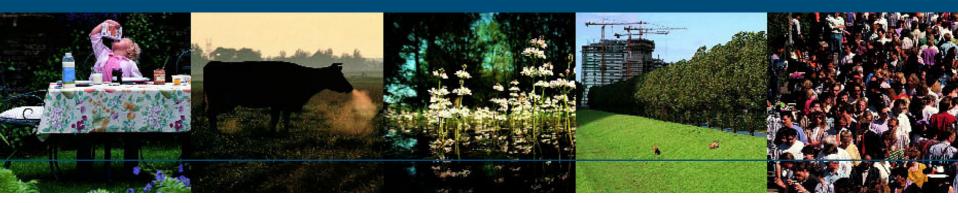
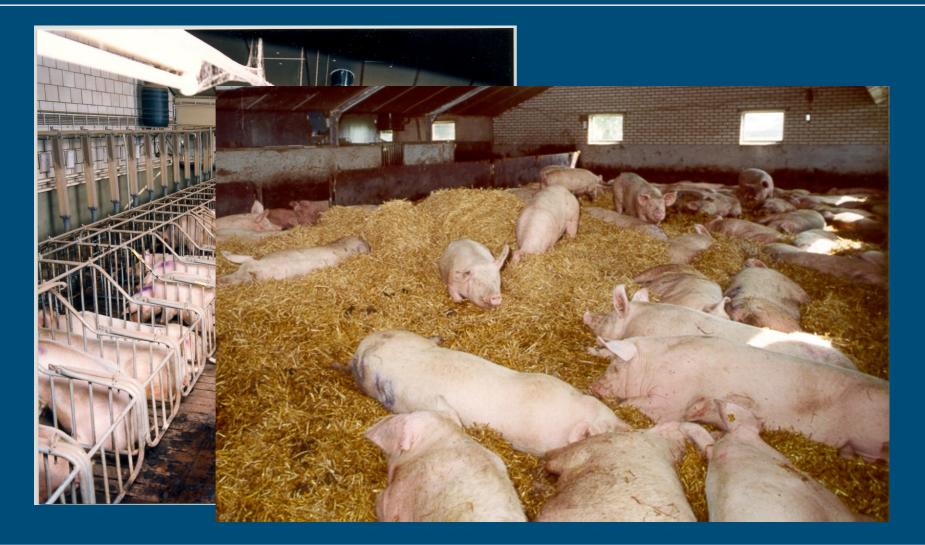
Effect of straw bedding in pig housing on emissions of greenhouse gases

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#### Animal welfare





### Straw in pig husbandry

Cost,

Labour,

- Hygiene
- Incompatibility with manure drainage systems

Physical comfort Thermal comfort Exploration, Foraging, Rooting Chewing Nesting Maternal behaviour

-



Another potential -: Environmental issues Agricultural emissions: focus of the Netherlands

Focus for straw systems:

■ NH<sub>3</sub>

N<sub>2</sub>O

CH<sub>4</sub>

Odour

Particulate Matter (PM10 and PM2.5)



#### **Deep litter**



- Mixture of litter and slurry
- High C/N ratio
- Anaerobic as well as aerobic conditions
- Methanogenese =  $CH_4$
- Nitrification/denitrification =  $NH_3$ ,  $N_2O$ , (NO,  $N_2$ )



#### Literature review

# Fatteners (n=13): $NH_3$ 3.0-16.2g/d per pig $CH_4$ 2.5-13.4g/d per pig $N_2O$ 0.03-11.3g/d per pig

 Sows (n=1)

  $NH_3$  6.7-8.7
 g/d per pig

  $CH_4$  39
 g/d per pig

  $N_2O$  0.5
 g/d per pig



#### Key factors affecting emissions

	$CH_4$	$N_2O$	$NH_3$
Animal-related factors			
Age/Live weight	+	+	+
Amount and composition of feed	+	+	+
Water use	0	0	-



#### Key factors affecting emissions

	$CH_4$	$N_2O$	$NH_3$
Environment-relating factors			
Housing configuration	+/-	+/-	+/-
Air velocity	0	0	+
Temperature inside	+	+	+
Temperature outside	+	+	+



Key factors affecting emissions					
Factors related to slurry/litter mixture	$CH_4$	N <sub>2</sub> O	NH <sub>3</sub>		
C/N ratio	+	+	-		
O2 concentration	-	+/-	+		
Surface area	0	0	+		
Maturity of litter/slurry mixture	+	+	0		
Optimal pH	7	6	+		
Temperature of the slurry/litter	+	+	+		
NH <sub>4</sub> <sup>+</sup> concentration	-	+	+		
Volatile Solids concentration	+	0	0		
Drymatter	-	0	0		



#### Litter and slurry: complex ecosystem

Litter management affects keyfactors

Type of litter Amount of litter Depth of the litter bed Additives Addition of fresh litter Litter mixing Litter removal

Littered surface area Location of litter Sawdust, wood shavings, straw 50–1000 g/d per pig 0-70 cm Yes or no None to weekly None, two or three times a week partly; completely; daily; weekly; monthly; yearly 40–100% of total living area Resting, feeding or excretion area



#### Nitrous oxide

- C/N ratio and N<sub>2</sub>O not well correllated
- Higher emissions with woodshavings and sawdust
- ws and sd contain more lignine and hemicellulose
- Straw contains more cellulose
- Cellulose is more biodegradable
- Biodegradability > C/N ratio



#### <u>Methane</u>

<u>CH4 from Digestive tract: endogene CH<sub>4</sub>:</u> regular diets: 3-4 g/d Fibrous diets (250 g/kg) up to 10 g/d  $\blacksquare$  CH<sub>4</sub> from Slurry Slurry based systems fatteners: 2.5-30 g/d Litter based systems within this range No substantial CH<sub>4</sub> production in litter/slurry??



#### Methane

- Anaerobic bed
- Deep litter systems dairy: ca 1000 g/d CH<sub>4</sub> per cow
- Sows root, cows don't
- CH<sub>4</sub> in aerated top layer >> CO<sub>2</sub>



#### **Conclusions**

N<sub>2</sub>O and CH<sub>4</sub> from littered systems variable
 N<sub>2</sub>O is lower with straw
 CH<sub>4</sub> is oxidised in rooted top layer
 With good litter management emissions of greenhouse gases can be limited



## Thank you for your attention

