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MIPAAF Ministero delle Politiche Agricole Alimentari e Forestali

PREDICTED FEED EFFICIENCY INDEX APPLIED TO ITALIAN HOLSTEIN FRIESIAN CATTLE POPULATION

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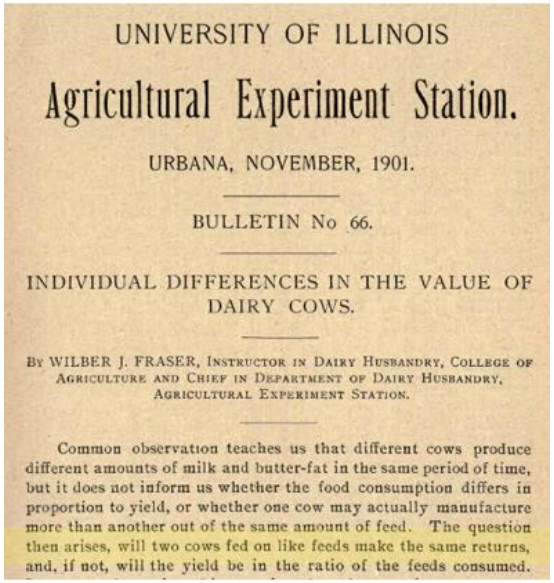
International Symposium 28 Animal Science Days
Padova 2020
September 23 - 25
Italy - Padova University

September 23-25, 2020 – Padova (Italy)

Session: Breeding and Genetics

Feed Efficiency: why is important?

Feed efficiency: Amount of milk produced per quantity of dry matter ingestion



UNIVERSITY OF ILLINOIS

Agricultural Experiment Station.

URBANA, NOVEMBER, 1901.

BULLETIN No 66.

INDIVIDUAL DIFFERENCES IN THE VALUE OF DAIRY COWS.

By WILBER J. FRASER, Instructor in Dairy Husbandry, College of Agriculture and Chief in Department of Dairy Husbandry, Agricultural Experiment Station.

Common observation teaches us that different cows produce different amounts of milk and butter-fat in the same period of time, but it does not inform us whether the food consumption differs in proportion to yield, or whether one cow may actually manufacture more than another out of the same amount of feed. The question then arises, will two cows fed on like feeds make the same returns, and, if not, will the yield be in the ratio of the feeds consumed.

- **Huge economic value** for farmers
  - *"Will two cows fed on like feeds make the same returns, and if not will the yield be in the ratio of the feeds consumed" University of Illinois, 1901*
- International interest
- One of the promises enabled by the introduction of Genomic Selection
- **Still big challenges**

Many International Initiatives

1. RobustMilk
2. Australasian RFI project
3. Global Dry Matter Initiative: gDMI and gDMI2
4. RFI: Michael VanderHaar
5. FUNC (Feed Utilization in Nordic Cattle)
6. Efficient Dairy Genome Project Canada
7. GenTore
8. …

Feed Efficiency - **Big challenges**

In dairy genetic **selection for improved feed efficiency has been rather limited**, especially due to the **costs and practical limitations of individually measuring feed intake** for a large number of animals.

- No Commercial data
  - Data collected in experimental farms

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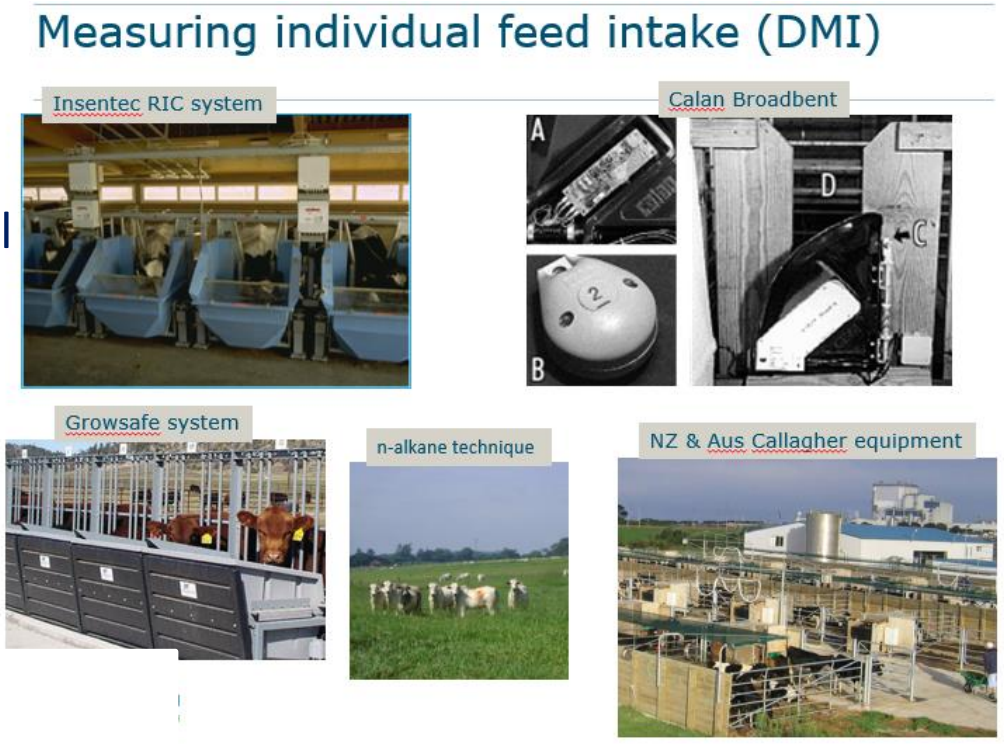

Feed Efficiency → Feed intake ?

- **Direct phenotype** → Few and expensive (time, work and costs)
  - **Genomic Selection**
    - Individual phenotypes and genotypes in a "population subset" → genomic predictions are applied on the genotyped population but without phenotypes.
    - **Reference population is fundamental** → reliable estimates
  - Important to know the phenotype

- **Predicted phenotype**
  - Prediction formulas (using data of the **national data-collection system**)
    - Prediction traits:
      a) easy to detect
      b) collected routinely
      c) economic
      d) heritable
      e) genetically correlated with the character of interest.
  - Define the phenotype → genetic evaluation to set up

Italian Holstein → Efficiency

- Genetic evaluation for feed efficiency in Italian Holsteins. (This presentation)
- Estimate live weight at a specific time of lactation (Finocchiaro et al., 2017)

- It is important to establish «standardized» data collection and to know the phenotype:
  - Since **September 2015** ANAFIJ is part of the ICAR working group Feed&Gas. (Seymour et al. 2019 J. Dairy Sci.)
  - Ongoing experiments for Individual Feed Intake and Methane emission
    - **Cows and heifers** feed intake (RIC system) and CH_4 (LMD)
    - **Young bulls** feed intake (RIC system) and GHG (GF)
    - **Feces collection** →Chemical analysis through the use of NIRS FOSS DS-2500 technology (SS%; NDF%; ADF%; ADL%; Ceneri%; uNDF (% SS); uNDF; (% NDF); ADLom)

Italian Holstein → Efficiency

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Feed & Gas working group who?

Chair		
Roel Veerkamp	Yvette de Haas	
Members working group		
Jennie	Pryce	Australia
Filippo	Miglior	Canada
Nina	Krattenmacher	Germany
Raffaella	Finocchiaro	Italy
Birgit	Gredler	Switzerland
Phil	Garnsworthy	United Kingdom
Rouillé	Benoit	France
Jan	Lassen	Danemark
Gilles	Renand	France
Industry liaison group		
Marco	Winters	UK
Daniel	Abernethy	AUS
Juan	Pena	Spain
Andrew	Cromie	Ireland
Sijne	Van Beek	The Netherlands

Research liaison group with researchers in

Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Norway, UK

Cassandro M. UNIPD

WAGENINGEN UNIVERSITY & RESEARCH

LMD)

Italian Holstein → Efficiency

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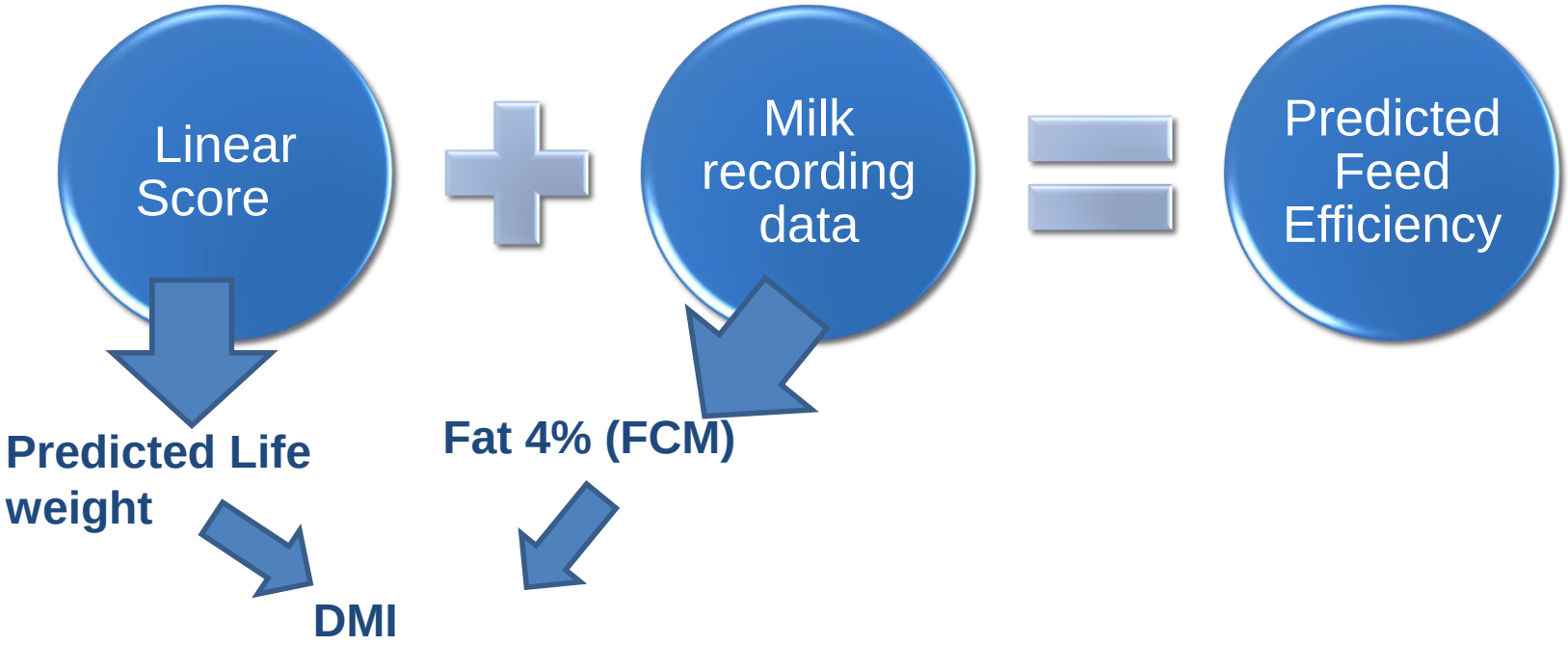

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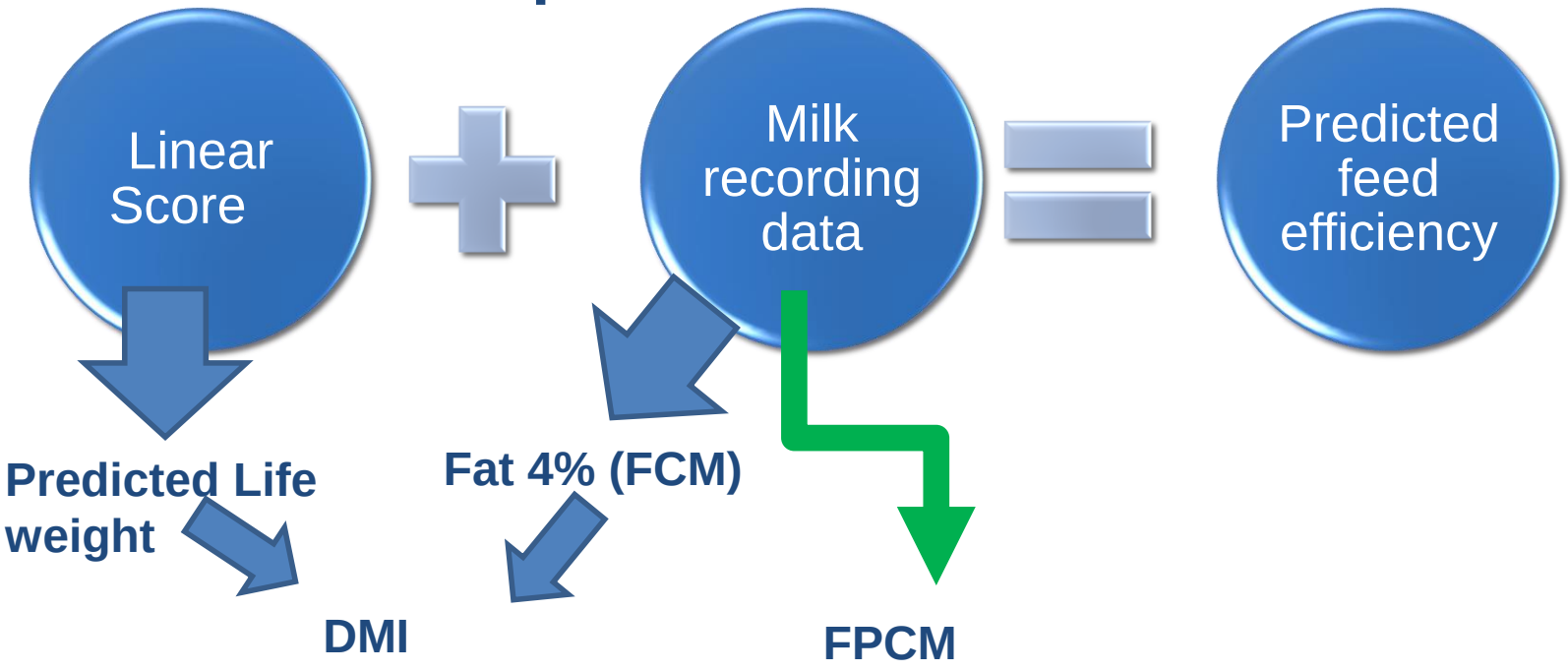

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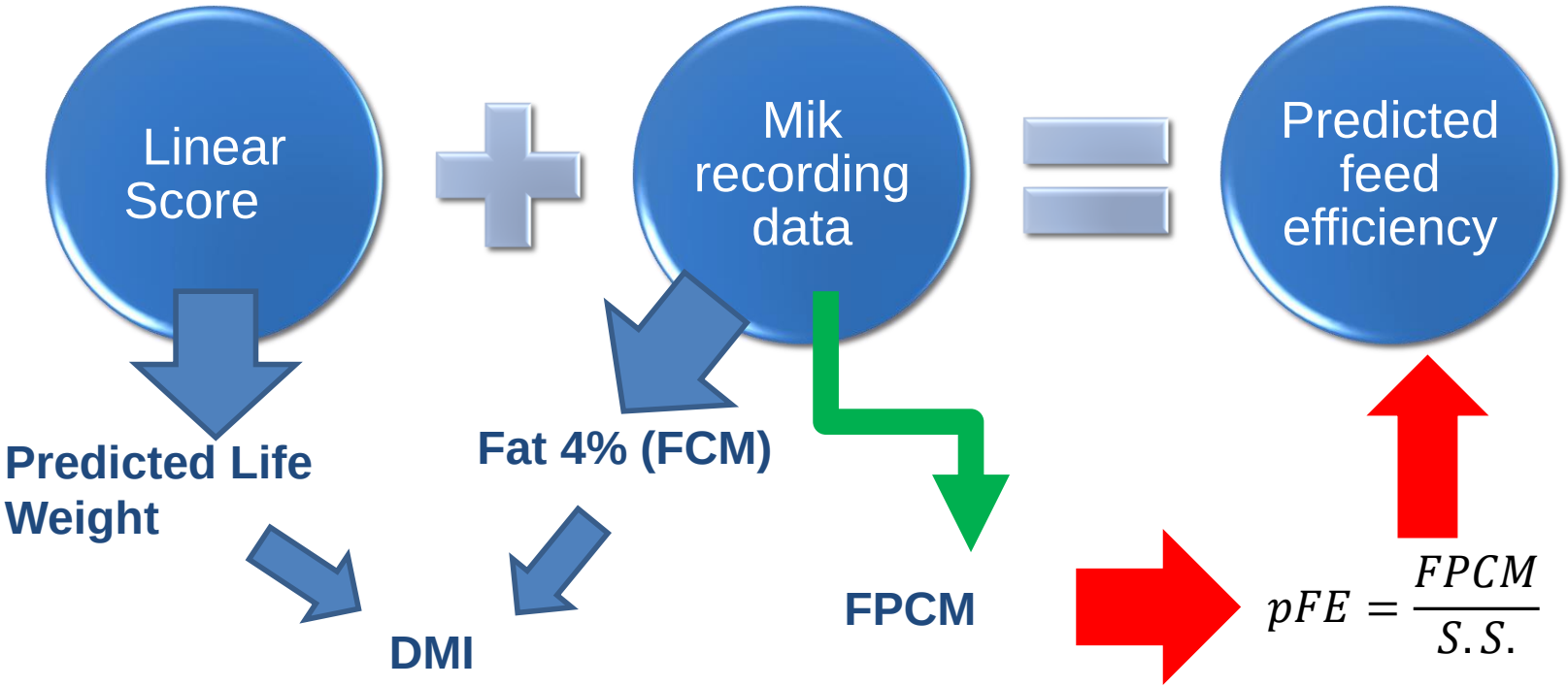


- **BW**: Age at scoring (±30 d to milk recording), Stature, Body Depth, Chest and Rump Width (Finocchiaro et al., 2017)
- **FCM**(4%), **DMI**: Nutrient Requirement for Dairy Cattle, 2001
- **FPCM**: milk, fat%, protein% (Sjaunja et al., 1990)
- **FE**: FPCM/DMI

Methods

Step 1: Estimate body weight at a specific time of lactation and only for first parity cows (Finocchiaro et al., 2017)

Step 2: Body weight coefficients estimated base to lactation stage and parity (publication in progress)

a) Huge data-set with individual real weights in different lactation stages and parity
b) Coefficients applied to the national data-set

Step 3: Predicted Feed Efficiency Index

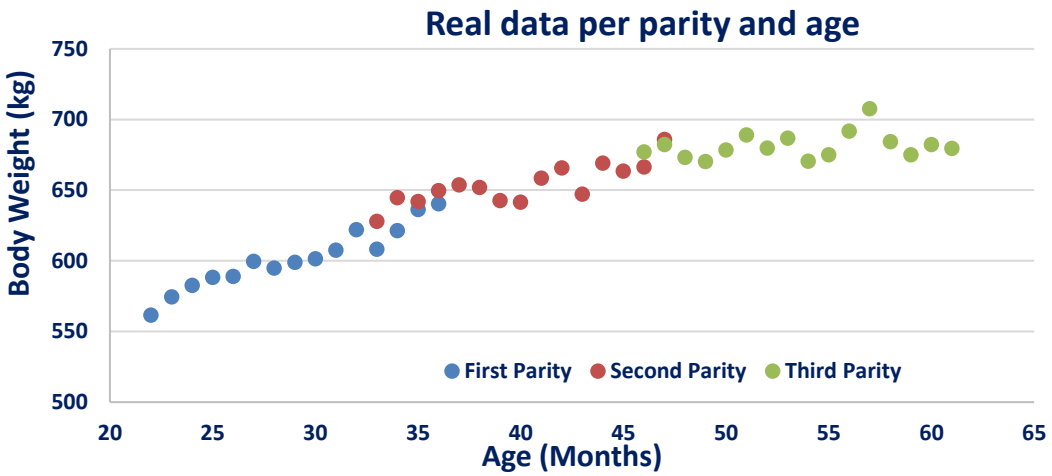
a) Genetic parameter estimation (VCE software)
b) Genetic evaluation for the new trait (Mix99 software)

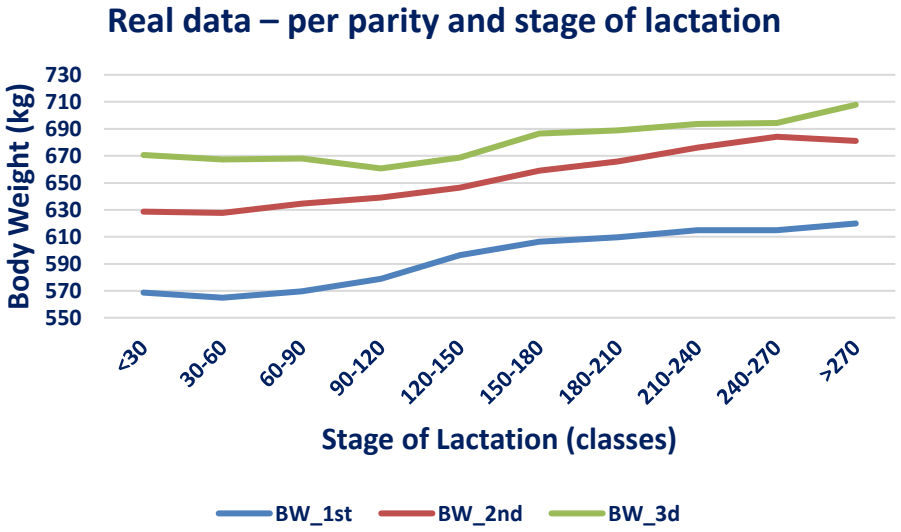
A test-day repeatability model was applied. Fixed effects were the **herd-test-date** (HTD), interaction **parity*stage of lactation** and interaction **parity*age at calving**. Random effects included the **cow,** the **animal** and the **error**.

Results – Phenotype -Body Weight

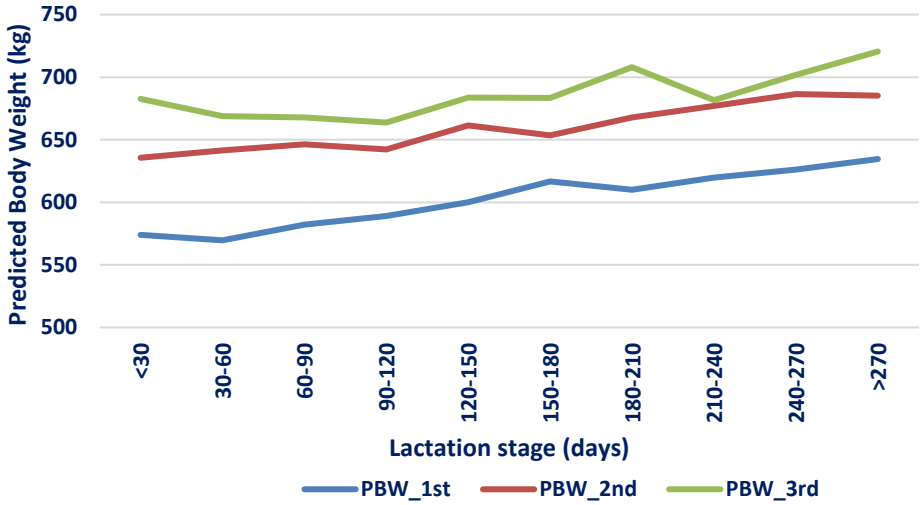
First Parity Cows

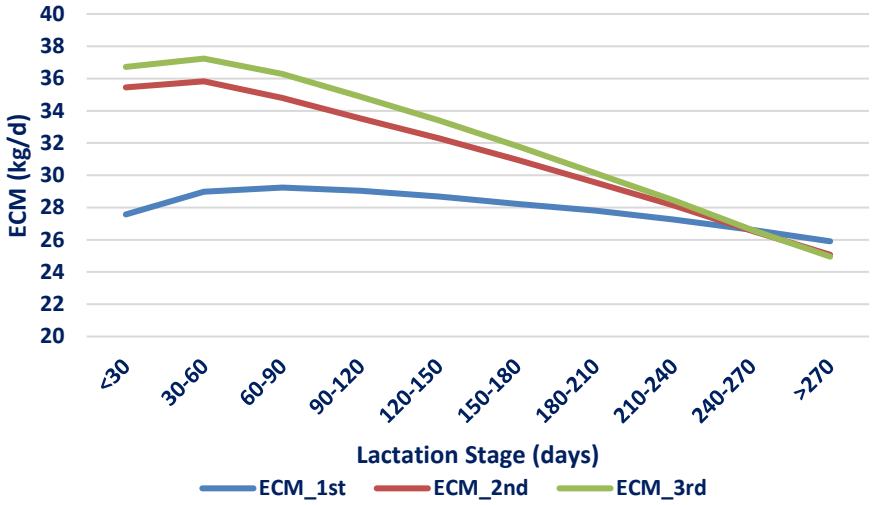
Trait	Mean±SD
Body Weight	598.24±73.00
Predicted BW	598.29±46.45

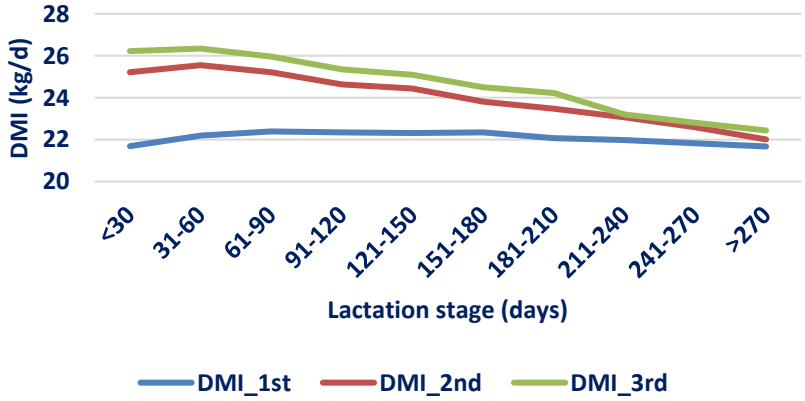


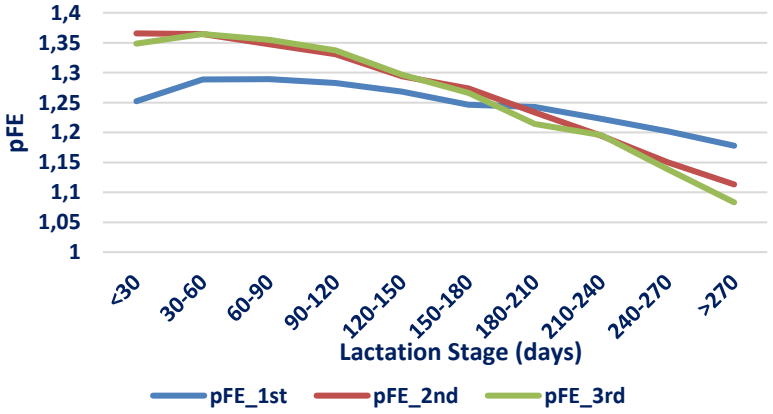


Results – Phenotype per Lactation









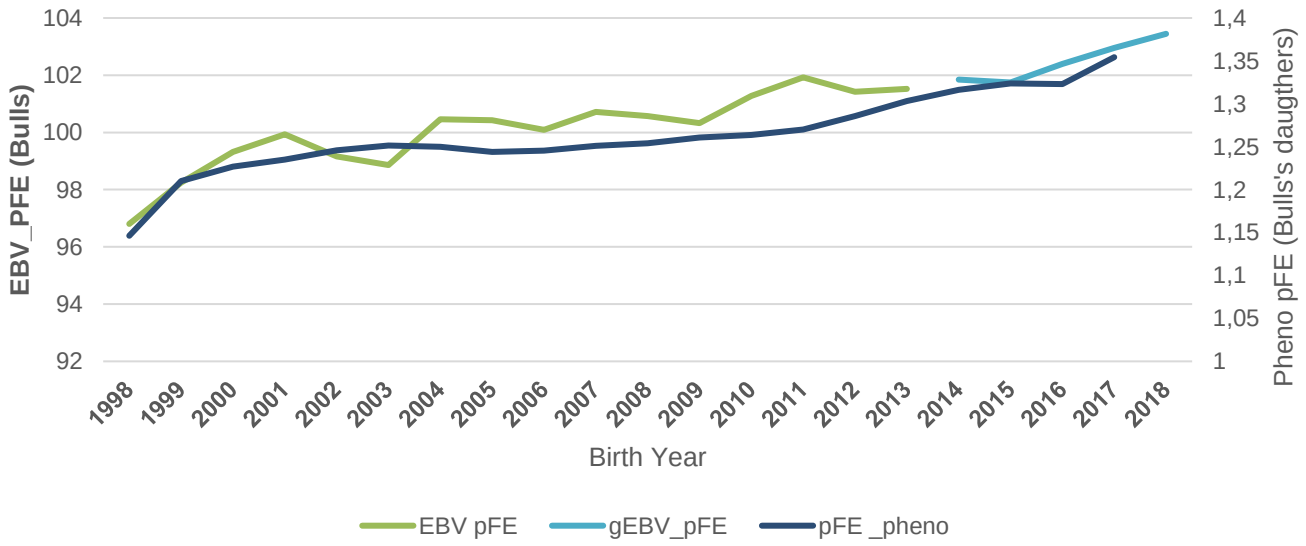
Feed Efficiency Breeding value

Bull breeding value	Mean±SD	Average rel
ebv_pFE100**	99,33±4,44	95
gebv_pFE100	101,68 ±2,43	64

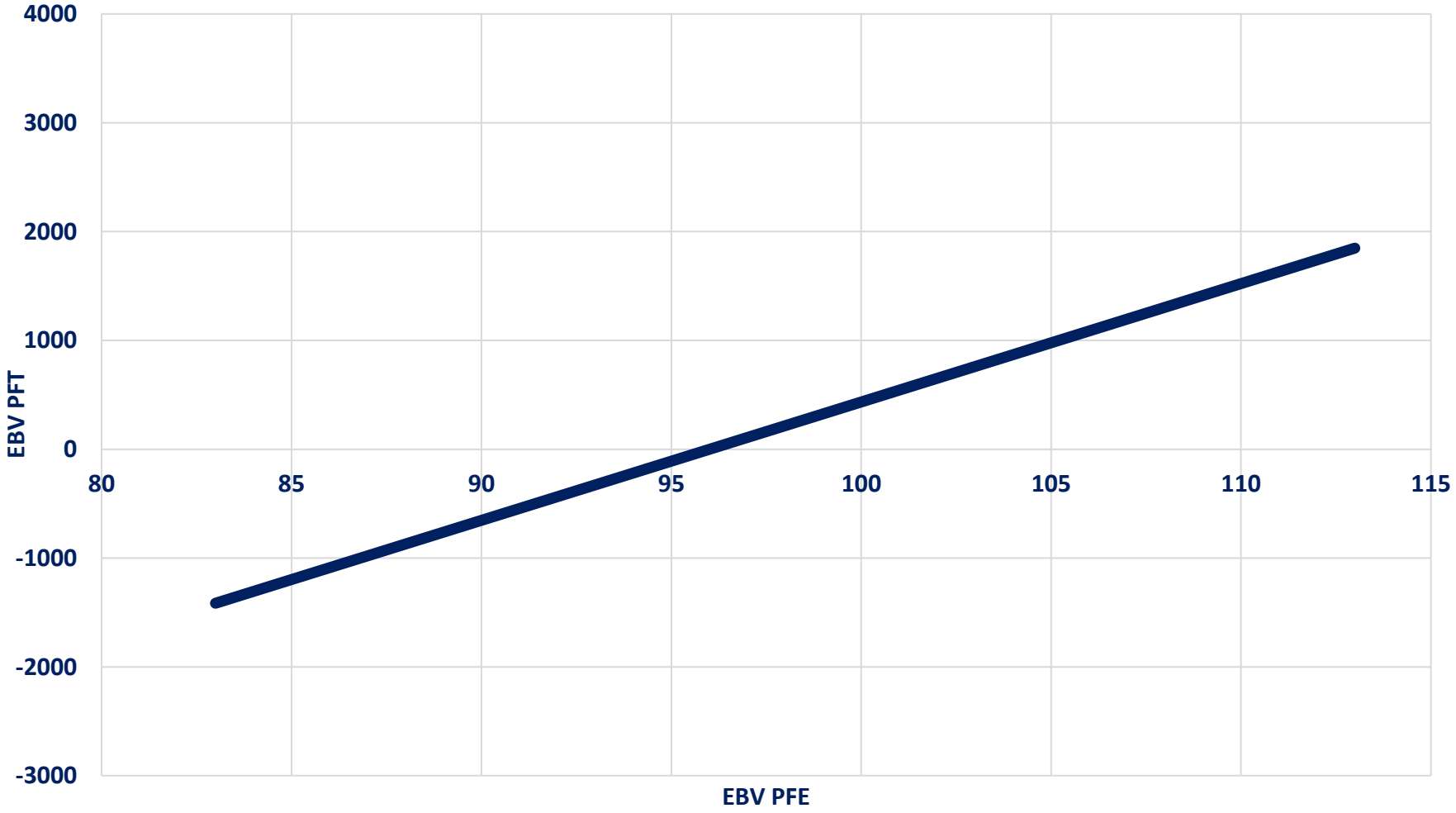
* Standardized breeding value with cows born 2011-2013
** Mean 100 and DS±5

Trait	Mean ± SD	h^2
PFE	1,27± 0,18	0,32

Feed efficiency – Phenotypic Genetic and Genomic trend



Results – EBV PFE and Italian Holstein breeding objective (PFT)



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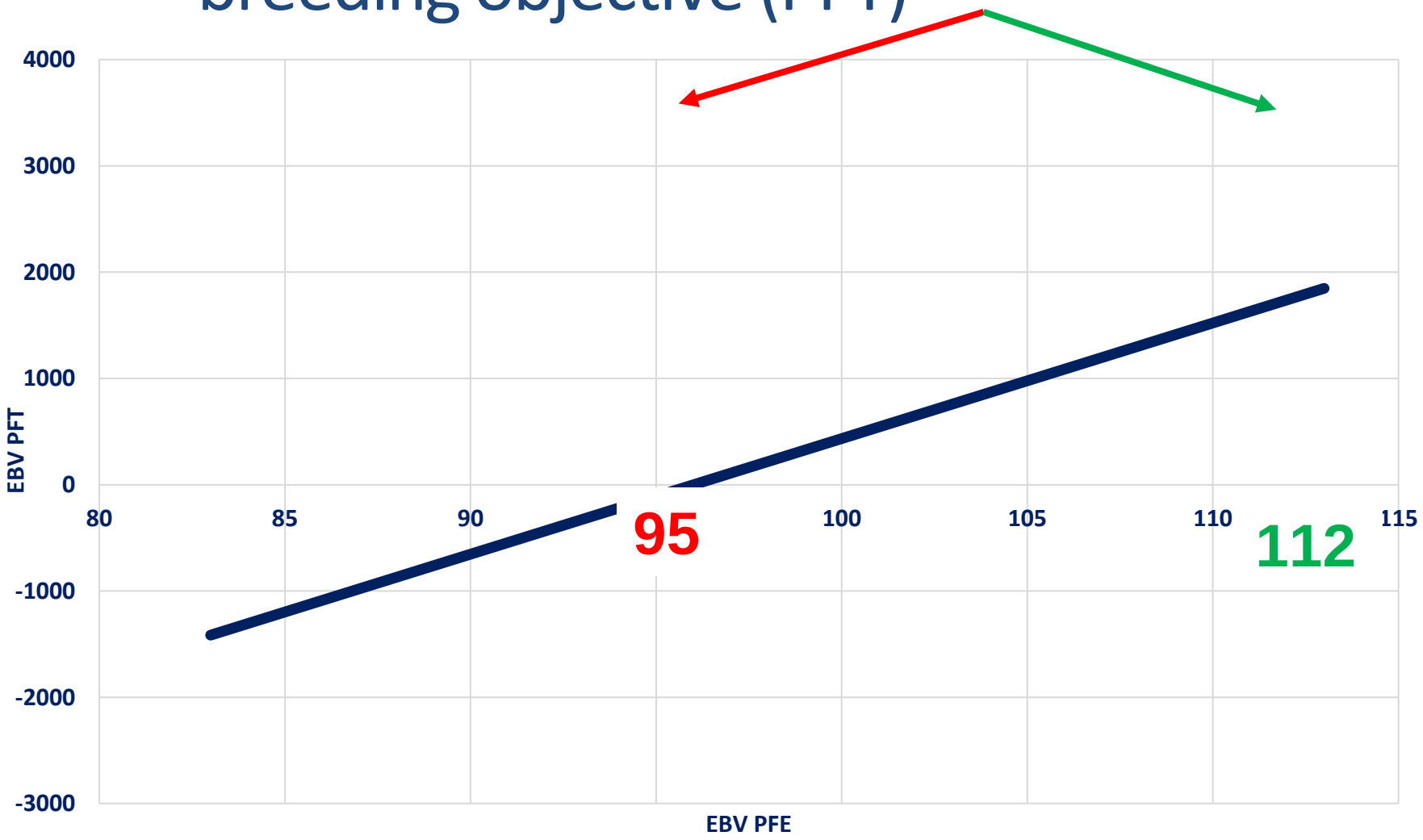

Who is the most efficient cow?

$$PFE = \frac{FPCM}{Dry\ Matter\ Intake}$$

Bull genetic level	Phenotype
>105	1,32
95-105	1,27
<95	1,21

Fixed parameters

	kg	Price
Milk (kg)	1	0,40 €
Dry matter (kg)	1	0,28 €

- Comparing 2 cows with the SAME Dry Matter Intake
- 30 kg of milk → 23,62 kg DMI

	Milk (kg)	Dry matter (kg)	Euro Milk	Euro DM	Profit	Comparison
Efficient cow	31,18	23,62	12,47 €	6,61 €	**5,86 €**	121,6%
Inefficient cow	28,58	23,62	11,43 €	6,61 €	**4,82 €**	82,3%
					1,04 €	**39,3%**
		x 305 day lactation →			316,98 **€**	
		1 SD →			**~ 109 €**	

Extra profit from the efficient cow

Conclusions

- Results suggest PFE can be used as selection trait to enhance profitability for Italian Holsteins
  - At this stage this trait can be derived from the official milking recording system
  - PFE became official December 2019
- Direct individual phenotypes for DMI will arrive in a second step for more advanced selection strategies and for a better genetic control on daily feed efficiency estimation
- Several projects (National and International) are in progress. Cooperation is fundamental in order to build up a critical mass.

Aknowledgments

- ANAFIJ group and all the collaboration groups
  - University of Milan
  - University of Padova
  - Farmers contributing with data

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