The economic and environmental performance of grazing and zero-grazing systems for Dutch dairy farms


Animal Production Systems group, Wageningen University
Dairy sector - developments past years

Larger herd sizes
Higher milk yield/cow
More use of automatic milking systems (AMS)

CBS, 2014

% Dutch dairy cows


92 70

Grazing
Current situation summer period

day and night grazing 16% (of Dutch dairy cows)

day grazing 54%

zero-grazing 30%
Recent changes in legislation

Milk quota abolition

Phosphate ($P_2O_5$) excretion limits

$P_2O_5$ surplus removal
Objective

Future farm structure?
Limiting factors?
Grazing and AMS?
Day and night grazing, day grazing or zero-grazing?

To analyse the labour income and greenhouse gas emissions of Dutch dairy farms in a post-quota era
Modelling dairy farms with AMS for 2020

Dairy farm model with relevant activities and constraints

- Day and night grazing
- Day grazing
- Zero-grazing

Linear programming – maximise labour income

| € | Labour income in €/year |
| CO₂, CH₄, N₂O | Greenhouse gas emissions (GHG) in CO₂-eq: |
Activities

On-farm feed production

- Fresh grass → only in summer
- Grass silage
- Maize silage

*Grass yield dependent on nitrogen (N) application: 100-500 kg

Feed purchases

- Concentrates → 3 levels of protein
- Maize silage
Related constraints

• Dietary requirements
  – Protein
  – Energy $\rightarrow$ higher when grazing
  – Feed intake capacity

*Dependent on milk production

• Capacity machinery

• Labour availability

• Nutrient content manure $\rightarrow$ N and $P_2O_5$ balance
Model assumptions 2020

**Input**

- Artificial fertilizer
- Feed
- Prices

**On-farm**

- Field operations
- Farmland
- Land costs
- Feed production
- Grass and maize yields
- Max. grass intake
- Animal production

**Output**

- Manure
- Animals
- Replacement rate
- Milk
- Milk yields

Uncertainty → sensitivity analysis
## Results basic scenario – farm structure

<table>
<thead>
<tr>
<th></th>
<th>unit</th>
<th>Day and night grazing</th>
<th>Day grazing</th>
<th>Zero-grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total farmland</td>
<td>ha</td>
<td>64</td>
<td>74</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>80% grassland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milking cows</td>
<td>n</td>
<td>113</td>
<td>126</td>
<td>123</td>
</tr>
<tr>
<td>Farm intensity</td>
<td>kg milk/ha</td>
<td>14,888</td>
<td>15,282</td>
<td>21,208</td>
</tr>
</tbody>
</table>
## Diet composition milking cows

<table>
<thead>
<tr>
<th>% DM summer</th>
<th>Day and night grazing</th>
<th>Day grazing</th>
<th>Zero-grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazed grass</td>
<td>75</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Grass silage</td>
<td></td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Maize silage</td>
<td>21</td>
<td>52</td>
<td>62</td>
</tr>
<tr>
<td>Concentrates</td>
<td>4</td>
<td>6</td>
<td>29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% DM winter</th>
<th>Day and night grazing</th>
<th>Day grazing</th>
<th>Zero-grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass silage</td>
<td>18</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>Maize silage</td>
<td>42</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Concentrates</td>
<td>40</td>
<td>28</td>
<td>21</td>
</tr>
</tbody>
</table>
Labour income in €/year

- day and night grazing
- day grazing
- zero-grazing

Higher milk revenues

Lower total feed costs
GHG emissions in CO$_2$-eq/t FPCM

- **day and night grazing**: 950
- **day grazing**: 850
- **zero-grazing**: 800

Less enteric methane and grassland emissions
Restrictions in farm size and intensity

Day and night grazing
- Max. allowed $P_2O_5$ excretion
- No manure export

Day grazing
- No roughage purchases

Zero-grazing
- Max. allowed $P_2O_5$ excretion
Sensitivity analysis: influencing factors

All systems: Milk price and land costs

Day and night grazing

— Milk production per cow
— Grazing losses

Day grazing

— Milk production per cow
— Max. grass into milk (in combi with AMS!)

Zero-grazing

— Manure removal costs
— Feed prices
Conclusions

All economically feasible in 2020

**BUT** different vulnerability to different future scenario’s

Economically most attractive

Greenhouse gas emissions in between

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