

Environmental aspects of manure treatment

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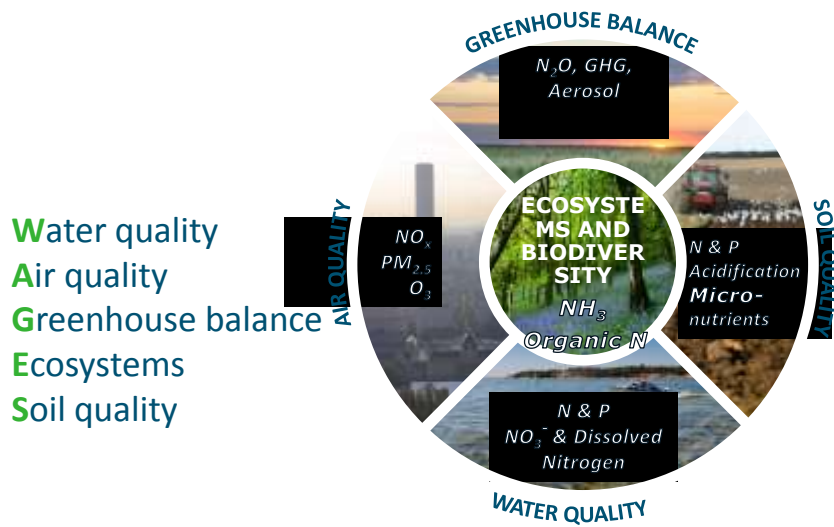


Outline

- Introduction
- Gaseous N losses: ammonia and nitrous oxide
- Methane emission
- Nitrate leaching
- Phosphorus
- Effects of large scale manure treatment
- Other environmental aspects
- Conclusions



Introduction: key threats of excess nutrients



Sutton et al., 2013

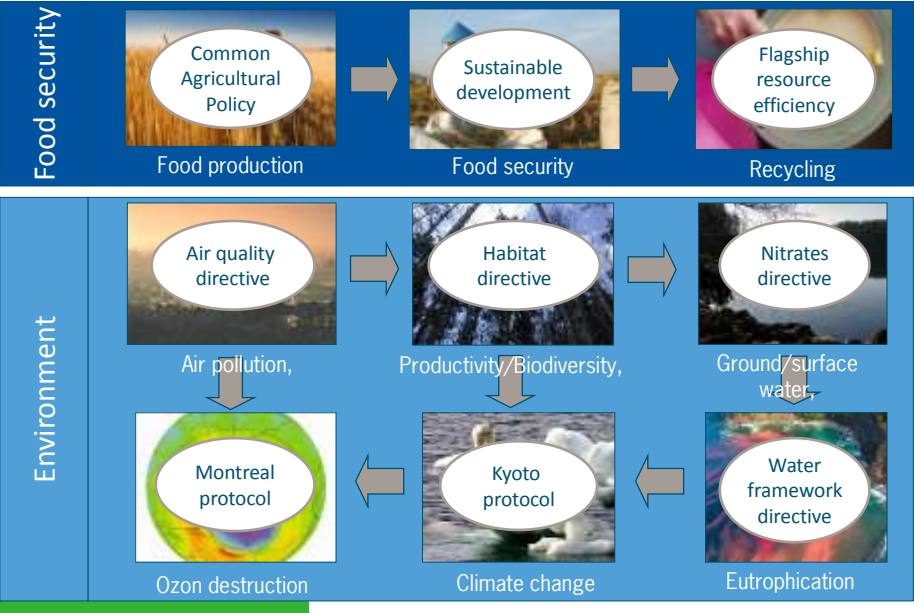
Introduction: high N emissions in regions with high livestock density



Velthof et al. (2012)

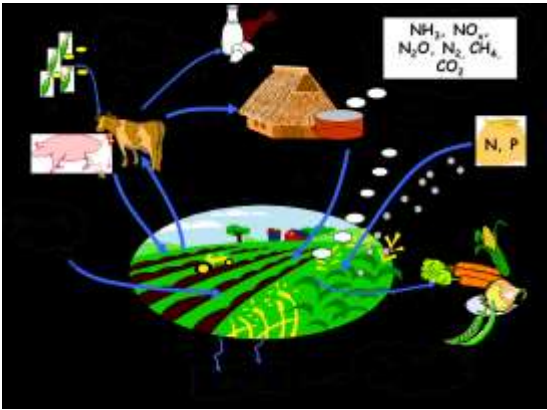


Introduction: Nutrient impacts related to policies



Introduction: manure chain approach

Feed–Animal–Housing–Storage–Treatment–Storage–Grazing–Application–Crop

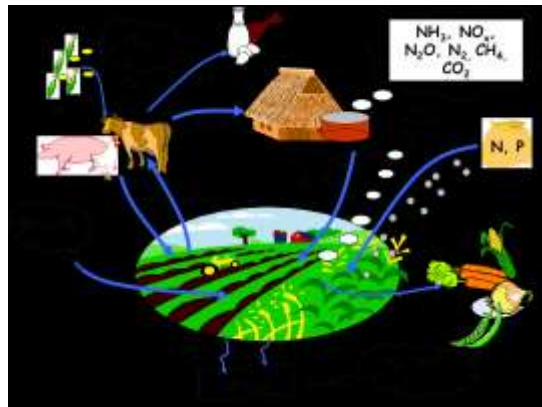


Introduction: manure chain approach

Feed-Animal-Housing-Storage-Treatment-Storage-Grazing-Application-Crop



In this presentation:
focus on separation and
reverse osmosis



Gaseous N losses



Controlling factors: ammonia

Housing - storage - treatment

- Manure composition: NH_4 , pH, dry matter
- Storage: cover

Soil

- Manure composition: NH_4 , pH, dry matter
- Application method
- Weather



Controlling factors: nitrous oxide

Housing - storage - treatment

- Manure composition: NH_4 , NO_3 , available C, pH
- Type of storage: aeration
- Temperature

Soil

- Manure composition: NH_4 , NO_3 , available C, pH
- Soil properties
- Application method
- Weather

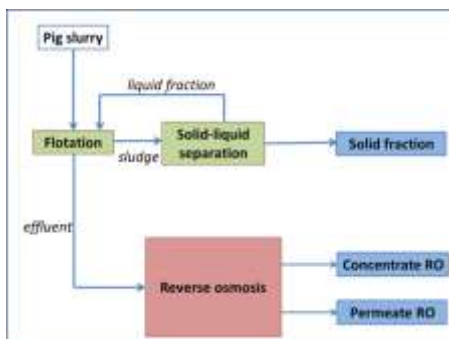


N losses during slurry treatment

Average output (in % of input) of 4 manure treatment installations using reversed osmosis

	Total N	NH ₄ -N	P
Solid fraction	44	29	96
Mineral concentrate	53	70	4
Permeate	2	0	0
Total	99	99	100

Hoeksma and Buissonjé, (2011)



N losses during storage

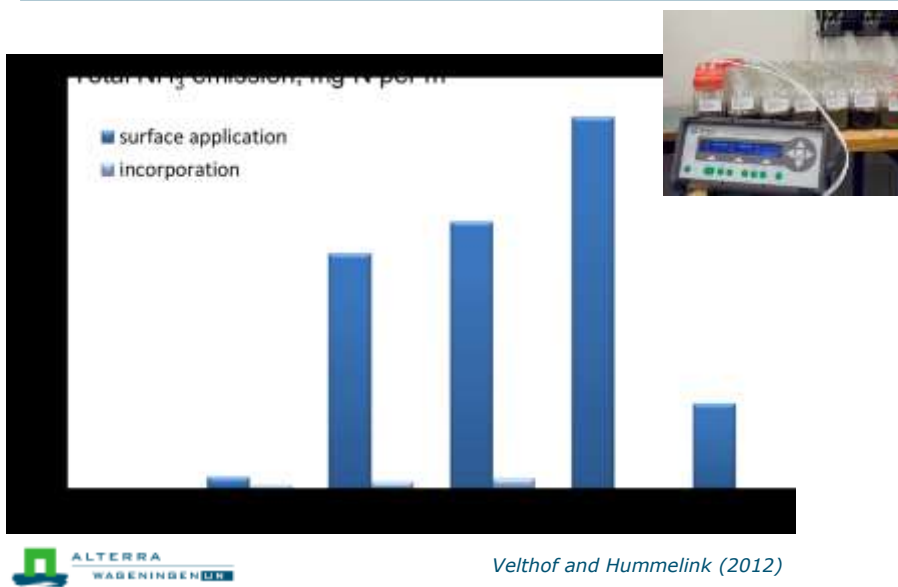
<i>Nitrogen losses during storage (literature review)</i>			
Manure type	N loss during storage, %	n	
Pig slurry Untreated	23	8	
Solid fraction; centrifuge	32	8	
Liquid fraction; centrifuge	19	8	

Mosquera et al. (2010)

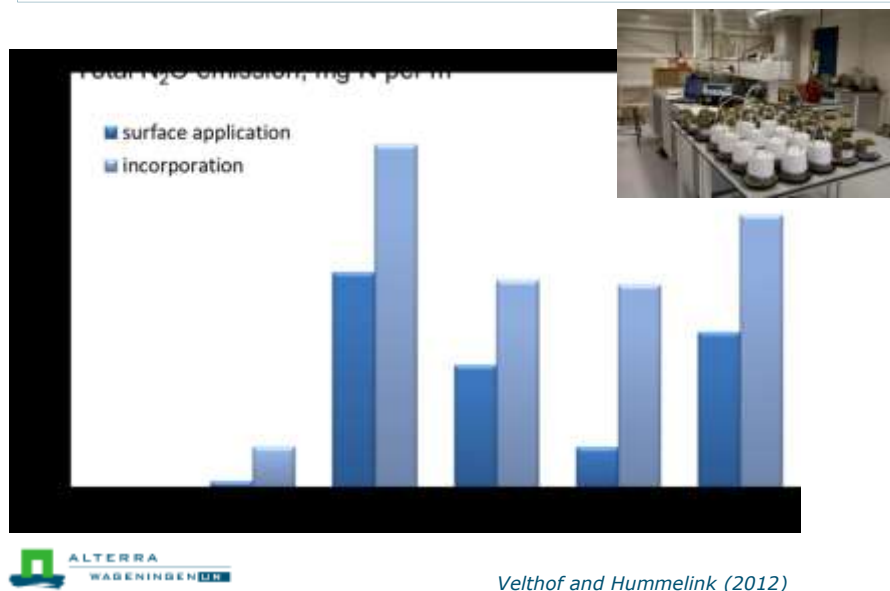
- Slurry systems: NH₃ emission >> N₂O emission
- N₂O emission solid manure storage >> slurry storage



Soil: ammonia emission



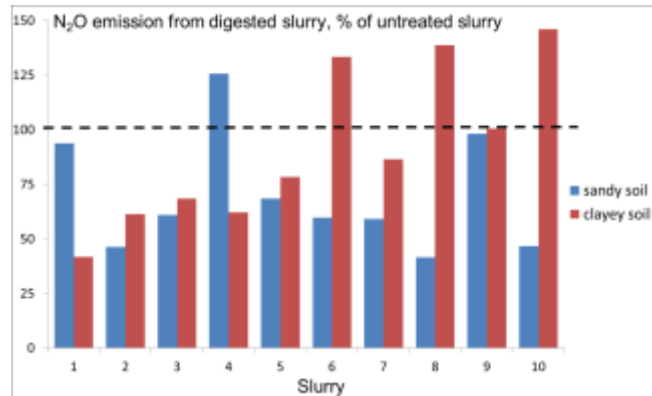
Soil: nitrous oxide emission



Untreated pig slurry - digestate

Digestate

- Higher NH_4 content and higher pH
- Less available C
- Lower dry matter content
- Co-product influences the composition of digestate



Methane



Controlling factors: methane

Housing - storage – treatment

- Manure composition: C, N, pH
- Storage: slurry – solid (oxygen content)
- Temperature

Soil

- No/small methane emissions because of aerobic agricultural soils



Storage: methane emission

Emission during two month storage (incubation study)

Manure type		organic matter loss, %	CH ₄ , mg/kg manure
Solid cattle manure		26	1.0
Cattle slurry	Untreated	33	11.8
	Solid fraction; centrifuge	11	0.0
	Liquid fraction; centrifuge	19	9.1

Mosquera et al. (2010)



Nitrate leaching



Controlling factors: leaching

Housing - storage – treatment

- Slurry: generally no leaching
- Solid
 - Concrete floor
 - Storage in fields



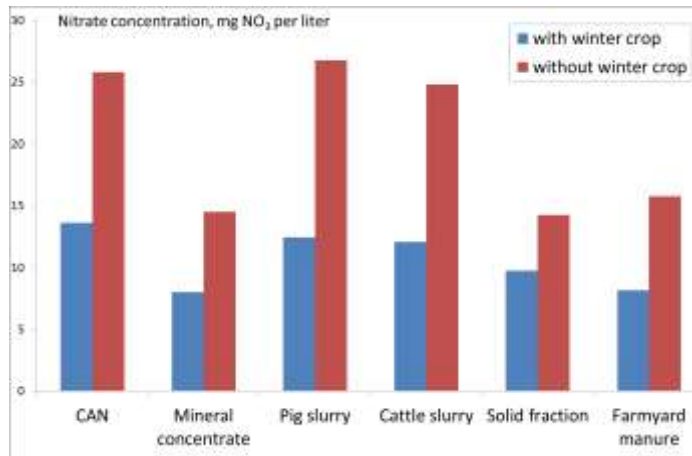
Soil application

- Manure composition
- Input – output balance: N, and P
- Soil properties and weather
- Hydrology



Nitrate leaching

Average nitrate concentration upper groundwater in maize experiments (2010 and 2011)



Schröder et al. (2012)

Phosphorus



Risk of phosphorus accumulation

P-content of separated manure

		Untreated slurry	Separation	
			solid fraction	liquid fraction
Organic matter	g/kg	35	142	5
Total N	g/kg	4.8	8.9	2.6
N-NH ₄	g/kg	3.2	3.5	2.2
NH ₄ -N, % Ntot		66	39	85
P	g/kg	1.3	5.0	0.1

Hoeksma et al. (2011)



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Hoeksma et al. (2011)

Use of additives

Relative P effectiveness, % of P fertilizer		
Manure	8 weeks	24 weeks
I	87	73
II	33	41
III	80	68
IV	73	70

← iron sulfate flocculant

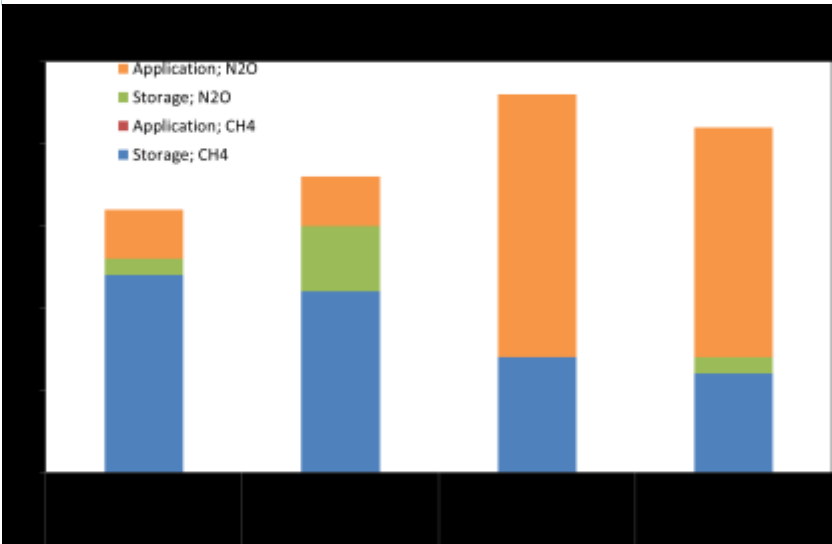


Schröder et al. (2012)

Large scale manure treatment

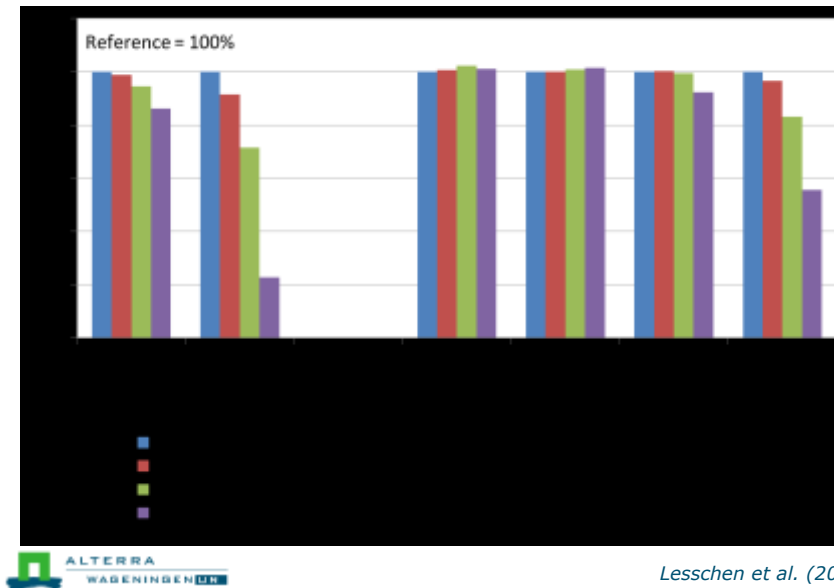


Large scale separation in NL



Mosquera et al. (2010)

Large scale reverse osmosis in NL



Lesschen et al. (2011)

Other environmental aspects



Other environmental aspects

- Energy
- Fine particles, odour
- Heavy metals and excess of other minerals, e.g. S, Ca + Mg (hardness)
- Antibiotics, hormones
- Diseases
- Spatial planning, logistics, noise



Conclusions

- Environmental assessment of manure treatment is complex
 - Different parts of the manure chain
 - Many compounds/aspects involved
 - Risks of pollution swapping
- Manure treatment may strongly affect emissions in different parts of the manure chain.
 - overall effect on a national level may be small
- Manure treatment may improve use of manure N and P, so that less fertilizer is needed



Thank you

