Models for regional scale farming systems evaluation of climate change mitigation and environmental impact assessment

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Program

- Introduction
- The cycle of applied research
- Modelling results
  - Temporal heterogeneity
  - Spatial heterogeneity
- Perspectives for future research
The cycle of applied research

- Decision-makers
- Questions
- Observations
- Suggestions
- Modelling

Gap of scale

Bierkens et al. (2000)
Examples from Macsur

Koenig et al. (2015, under submission)
Farm study case landscapes in Denmark and the EU

See also: www.dNmark.org
Farm modelling

**EF** = Emission factor

N products

NH$_3$

NH$_3$, N$_2$, N$_2$O

N feed

EF

N products

C-tool model

Change in soil N

SIM-DEN model

NH$_3$

N$_2$

N$_2$O

NO$_3$

www.Farm-N.dk/farmNtool
EU farm study case landscapes - variation in farm N surplus

Biogeosciences 9, 5303–5321  
Dalgaard et al. (2012)
## Temporal heterogeneity

**example: livestock farm in DK and DE**

<table>
<thead>
<tr>
<th>Crop Rotation</th>
<th>Set aside</th>
<th>Winter wheat</th>
<th>Winter rape</th>
<th>Winter wheat</th>
<th>Winter wheat</th>
<th>Winter barley</th>
<th>Winter rye</th>
<th>Winter rape</th>
<th>Winter wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field area (ha)</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Fertilisation Organic (kg N ha(^{-1}))</td>
<td>0</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>118</td>
<td>102</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Fertilisation Inorganic (kg N ha(^{-1}))</td>
<td>0</td>
<td>54</td>
<td>59</td>
<td>27</td>
<td>54</td>
<td>63</td>
<td>45</td>
<td>59</td>
<td>27</td>
</tr>
</tbody>
</table>

### River Gudenaa, Denmark

- Total field area: 546 ha
- Total fertilisation: 58283 kg N ha\(^{-1}\)

### Brandenburg, Germany

- Total field area: 21009 ha
- Total fertilisation: 58283 kg N ha\(^{-1}\)

### Total

- Total field area: 26475 ha
- Total fertilisation: 116566 kg N ha\(^{-1}\)
Temporal heterogeneity example

Pig Bacon - River Gudenaa

Pig Bacon - Brandenburg

House & store (kg N)

Field loss (kg N)

Housing
Stores
Fields

Fields
Stores
Housing

www.fasset.dk
Ammonia-emissions

Spatial heterogeneity effects the total emission

Env Pol 159: 3183-3192.
Farms heterogeneity:
Ammonia emission example

\[(55+12)/2 = 33\frac{1}{2}\]

\[\neq\]

26

Env Pol 159: 3183-3192.
Dalgaard et al. (2011)
Geographically targetted measures needed

Present impact on the coastal aquatic environment

Low

High
Geographically targetted measures needed

Present impact on soil fertility decrease

Low
High
The challenge of sensitive ecosystems in Europe

Source: EEA.eu
L4 Cross-cutting activities and integration at regional level

- L 4.1 Methods of regional scale modelling of livestock farms and adaption to climate change
- L 4.2 Methods for stakeholder involvement in climate-related policy measures applied at the regional scale
- L 4.3 Multidisciplinary approach to the assessment of climate change in the dairy sector
The cycle of applied research

Gap of scale

- questions
- observations
- modelling

- decision-makers
- suggestions

Bierkens et al. (2000)