td>
</tr>
<tr>
<td>2005</td>
<td>10k</td>
<td>10k</td>
<td>10k</td>
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</table>

Developments: Costs of land

- Land: fourfold increase

Developments: Costs of labour

- > threefold increase

Developments: Price of milk

- Milk price: 50% decrease
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Milk harvesting: history

- Milking cows 3000 BC
  - Manual labour
- 19th century
  - Industrial development
  - Lack of labour / increased labour costs
  - First ideas to milk cows mechanically
  - Several approaches
  - Invention of liner and pulsator

Some ideas

- Colvin vacuum milker 1860
- Beyer and Rohde Lactator 1886

Milk harvesting: history

20th century – introduction milking machines
Focus on increasing capacity per manhour
- Bucket milking machines
- Pipe line systems
- Bulk tanks
- Milking parlours
- Automation (ID, ACR, sensors)
- Automatic milking

50 years development in dairying

Current milk harvesting systems

- Focus on productivity per manhour
- Use of technology
  - ACR and other ancillary equipment
  - Machine settings
  - Sensors and computer technology
- Rapid exit systems
- Design parlour / waiting area
- Cost / benefit analysis
Number of milking Systems (NL)

<table>
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<tr>
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<tr>
<td>Bucket</td>
<td>26.3</td>
<td>5.3</td>
<td>0.8</td>
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<tr>
<td>Pipe line</td>
<td>27.3</td>
<td>21.1</td>
<td>14.4</td>
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<tr>
<td>Herringbone</td>
<td>40.4</td>
<td>62.7</td>
<td>68.6</td>
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<tr>
<td>Side by Side/Tandem</td>
<td>5.6</td>
<td>10.1</td>
<td>12.5</td>
</tr>
<tr>
<td>Rotary</td>
<td>0.4</td>
<td>0.6</td>
<td>1.3</td>
</tr>
<tr>
<td>AMS</td>
<td>0.0</td>
<td>0.04</td>
<td>2.4</td>
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<tr>
<td>Nr of farms</td>
<td>49500</td>
<td>35540</td>
<td>23595</td>
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</table>

Share of milking systems in NL (%)

Typical Dutch milking parlour
- One man milking system
- 2 * 6 herringbone parlour
- 12 clusters
- Maximum milking time 1.5 hours
- Low level milk line
- Automatic cluster removers
- (Electronic) milk meters
- PC management system
- Concentrate feeders / TMR feeding

Computer systems (farms > 30 cows (2001))

<table>
<thead>
<tr>
<th>Year</th>
<th>Conc feeding</th>
<th>EMM</th>
<th>Cond</th>
<th>Activity</th>
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<td>2001</td>
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Use of computer technology (farms > 30 cows)

- PC
- Internet
- MIS
- Acc.
- Telebanking

1997 1999 2001

High capacity milking parlours
- Limited time per cow available
- Udder pre-treatment
  - Cleaning
  - Milk let down
  - Milking routine
- Attachment
- Control
- 120 cows per man hour = 30 seconds per cow
- Faster ≠ better!!

High capacity milking parlours

Labour requirements for milking (h/year)

- Milking parlour
- High cap.
- AM - system

Parlour or automatic milking?

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Automatic milking: History
- First patents early 70’s
- First prototypes 1984-1986
- Institutes in Netherlands, Germany, UK, France
- Manufacturers of AM-systems
- Introduction in 1992
- 1992-1997: variable results and experiences
  - some farmers stopped (management, technical problems, milk quality, economical aspects)
  - research, extension, courses

Automatic milking - some historical pictures

Original Manufacturers of AMS


Farms with AM world wide (Dec 2003)

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Automatic milking in Europe

- First patents early 70’s
- First prototypes 1984-1986
- Introduction in 1992
- 1992-1997: variable results and experiences
- Effect on milk quality, farm economy, many questions
- Idea of an integrated research project

Potential Benefits and Concerns

**Benefits**
- Quality of life
- Labour saving/relief
- Animal welfare
- Udder health

**Concerns**
- Milk quality
- Economical aspects
- Grazing

EU-project “Implications of automatic milking”

**Objectives**
- To identify determinants for the adoption of automatic milking
- To assess the implications of the adoption of automatic milking
- To generate solutions for adverse effects
- To disseminate results

From dec 2000 till June 2004

The project work packages

1. Socio-economic aspects
2. Public acceptance
3. Redefinition of acceptable milk quality
4. Milk quality
5. Prevention of antibiotic residues
6. Effectiveness of automatic udder cleaning
7. Optimal cleaning of equipment
8. Health
9. Welfare assessment
10. Grazing
11. Operational management support

Dissemination

- 28 Research reports
- Progress and final reports
- Articles & Presentations
- Web-site www.automaticmilking.nl
- Proceedings Symposium March 24-26, 2004 Lelystad, The Netherlands

Automatic Milking: consumer’s perception

- Not really an issue for consumers (Maris & Roe, 2004)
- General: positive image for milk and dairy
- Consumers worried about food scares and safety in general
- Followed by animal welfare in general
- Automatic Milking: milk quality, animal welfare
- Concerns about grazing
Automatic Milking: Reasons to invest

- Labour reduction: 29%
- Labour flexibility: 27%
- Get rid of hired labour: 15%
- Improving technical parameters: 12%
- Future, challenge: 8%
- Other activities: 9%

Social reasons (67%) > economic reasons (33%)
(Mathijs et al., 2004)

Automatic milking: Economical aspects

- Labour saving ~ 20%
- Variable results
- Depending on:
  - Increase milk yield, labour saving
  - Reference milking system
  - Labour redeployment
  - Efficiency of the system
  - Capacity of the system
  - Economic results variable

Room for Investment (RFI value)

Annual accumulated returns from:
- additional milk +
- labour reduction +
- savings by not investing in a milking parlour

divided by
- Annual costs of an AM-system
  (depreciation + maintenance in %)

RFI value (20% annual costs)

Maximal investment (€)

Increase in milk yield (kg)

Labour saving (h/day)

Differences installation dates + 3 years

TPC (*1000)

Total plate count (NL)

Days after introduction

Automatic Milking: Milk Quality

- Milk quality is influenced by AM
- Transition period
- TPC and BMSCC more or less equal
- FFA and FP-levels increase and stay higher
- Other parameters – no differences

Risk factors found:
- Technical and management factors
- Equal to conventional milking
### Automatic Milking: Cleaning procedures
- Same principle
- 2 times versus 3 times cleaning per day
- Small but significant increase in TPC
- Significant increase in Coliform, Psychrotrophic and Thermoduric Counts
- Farm effects

### Automatic Milking: abnormal milk
- Test “State of the Art” (Rasmussen et al, 2004)
  - 6 models tested
  - Sensitivity ranged from 13 to 50%
  - Specificity ranged from 87 to 100%
- Conclusion: Current systems are designed to produce alarm lists and are not ready to separate automatically

### Impact on Grazing
- Consumers concern in NW Europe
- Different grazing strategies
- Technically possible
- Effect on milking frequency
- Labour requirements
- Less grazing

### Impact on management
- Physical labour replaced by management tasks
- Increased decision-making tasks
- Sensor and computer technology
- Labour reduction ~ 20%
- Work is less time-bound
- Person “on call” at all times
- Herd observation very important
- It takes ~6 months to get used to it!

### Impact on cows
- Max. 5-10 % not suitable
- Voluntary visits at non-regular times needs training
- No effects on health and welfare
- Udder and claw health be monitored
- Feed intake be monitored; roughage be always available
- Urge to fetch cows highly variable
- Increase in milk yield highly variable
  (-6% to +35%)
- Cows get used much faster than the herdsman!

### Impact on Animal health
- Studies in 3 countries on 45 farms (Hillerton et al, 2004)
- No major effects (nor negative of positive)
- Period before transition important
- Transition period
  - Fresh cows - 2nd and 3d lactation
  - No problems for heifers
- Risk factors more or less equal to conventional milking
Somatic Cell Counts,
Effect of DIM (Poelarends et al., 2004)

Days in milk
SCC x 1000 cells/ml
-60 60-120 120-180 180-240 240-300 >300
0 50 100 150 200 250

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General experiences automatic milking

Too complicated!
Very useful!
Too expensive!

Future developments
- Labour output and efficiency
- High capacity milking systems vs AM
- Further growth AMS expected
  - Countries with high labour costs, high milk prices
  - Family farms vs. Large farms
- Technical developments / sensor technologies
  - Improved management strategies
  - Integration with feeding systems
- Increased capacity – reduced annual costs

Individual Feeding System
- Individual rations
- Labour reduction
- Effect on yield
- With AM-system and milking parlour
**Utilisation of AM-systems**

- 2004
  - Europe 0.5 – 5% market share
  - North America: < 0.7%
  - Mainly ‘family farms’, moderate size

- 2020
  - Growth in countries with high labour costs
    - Up to 30-40% in NW Europe
  - North America
    - Systems for large farms
  - Oceania – new approaches with grazing strategies

**Robots in milking parlour?**

- Pre treatment
- Automatic attachment
- Control / check
- Costs involved
- Market?

**New technologies?**

**Grazing Strategies – Mobile robots?**

Source: IceRobotics

**Thanks for your attention**

Source: Wageningen UR, Animal Sciences Group