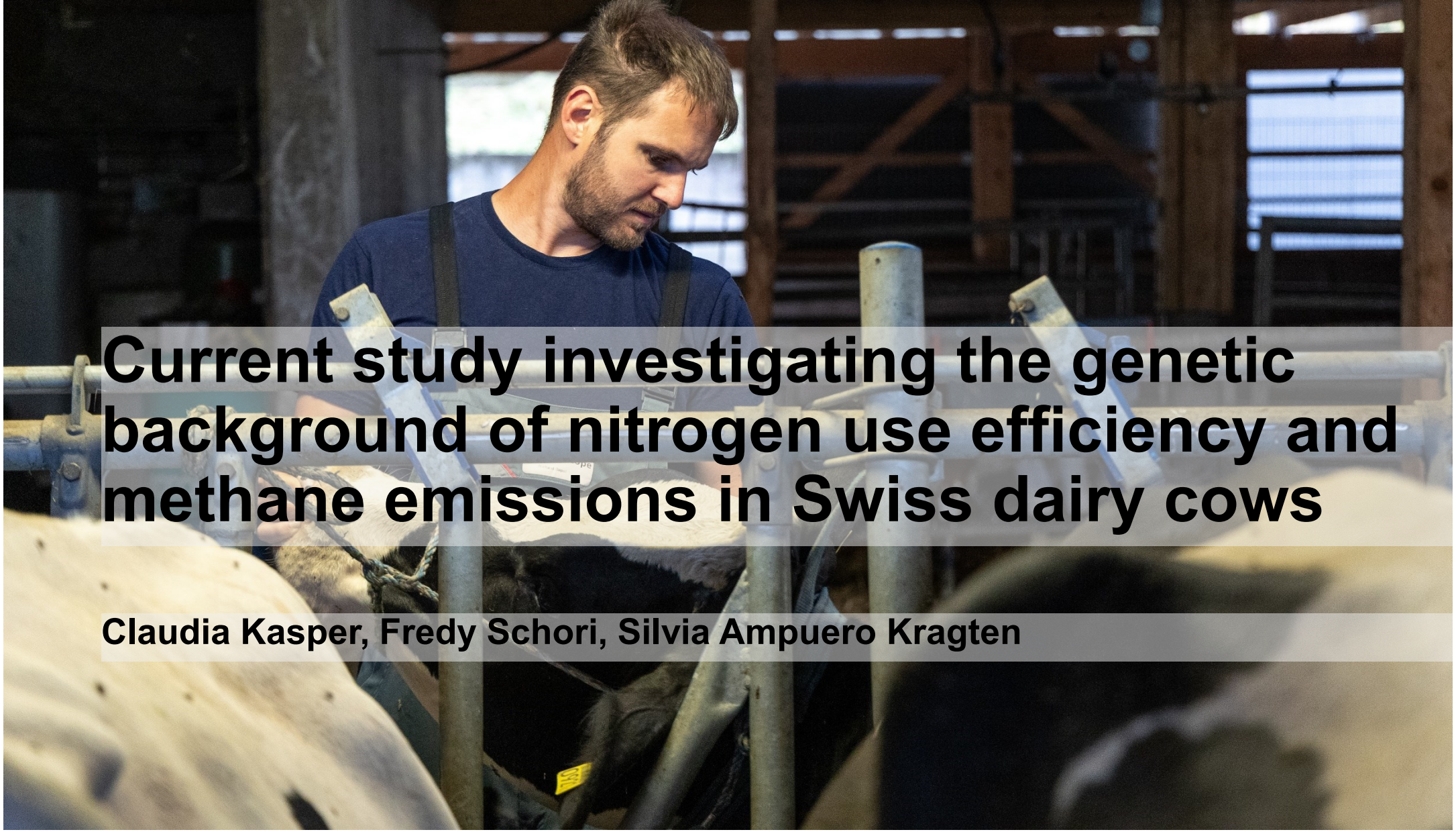
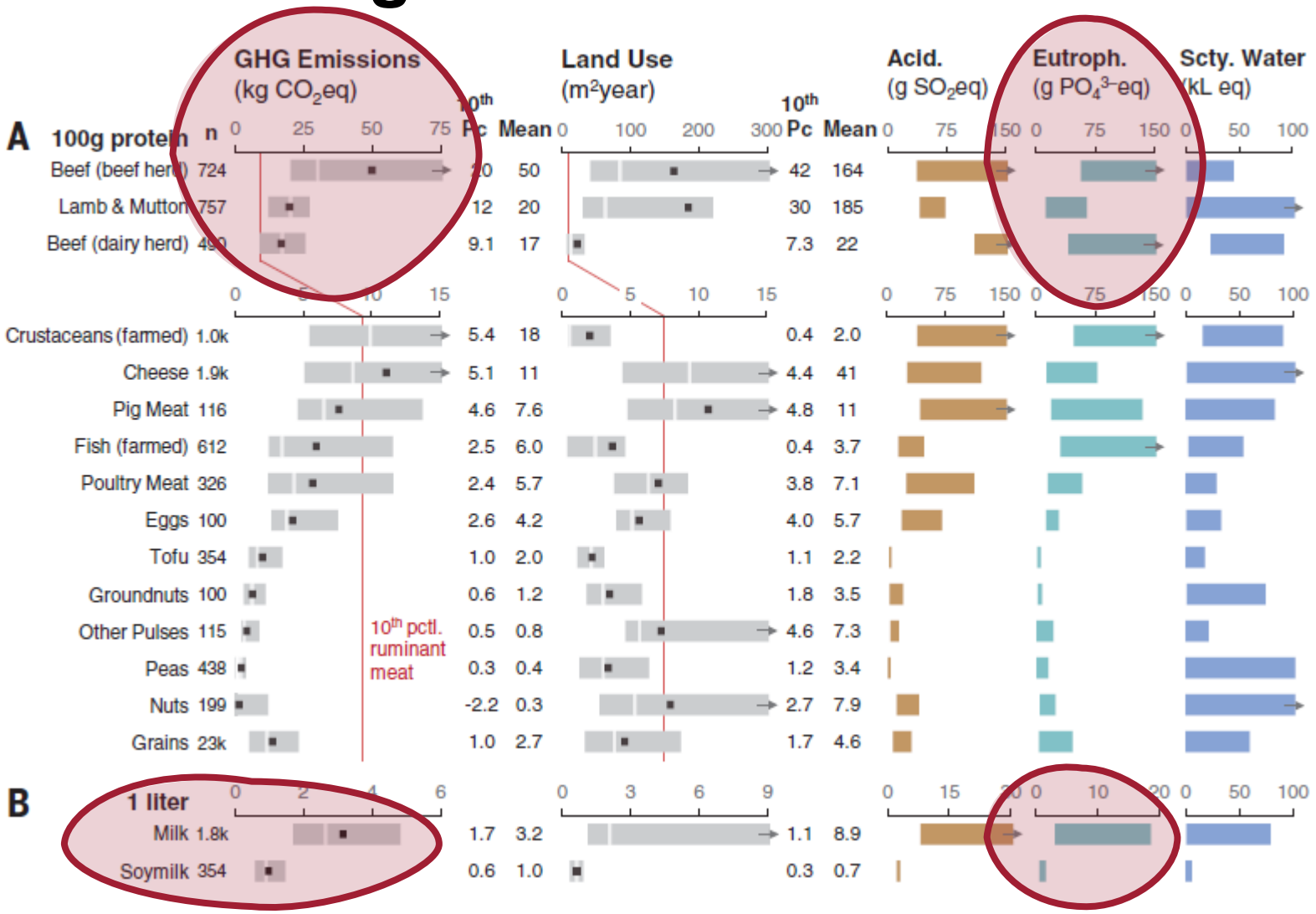


Current study investigating the genetic background of nitrogen use efficiency and methane emissions in Swiss dairy cows

Claudia Kasper, Fredy Schori, Silvia Ampuero Kragten

Interbull Lyon, August 26

Nitrogen and methane emissions of livestock



Increase nitrogen use efficiency **NUE** (decrease methane(CH_4) emissions) through ***breeding***

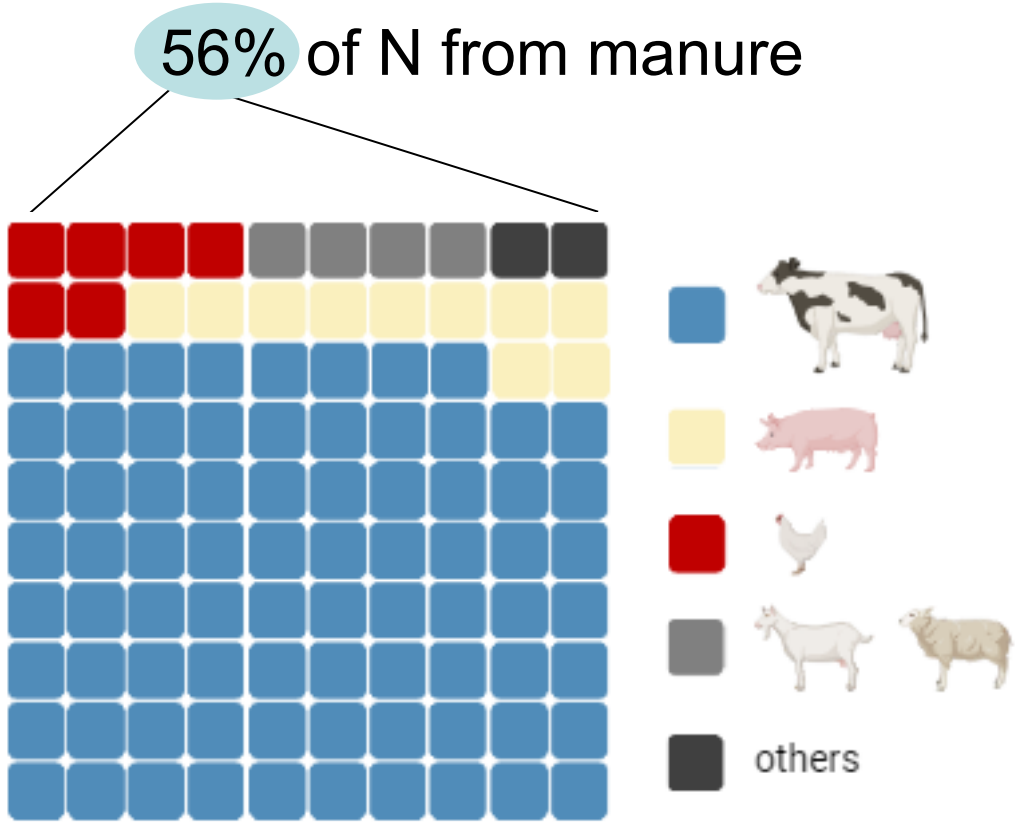
→ help reduce nitrogen and GHG emissions from agriculture ***in the long term***

Poore & Nemecek, 2018

Agroscope

Background & motivation

Nitrogen balance of the agricultural sector in Switzerland 2021



- Pig project on protein efficiency
  - $h^2 = 0.54 \pm 0.10$
- Highest proportion of N from cattle!
- Estimates of h^2: rely on ***proxies***
  - Milk urea
  - Infra-red spectra (MIR, NIR)

Ewaoluwagbemiga et al., 2023; Jahnel et al., 2023; Grelet et al., 2020

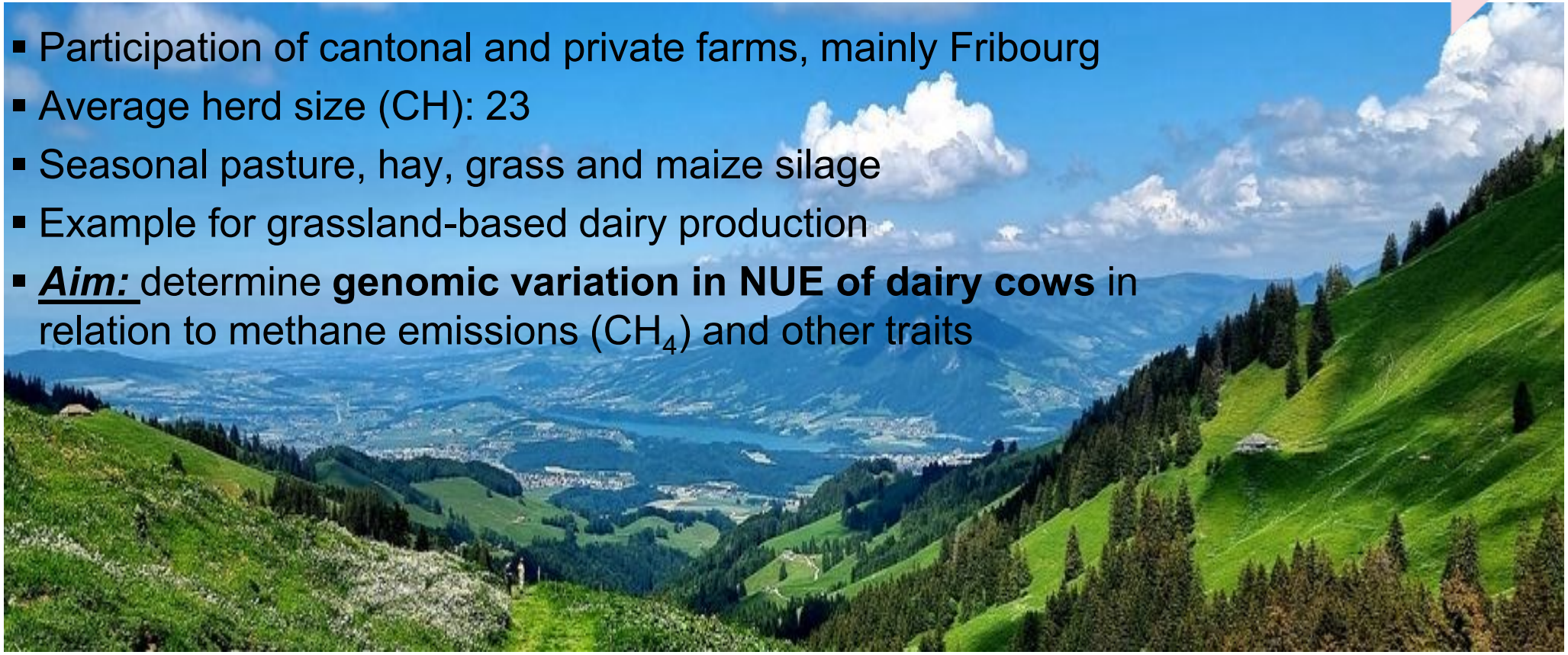
Background & motivation

- **Emphasis on phenotyping**:
  - Precision vs feasability
  - Consider feed quality & quantity (?)
  - *Record phenotypes in environment in which future animals will perform*
  - Provide solid basis for implementation to practice

- Heritability
- Genetic correlations with other relevant traits
  - CH_4 (see poster EAAP)
  - Production

Running project

2022 | 2023 | 2024 | 2025

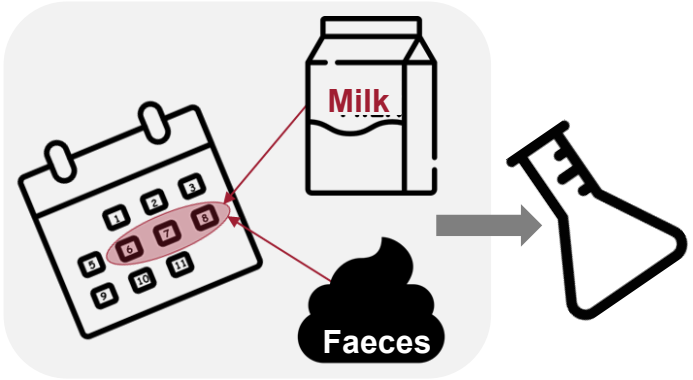


- Participation of cantonal and private farms, mainly Fribourg
- Average herd size (CH): 23
- Seasonal pasture, hay, grass and maize silage
- Example for grassland-based dairy production
- ***Aim:*** determine **genomic variation in NUE of dairy cows** in relation to methane emissions (CH_4) and other traits

Phenotypes

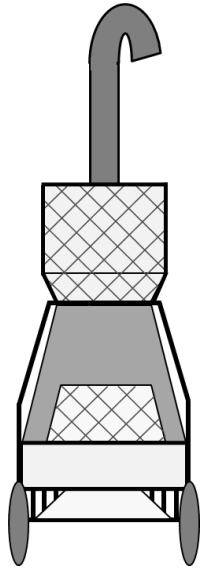
★ ***Reference methods ("Gold standard") in subset of cows***

NUE
measured



DM intake

CH_4
measured



- Mobile GreenFeed system
- Measured ∅ 34.3 days

Phenotypes

★ ***Infrared spectroscopy (IR)***

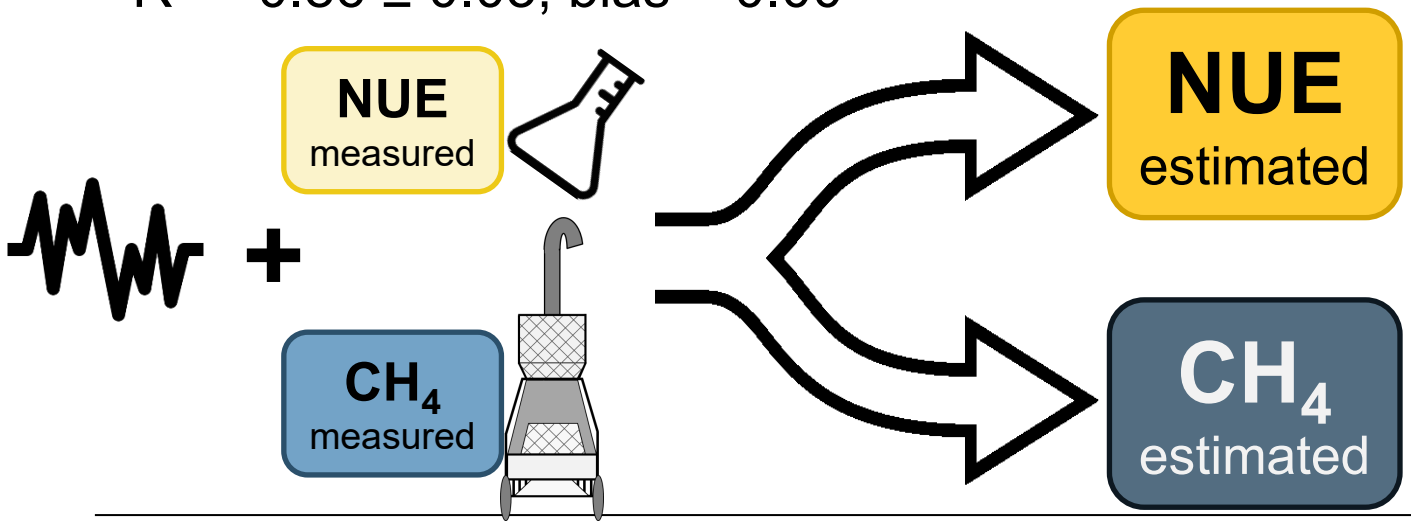
- **Cost-effective** alternative to wet-chemistry analysis
- High-throughput phenotyping of NUE and CH_4; DMI?
- **Algorithms** «translate» IR spectra of milk or faeces into NUE or CH_4
- Developed based on reference data *and* IR spectra
- Existing algorithms will be **further developed** in international collaboration

- Goal: **IR sufficient for determination of NUE or CH_4**

NIR calibration model

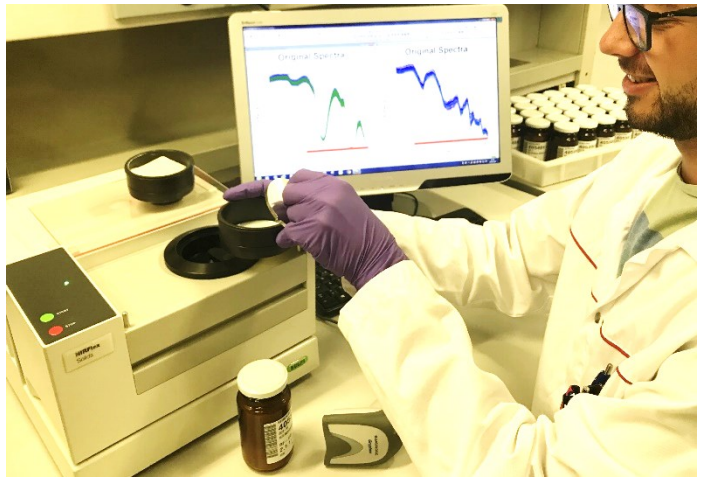
★ *Algorithms*

- ‘Local’ NIRS model NUE (EAAP 2021)
- Freeze-dried milk and faeces
- 54 cows
- PLS
- $R^2 = 0.86 \pm 0.03$, bias = 0.00



Currently:

- Add reference + IR samples
- International collaborations
  - Local → global
- MIR



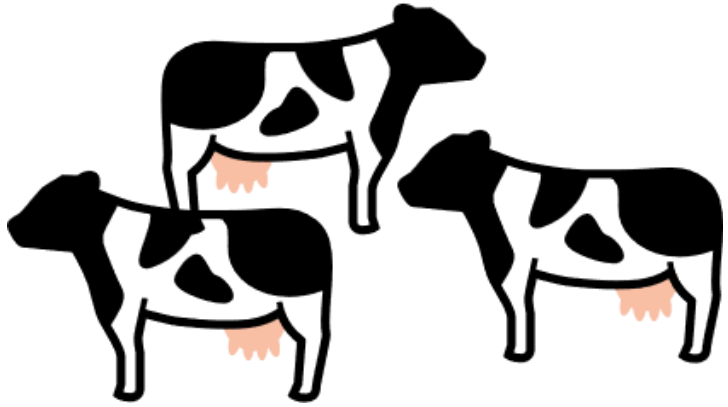
Ampuero Kragten et al., 2021

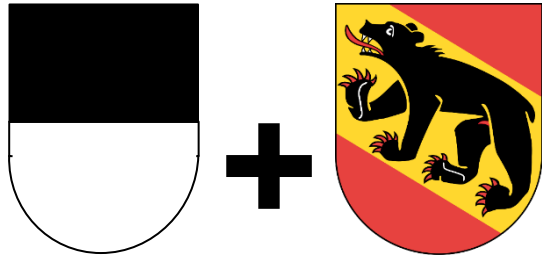
Genotypes

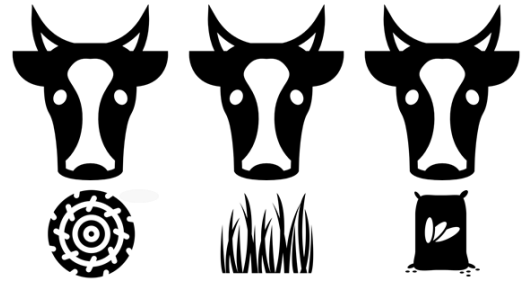
- Low-pass (1x)
- Imputation from reference panel

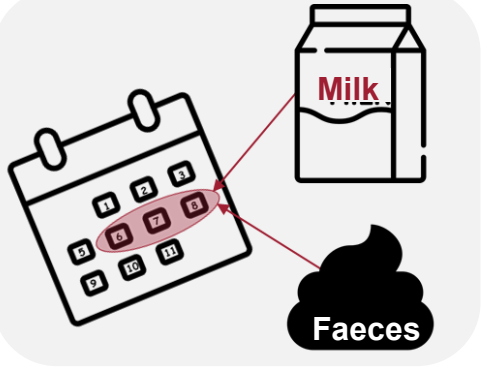
Data collection

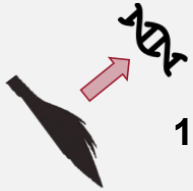
- Holstein cows (goal: 1,500 to 2,000)
- Mid lactation (lactation day 90-250)
- Milking parlour, no AMS yet
- Ration depending on farm and season











1 × / cow

Hair (for DNA)

1 × / cow

Blood (for physiology)

Feed analysis
1 × / farm and measuring period

State of data collection

- **Gold standard**
  - Feed intake (cribs) – 55 periods of 40 different individuals (+ 66 SRUC)
  - GreenFeed – 211 (potential) individuals
- **IR**
  - 896 samples (milk, faeces, hair, blood each)
  - 851 different individuals
- **Farms**
  - 4 cantonal
  - 16 private

Giving back to farmers

- Expense allowance
- Feed analyses
- Efficiency/emission data of their cows
- «Benchmarking»

Outlook

- Acquisition of funding
- Continuation of sampling & sequencing
- Improvement of phenotyping & IR models
- …

Thank you!

- Lukas Eggerschwiler & team, Raphael Siegenthaler, Bastien Hayoz
- Farms for participation
- SRUC: Richard Dewhurst for freeze-dried milk & feed intake data
- Agroscope chemistry and biology labs for sample preparation, wet-chemistry and NIR analysis


















Thank you for your attention

Claudia Kasper
claudia.kasper@agroscope.admin.ch

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