BOVI-ANALYTICS

Universiteit Utrecht

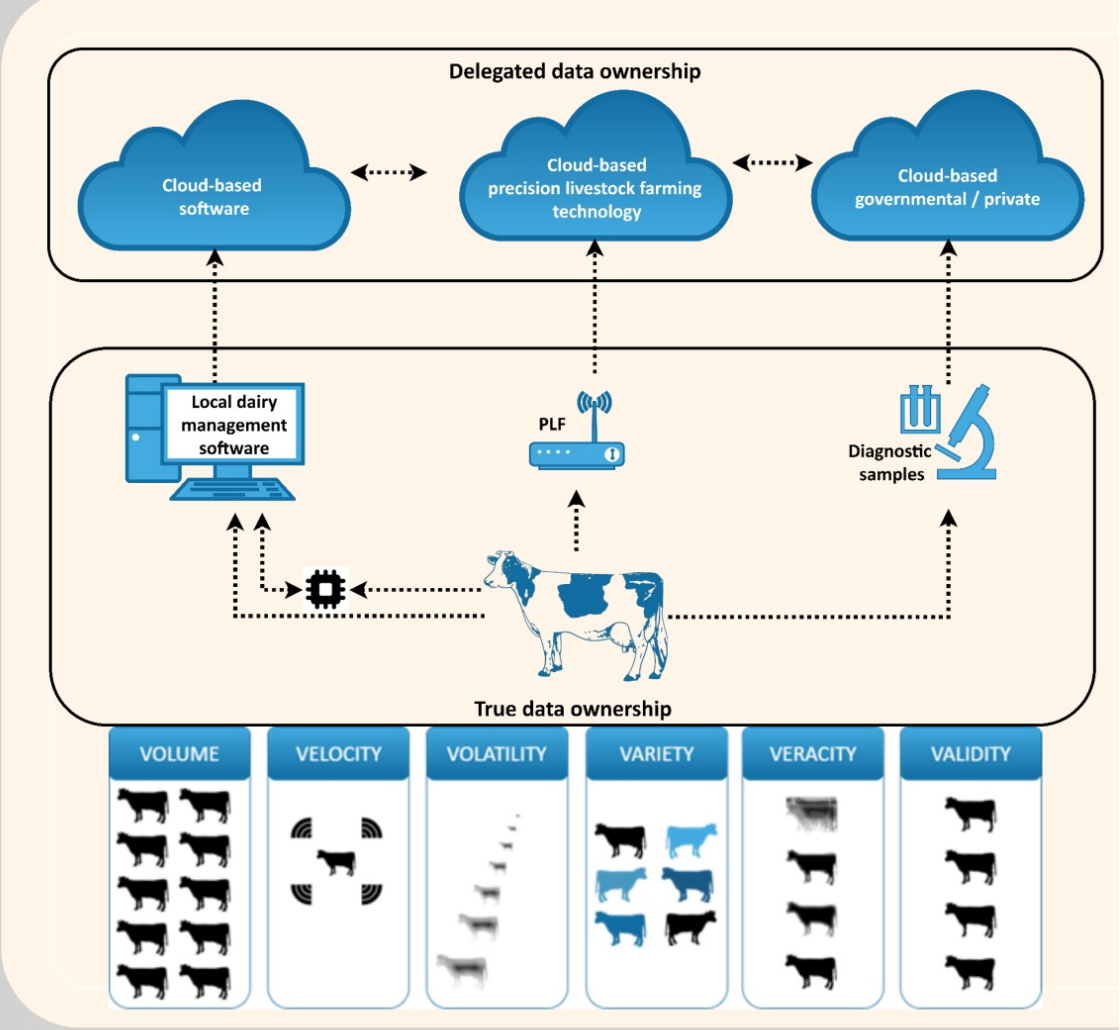
FACULTY OF BIOSCIENCE ENGINEERING

Why do we need modern tools for milk recording management?

DATA

MRO

ON FARM


Delegated data ownership
Cloud-based software
Cloud-based precision livestock farming technology
Cloud-based governmental / private
Local dairy management software
PLF
Diagnostic samples
True data ownership
VOLUME
VELOCITY
VOLATILITY
VARIETY
VERACITY
VALIDITY

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www.gpluse.eu

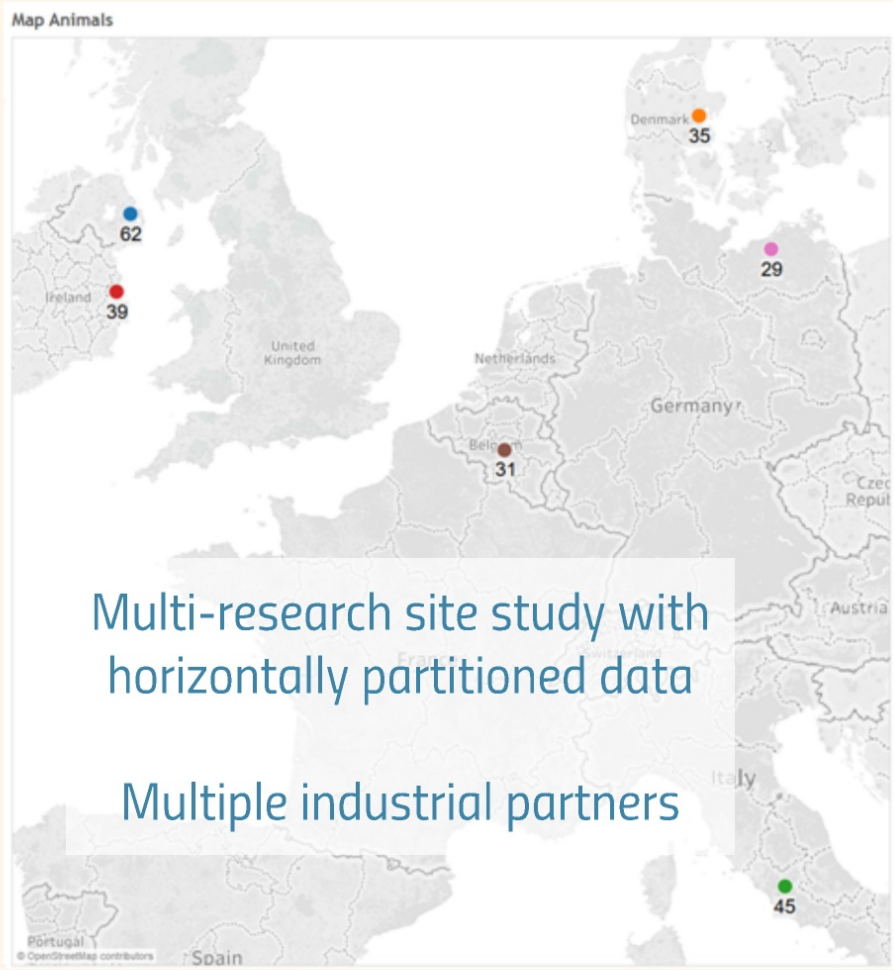
Genotype and Environment contributing to the sustainability of dairy cow production systems through the optimal integration of genomic selection and novel management protocols based on the development and exploitation of genomic data and supporting novel phenotyping approaches.

www.gpluse.eu

Invited review: overview of new traits and phenotyping strategies in dairy cattle with a focus on functional traits

C. Egger-Danner[1†], J. B. Cole[2], J. E. Pryce[3], N. Gengler[4], B. Heringstad[5], A. Bradley[6,7] and K. F. Stock[8]

[1]ZuchtData EDV-Dienstleistungen GmbH, Dresdner Str. 89/19, A-1200 Vienna, Austria; [2]Animal Genomics and Improvement Laboratory, ARS, USDA, 10300 Baltimore Avenue, Beltsville, MD 20705-2350, USA; [3]Department of Environment and Primary Industries, La Trobe University, Agribio, 5 Ring Road, Bundoora, Victoria 3083, Australia; [4]University of Liège, Gembloux Agro-Bio Tech (GxABT), Animal Science Unit, Passage des Déportés 2, B-5030 Gembloux, Belgium; [5]Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, PO Box 5003, N-1432 Ås, Norway; [6]Quality Milk Management Services Ltd, Cedar Barn, Easton Hill, Easton, Wells, Somerset, BA5 1EY, UK; [7]University of Nottingham, School of Veterinary Medicine and Science, Sutton Bonington Campus, Sutton Bonington, Leicestershire, LE12 5RD, UK; [8]Vereinigte Informationssysteme Tierhaltung w.V. (vit), Heideweg 1, D-27283 Verden, Germany



Multi-research site study with horizontally partitioned data

Multiple industrial partners

Can we create novel indicators of metabolic imbalance during the transition period and their association with production parameters ***ACROSS*** *European research farms*


Wallonie
recherche
CRA-W
UCD
DUBLIN
AARHUS UNIVERSITY
FBN
crea
Consiglio per la ricerca in agricoltura
e l'analisi dell'economia agraria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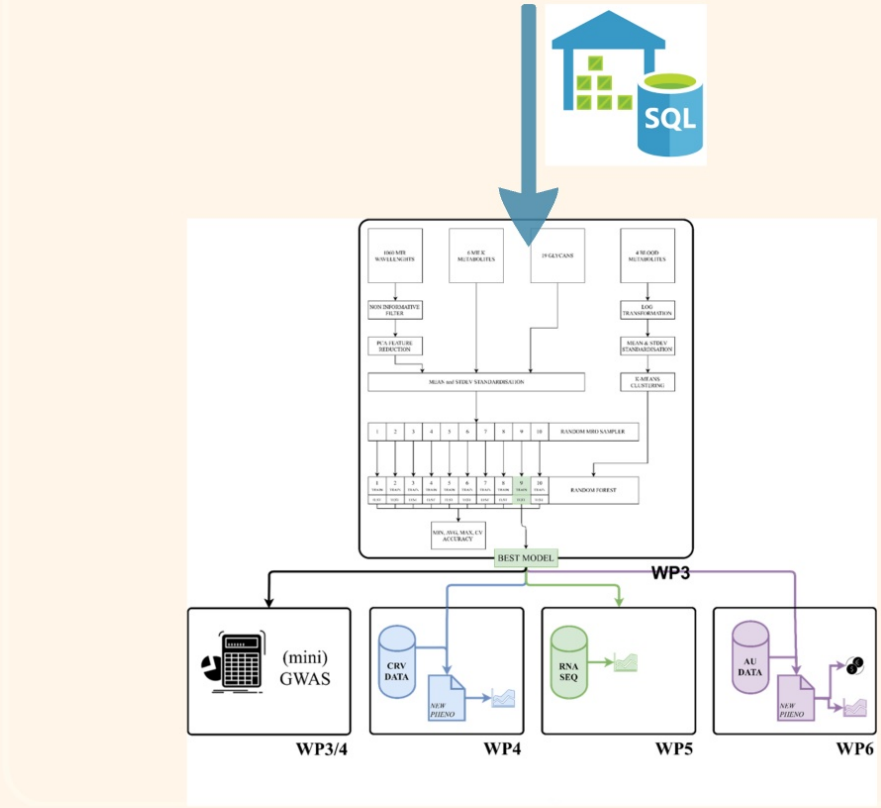
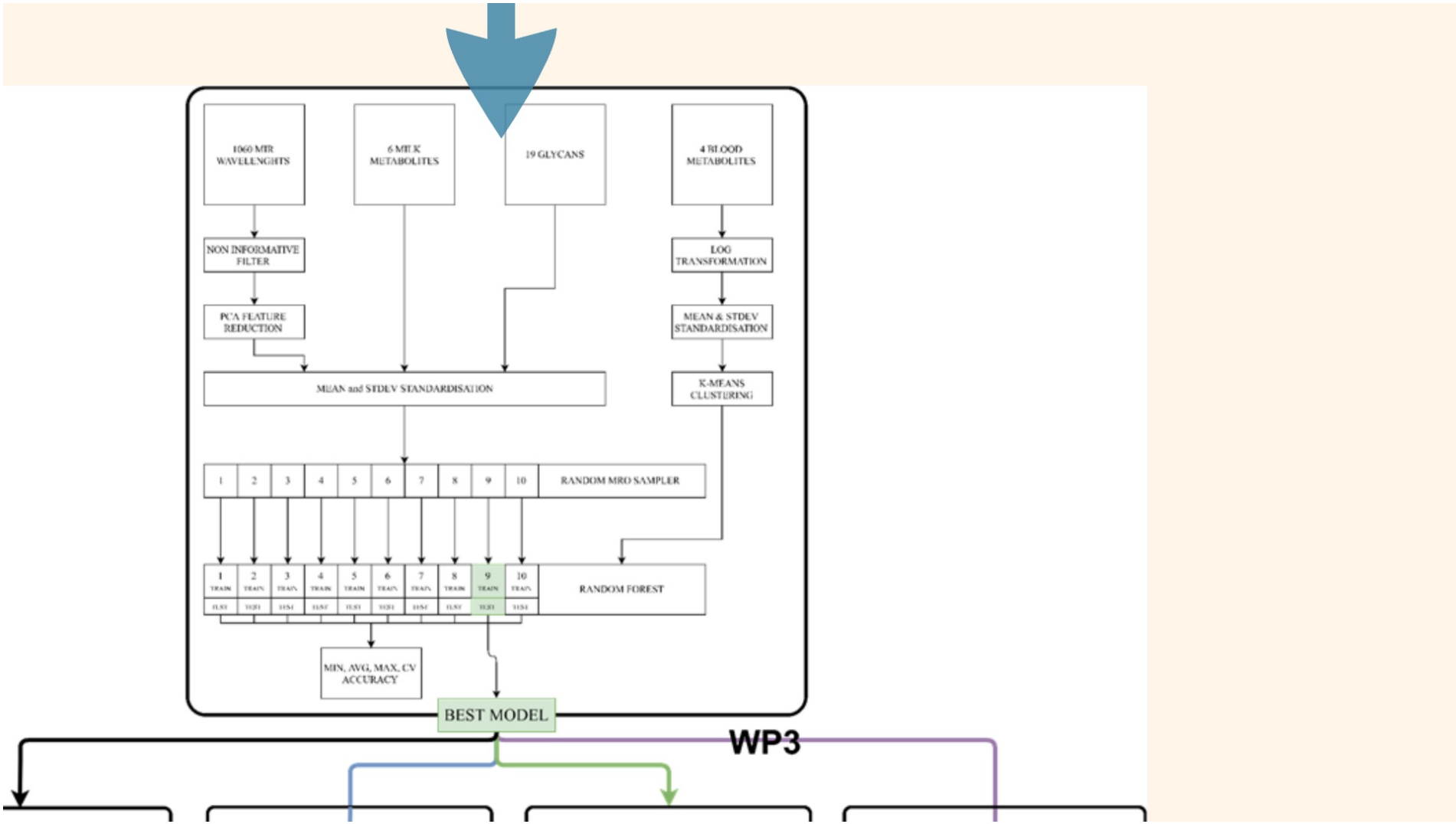
SQL


SQL
BEST MODEL
WP3
(mini)
GWAS
CRV
DATA
RNA
SEQ
AU
DATA
WP3/4
WP4
WP5
WP6


1060 MIR WAVELENGHTS
6 MEK METABOLITES
19 GLYCANS
4 BLOOD METABOLITES
NON INFORMATIVE FILTER
PCA FEATURE REDUCTION
LOG TRANSFORMATION
MEAN & STDEV STANDARDISATION
MEAN and STDEV STANDARDISATION
K-MEANS CLUSTERING
1 2 3 4 5 6 7 8 9 10 RANDOM MRO SAMPLER
1 TRAIN 2 TRAIN 3 TRAIN 4 TRAIN 5 TRAIN 6 TRAIN 7 TRAIN 8 TRAIN 9 TRAIN 10 TRAIN
RANDOM FOREST
MIN, AVG, MAX, CV ACCURACY
BEST MODEL
WP3

BALANCED vs OTHER

ELSEVIER

Journal of Dairy Science
Volume 102, Issue 3, March 2019, Pages 2631-2644

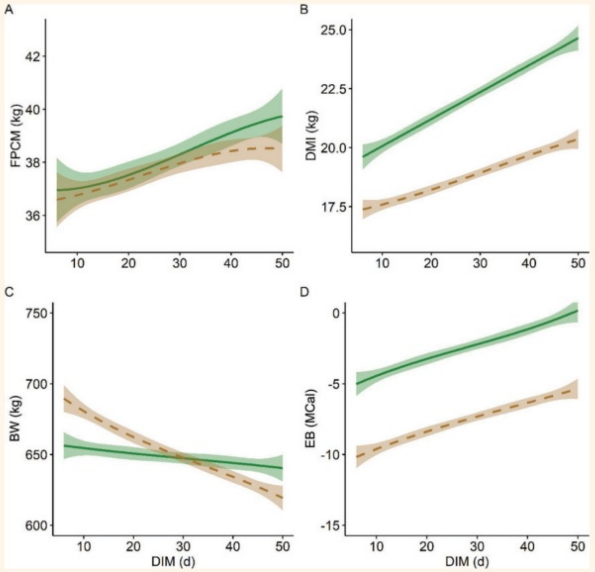
Research

Prediction of metabolic clusters in early-lactation dairy cows using models based on milk biomarkers

J. De Koster [1], M. Salavati [2], C. Grelet [3], M.A. Crowe [4], E. Matthews [4], R. O'Flaherty [5], G. Opsomer [1], L. Foldager [6, 7], GplusE *, M. Hostens [1]

BALANCED vs OTHER

BALANCED vs OTHER

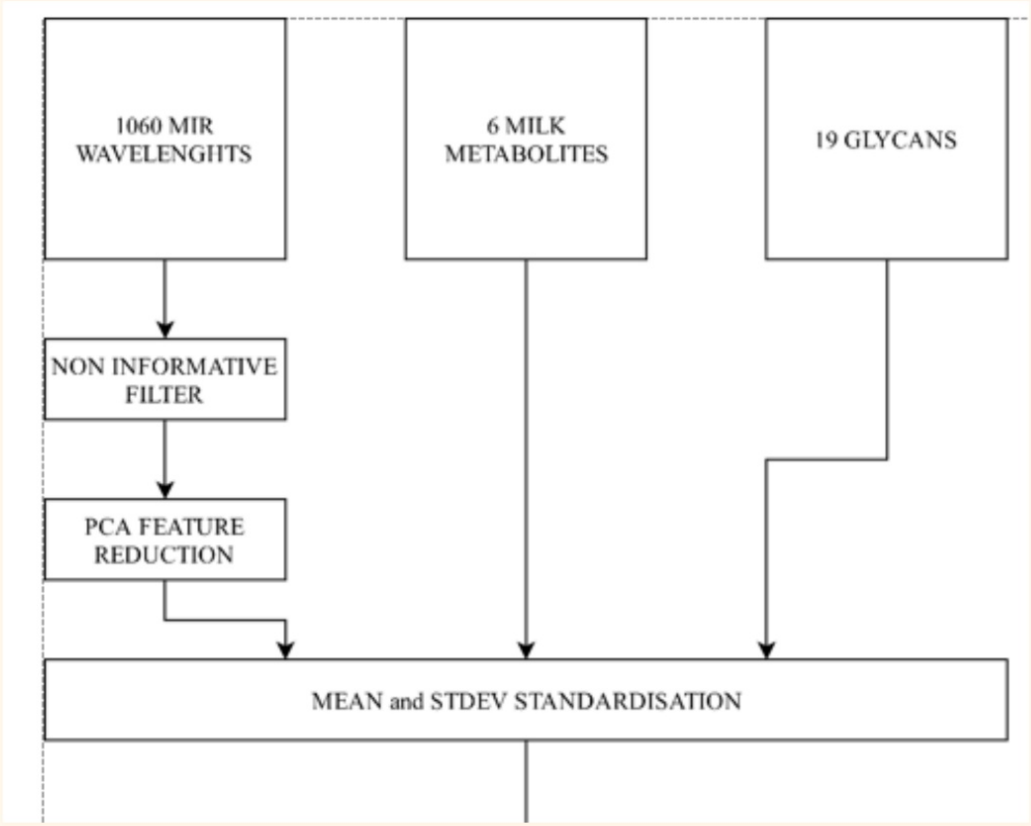


So we have a new phenotype to identify metabolically balanced cows, that are resilient during the transition

But what is next?

3 biomarkers in milk

- **Metabolites and enzymes**
  - glucose
  - glucose-6-phosphate
  - BHB
  - LDH
  - NABD-glucosaminidase
  - isocitrate
- **Glycans** (19 peaks)
- **FT-MIR spectra** (1060 peaks grouped into 15 principal components)


1060 MIR WAVELENGHTS
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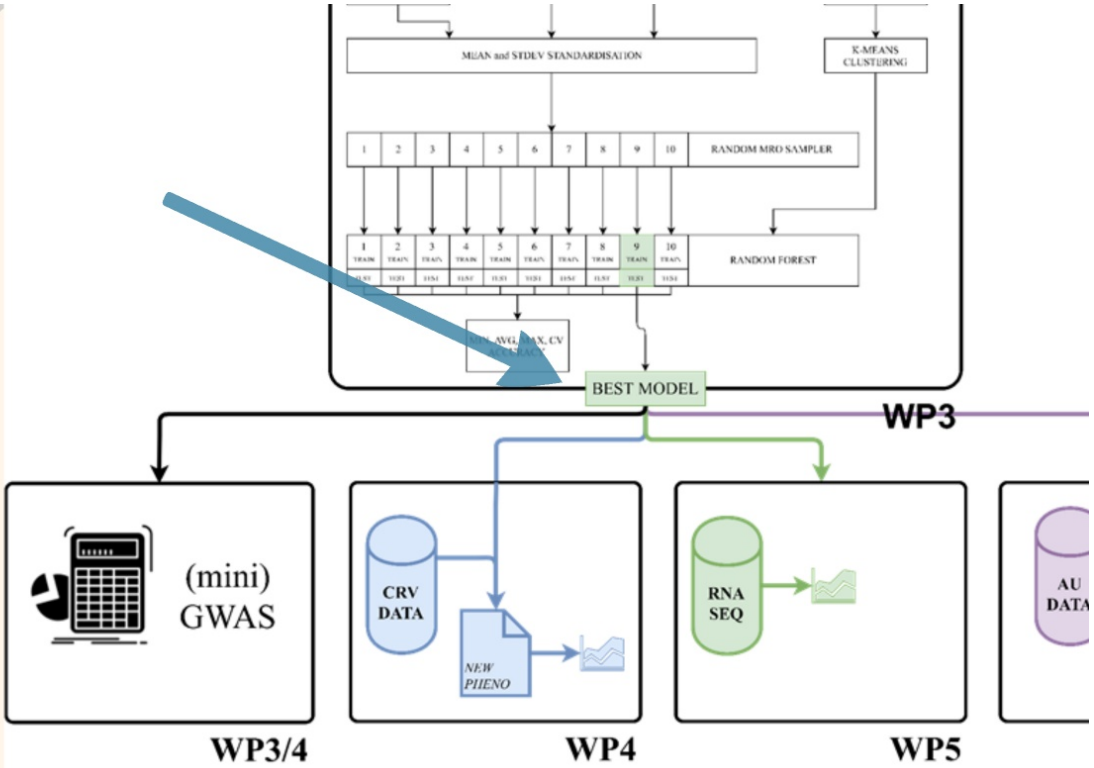
MEAN and STDEV STANDARDISATION


MEAN and STDEV STANDARDISATION
K-MEANS CLUSTERING
RANDOM MRO SAMPLER
RANDOM FOREST
BEST MODEL
WP3
(mini) GWAS
CRV DATA
NEW PHENO
RNA SEQ
WP3/4
WP4
WP5

Can we predict "balanced cows" from milk?

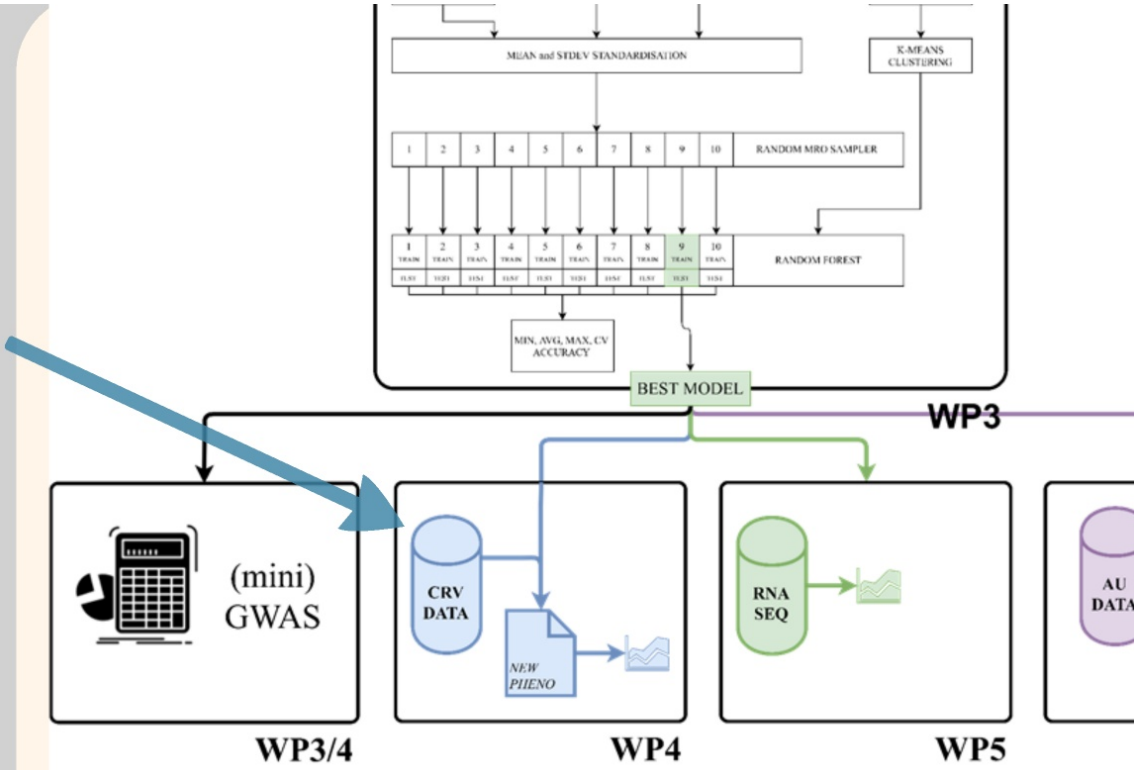
Can we predict "balanced cows" from milk?

J. Dairy Sci. 102:2631–2644
https://doi.org/10.3168/jds.2018-15533

Prediction of metabolic clusters in early-lactation dairy cows using models based on milk biomarkers

J. De Koster,[1] M. Salavati,[2] C. Grelet,[3] M. A. Crowe,[4] E. Matthews,[4] R. O'Flaherty,[5] G. Opsomer,[1] L. Foldager,[6,7] GplusE,* and M. Hostens[1]†
[1]Department of Reproduction, Obstetrics and Herd Health, Ghent University, B-9820 Merelbeke, Belgium
[2]Royal Veterinary College, NW1 0TU London, United Kingdom
[3]Walloon Agricultural Research Center, Valorisation of Agricultural Products Department, B-5030 Gembloux, Belgium
[4]University College Dublin, 4 Dublin, Ireland
[5]GlycoScience Group, NIBRT, Fosters Avenue, Mount Merion, 4 Dublin, Ireland
[6]Department of Animal Science, Aarhus University, DK-8830 Tjele, Denmark
[7]Bioinformatics Research Centre, Aarhus University, DK-8000 Aarhus, Denmark

Yes, using milk MIR!
or Milk Metabolites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WP3
(mini) GWAS
CRV DATA
NEW PHENO
RNA SEQ
AU DATA
WP3/4
WP4
WP5

Is being "metabolically balanced" heritable?

- The region of 36,258 to 36,295 kb on BTA27 was the most highly associated region for the predicted metabolic clusters.
- The heritability (0.17) of the predicted metabolic clusters indicates that its genetic variation is large enough for genetic selection.
- BUT ONLY VALIDATED IN ONE COUNTRY ALTHOUGH MORE PARTNERS

Is being "metabolically balanced" heritable?

J. Dairy Sci. 103:6392–6406
https://doi.org/10.3168/jds.2019-17369

Genome-wide association for metabolic clusters in early-lactation Holstein dairy cows

H. Atashi,[1,2] M. Salavati,[3] J. De Koster,[1] M. A. Crowe,[4] G. Opsomer,[1] the GplusE consortium, and M. Hostens[1]*
[1]Department of Reproduction, Obstetrics and Herd Health, Ghent University, Merelbeke 9820, Belgium
[2]Department of Animal Science, Shiraz University, Shiraz 71441-65186, Iran
[3]The Roslin Institute and Royal (Dick) School of Veterinary Studies, University of Edinburgh, Easter Bush, Midlothian EH25 9RG, UK
[4]University College Dublin, 4 Dublin, Ireland

Yes, it is!

- The region of 36,258 to 36,295 kb on BTA27 was the most highly associated region for the predicted metabolic clusters.
- The heritability (0.17) of the predicted metabolic clusters indicates that its genetic variation is large enough for genetic selection.
- BUT ONLY VALIDATED IN ONE COUNTRY ALTHOUGH MORE PARTNERS

Data driven lessons learned ...

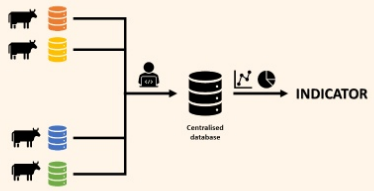
Data driven lessons learned ...

- People sometimes refused to share data, although agreed in "the project agreement"
- We lost over 3 years of the project debating about "the industry agreement" with new partners

Technical lessons learned ...

Technical lessons learned ...

- Don't use data warehouses in your research
- Create flexible data stores & pipelines
- Model & indicator development took 5 years




Your milk recording organisation


Your milk recording organisation

The future ?

- Is the industry really willing to share data?
- Are solutions such as BlockChain/JoinData/DjustConnect/IDDEN the solution if we even fail in the willingness to share data?
- Do we have profound knowledge of integrating 'Big Data' in the industry?
- Do farmers get any benefits yet?
- Is the VALUE ever flowing back to the farmers?

The future ?

But this is still reality,...

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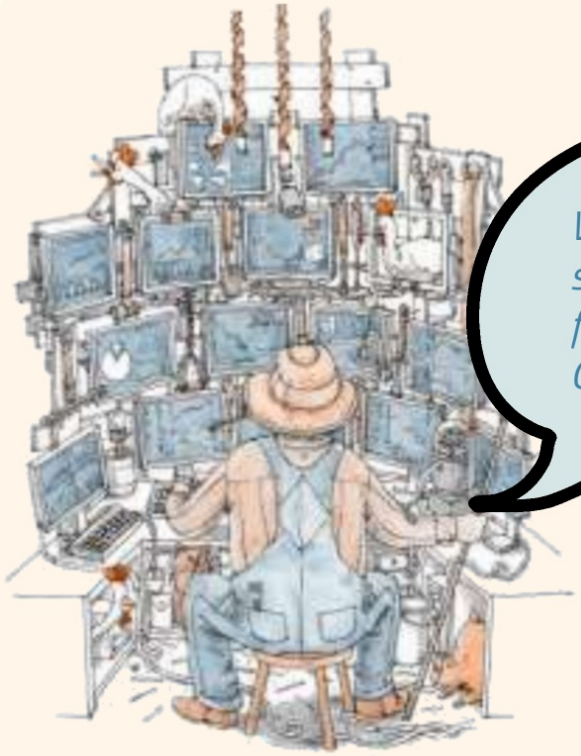

Which cow(s) should I have my focus on, right now, GIVEN all my data?

UNIVERSITEIT GENT

MmmooOgle

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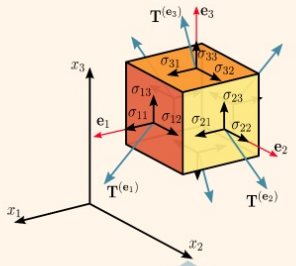
Can we represent all this information from different sources as a **TENSOR**

Can we represent all this information from different sources as a **TENSOR**



MmmooOgle

DeLaval GEA uniform agri vas LELY AgroVision Smart farming

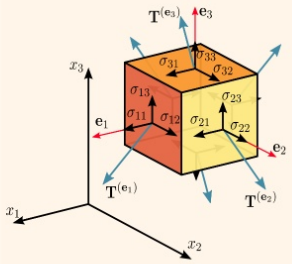


Table 1
Independent variables used in this study.

Variable Group	Dimension	Variable Name
Milk Yields	1 × 305	
		Milk Yield
Herd Statistics	10 × 1	
		Avg 21d Milk
		Avg 75d Milk
		Avg 305d Milk
		Avg Milk
		Avg Days Dry
		Avg Days Open
		Avg Days Pregnant
		Avg Days In Milk
		Avg Calving Interval
		Avg Sequence Quality
Events	1 × 305	
		Mastitis
		Abort
		Breeding
		Stop Breeding
		Pregnancy Negative
		Pregnancy Positive
		Calving
		Disease
		Died
		Heat
		Cull
		Dryoff
		PAD
		UNKNOWN
Parity	1 × 1	
		Lactation Number

In mathematics, a tensor is an algebraic object that describes a (multilinear) relationship between sets of algebraic objects related to a vector space.

Neural network pipeline

Contents lists available at ScienceDirect

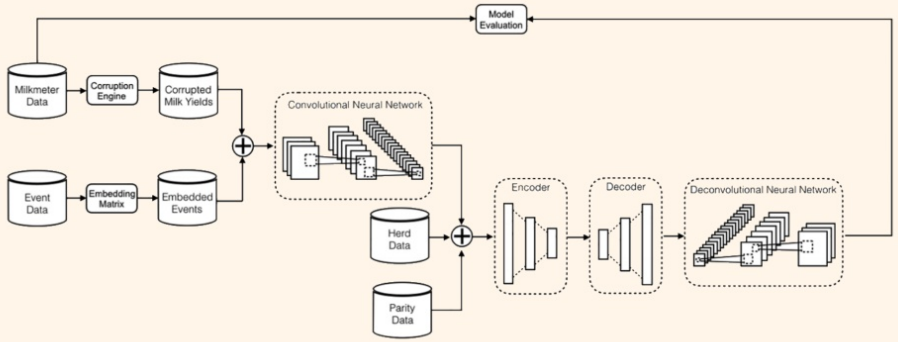
Computers and Electronics in Agriculture

journal homepage: www.elsevier.com/locate/compag

Leveraging latent representations for milk yield prediction and interpolation using deep learning

Arno Liseune[a,*], Matthieu Salamone[b], Dirk Van den Poel[a], Bonifacius Van Ranst[b], Miel Hostens[b]

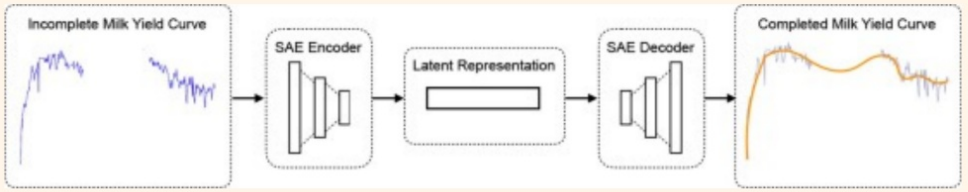
[a] Faculty of Economics and Business Administration, Ghent University, Tweekerkenstraat 2, B-9000 Ghent, Belgium
[b] Faculty of Veterinary Medicine, Ghent University, Salisburylaan133, B-9820 Merelbeke, Belgium



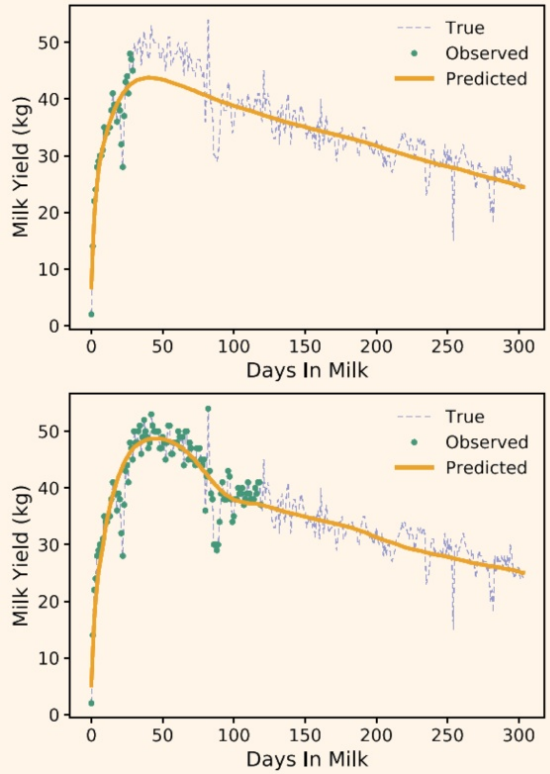
Use of Neural Networks

To ...

- Represent the lactation curve and see the effect of lifetime events
- Predict milk yield (interpolation, prediction)
- Predict subsequent life (disease) events



Prediction of milk yield in current lactation



Computers and Electronics in Agriculture
Volume 180, January 2021, 105904

Original papers

Predicting the milk yield curve of dairy cows in the subsequent lactation period using deep learning

Arno Liseune [a], Matthieu Salamone [b], Dirk Van den Poel [a], Bonifacius van Ranst [b], Miel Hostens [b]

Liseune et al. 2021

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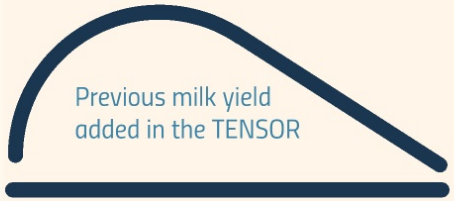

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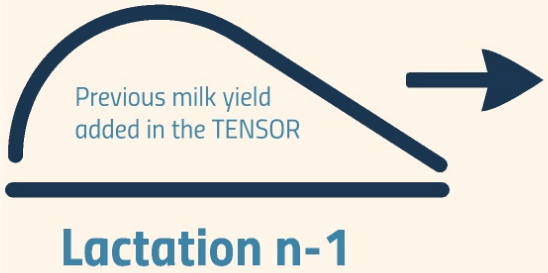

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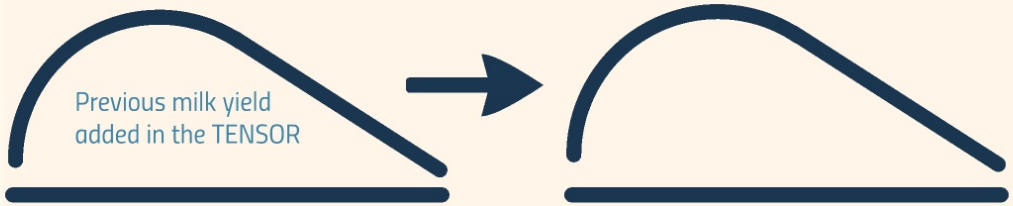

Lactation n-1

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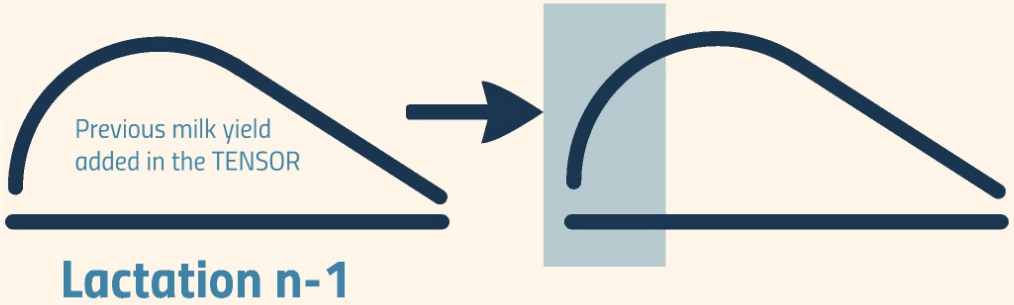

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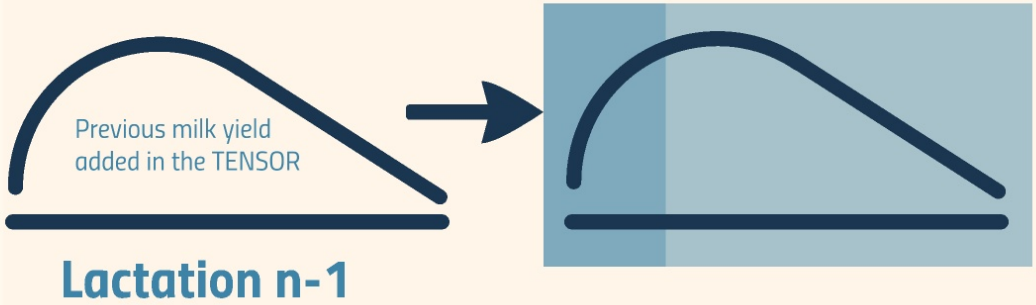
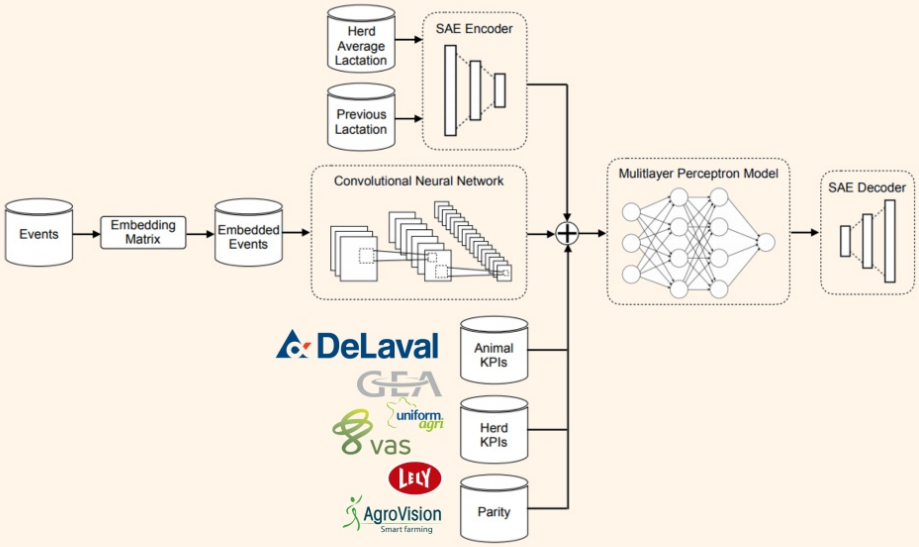


Liseune et al. 2021

Subsequent Lactation Milk Yield Predictor



Liseune et al. 2021

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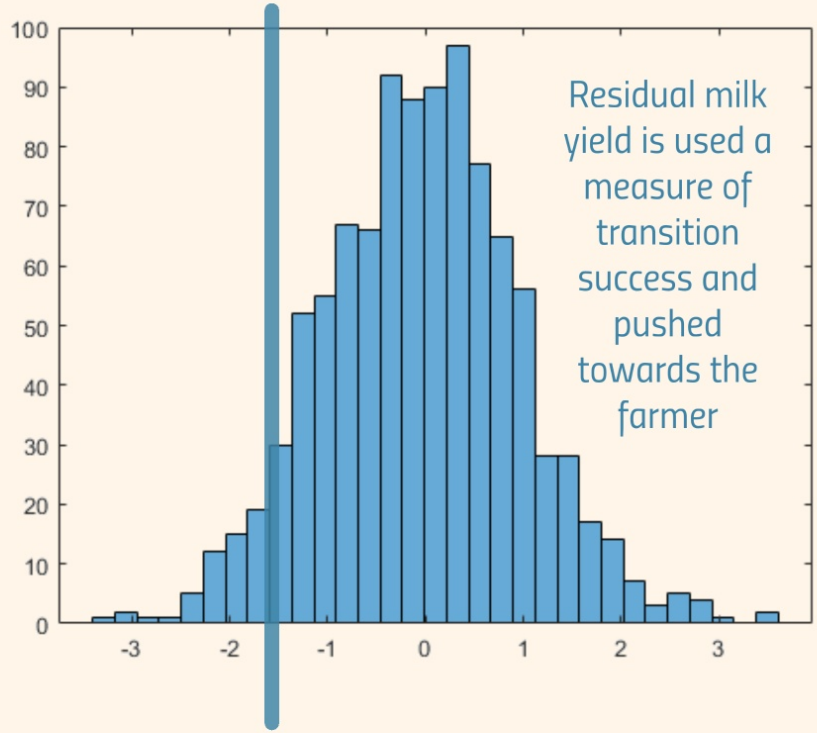

Further info

See sessions by

- Matthieu Salamone
- Chen YongYan
- Arno Liseune

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