N management in Denmark
-trends, challenges & prospects for improved N efficiency

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Session 3: National case studies. The Ministry of Environment (MAOTE)
Lisbon, Portugal. April 29-30 2015.
Program

- Introduction
- The Danish Nitrogen Alliance
- Trends, challenges and prospects for improved N management and N efficiency
- Conclusions
Agriculture in Denmark

- 2.6 mio ha agricultural land (62% of total area)
- 5.5 mio people – 4.5 mio t milk - 29 mio pigs/yr
  - 9.7 t milk/cow/yr
  - 30 piglets/sow/yr
  - 7.5 t wheat/ha/yr
- 7500 km coastline
Development phases

N-imports

N-exports

- N-fertiliser import
- Fodder import
- From the atmosphere

NB: year 2000 = index 100
I: Traditional livestock farming (1900-1950)

- N-fertiliser import
- Fodder import
- From the atmosphere

NB: year 2000 = index 100
II: The "green" revolution (1950-1983)

- N-fertiliser import
- Fodder import
- From the atmosphere

Vegetable exports
Animal exports

NB: year 2000 = index 100
III: Limits to growth (1984-1993)

- N-fertiliser import
- Fodder import
- From the atmosphere

Note: year 2000 = index 100
IV: Globalisation and sustainable development? (1994-?)

- N-fertiliser import
- Fodder import
- From the atmosphere

- Vegetable exports
- Animal exports

NB: year 2000 = index 100
N-efficiency in Danish Agriculture

Intensive agriculture near to the coast

Max 50 km

2000 km
Action plans

- The 1985 Action Plan
- AP-I for the Aquatic Environment (1987)
- AP-II for the Aquatic Environment (1998, 2000)
- Ammonia Action Plan (2001)
- AP-III for the Aquatic Environment (2004)
- Green Growth (2009)
Studying all components of Danish nitrogen landscapes

Research components:

- Air, NH₃ (4.6)
- Waste (4.1)
- Products (4.2)
- Biodiversity (4.5)
- City consumers, DK, international (4.3)
- Agriculture (4.4)
- Groundwater

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RC4 CRITICAL N ISSUES

air, NH₃
4.6

health
4.7

city consumers
DK, international
4.3

groundwater

 MANAGEMENT
RC3

agriculture
4.4

water

 LANDSCAPES
RC2

biodiversity
4.5

 RC1 NATIONAL N-MODEL

 RC6 SYNTHESIS

 RC5 DISSEMINATION
Surface water outflow to the sea

Atmospheric N deposition

Total N deposition to land surface

Groundwater concentration

Upward nitrate trend

Downward nitrate trend

Age of groundwater (yr)

Change in nitrate (mg/L/yr)

Oldest (25-50 years) Medium (15-25 years) Youngest (0-15 years)

Danish Farm N surplus Development and Variation

Dalgaard et al. BiogeoSciences 9 (2012)
FarmAC – farm C and N model

- Focusses on livestock farming systems
  - Can be used for arable agriculture
- Intended to have wide applicability
- Simple enough that demand for inputs and parameters is manageable
- Complex enough to describe consequences of mitigation/adaptation measures
## Types of regulation

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<thead>
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<th>General regulation</th>
<th>Geographically targeted regulation</th>
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<tr>
<td></td>
<td>Input based</td>
<td>Output based</td>
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<td>Command and Control (C&amp;C)</td>
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<td>Market-Based Regulation and Governmental Expenditure (MBR)</td>
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<td>Information and Voluntary Action (IVA)</td>
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European farm N surplus

Dalgaard et al. BiogeoSciences 9 (2012)
A general NW EU challenge

The EU Waterframework directive challenge

Source: EEA.eu
The cycle of applied research

Adapted from Bierkens (2000)
It is all about a balanced approach!
The dNmark.org research alliance

Innovative solutions for a
SUSTAINABLE MANAGEMENT OF NITROGEN IN AGRICULTURE
PhDs and post-docs

- RC 4.3: Philosophical-anthropological Perspectives on the Culture of Food in the City of Horsens, with Special Regard to Diminished Consumption of Meat Products
- RC 4.4a: Stakeholder involvement in sustainable management of nitrogen - a framework for integrated participatory modelling
- RC 4.4b: Methods for Assessing Spatially Differentiated Nitrogen Mitigation in Agriculture
- RC 4.5: Ecosystem services as a framework for sustainable natural resource management in Denmark
- RC 4.7: Groundwater N-pollution and public health effects – The example of gastrointestinal cancer

http://dnmark.org/?page_id=980&lang=en
PhDs and Post-docs

- RC 2: Modelling N reduction effects in Danish agricultural landscapes based on local stakeholder suggestions of future landscape changes
- RC 3: Management strategies – Implementation of N reduction measures by use of policy instruments
- RC 4.1: Urban-rural N recycling for waste
- RC 4.6: Agricultural airborne N-Pollution, particle pollution and public health effects
- RC1/RC6: Geographically Targeted Solution Scenarios and Impact Assessment
- RC2/RC6: GIS platform for landscape scenarios

http://dnmark.org/?page_id=980&lang=en
Policies for agricultural nitrogen management—trends, challenges and prospects for improved efficiency in Denmark

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