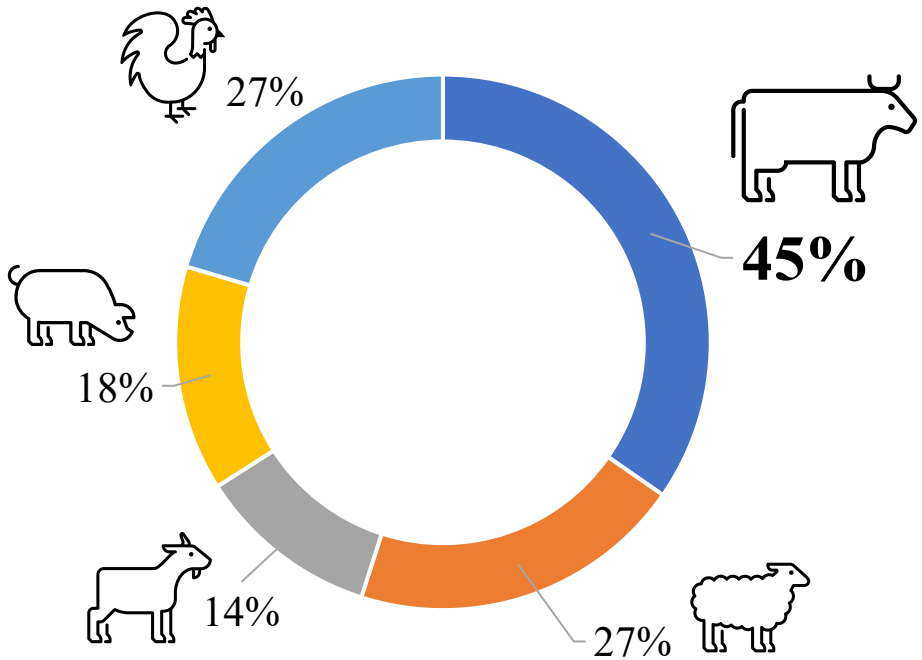
STRATEGIES FOR GREENHOUSE GAS AND AMMONIA EMISSIONS MITIGATION IN DAIRY HOUSES

Friuli, M., Dela Pierre, F., Rollè, L., Dinuccio, E.

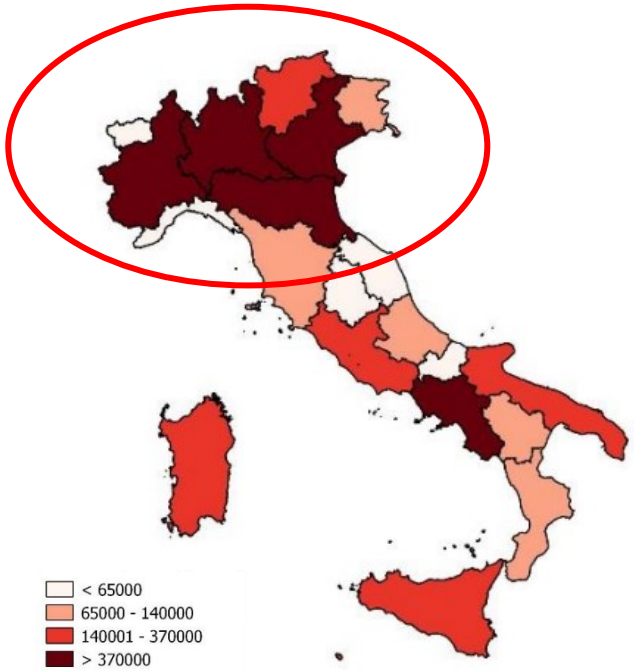
University of Turin, Department of Agricultural, Forest and Food Science – Disafa, Italy

CURRENT SITUATION IN ITALY

Livestock farms ➡ **213.984**

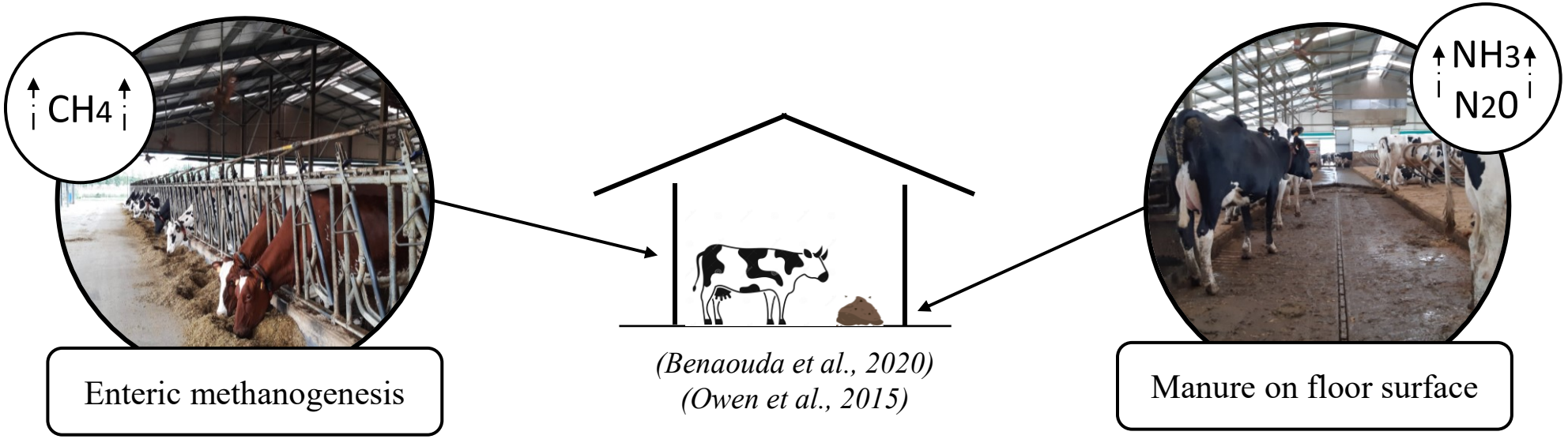


Intensive dairy cattle production
mainly concentrated in Northern Italy



(ISTAT, 2021)

GASEOUS EMISSIONS FROM DAIRY BARNS



Enteric methanogenesis

(Benaouda et al., 2020)
(Owen et al., 2015)

Manure on floor surface

Strategies for gaseous emissions mitigation are fundamental actions to improve livestock production sustainability

LIFE CLINMED FARM project- «Towards a Mediterranean Climate Neutral Farm model»

OBJECTIVES OF THE STUDY

1) Evaluation of **increased slurry removal frequency in affecting gaseous emissions**

   - Two natually-ventilated dairy barns (B1 and B2) with similar structures and slurry management were selected
   - B1 and B2 are characterized by different slurry removal frequencies: **12 vs 4 times/day**
   - Spring conditions

2) Evaluation of **feed additives use on enteric methane production**

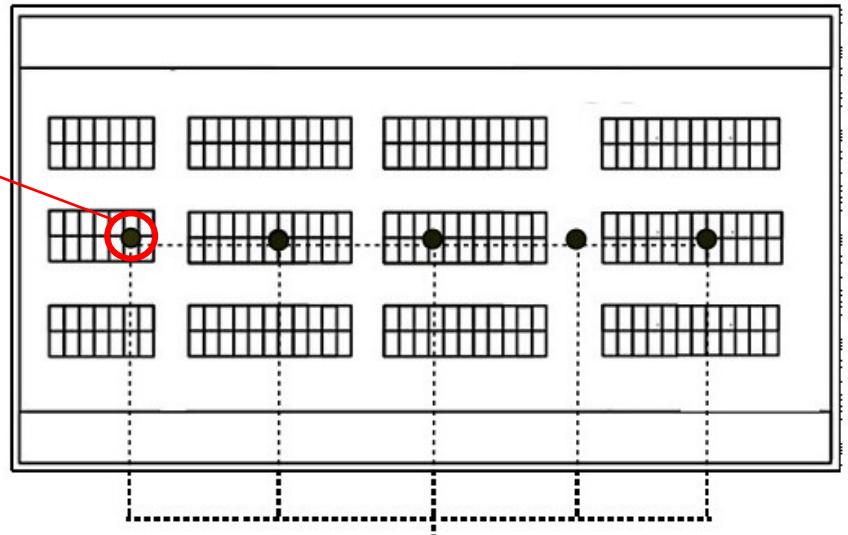
   - Two feed additives were tested: **a garlic-based (GAR) and a hydrolysed yeast product (BIS)**

This work has been realized within the project "Towards a Mediterranean Climate Neutral Farm model (CLINMED-FARM - LIFE20 CCM/ES/001751)"

MEASUREMENT OF GASEOUS EMISSIONS FROM DAIRY BARNS

- 5 internal sampling points every 10 m, equipped with dust filters
- 1 external sampling point
- 6 mm Ø PTFE tubes
- QEPAS gas analyzer with a multipoint sampler device
- 2D anemometer to detect wind direction
- Hobo thermocouple

*Barn equipment according to **Vera protocols (2018)***



Internal sampling points

External sampling point

QEPAS analyzer

Each measurement session lasted 24 h

MEASUREMENT OF GASEOUS EMISSIONS FROM DAIRY BARNS

Gas concentration (ppm) × Ventilation rate ($m^3\ h^{-1}$) = Gas emission ($g\ h^{-1}$)

Quartz-enhanced photoacoustic analyzer

CO_2 mass balance method

$$VR\ (m^3\ h^{-1}\ animal^{-1}) = Cprod\ /(\mathbf{CO_2\ inside - CO_2\ outside})*10^{-6}$$

$$Cprod = 0.185 * \phi tot\ /1000$$

CIGR, 2002

→ 0.185 is the amount of CO_2 produced by one dairy cow for 1000 W of produced heat

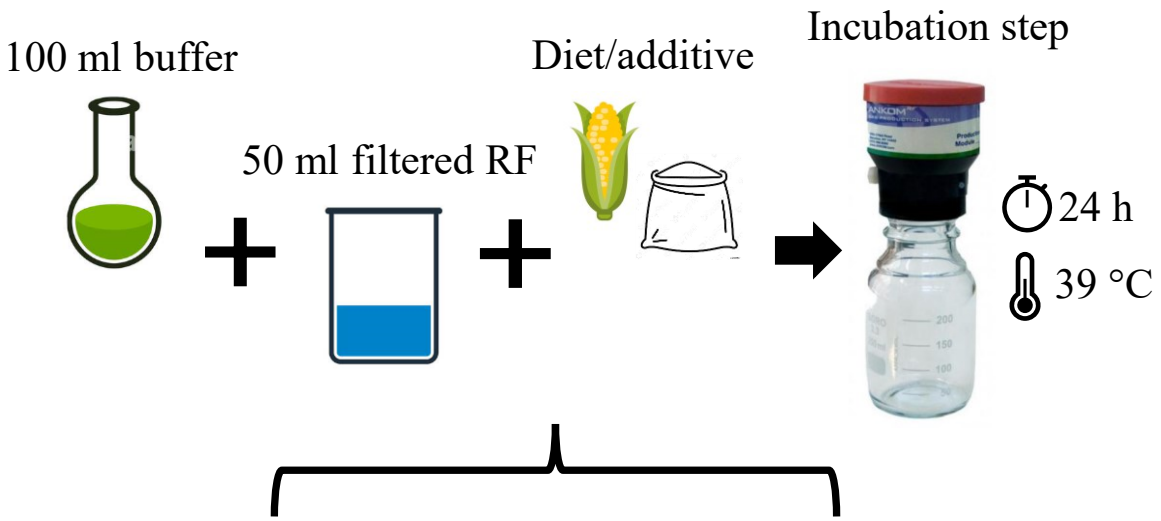
→ Φtot is the total heat production for one dairy cow, function of:

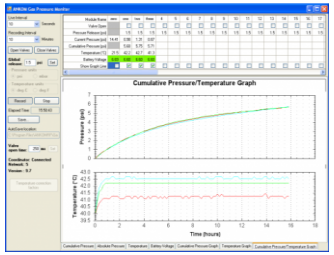
- Daily milk production
- Days of pregnancy
- Live weight
- Average temperature

EVALUATION OF THE EFFECTIVENESS OF FEED ADDITIVES

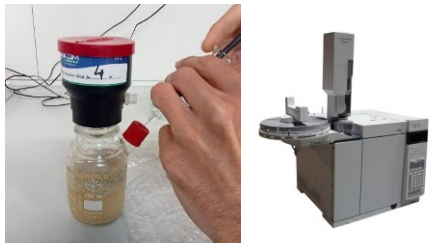
Ankom RF Gas Production System (Ankom Technology®)

- 250 mL glass bottles equipped with pressure sensor cap
- Automatic communication system
- P and T data are continuously recorded
- Gas is vented at a fixed P threshold





Biogas production



CH_4 analysis

EVALUATION OF THE EFFECTIVENESS OF FEED ADDITIVES

- Two feed additives were evaluated
- Three doses were tested in three replicates

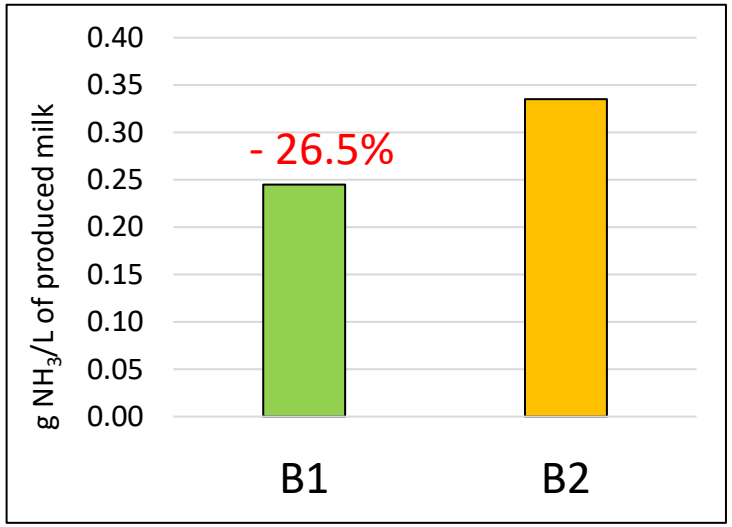
Diet — Garlic additive (GAR) — Hydrolysed yeast product (BIS)

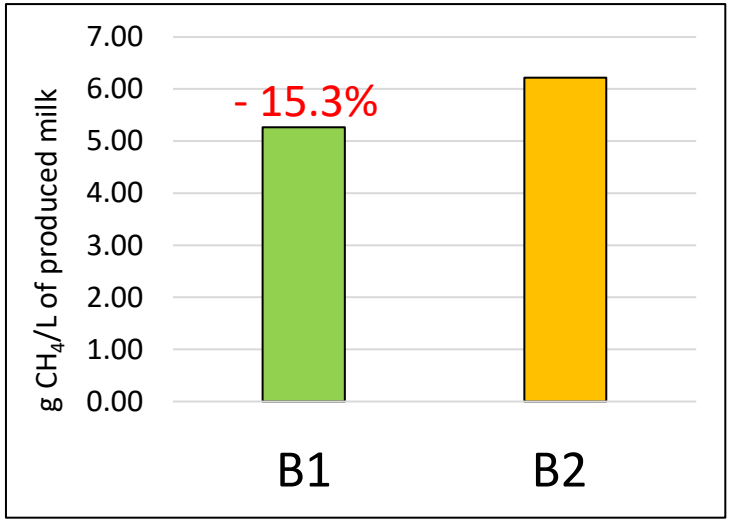
Treatment	Diet (gDM)	Additive
CONTROL	1.0 ± 0.0010 g	•
D1	1.0 ± 0.0010 g	0.05 g
D2	1.0 ± 0.0010 g	0.1 g
D3	1.0 ± 0.0010 g	0.2 g
BLANK	•	•

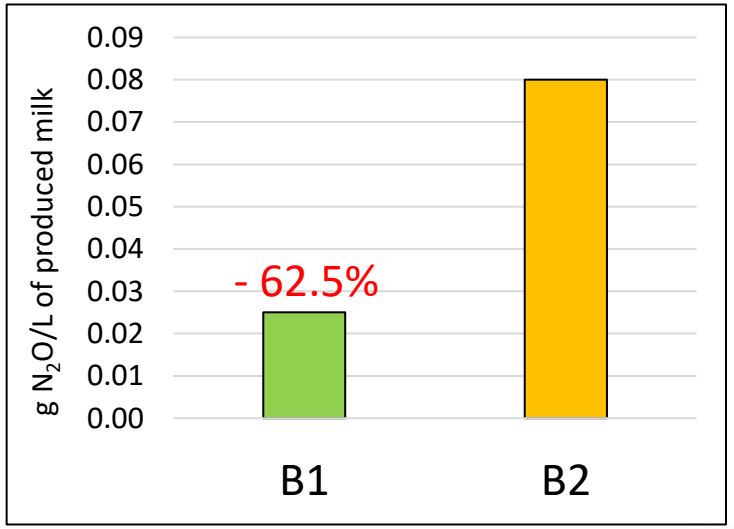
Blank CTR GAR1 GAR2 GAR3 BIS1 BIS2 BIS3

EFFECT OF SLURRY REMOVAL FREQUENCY

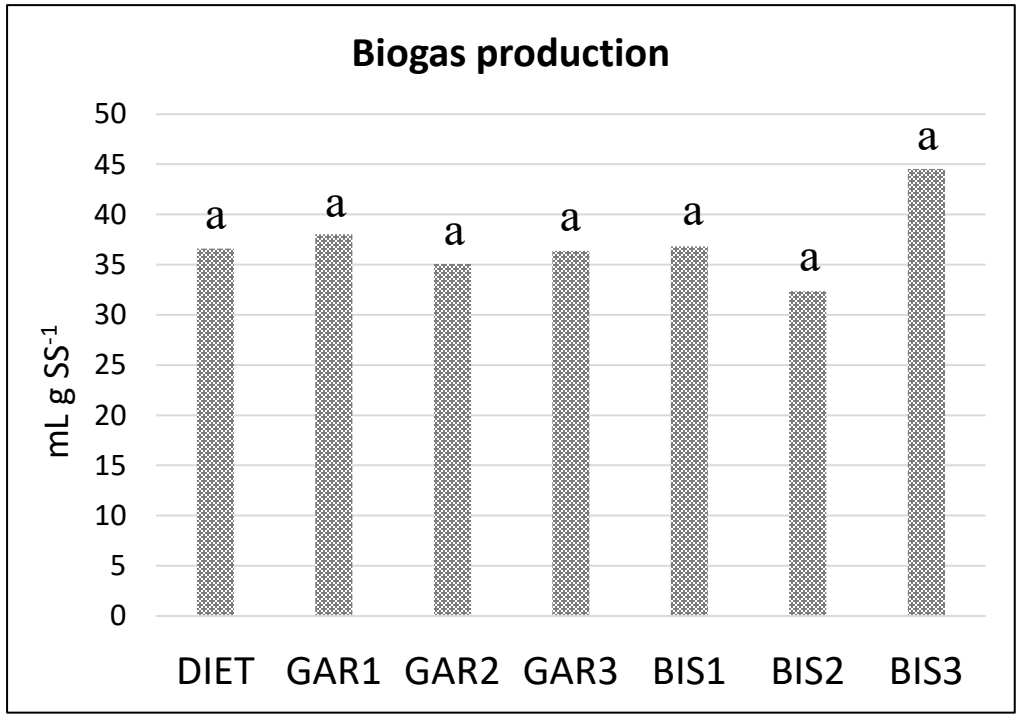
Barn	Removal frequency	E_t NH_3 (g l_{milk}^{-1})	E_t CH_4 (g l_{milk}^{-1})	E_t N_2O (g l_{milk}^{-1})
B1	12	0.25 b	5.27 a	0.03 b
B2	4	0.34 a	6.22 a	0.08 a

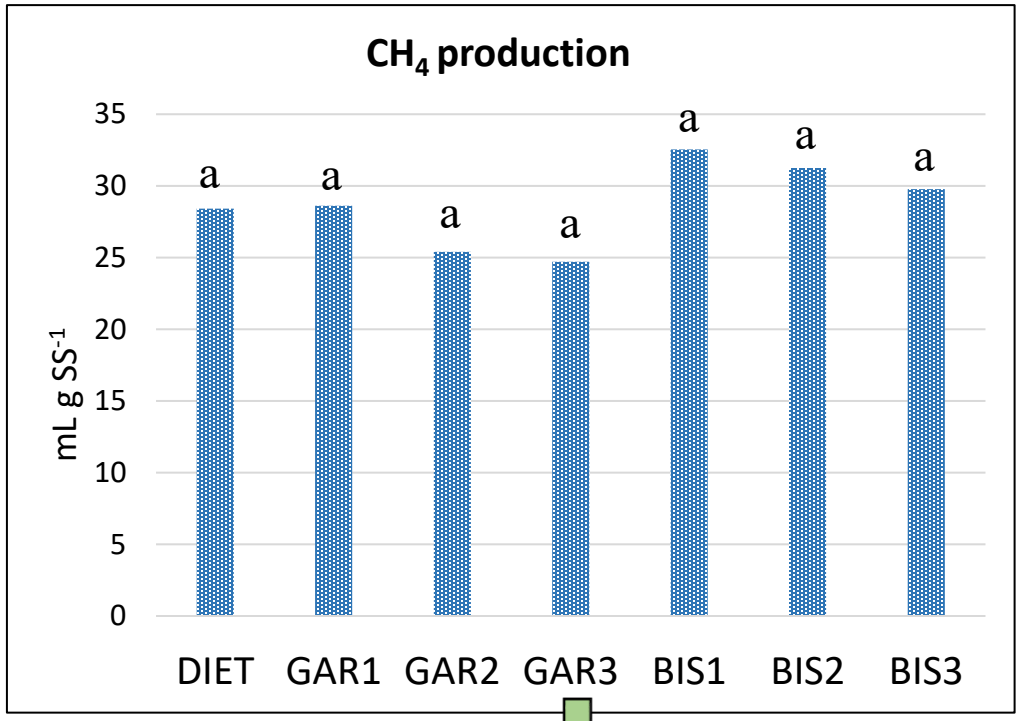






EFFECT OF FEED ADDITIVE USE





- 15%

EFFECTIVENESS OF THE SELECTED MITIGATION STRATEGIES

- Frequent slurry removal from the animal building's floor has shown to be an effective technique to mitigate mainly NH_3 and NO_2 emissions from the livestock activity.
- Experimental results have shown no effect of the tested additives on the analyzed parameters.
  - The active anti-methanogenic molecules could be too low-concentrated to determine significant effects during the fermentation trials.
- Within the Life Clinmed farm project, further trials to better investigate the efficacy of frequent slurry removal and to test the effect other additives at different doses will be performed.

martina.friuli@unito.it

Thank you for your attention!