Genetic evaluation for saved feed and methane emission

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Outline

- **Feed Saved**
  - **Plan for a genetic evaluation (Gert)**
  - **Maintenance (Rasmus)**
  - **Feed intake (research farm data, and CFIT) (Jan)**
  - **Reliability – what can we expect? (Gert)**
- **Methane**
  - **Registration, genetics, impact on climate (Jan)**

The overall aim

EBV(Saved Feed) =

V1 x EBV(Maintenance) + V2 x EBV(Metabolic)

Key data is cow weights from practice

Key data is Feed intake from Research farms data and CFIT

Preliminary plan for publication of NAV Breeding values for Feed Saved

Date	Published EBVs*	Phenotypes included	Comments
May 2019	*$EBV_{maintenance}$*	*Weight, conformation from practice*	*All 3 breeds*
Aug/Nov 2019	*$EBV_{metabolic}$*	*Feed intake, weight, yield from research farms*	*HOL, (RDC)*

***Means also genomic breeding values**

EBV for feed saved will <u>not</u> be included in NTM in 2019, but can be given as an extra information trait

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Nov 2019+	***$EBV_{metabolic}$***	***CFIT data***	***All 3 breeds***

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The overall aim

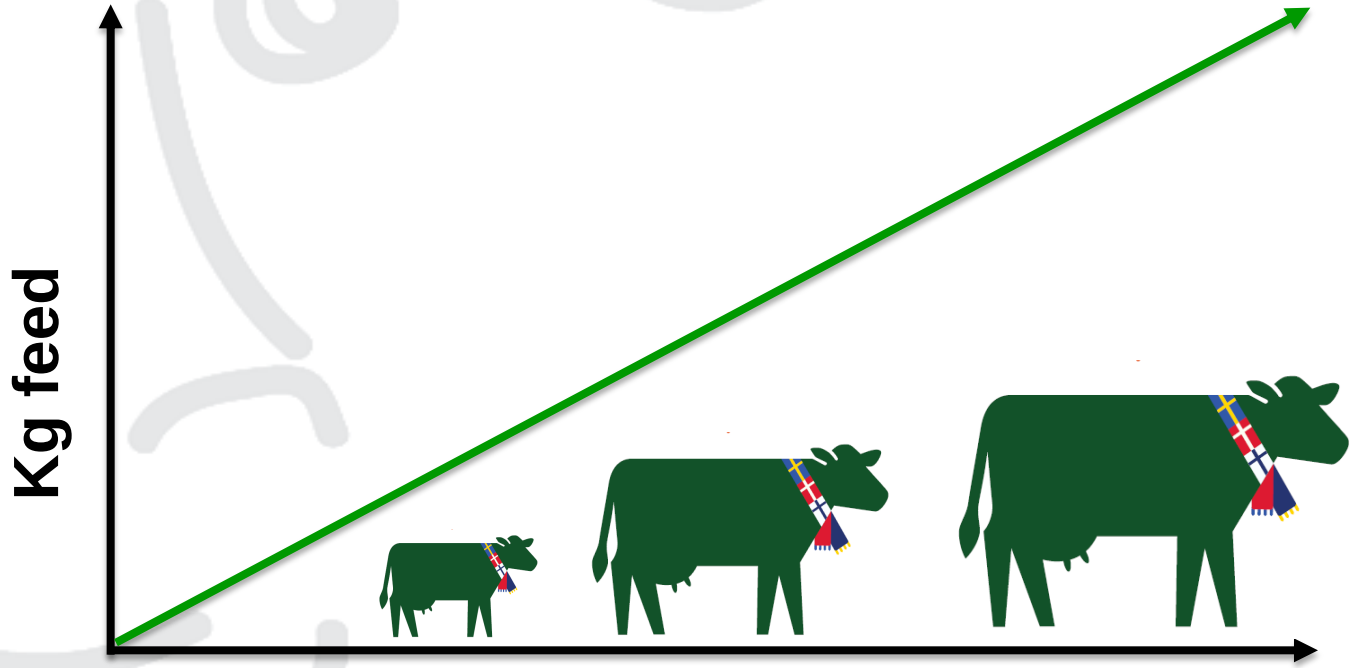
$$EBV_{(Saved\ Feed)} =$$

$$V_1 \times EBV_{(Maintenance)} + V_2 \times EBV_{(RFI)}$$

Focus

The core trait

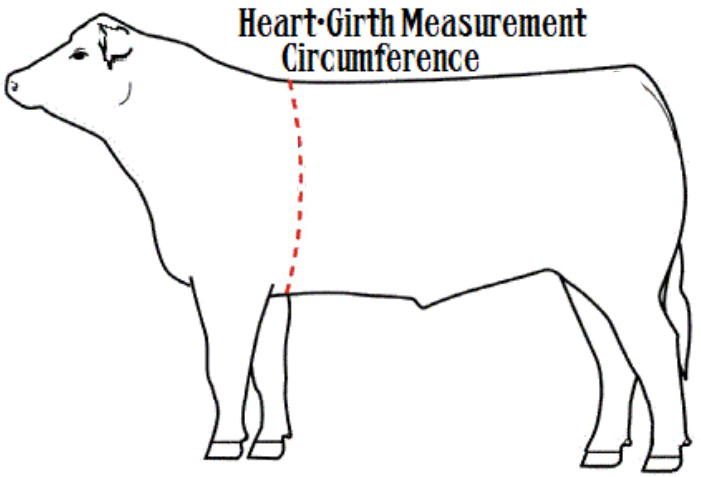
- **Metabolic body weight (MBW = body weight$^{0.75}$)**
  - **~1 kg dry matter to maintain 100 kg body weight (~30% of the total energy requirement for a dairy cow)**



Data sources

- A small proportion of the cows have scale/tape measurements (only in DNK and FIN)
- A larger proportion has conformation data
  - Genetic correlation with body weight

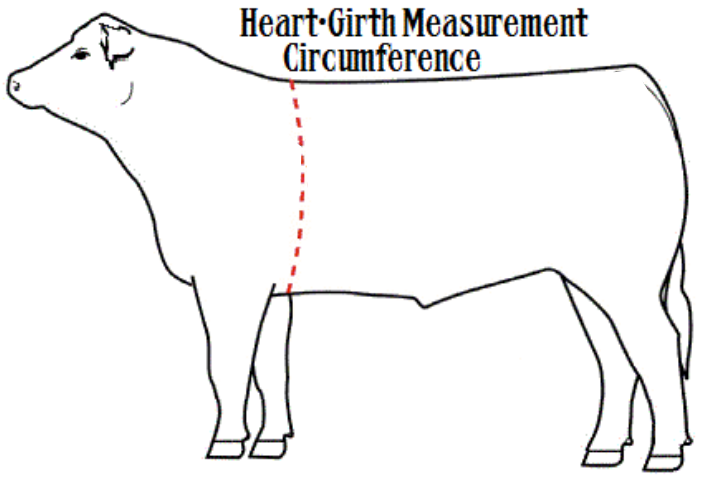
Landbrugsavisen.dk



Miniature-cattle.com

Tape measurements (FIN data)

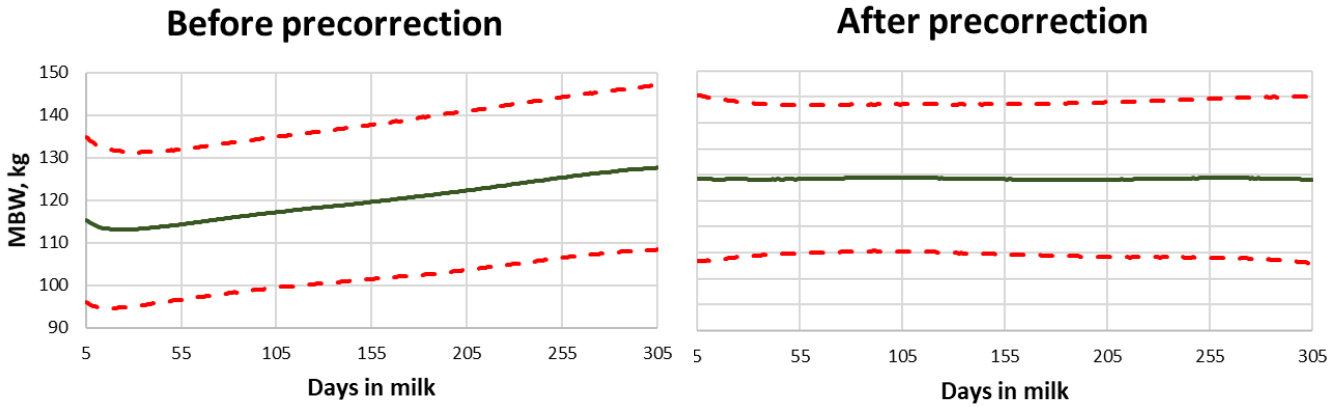
- **Voluntary measurements in 25 % of the Finnish herds (~10% of the cows in Finland)**
- **Measured once per lactation (mostly) from 1990 and onwards**
- **Data from RDC and HOL**
  - **700,000 cows in 1st parity**
  - **440,000 cows in 2nd parity**
  - **150,000 cows in 3rd parity**



Miniature-cattle.com

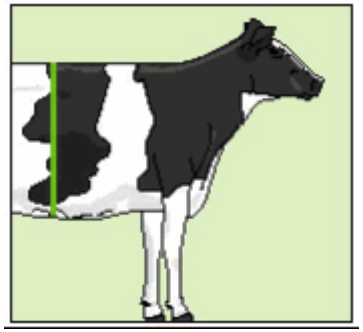
AMS scale (DNK data)

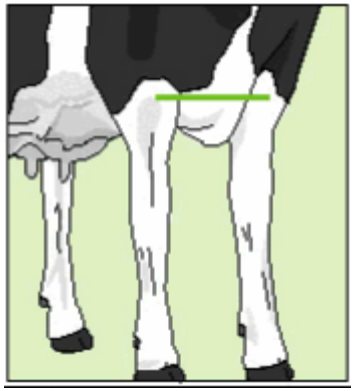
- Number of 1st parity cows
  - 59,000 HOL (2008-2018)
  - 4,400 RDC (2011-2018)
  - 3,800 JER (2011-2018)
- Repeated trait
  - Mean lactation body weight is calculated
  - Precorrection necessary



Conformation – indicator traits

- **Conformation traits recorded in Denmark, Finland and Sweden**
  - **Stature, body depth, chest width**
- **Currently evaluated in NAV**
  - **79,000 HOL 1st parity cows in 2017**
  - **34,000 RDC 1st parity cows in 2017**
  - **13,500 JER 1st parity cows in 2017**





Genetic evaluation

Multiple-trait model with following traits:

- **Metabolic body weight 1st parity (MBW 1)**
- **Metabolic body weight 2nd parity (MBW 2)**
- **Metabolic body weight 3rd parity (MBW 3)**
- **Conformation traits from 1st parity (indicator)**
  - **Stature**
  - **Body depth**
  - **Chest width**

Heritabilities

- **Tape is based on Finnish field data (RDC & HOL)**
- **Scale is based on Danish AMS data (HOL)**

	Tape	Scale
MBW 1	0.46	0.58
MBW 2	0.51	0.55
MBW 3	0.56	0.54

- **Approximately at the same level**

Genetic correlations

- Between MBW traits

- **Based on 284 primiparous cows (Luke's research herd Jokioinen)**
  - **MBW – tape**
  - **MBW – lac_avg (lactation average, similar to Danish AMS trait)**
    - **Genetic correlation >0.93**

Genetic correlations
- Between MBW traits

- **Based on Finnish field data (RDC & HOL)**

Traits	1st parity	2nd parity
2nd parity	0.98	0.96
3rd parity		1.00

- **The same trait across parities**

Genetic correlations

- Between MBW 1 and indicator traits

- **Between MBW in 1st parity and indicator traits**

HOL	Stature	Body depth	Chest width
MBW 1	0.65	0.51	0.59

Conclusion

- **Strong genetic correlation between tape and AMS scale measurements**
- **MBW is a highly heritable trait**
- **MBW the same trait in different parties**
- **Conformation traits are good indicator traits**




Perspectives

- **Camera technology looks promising for prediction of body weight**
- **Some large herds might install scales for management purposes**
- **Use slaughter weight – not included to keep the evaluation simple**

Residual feed intake (metabolic efficiency)

- **What does it mean?**

- **Feed intake corrected for energy sinks:**
  - **Yield level**
  - **Body weight**
  - **Body weight chance**
  - **…**

Database on Holstein

Country	# cows	DMI records	Yield records	Weight records
Denmark	900	58,000	58,000	56,000
Canada	500	28,000	33,000	3,000
USDA	700	20,000	20,000	9,000
CHE	100	800	2,000	1,100
UK	2,300	125,000	156,000	5,000
AUS	600	2,100	2,100	2,100

4,500 total cows with feed intake data
3,300 total cows genotyped

Research farm data

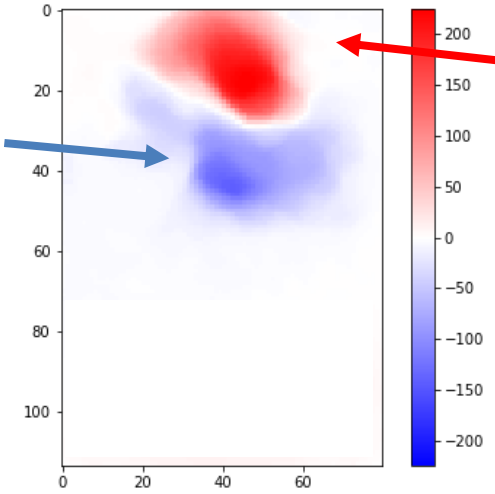
- **Different diets and experiments**
- **Different production environments**
- **Hardly correlations of 1 between countries**

Cattle Feed Intake
CFIT

System setup

Example of feed intake from a visit

Blue is higher



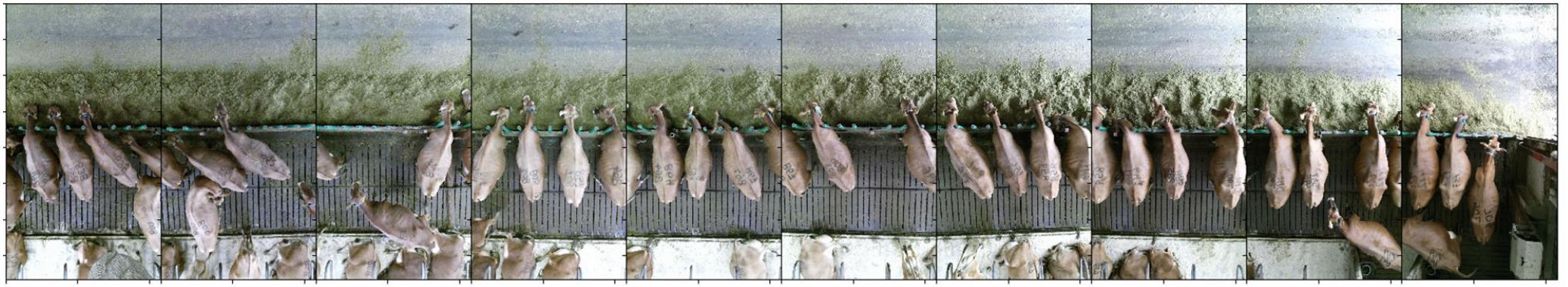
Red is deeper

Removed	14.39 l
Added	10.75 l
Total	3.64 l

Total is difference between red and blue

Data

- 97 Jersey cows (19 cameras) measured for 14 days
- Two consecutive milk recordings were used

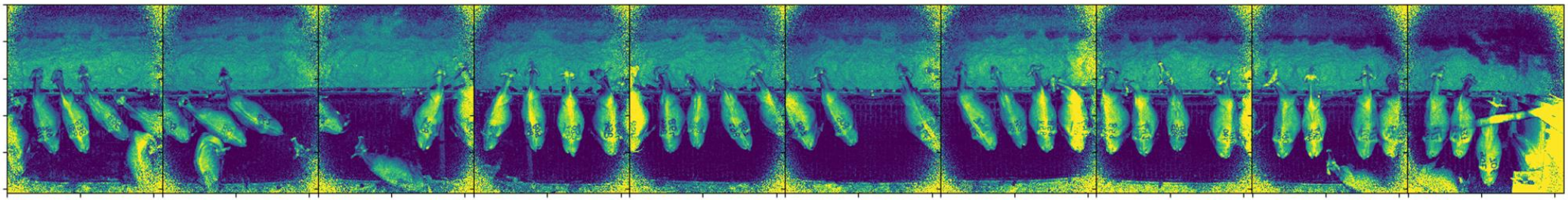


Results

- Repeatability between weeks 0.84
- Repeatability between days 0.65
- $r_{FI,ECM}$ =0.65

Ongoing activities and next steps

- Installation and test in 4 herds
- Analysis on live data including live weight prediction
- Dialogue with farmers on interface
- Alarm diagnostics – when and when not
- Economic benefits of having records



Status and plans installation

	Today	1. Juli 2019	1. Jan 2020	1. Jan 2021
Number of herds with CFIT	1 JER	2 JER, 1 HOL 1 RDC	2 JER 2 HOL 2 RDC	5 JER 10 HOL 5 RDC
Number of 1. lact cows with CFIT	40 JER	100 JER 100 HOL 50 RDC	150 JER 200 HOL 150 RDC	600 JER 1200 HOL 600 RDC
Number of cows in total with CFIT	100 JER	400 JER 400 HOL 200 RDC	600 JER 800 HOL 600 RDC	3000 JER 6000 HOL 3000 RDC

Reference population size, Jan. 2019

Breed	Category	Maintenance* (weight data)		Metabolic (feed intake data)
		Phenotypes	Genotypes*	Phenotypes
Holstein	Bulls >10 daughters	2,500	2,500	62
	Cows	300,000	2,500	4500**
RDC	Bulls >10 daughters	3,000	3,000	22
	Cows	635,000	4500	1000**
Jersey	Bulls >10 daughters	98	98	5
	Cows	3,800	<200	300**

***estimates; ** genotypes on about 2/3 of the cows**

How reliable will the Saved Feed breeding values be?

	Maintenance (weight data)	Metabolic (feed intake data)
Cows with data	60%	20-30% (only research farm cows)
Bull with 20 daughters having data	90%	60% (very few bulls)
Heifer pedigree information in practice	30%	<5%
Heifer/bull calf with genotype	50-55%	5-10%

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Heifer pedigree information in practice	30%	<5%
Heifer/bull calf with genotype	50-55%	5-10% (HOL)
Comments	Jersey lower	HOL>RDC>(Jersey) CFIT ⬆

Methane emission

- **Climate debate every day in all news media**
- **Anti-animal production agenda**
- **Agriculture is a part of the contribution to GHG emission**
- **Agriculture is also a part of the solution – but not all the solution!**

Measurering

Results

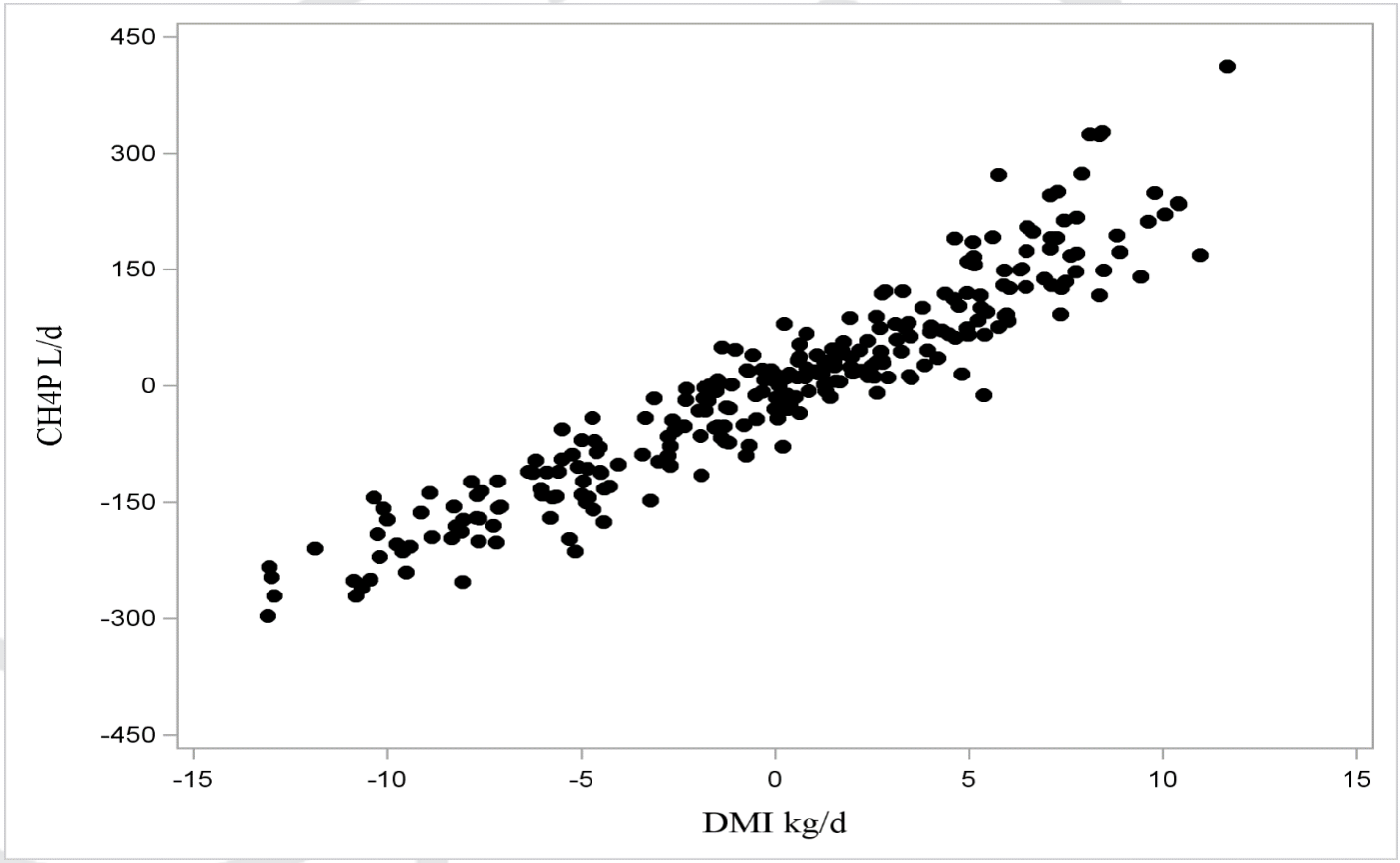
- Data on Holstein (+3000 cows) and Jersey (+1200 cows)
- Heritability ~20%
- Genetic correlations (inaccurate)
  - Between Methane and Yield - positive (unfavorable)
  - Between Methane and other NTM traits - no unfavorable

Results

- **Data collection in research projects still ongoing**

- **Quantification methods are equivalent to respiration chamber data but can be improved**

Relationship between methane and DMI



Implementation?

- **Possibilities for genetic ranking**
- **VERY low initial reliabilities (~10%)**
- **Routine recordings to get more data and make documentation**
- **Cost approx. 20 Euro per cow**