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

Jean-Louis J.-L. Fiorelli, Amandine Durpoix

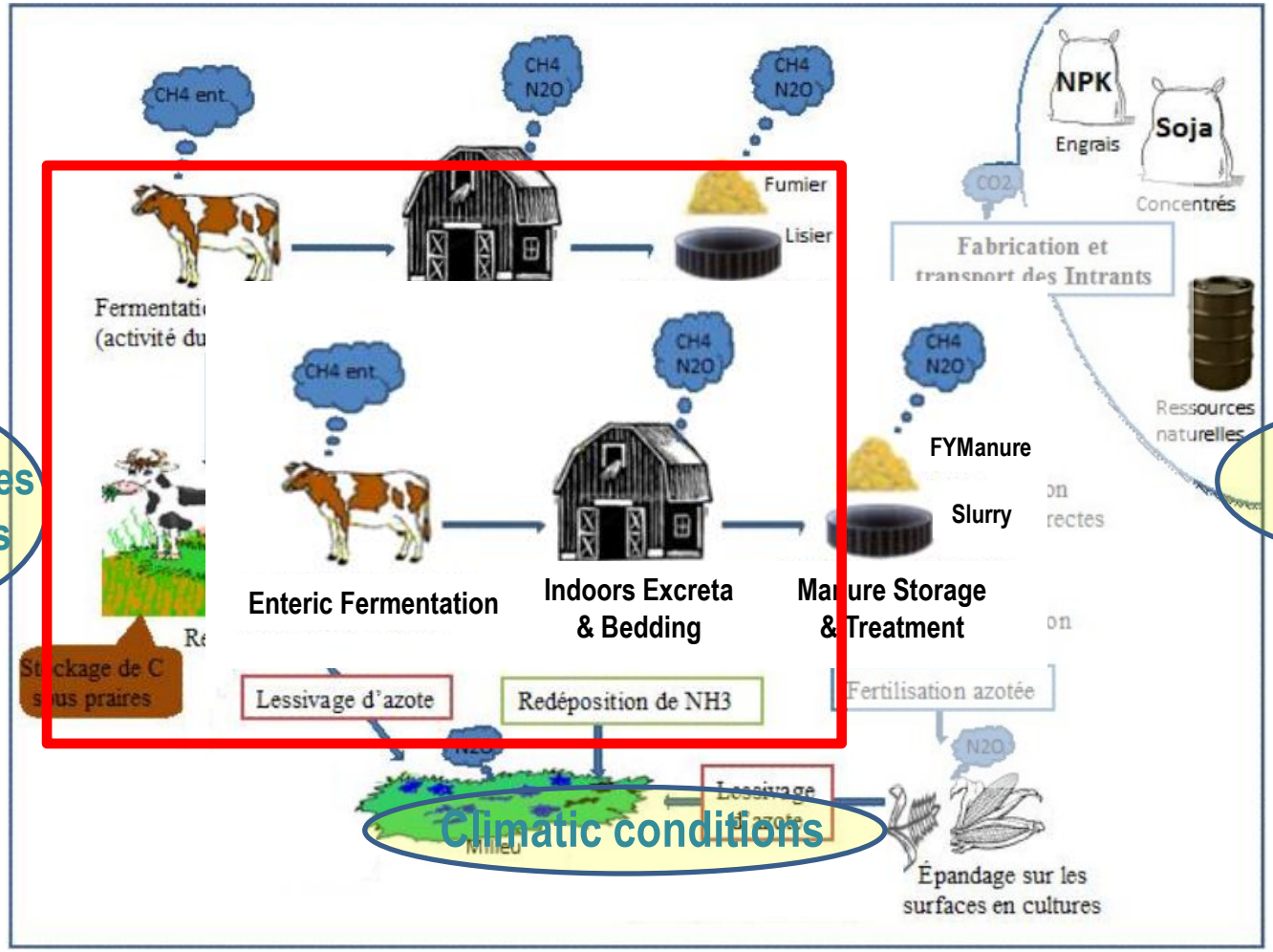
Greenhouse gases and ammonia emissions assessment from dairy housing by means of a simplified method

FIORELLI J.L. and DURPOIX A.

INRA SAD ASTER-Mirecourt
France

GHG sources in animal agriculture

IPCC



Animals'features
Feeding factors

Type of shed

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

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	A grassland dairy system
"Doing with" the diversity of available feeding resources	*Maximising grazing period Milk without concentrate*
62 Cows, calving: Aug-Nov	37 Cows Calving: Jan-Apr
Deep litter and scraped passageways	Cubicles & Rubber Mats
Housing period: November to April	Housing period: December to March
13.7 m² / LU	12.5 m² / LU
8.7 Kg Straw / LU / day	0.2 Kg Straw / LU / day

FarmYard Manure

Slurry

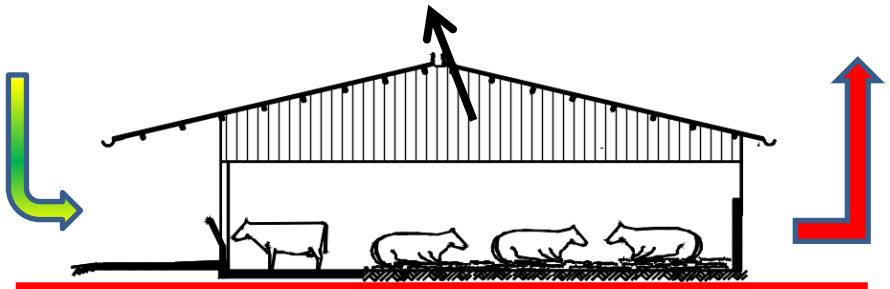
A mass balance approach at the building level

$$\text{C Losses} = Q_{C\text{ingested}} + Q_{C\text{straw}} - Q_{C\text{milk}} - Q_{C\text{pregnancy}} - Q_{C\text{growth}} - Q_{C\text{mobilisation}} - Q_{C\text{manure}}$$

INPUTS

CO_2, CH_4, N_2O, NH_3, (N_2)

OUTPUTS



Gases emissions = C Losses + N Losses

$$E_{C\text{-}CO2} = \text{C Losses} / [\ 1 + (\text{Gradient}_{\ C\text{-}CH4} / \text{Gradient}_{\ C\text{-}CO2})\ ]$$

Through measurements, models and analyses

Through contents measurements

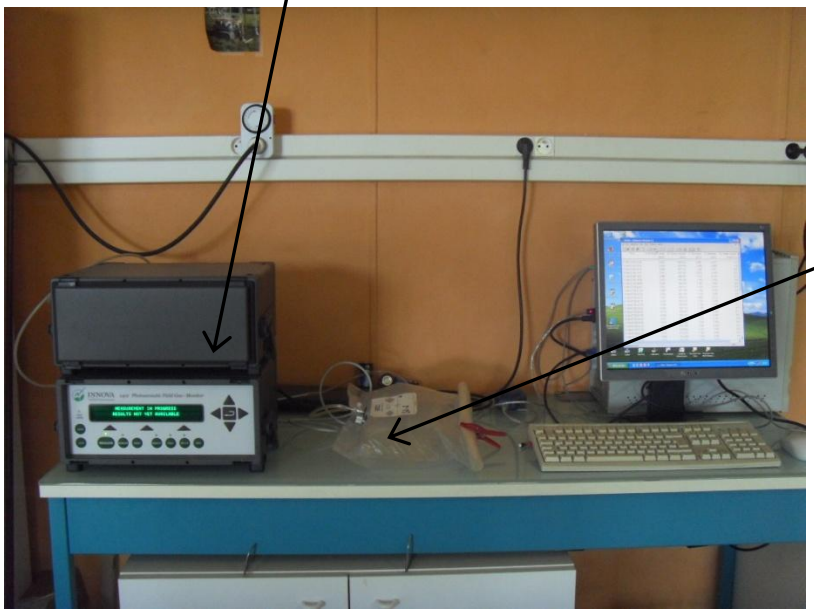
$$E_{C\text{-}CH4} = E_{C\text{-}CO2} * (\text{Gradient}_{\ C\text{-}CH4} / \text{Gradient}_{\ C\text{-}CO2})$$

$$E_{N\text{-}NH3} = E_{C\text{-}CO2} * (\text{Gradient}_{\ N\text{-}NH3} / \text{Gradient}_{\ C\text{-}CO2})$$

$$E_{N\text{-}N2O} = E_{C\text{-}CO2} * (\text{Gradient}_{\ N\text{-}N2O} / \text{Gradient}_{\ C\text{-}CO2})$$

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 CO_2, CH_4 and NH_3 (but only 10 dates for N_2O)**

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-N20	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 NH_3

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 H_20, 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