GEroNIMO and RUMIGEN Joint Final Event

Breeding the Future

Genomics, Epigenomics & Societal Acceptability for Sustainability in Livestock

Trade-offs - evolution and use in breeding strategies

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Trade-offs in breeding

- Unfavourable genetic correlations, e.g. milk yield & fertility
- Selection for milk yield only will *decrease* fertility

- *Solution:* Multi-trait selection for milk yield and fertility
- => *Improves both* traits simultaneously

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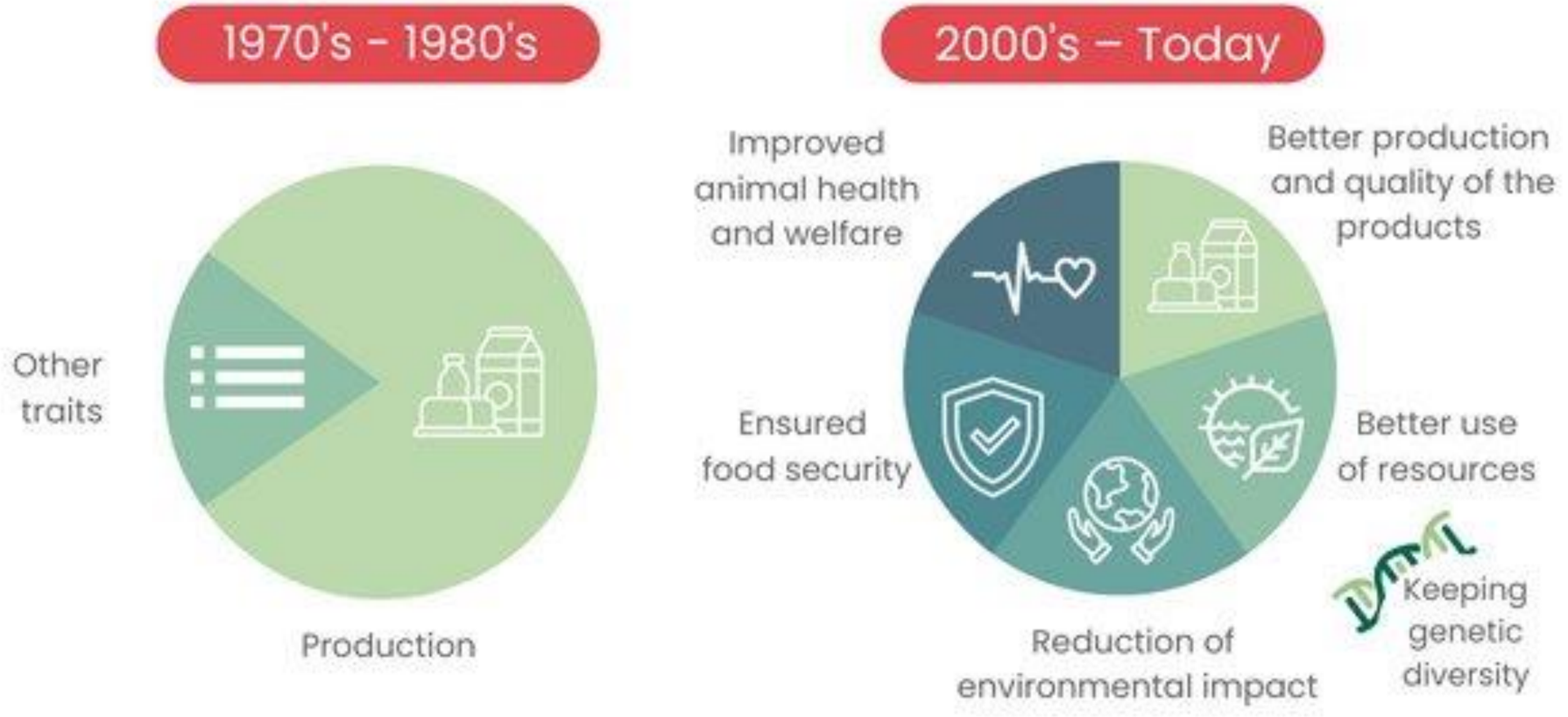
Multi-trait selection

Common practice for the last 20+ years:



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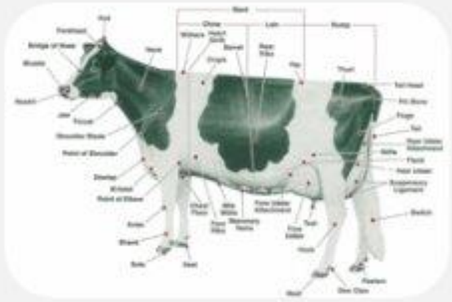
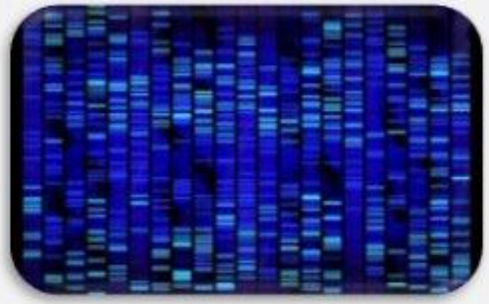
Source: Code EFABAR

Developments in breeding strategies

1980's	1990's	2000's	2010's	2020's
				
Solely on conformation	Milk production and components	Adding Fertility/ Health	Genomic selection	Feed efficiency / methane

Can we "see" the impact of those developments on trade-offs?

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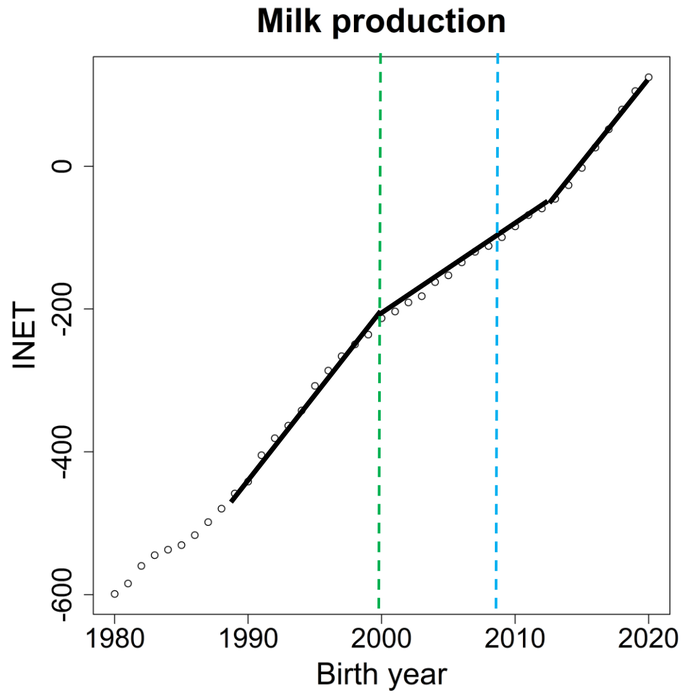
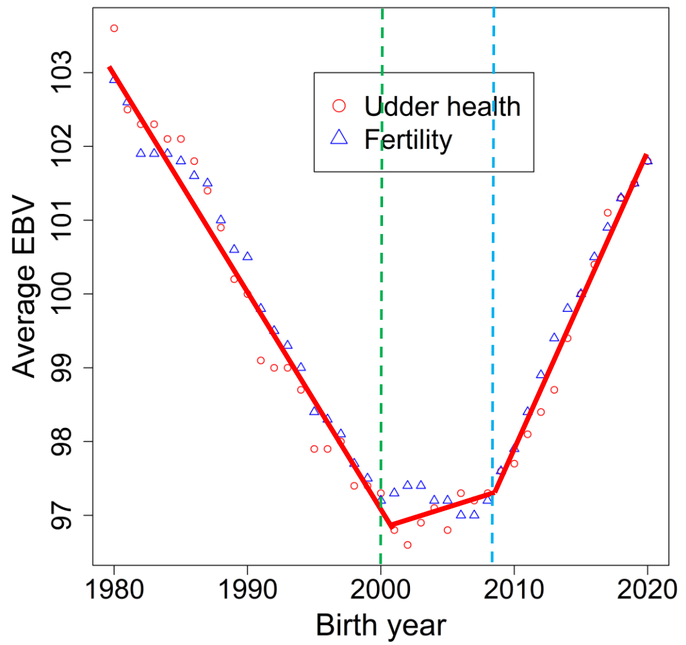
Genetic trends milk *versus* fertility

Expansion breeding goal

Introduction genomic selection





Source: https://www.crv4all.nl/

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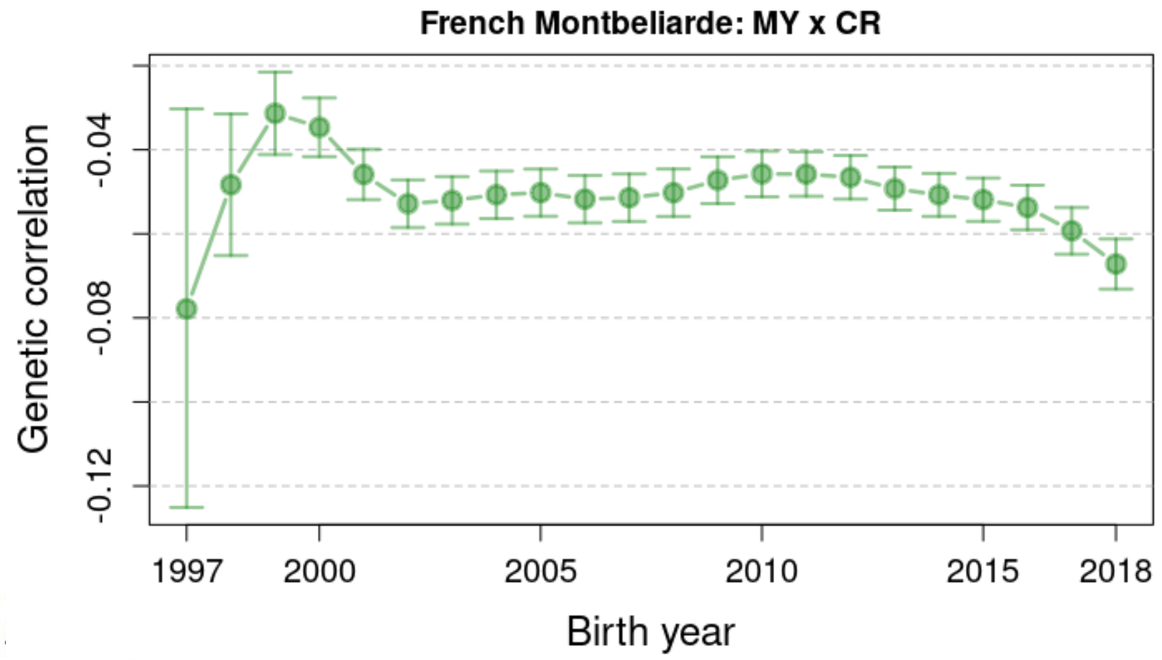
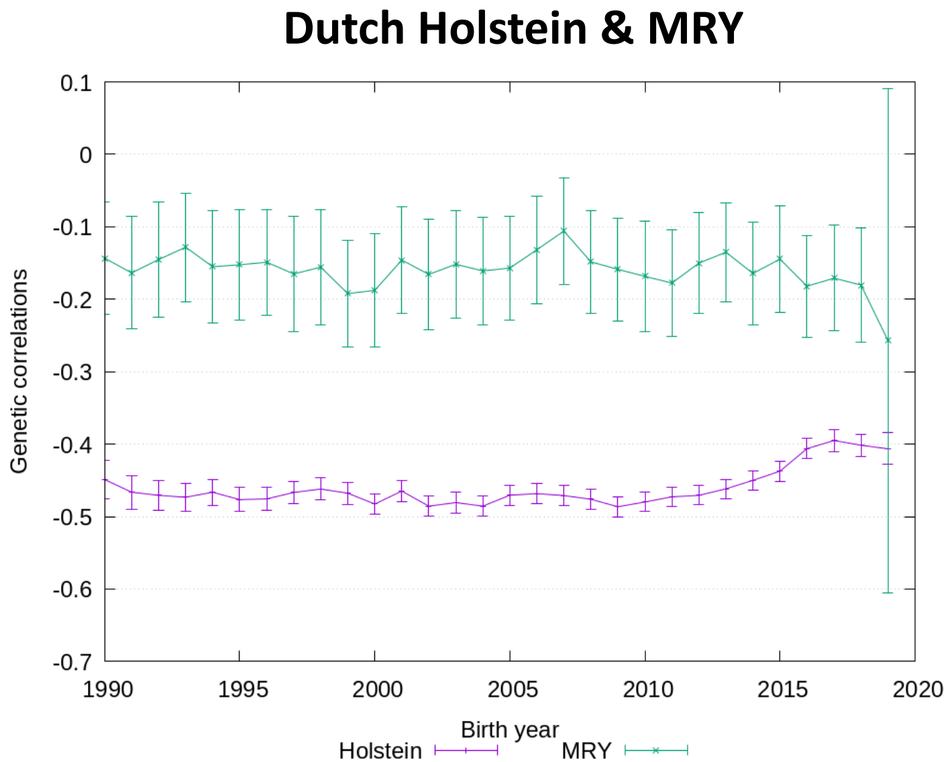
Changes in genetic correlations over time

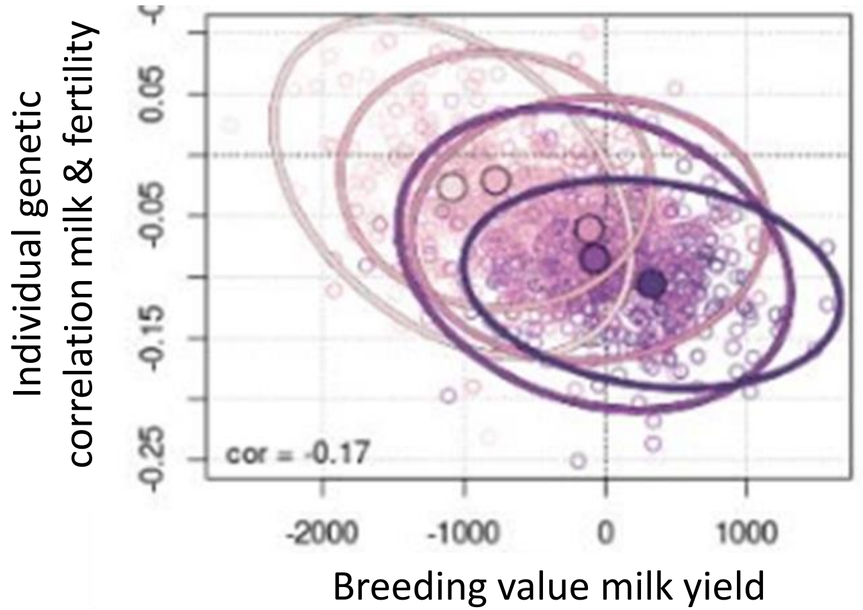
- **Expectation:** genetic correlations become *more unfavourable* due to selection
- **Observation:** *fairly stable* across the last 20-30 years in France (Holstein, Montbeliarde) and the Netherlands (Holstein, MRY)





How to *mitigate* unfavourable changes in genetic correlations?

Select on *observed* individual variation in genetic correlations:



Birth year: 1991 1995 2000 2010 2010 2015

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Cuyabano, B. C. D., M. R. Motta, J. Vandenplas, N. L. Garcia, F. Shokor, P. Croiseau, D. Boichard, S. Aguerre, and S. Mattalia. 2025. Trajectories of genetic correlations in populations under selection: from theory to a case-study. bioRxiv. https://doi.org/10.1101/2025.03.13.643026

Developments in breeding strategies

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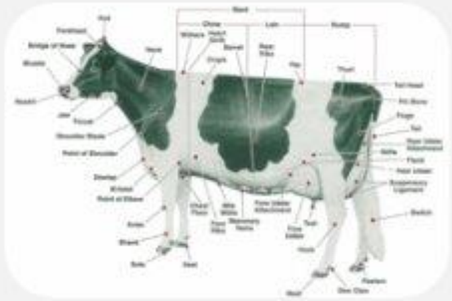			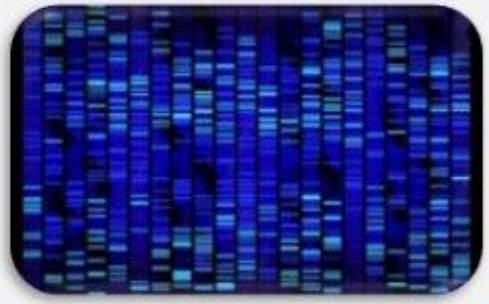	
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Can we use those developments to *limit* increasing trade-offs due to selection?

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How to *mitigate* unfavourable changes in genetic correlations (r_g)?

- Select on *predicted* individual variation in genetic correlations
  - Initial r_g = -0.3
- Observed correlations in *offspring* Mendelian Sampling terms (MS) & Breeding Values (BV):

Selection on:	Corr. MS	Corr. BV
Breeding values (*current standard*)	-0.30	-0.55
Including predicted individual correlation (in gametes)	-0.20	-0.46

=> Enables to *reduce* the impact of trade-offs!

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Calus, M. P. L., Y. C. J. Wientjes, P. Bijma, and T. A. M. Niehoff. Impact of considering gametic Mendelian Sampling (co)variances in multitrait selection. *In preparation.*

Take home messages

- Multi-trait genomic selection allows to improve *unfavourably* correlated traits simultaneously
  - Standard in animal breeding for the last ~15 years

- Genetic correlations expected to become *more unfavourable* due to multi-trait genomic selection

- Individual variation exists in genetic correlations & can be used to *reduce* impact of trade-offs
  - *New development*, leveraging multi-trait genomic selection

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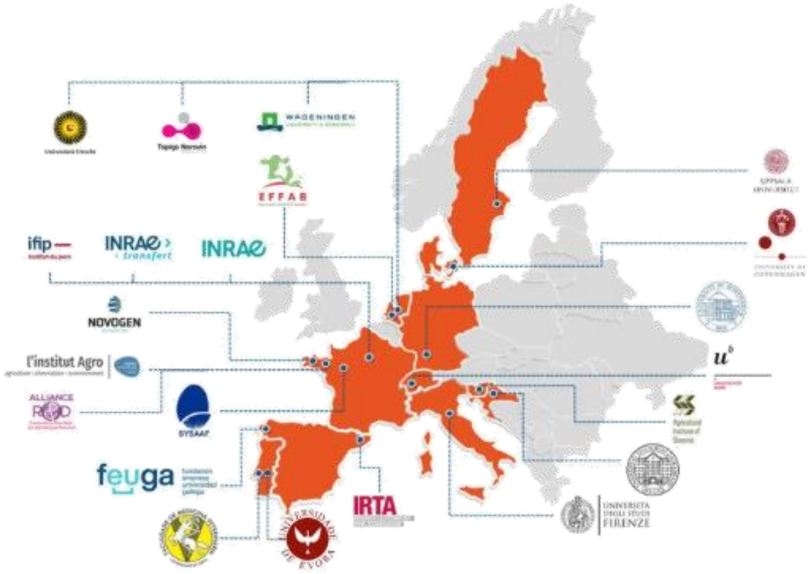
THANK YOU

TOWARDS IMPROVEMENT OF **RUMI**NANT BREEDING THROUGH **GEN**OMIC AND EPIGENOMIC APPROACHES

GENOME AND EPIGENOME ENABLED BREEDING IN MONOGASTRICS



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