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Greenhouse gases and ammonia emissions assessment from dairy housing by means of a simplified method

FIORELLI J.L. and DURPOIX A.



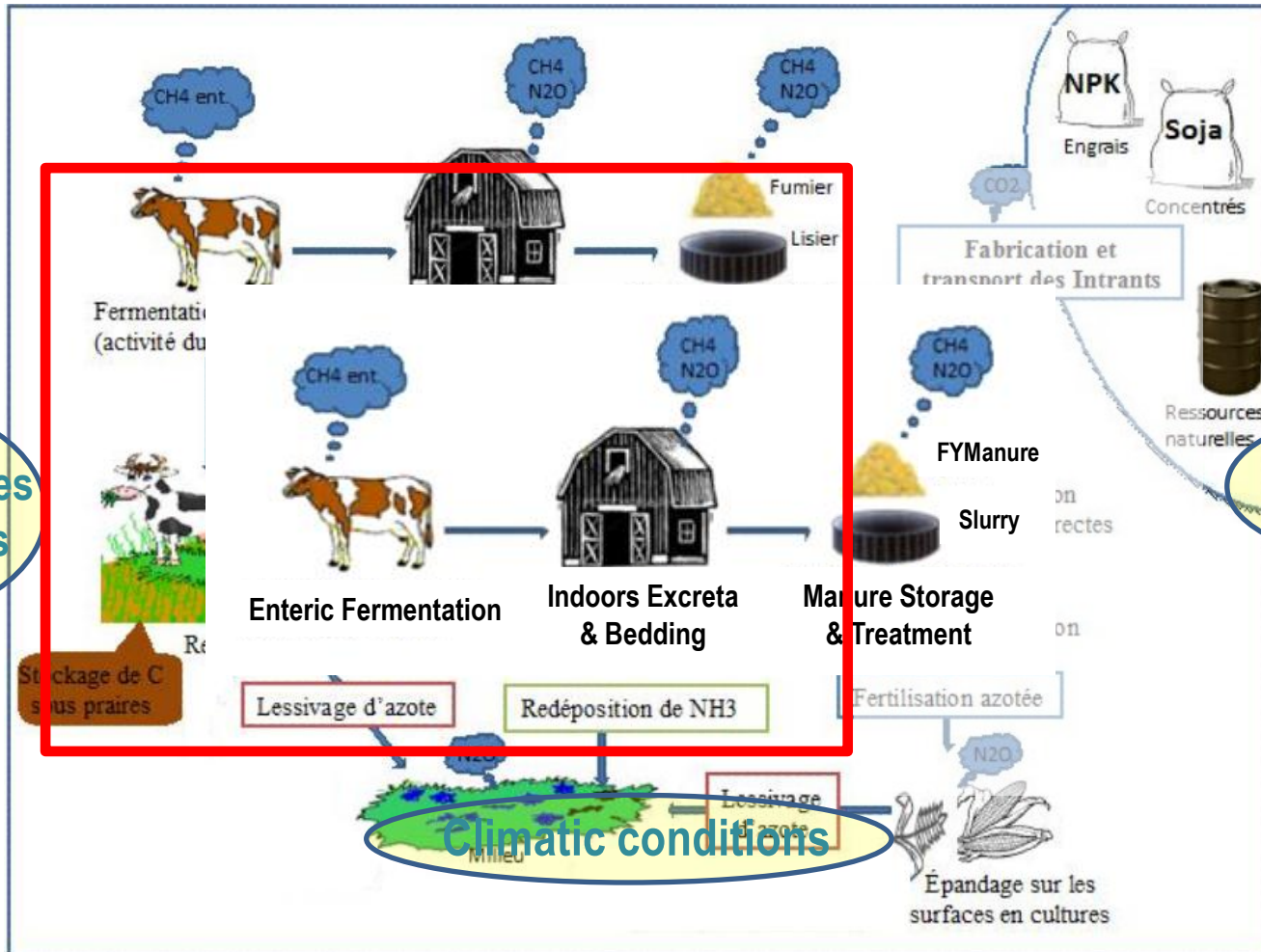
INRA SAD ASTER-Mirecourt
France



GHG sources in animal agriculture

IPCC

Animals' features
Feeding factors



Type of shed

Climatic conditions





**MS : loose housing and passageway
in front of the headlocks**

FYM & semi solid manure



**Strawing of the deep litter just
after scraping of the passageway**

Two dairy systems, two types of sheds and three types of manure...



**GS : scraping of the passageways
between the cubicles**



Just before standing up around 5am

Slurry

A systems experiment in Mirecourt (Eastern France) since 2005

- 2 environment friendly systems
- 2 sparing and self sufficient systems



As sustainable agriculture prototypes...

A mixed crop-dairy system

"Doing with" the diversity of available feeding resources

62 Cows, calving: Aug-Nov



Deep litter and scraped passageways

Housing period:
November to April

13.7 m² / LU **8.7 Kg Straw / LU / day**



FarmYard Manure



Slurry

A grassland dairy system

Maximising grazing period Milk without concentrate

37 Cows
Calving: Jan-Apr



Cubicles & Rubber Mats

Housing period:
December to March

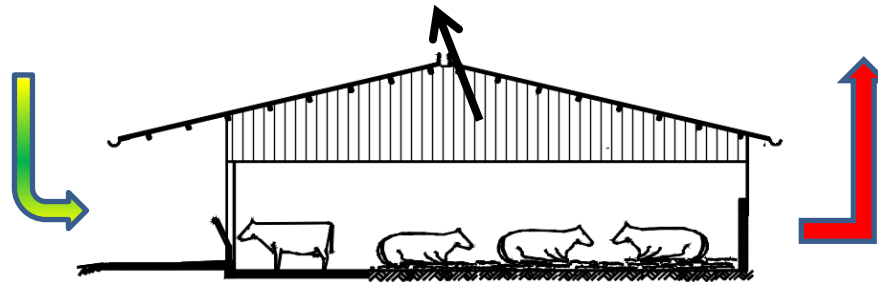
12.5 m² / LU **0.2 Kg Straw / LU / day**



A mass balance approach at the building level

$$\text{C Losses} = \underbrace{Q_{\text{Cingested}} + Q_{\text{Cstray}}}_{\text{INPUTS}} - \underbrace{Q_{\text{Cmilk}} - Q_{\text{Cpregnancy}} - Q_{\text{Cgrowth}} - Q_{\text{Cmobilisation}} - Q_{\text{Cmanure}}}_{\text{OUTPUTS}}$$

$\text{CO}_2, \text{CH}_4, \text{N}_2\text{O}, \text{NH}_3, (\text{N}_2)$



Gases emissions = C Losses + N Losses



$$E_{\text{C-CO}_2} = \underbrace{\text{C Losses}}_{\text{Through measurements, models and analyses}} / \left[1 + \underbrace{\left(\text{Gradient}_{\text{C-CH}_4} / \text{Gradient}_{\text{C-CO}_2} \right)}_{\text{Through contents measurements}} \right]$$

Through measurements, models and analyses

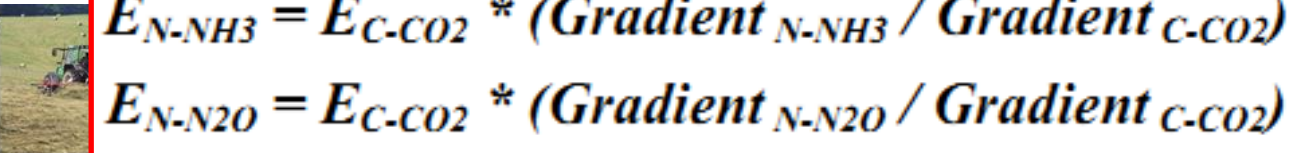
Through contents measurements



$$E_{\text{C-CH}_4} = E_{\text{C-CO}_2} * \left(\text{Gradient}_{\text{C-CH}_4} / \text{Gradient}_{\text{C-CO}_2} \right)$$

$$E_{\text{N-NH}_3} = E_{\text{C-CO}_2} * \left(\text{Gradient}_{\text{N-NH}_3} / \text{Gradient}_{\text{C-CO}_2} \right)$$

$$E_{\text{N-N}_2\text{O}} = E_{\text{C-CO}_2} * \left(\text{Gradient}_{\text{N-N}_2\text{O}} / \text{Gradient}_{\text{C-CO}_2} \right)$$



Sampling and measuring gas contents

Gas analyser
INNOVA® 1412



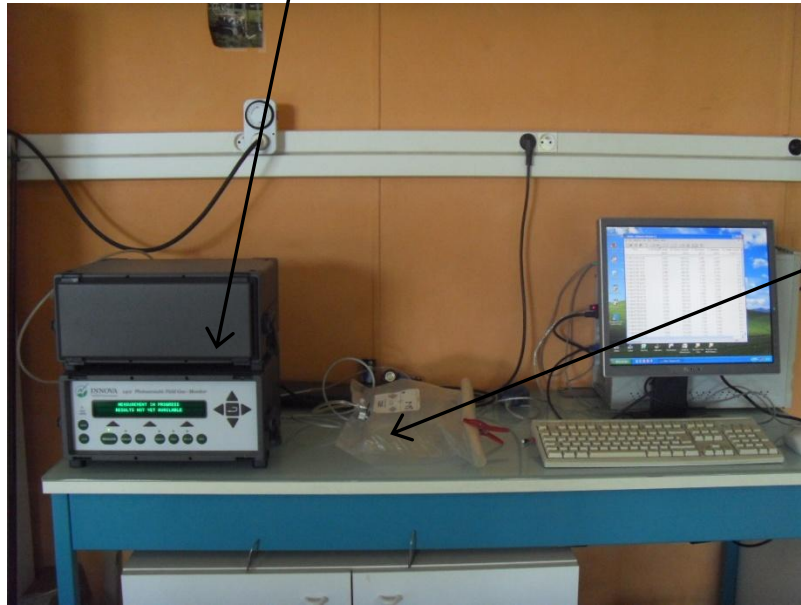
Electric pump

Flexible Tygon® tube

Tedlar® bag(10L)



Thermo-Hygrometer



Results & Discussion

- **Two successive winter periods : 2009-2010, 2010-2011**
- **Measurements 7 times along a day (night included) without change in cowshed operations (scraping, strawing, milking time...)**
- **18 measurements dates**
- **13 validated dates for CO₂, CH₄ and NH₃ (but only 10 dates for N₂O)**
considering... Gradient gas contents & enthalpy
Grass silage not used
Cows full housed

Outside mean temperature ranged -6°C / 13°C

Diverse weather conditions



Results & Discussion

Daily gas emissions from the dairy sheds in Mirecourt Unit, for grassland and mixed crop livestock systems during two winter periods (2009-10 and 2010-11)

g / LU / day	C-CO2	C-CH4	N-N2O	N-NH3
MS Mirecourt	8496 ± 233	804 ± 42	1.40 ± 0.30	19.18 ± 2.37
GS Mirecourt	2260 ± 178	237 ± 17	0.41 ± 0.05	3.70 ± 0.41

MS deep litter system has emitted 3 to 4 times more gases than the GS cubicles system

Our measurements appear consistent with Brachet (2007), except for NH₃



Conclusion

- Simplified method rather easy to operate and non invasive
- Further calculations and analyses to do in order to check sampling method and analyses through H₂O, P and K balances
- Impossible to conclude if the considered organic dairy systems are really less emitting than conventional ones:
 - from manure production to spreading, there are many ways...
 - even if GS seems very promising !





Thank you for attention

