Literature review on NH_3 and GHG emitted by pig production Part 1: Building emissions

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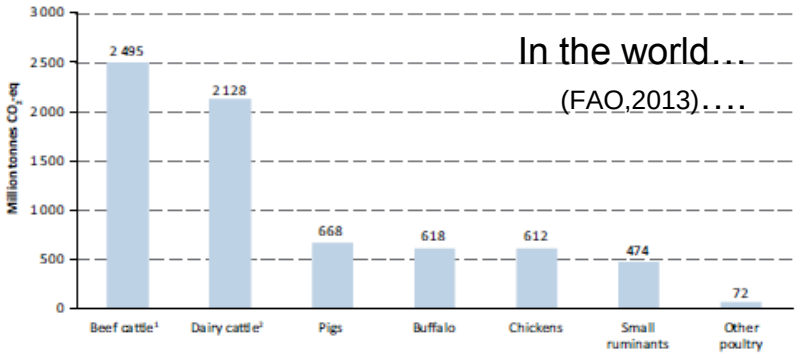
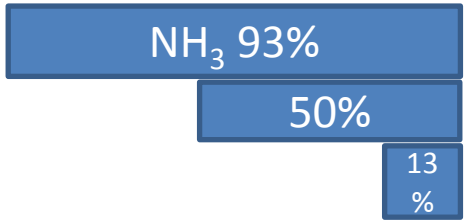
Context



75% of GHG for beef, dairy cattle and buffalo
9% for pigs and poultry

In EU-28…
(EEA, 2014).



NEC dire

IE directive

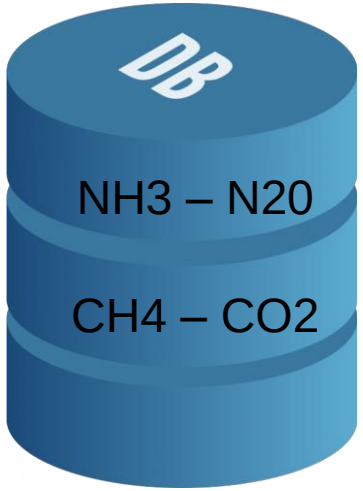
NATIONAL INVENTORIES
Number of animal
X
Emission Factor (EF)

Emission Factors (EF)

Animal

Manure type

Technical diversity of pig farm



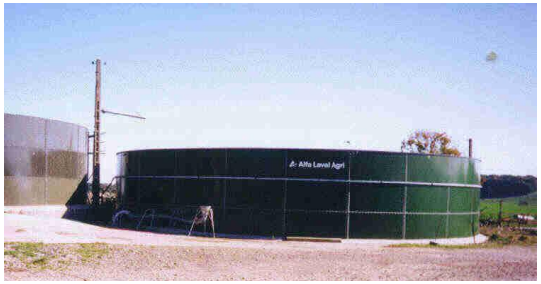
A « pig » data base

300 articles
International literature
pig production

NH_3 – N_20

CH_4 – CO_2

Building



Storage

Spreading and treatment

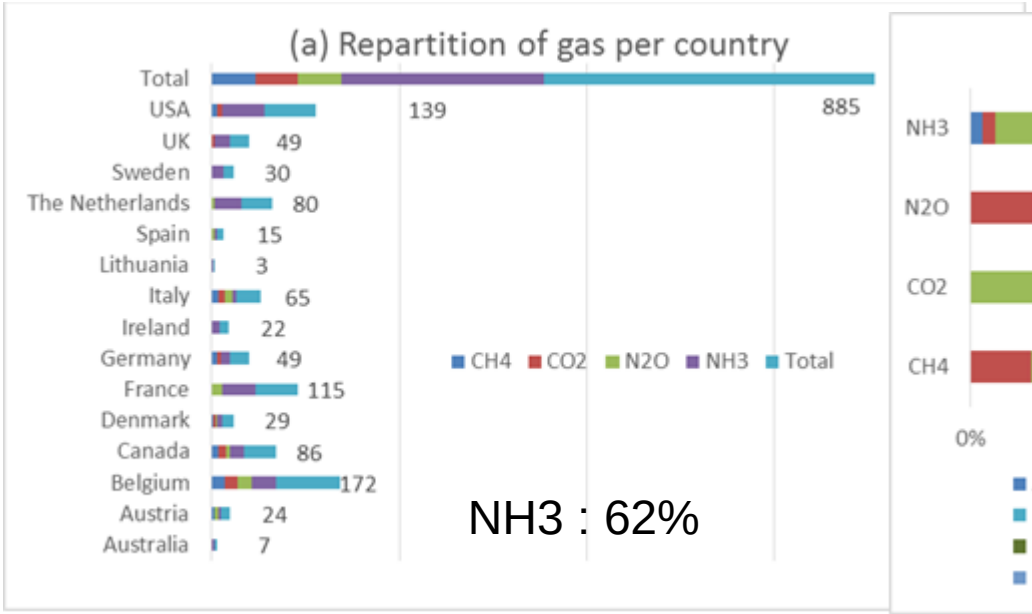
Part 1 - Building

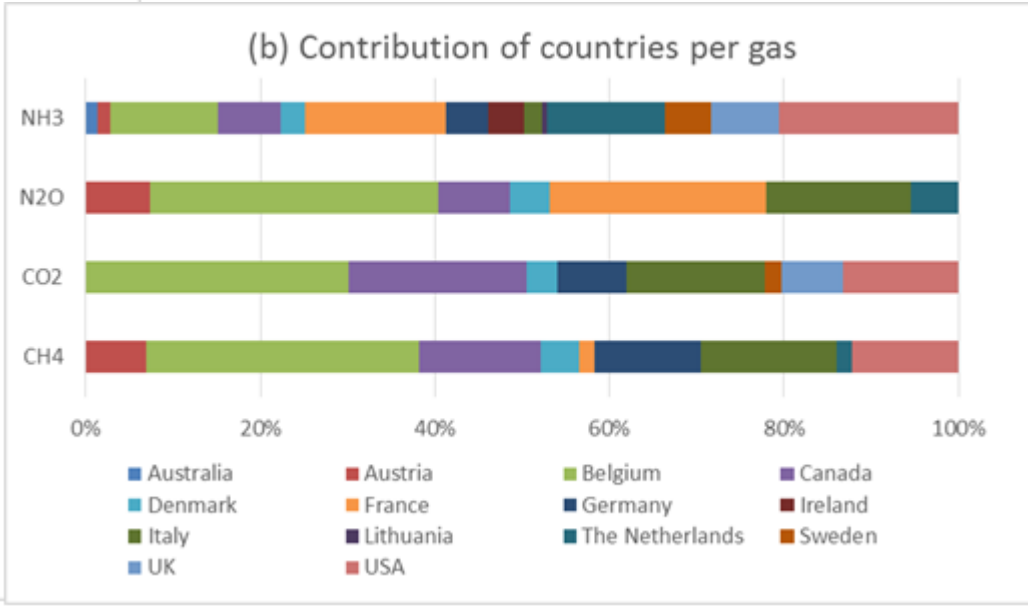
900 data extracted from 125 articles

Publication between 1981 and 2013

75 authors

14 countries





GHG : Belgium, Canada and the Netherlands

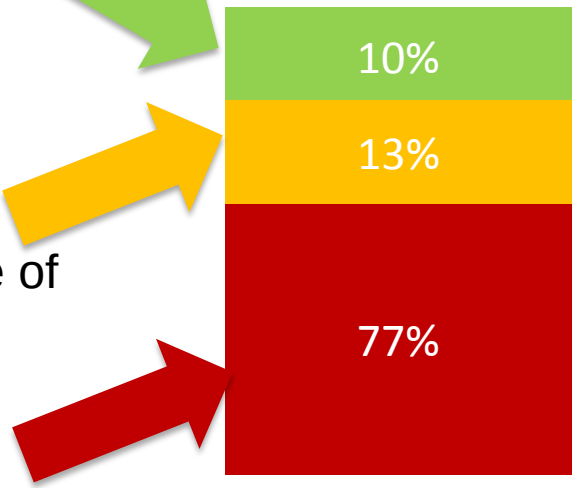
Part 1 - Building

3 physiological stages

Sows (gestating and farrowing sows)

Piglets after weaning (whatever age of weaning)

Growing-finishing pigs (over 25 kg until slaughtering)



Informations collected

Building
Floor (FSF, PSF, litter, material….)
Space allowance
Pit (surface, depth)
Inlet/outlet
Ambiant parameters (Temp, HR, ventilation rate…)
…..

Animal
Physiological stage
Number per room, per pen
Initial/final weights
ADG/FCR
…..

Manure
Volume
Characteristics (MS, N, P, K, density….)
Sampling (method, frequency, analysis method….)
…..

Article/publication
Author, co-author
Revue
Year
Title, key words
…..

More than 100 parameters for one EF

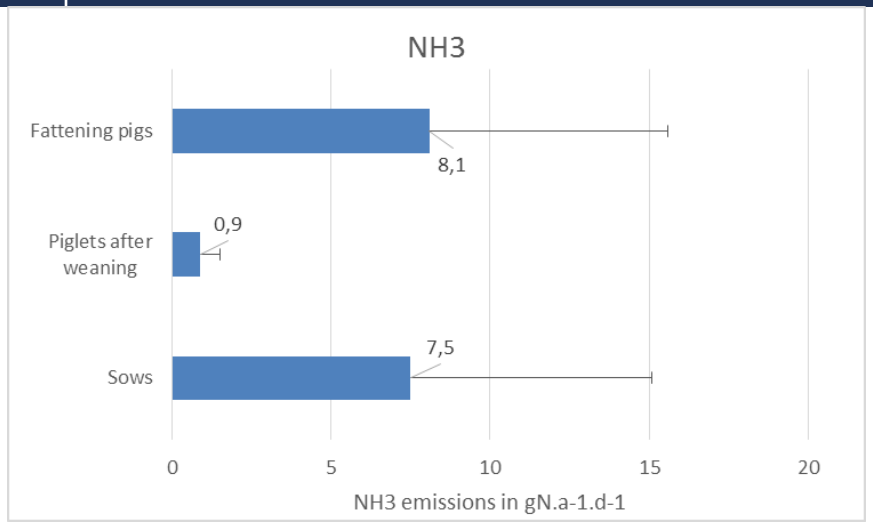
Emission Factor
Original value
Unit of expression
Conversion in standard unit

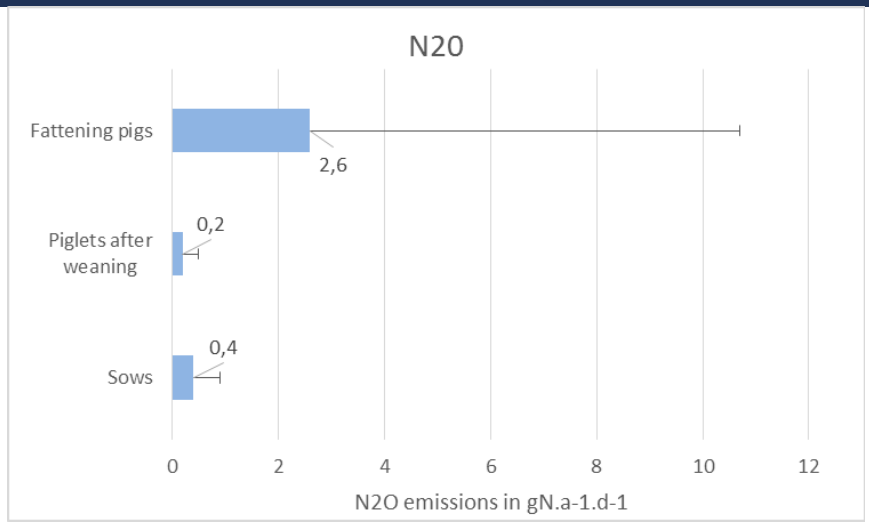
Geographic and climatic data
Localization
Climate conditions (outside temp, HR…)
Period of measurements
…..

Methodology sampling/measures
Sampling (method, frequency….)
Measurement method (equipment, devices….)
Calculation
Extrapolation
…..

Data on protocol
Number of batches
Duration of experiments
…..

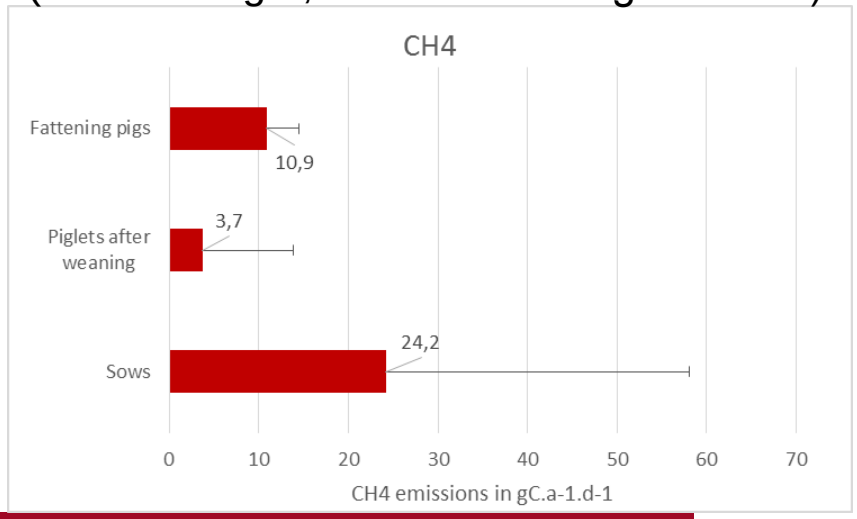
General emissions per physiogical stage

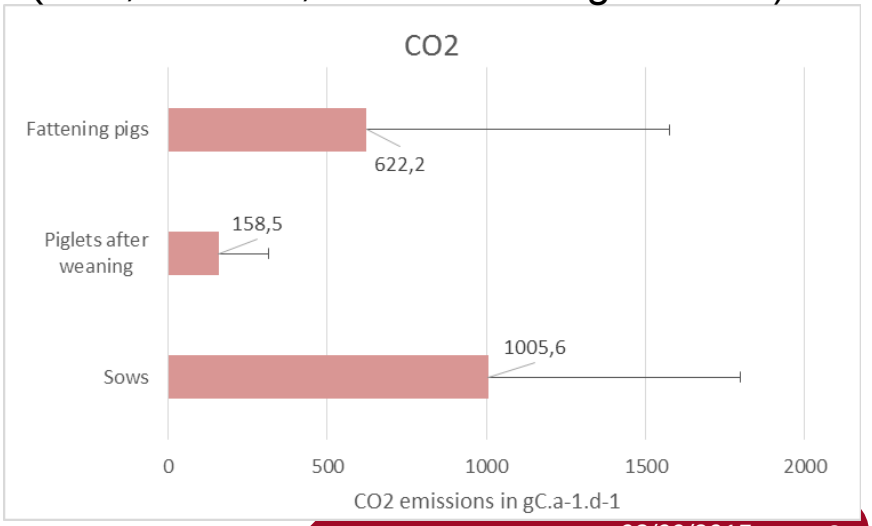




Effect of the physiological stage
(animal weight, technical management….)

Important standard deviation per EF
(floor, nutrition, manure management…)





Emissions of sows (1) – type of floor

Gas/Floor	Full Slatted Floor	Partially Slatted Floor	Litter	Not defined	Total
NH_3	10.4±12.6 (7)	12.2±2.3 (5)	5.4±3.0 (8)	3.5±5.1(7)	7.5±7.6 (27)
N_2O	0.15±0.18 (15)	0.17±- (1)	1.16±0.48 (5)	-	0.39±0.51 (21)
CH_4	30.6±40.5 (13)	8.9±- (1)	8.9±1.8 (5)	-	24.2±33.9 (19)
CO_2	1032.5±938 (13)	736.4±- (1)	729.3±110.5 (5)	-	1005.6±791.3 (19)

- Most data on FSF and litter
- Mainly on NH_3 (especially for FSF)
- Lower NH_3, CH_4 and CO_2 emissions with litter but more N_20 emissions
- Only data for litter with straw
- Not possible to analyse the influence of material (FSF and litter)
- A lot of « not defined » data

Emissions of sows (2) - season

Gas/Season	Hot	Cold	The whole year	Not defined
NH_3	-	-	4.76±5.30 (13)	10.2±8.6 (14)
N_2O	0.27±0.32 (2)	0.25±0.18 (4)	0.11±0.24 (9)	0.94±0.65 (6)
CH_4	17.4±16.7 (3)	32.6±55.7 (4)	30.9±39.2 (7)	14.2±16.7 (6)
CO_2	673.9±796.5 (2)	657.6 ±576.8 (4)	1559.8±973.3 (7)	701.5±359.6 (6)

- Not possible to compare season for NH_3
- Very few data for N_20, CH_4 and CO_2
- Big difference between contrasted season and measures achieved during « the whole year »
- A lot of « not defined » data

- No data on nutritional strategies
- No data on manure management
- Very influent parameters on gaseous emissions

Emissions of piglets after weaning (1) – type of floor

Gas/Floor	Fully Slatted Floor	Partially Slatted Floor	Litter	Not defined*	Total
NH_3	1.1±0.8 (19)	0.7±0.2 (11)	0.6±0.3 (7)	1.1±0.7 (15)	0.9±0.6 (52)
N_2O	0.04±0.05 (9)	-	0.4±0.3 (7)	-	0.2±0.3 (16)
CH_4	5.5±13.0 (11)	-	0.8±0.4 (7)	-	3.7±10.2 (18)
CO_2	189.3±209.9 (9)	-	118.9±13.4 (7)	-	158.5±157.7 (16)

- Not possible to compare type of slatted floor for N_2O, CH_4 and CO_2
- Lower NH_3, CH_4 and CO_2 emissions with litter but more N_20 emissions
- Not possible to analyse the influence of material (FSF and litter)
- A lot of « not defined » data for NH_3

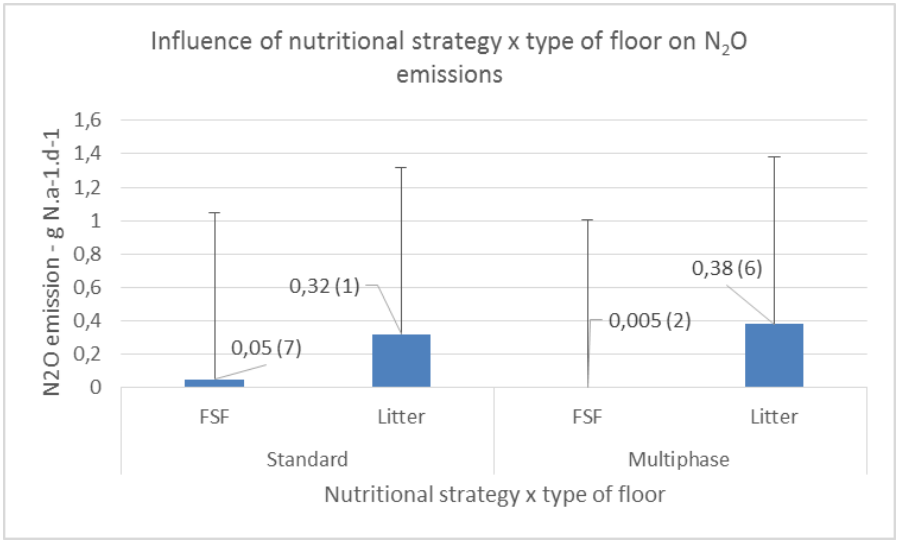
Emissions of piglets after weaning (2) – nutritional strategy

Gas/diets	Standard	Multiphase
NH_3	0,8±0.6	0.5±0.2
N_2O	0.08±0.1	0,3±0,2
CH_4	0,9±0,8	0,8±0,4
CO_2	111.2±36,3	111.4±19,3

- Reduction of NH_3 (37%) with multiphase
- No effect on CH_4 and CO_2
- Increase of N_2O (X3) (!!!)

Number of data per type of floor

The restriction of EF to a small number of categories can mask the influence of important parameters



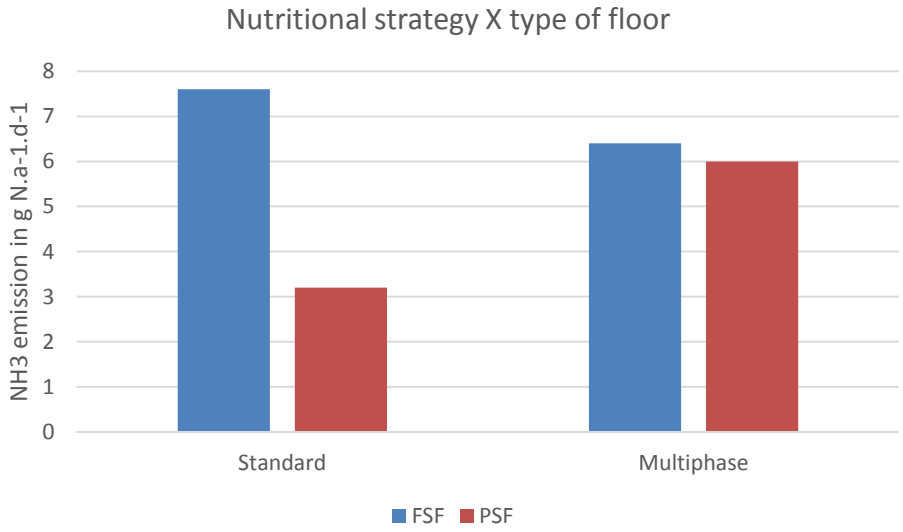
Emissions of fattening pigs (1) – FSF vs PSF

Gas/Floor	Fully Slatted Floor	Partially Slatted Floor
NH_3	9.3±8.5 (177)	5.8±3.9 (88)
N_2O	0.5±0.7(13)	0.08±0.06 (11)
CH_4	12.1±15.5 (39)	4.4±5.5 (15)
CO_2	659.0±983 (49)	782.4±1350 (12)

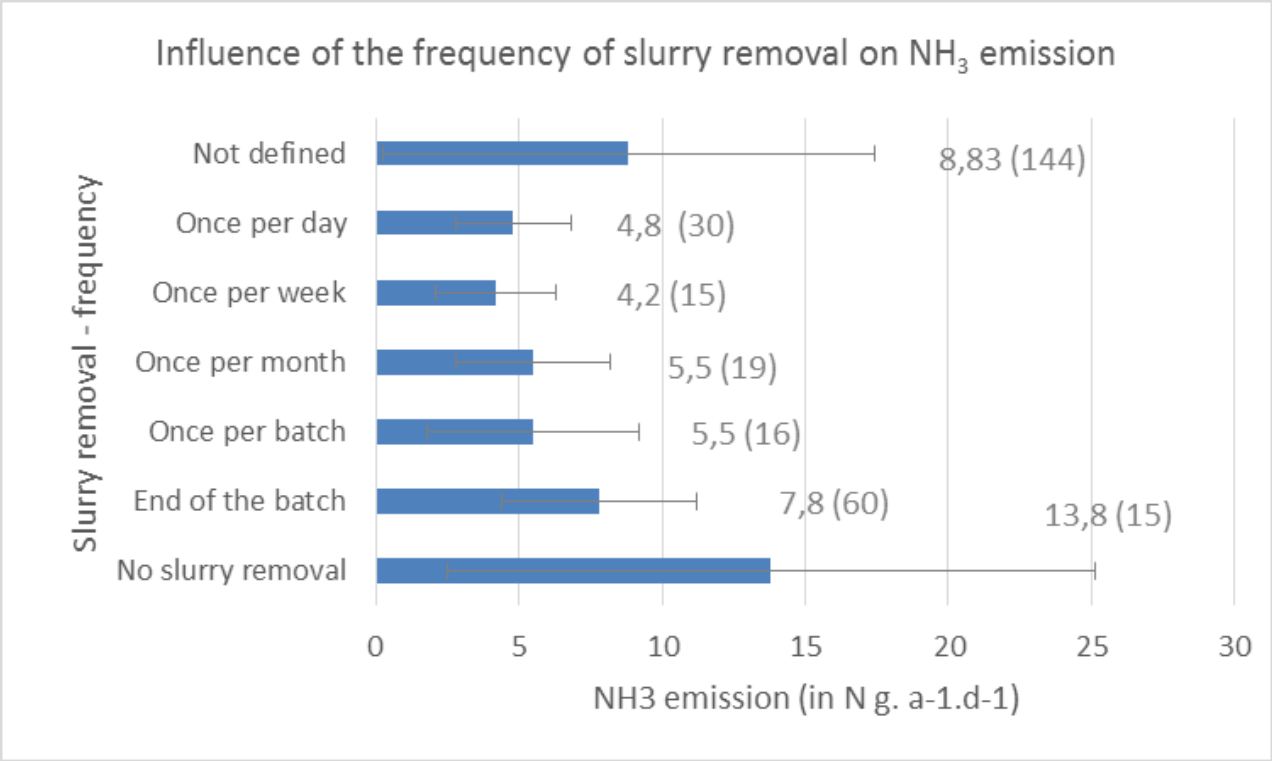
- No effect of PSF with multiphase
- PSF/ standard = individual pens with high frequency of slurry removal (60% data)

Lower NH_3, N_2O and CH_4 emissions with PSF than with FSF

Nutritional strategy x Floor



Emissions of fattening pigs (2) – manure management



- 50% data « not defined »
- Once per month = once per batch
- Once per day = once per week
- Efficient way to reduce NH_3 (50%)

Conclusions on Part 1

- Representative
- A lot of parameters created but not always filled
- Most data concerned fattening pigs (77%)
- Difficult to analyse data for sows and piglets – essentially influent parameters as nutrition and manure management
- Not possible to determine EF for a small number of categories (Animal, manure) because of crossing effects with others technical management (type of floor x nutritional strategy)

Thank you for your attention

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