



75th EAAP Annual Meeting
1/5 September 2024 - Florence, Italy



Session 51. Genetic progress vs animal welfare?

The evolution of dairy cattle breeding objectives

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Martino Cassandro – ANAFIBJ & University of Padua

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Breeding objectives evolution

from: Cassandro – Aspa 2019



Actors

1970

1990

2010

2030

years

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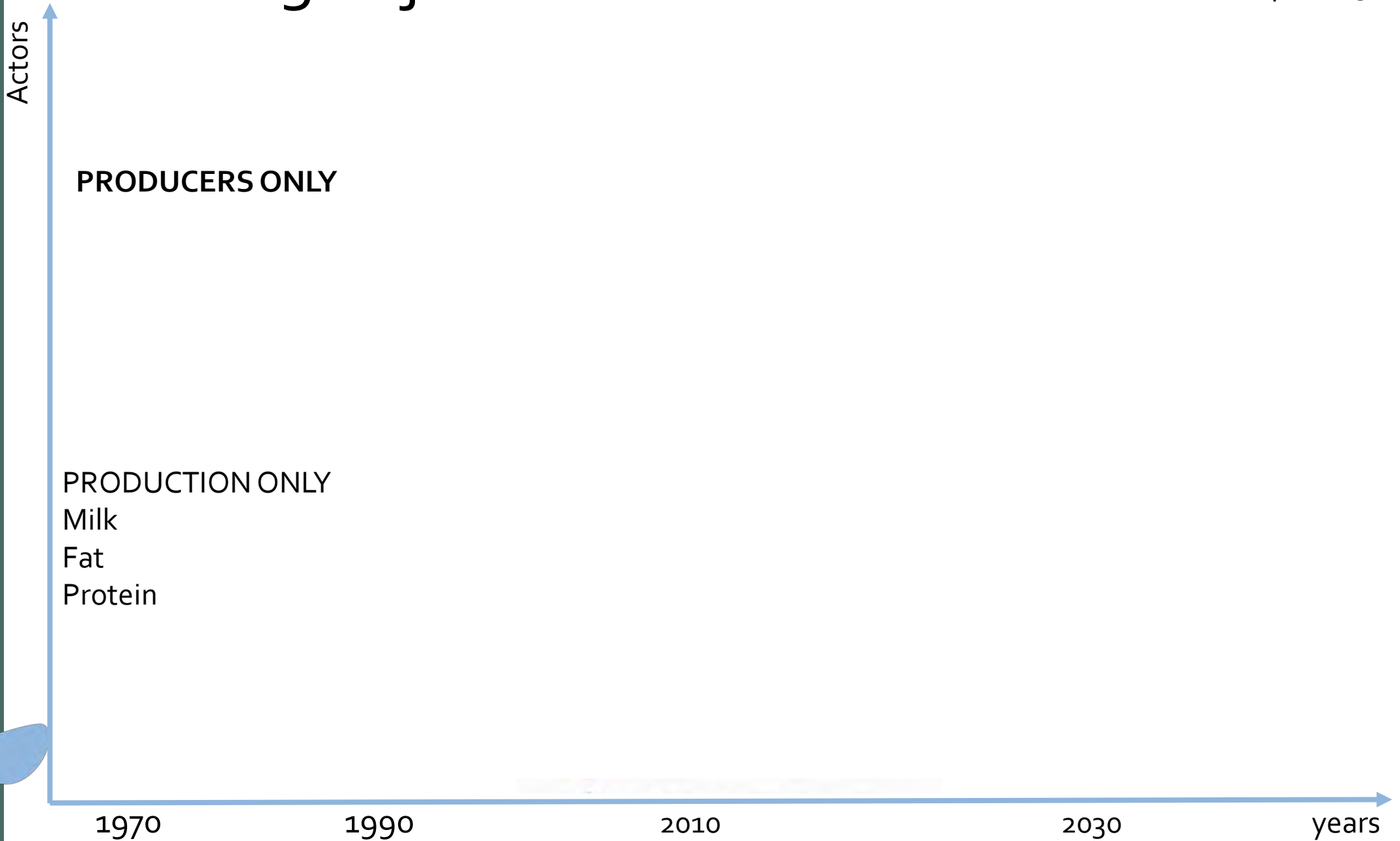


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Breeding objectives evolution

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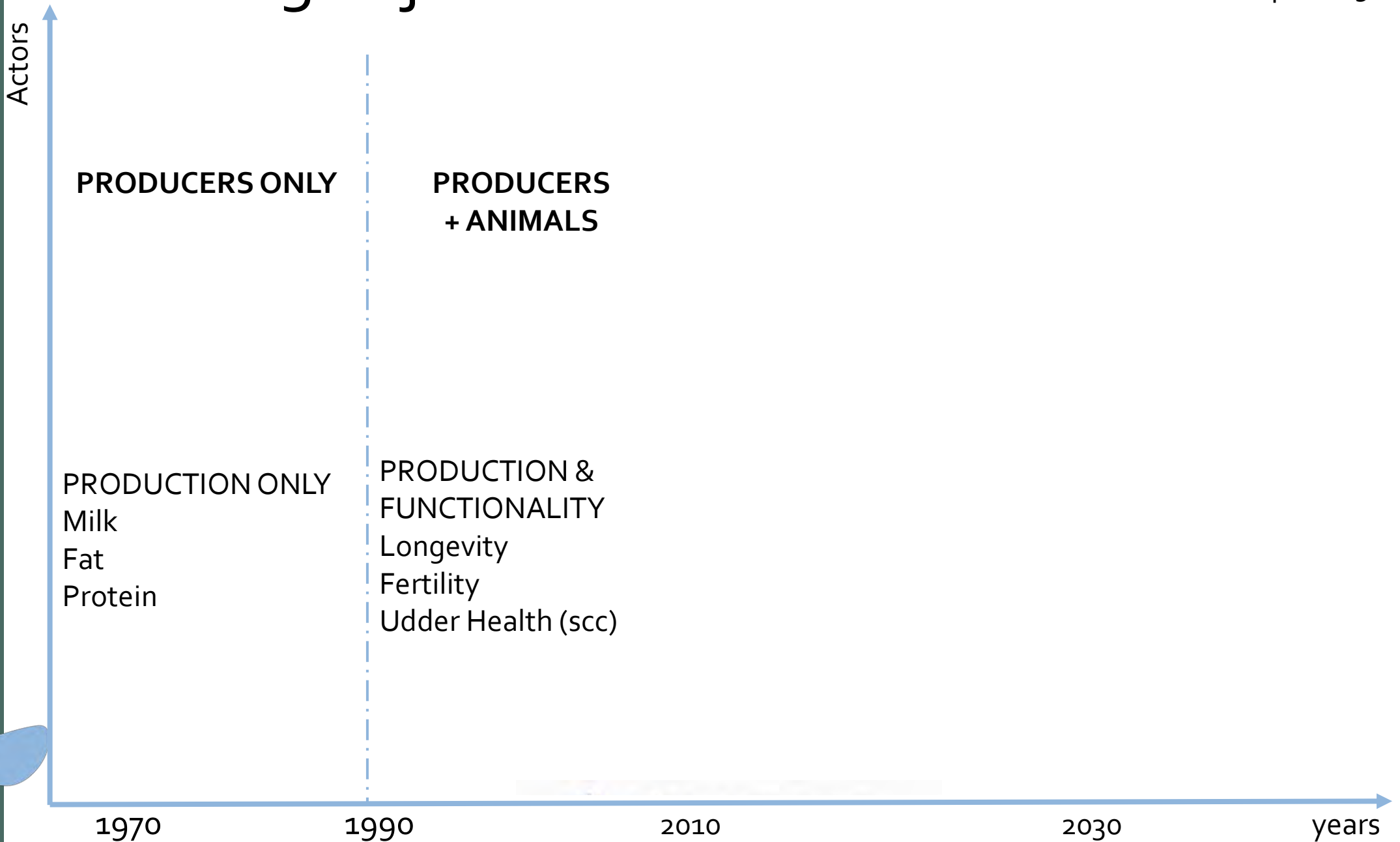


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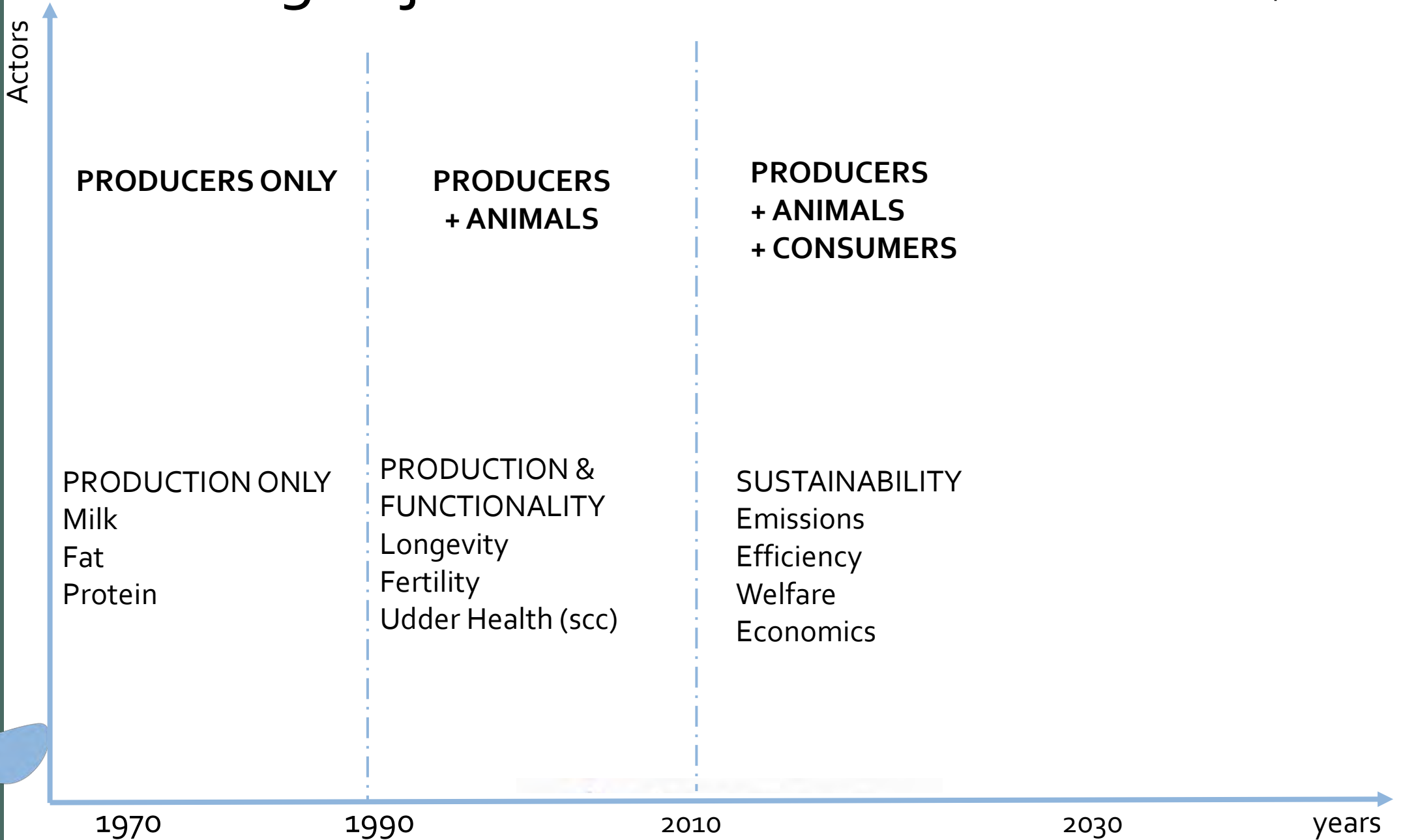


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Actors

PRODUCERS ONLY

**PRODUCERS
+ ANIMALS**

**PRODUCERS
+ ANIMALS
+ CONSUMERS**

**PRODUCERS
+ ANIMALS
+ CONSUMERS
+ SOCIETY**

PRODUCTION ONLY
Milk
Fat
Protein

**PRODUCTION &
FUNCTIONALITY**
Longevity
Fertility
Udder Health (scc)

SUSTAINABILITY
Emissions
Efficiency
Welfare
Economics

**PRESERVING NATURAL
RESOURCES**
Water
Air
Earth
Energy
Human Health

1970

1990

2010

2030

years

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Breeding objectives evolution

from: Cassandro – Aspa 2019



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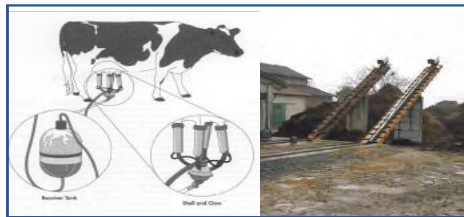
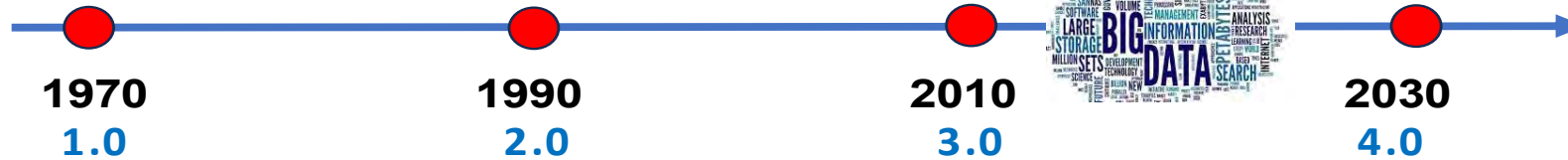
Evolution of the livestock system

LMF

LIF

LPF

LOF



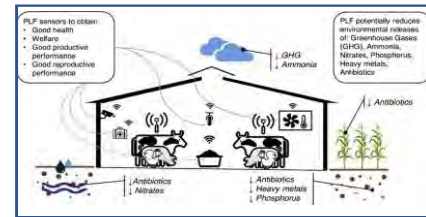
Livestock Mechanization Farming

- Mechanization
- Milking machine
- Less manual labor



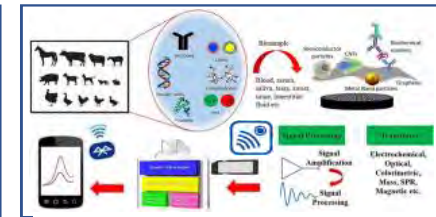
Livestock Intensive Farming

- Infrastructure (LMF)
- Nutrition
- Quantitative Genetics
- Recording data



Livestock Precision Farming

- Livest. Intensive (LIF)
- Automation/Robot
- Genomic analysis
- Management data
- Big-data



Livestock Holistic Farming

- Precision livestock farming (PLF)
- High-performance phenotyping
- Traits ontologies
- In-/Cross-Breeding
- Genome editing
- Microbiome
- Deep/Machine learning
- Artificial Intelligence



Evolution of the livestock system

LMF

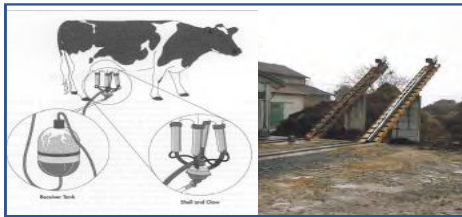
LIF

LPF

LOF

1970
1.0

WHAT WE WANT



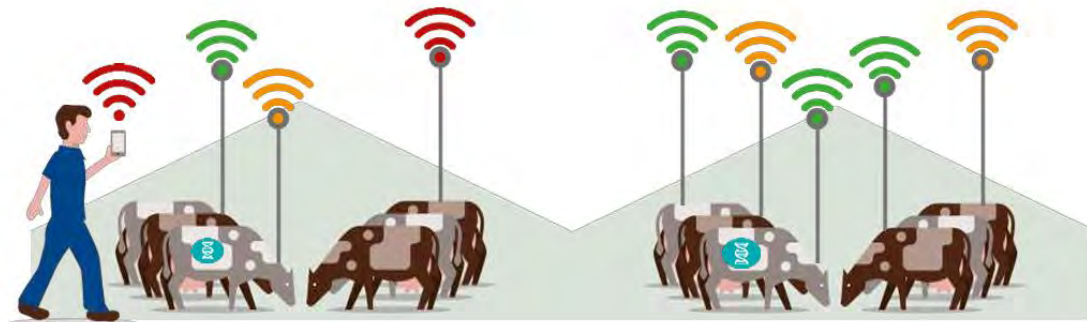
Livestock Mechanization Farming

- Mechanization
- Milking machine
- Less manual labor



Livestock Farming

- Infrastr
- Nutritio
- Quanti
- Recorc



PREDICT – PRESCRIBE – PERFORM

Integrating traditional and new data sources to enable Smart Herd Management

van der Beek et al. ICAR 2017

BETTER COWS | BETTER LIFE



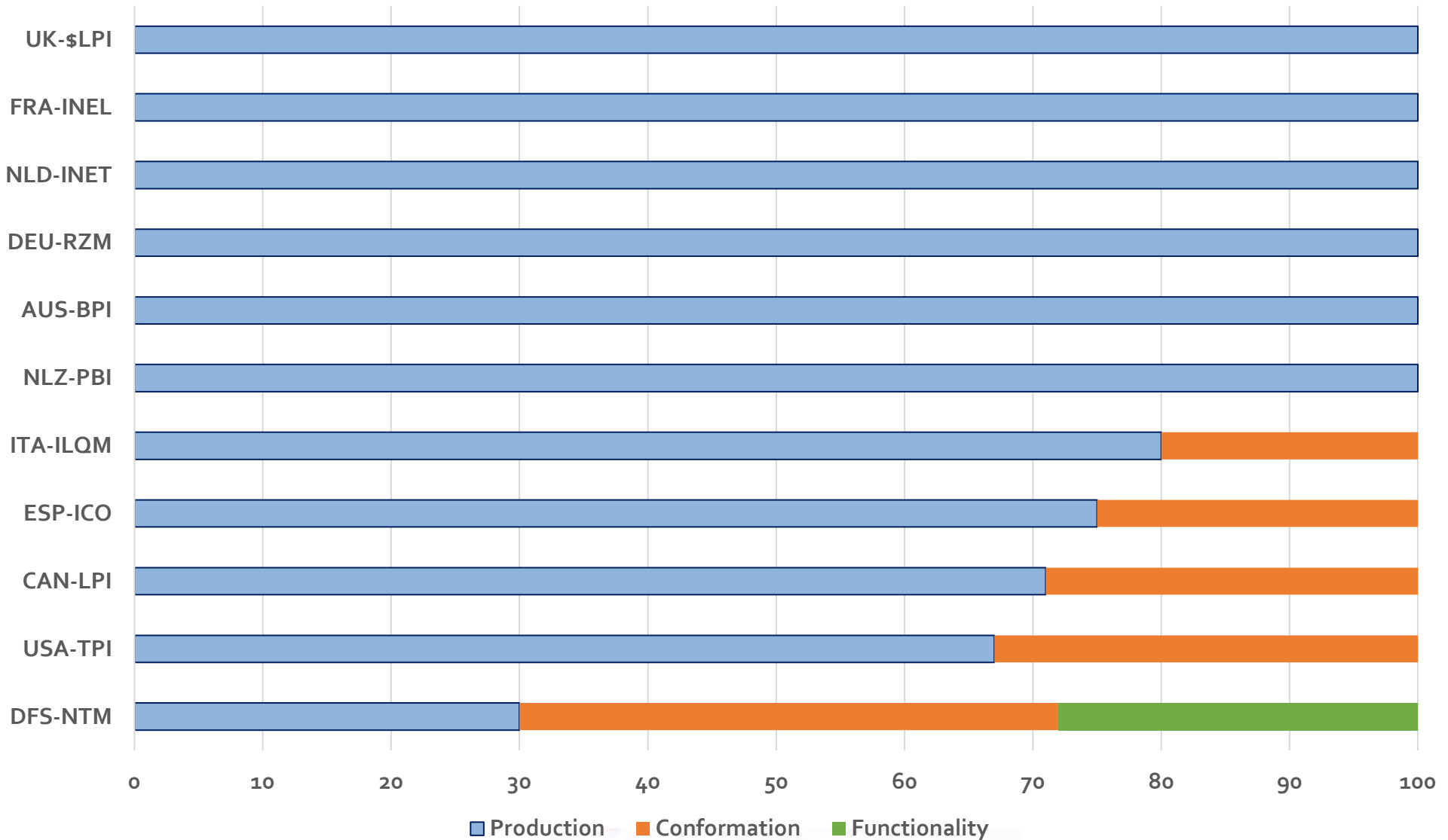


World breeding goal Evolution

'90s



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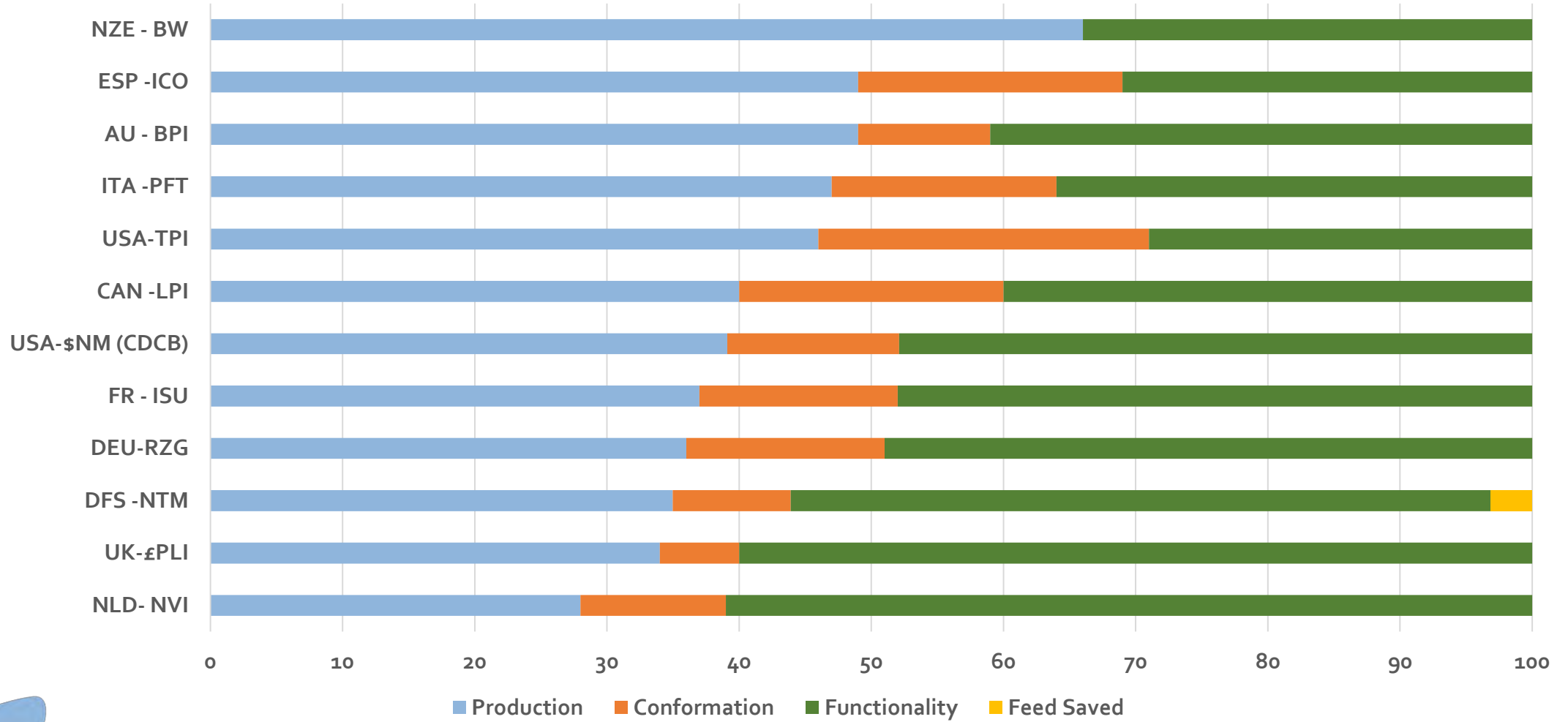


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World breeding goal Evolution (today)



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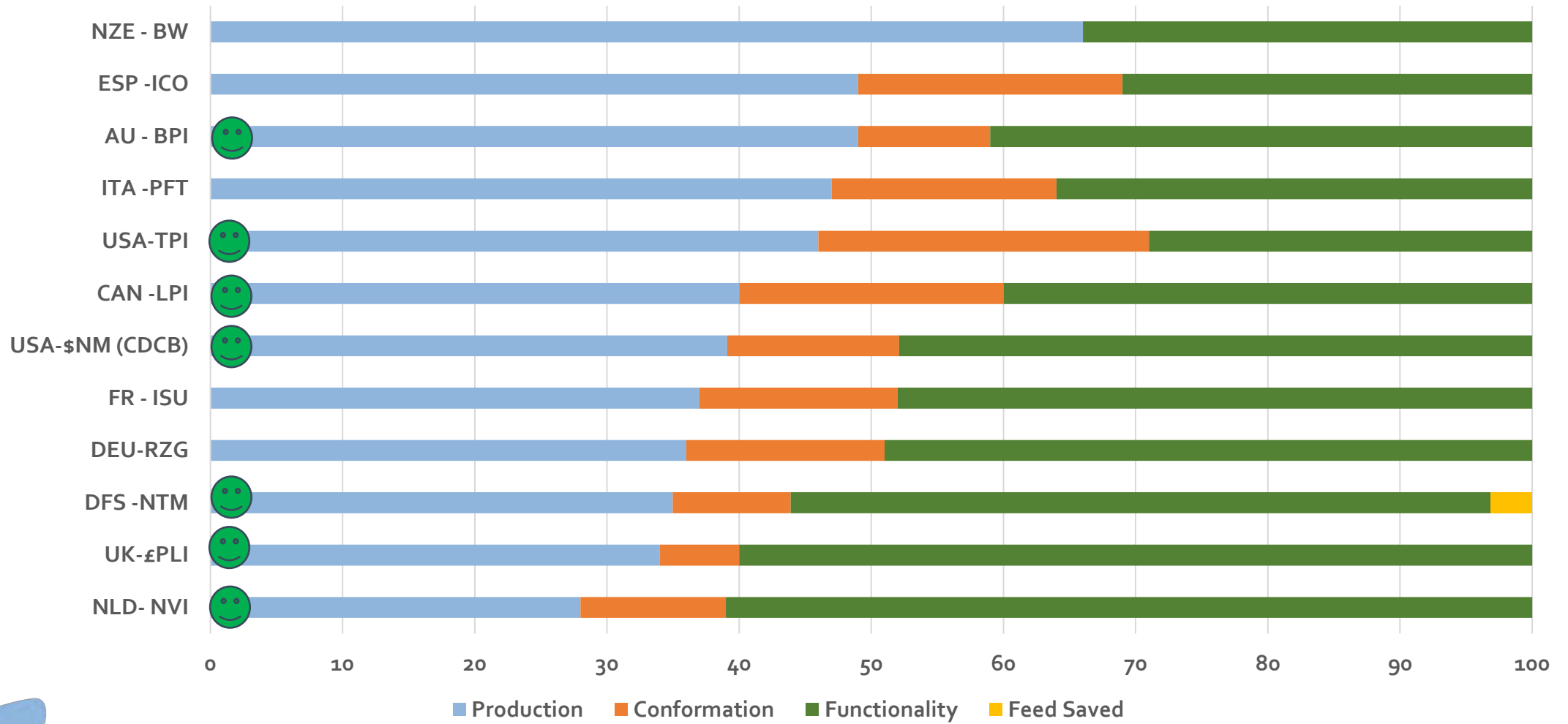


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World breeding goal Evolution (today)

😊 Countries with **Feed Efficiency** trait included in the breeding goal



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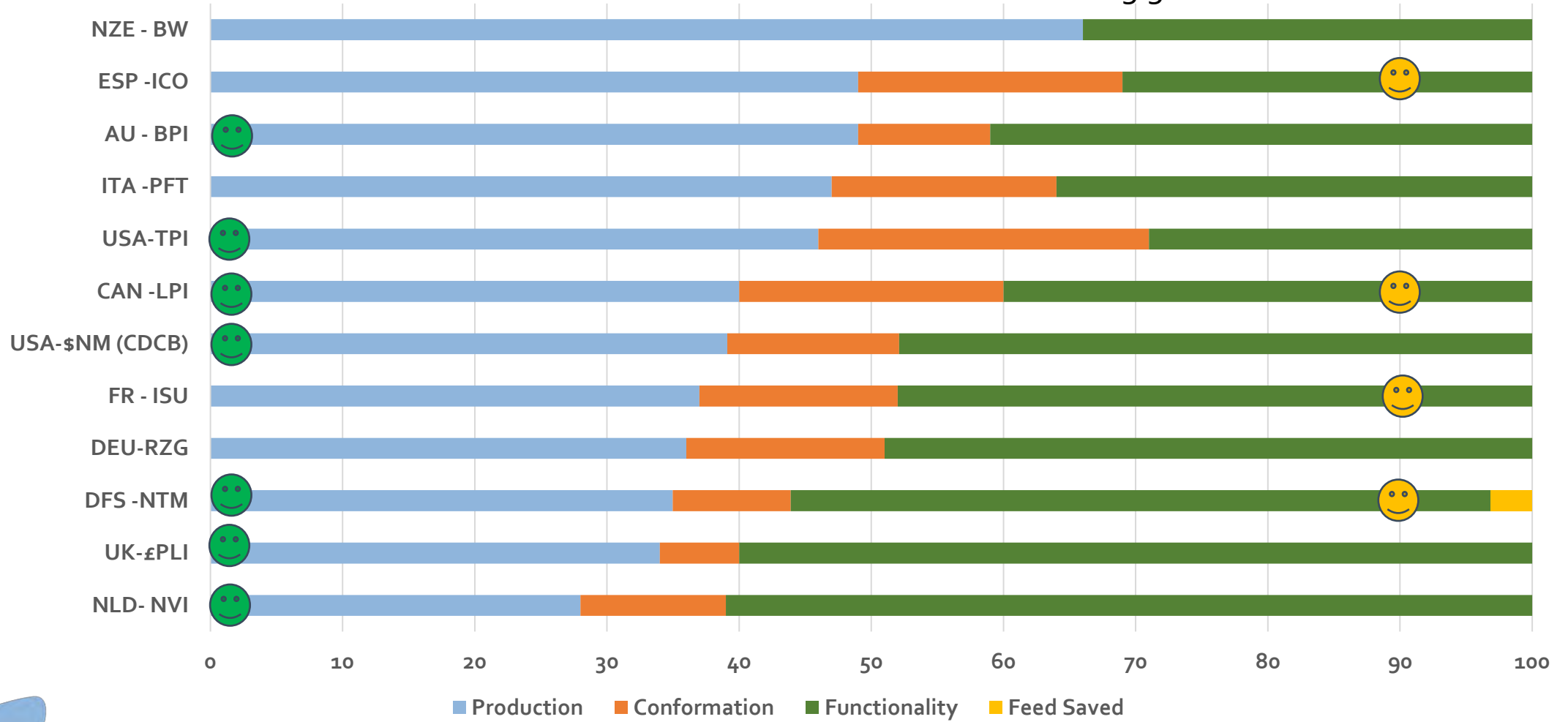


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World breeding goal Evolution (today)

- 😊 Countries with **Feed Efficiency** trait included in the breeding goal
- 😄 Countries with **Hoof Health** trait included in the breeding goal



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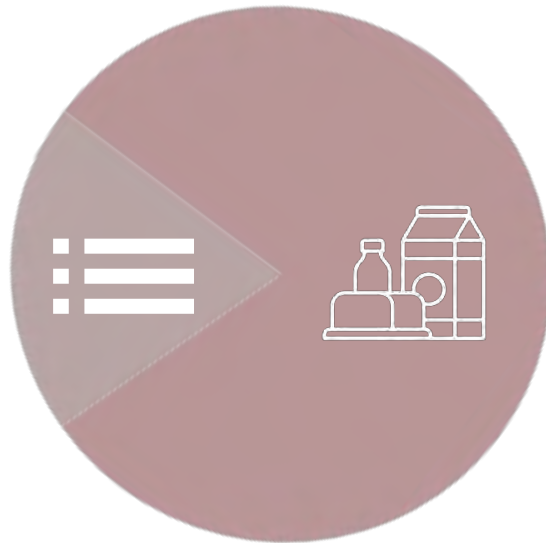
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Modern Animal Breeding

1970's - 1980's

2000's - Today

Other traits



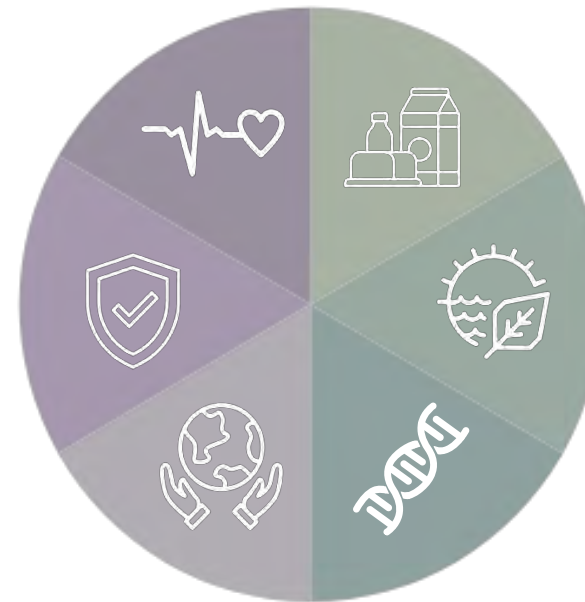
Production Traits

Improved animal health and welfare

Better production and quality of the products

Ensured food security

Better use of resources



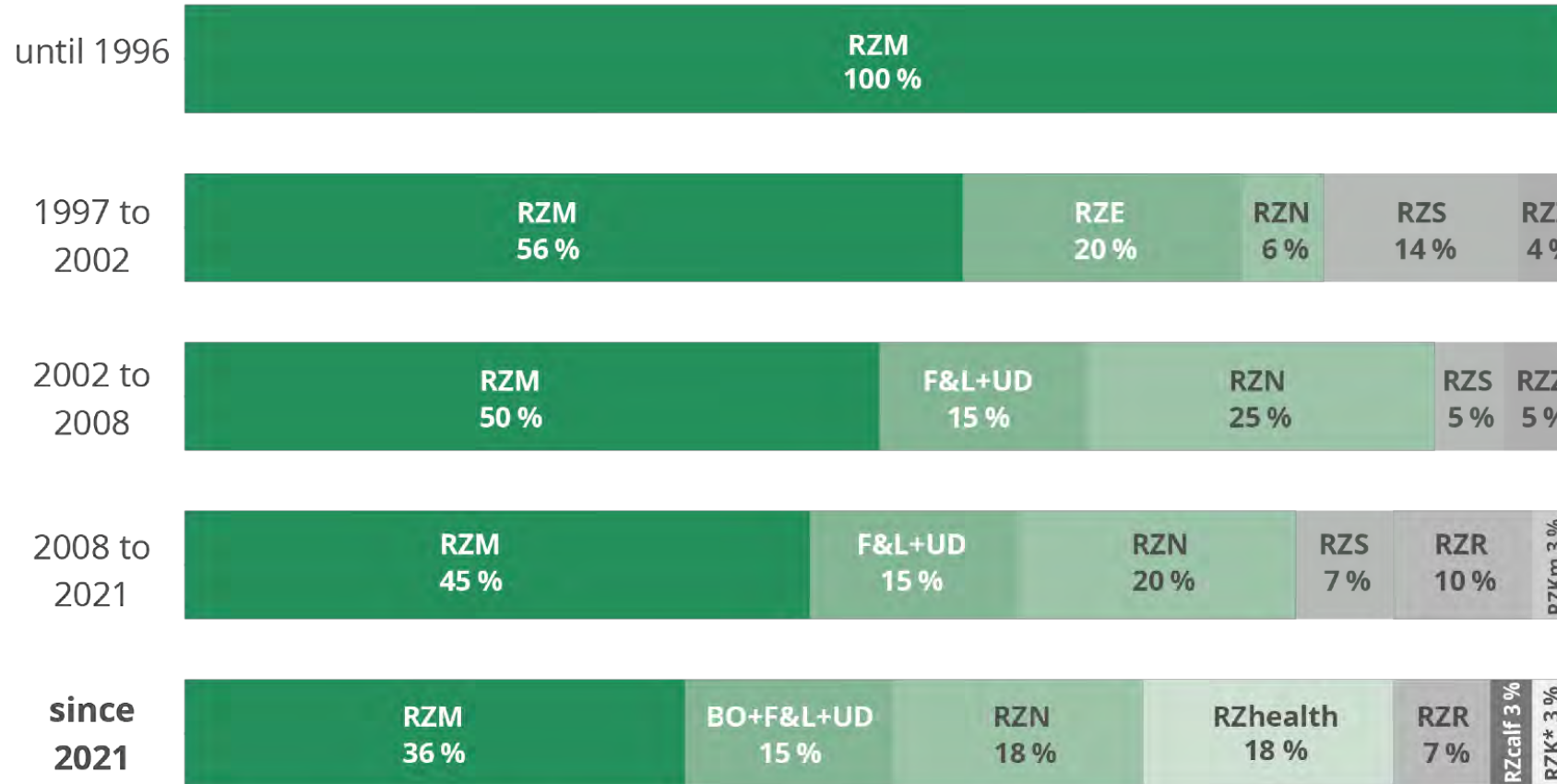
Reduction of environmental impact

Preserving genetic diversity





Few countries example: Germany



Total merit index (RZG) for German Holsteins

Explanation of the breeding value abbreviations

- RZM milk production
- BO body
- F&L feet and legs
- UD udder
- RZN functional herd life
- RZhealth health
- RZR daughter fertility
- RZcalf calf health
- RZK_m maternal calving ease
- RZK_d direct calving ease
- RZE conformation
- RZS somatic cell score
- RZZ breeding performance

* RZK = RZK_m 1,5 % + RZK_d 1,5 %

© www.rz-germanholsteins.com

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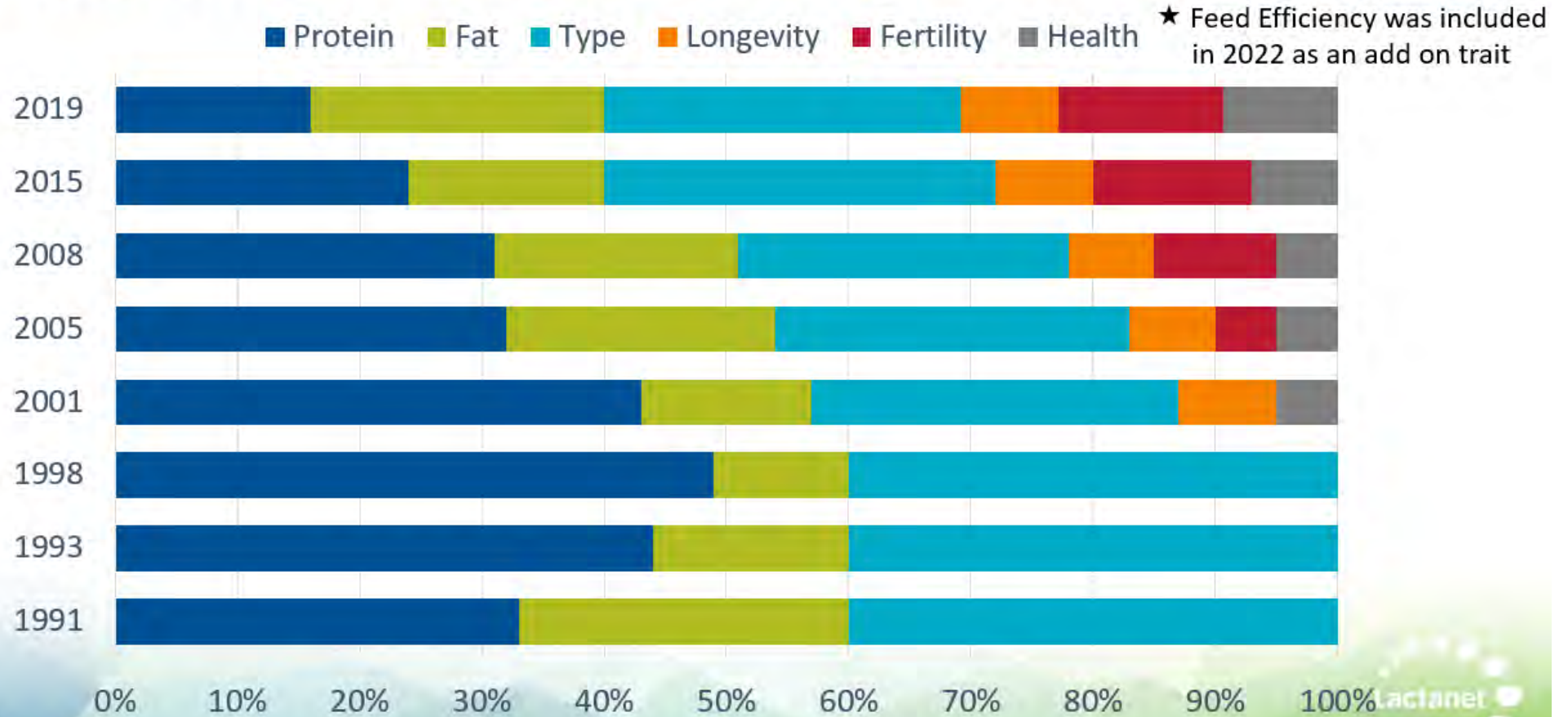
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Few countries example: Canada



Holstein LPI Relative Emphasis Over Time



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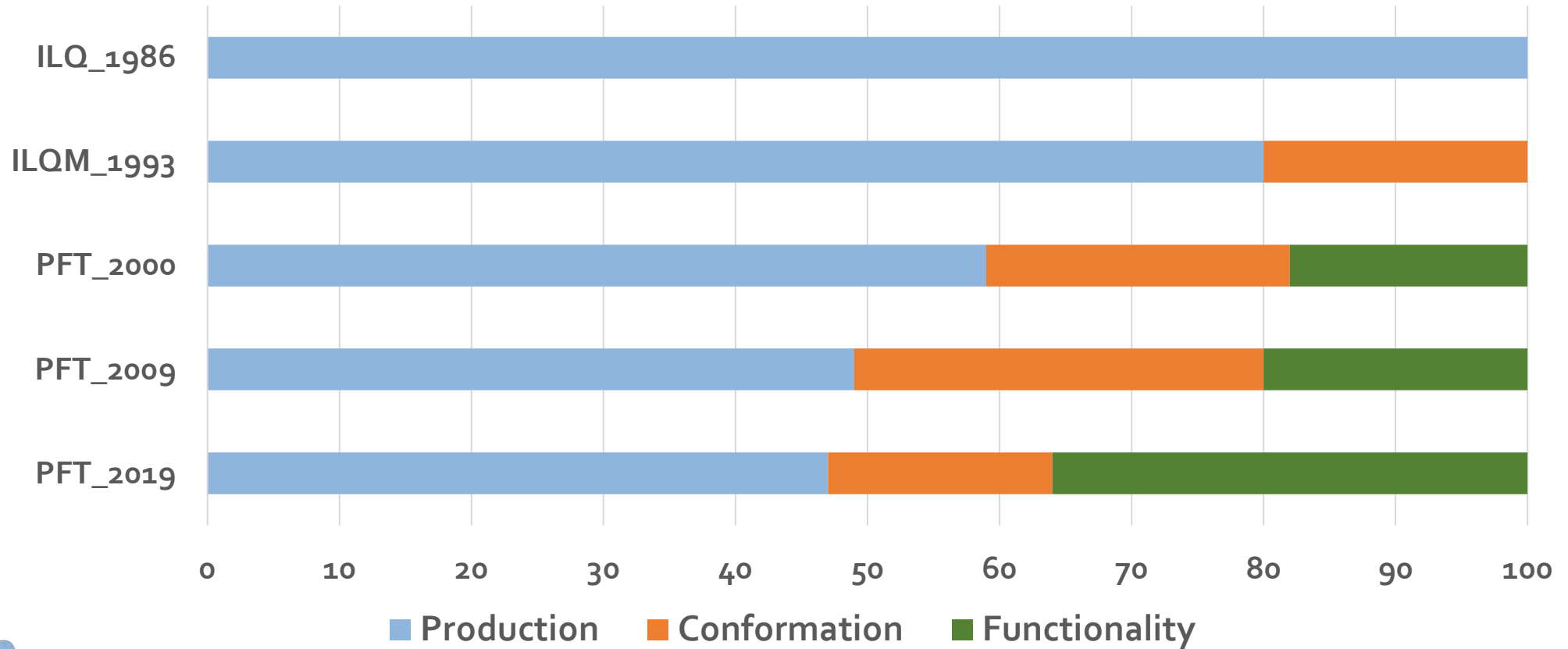
lactanet



Few countries example: ITALY



Italian Breeding Objectives evolution



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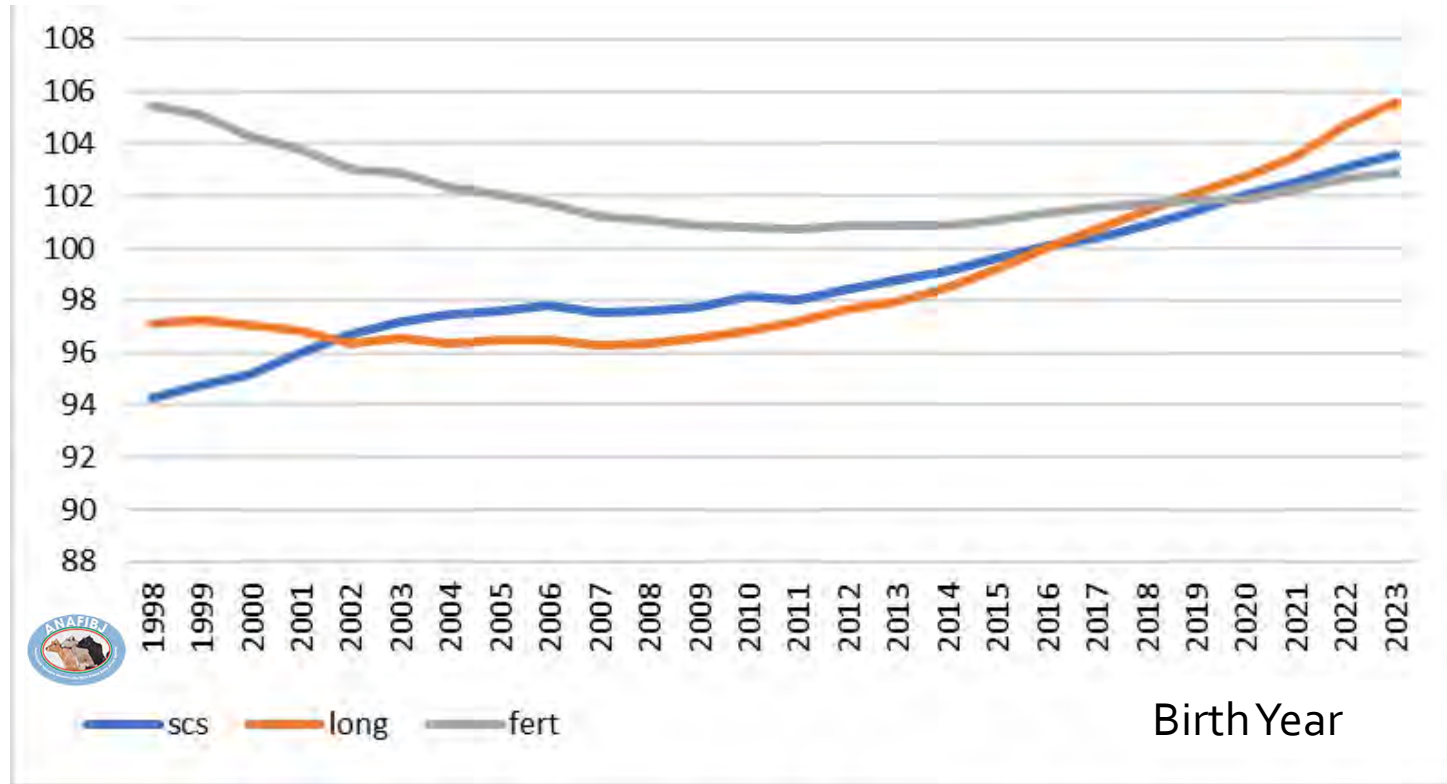
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Progress is made since fertility and longevity were included in breeding goals, resulting in a genetic progress for these traits



Genetic trend for Somatic Cell Count, Longevity and Fertility



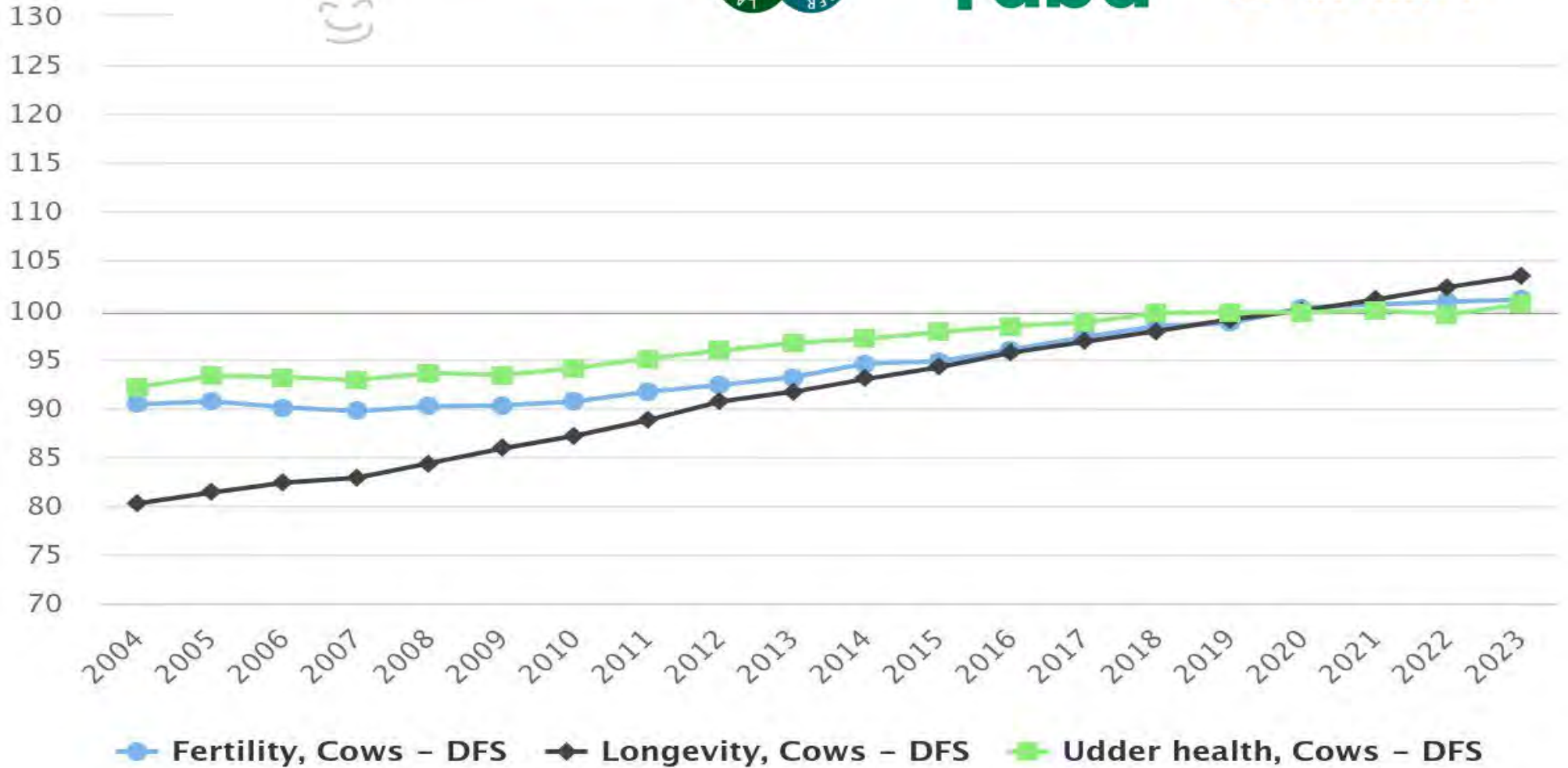
- -14 days calving-concive
- -80 000 cells / mL
- +92 productive days

Phenotypic value of 1 1 DS of index





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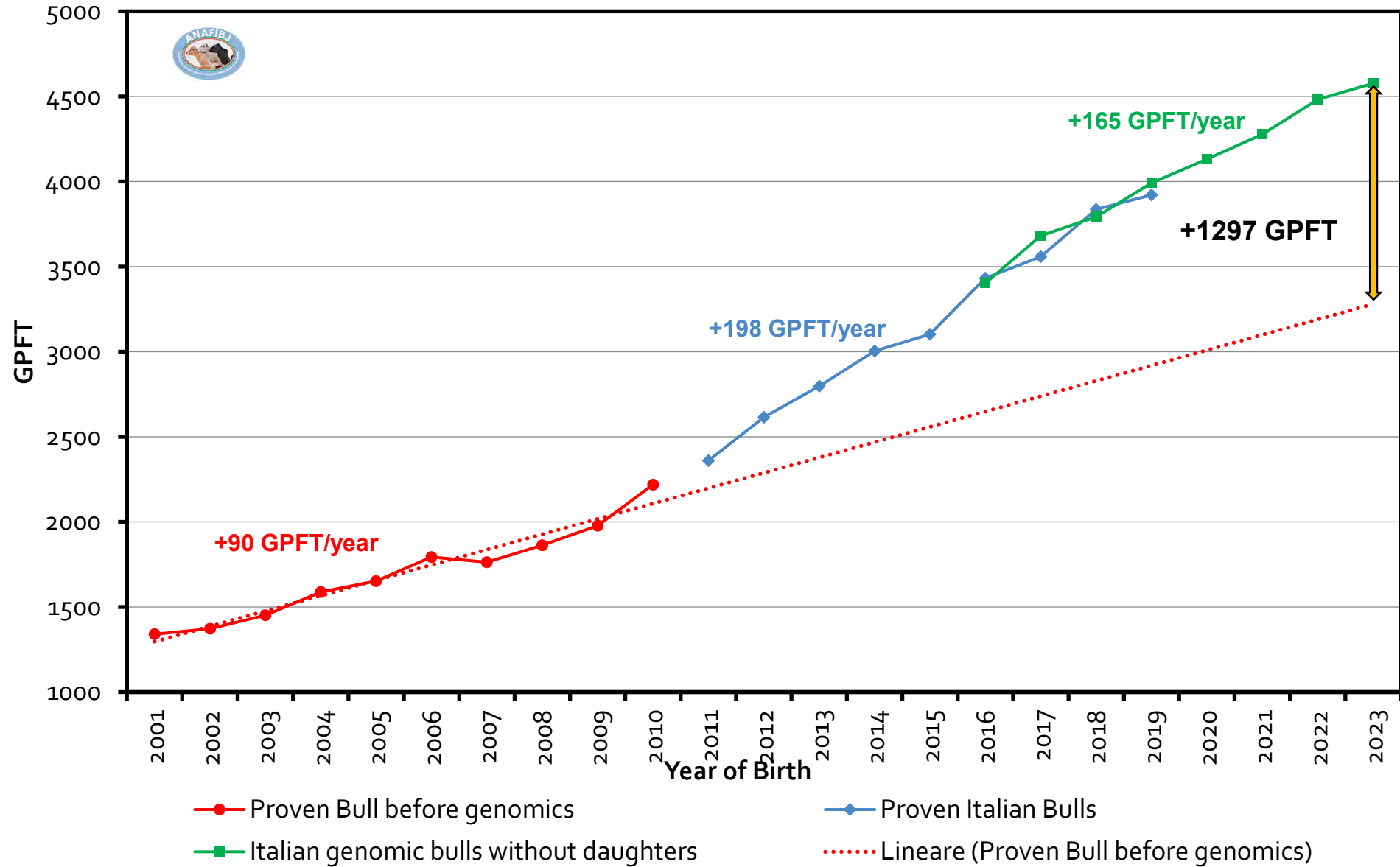
[NAV trends - Dairy \(mloy.fi\)](https://mloy.fi)

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PFT trend 2001-2023





...more and more on farmers side

- Each country has more indexes
- Efforts to select for **improved resilience** and **heat tolerance** are already implemented
- The evolution of breeding goals is also incorporating **environmental efficiency**, addressing **global warming** and developing selection indices **for improved efficiency**

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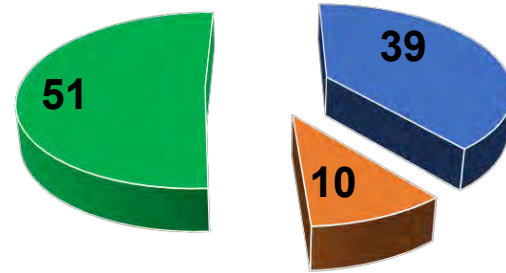


Economic and Sustainable Indexes



Production Type conformation Functionality

Economic Health Index (2016)



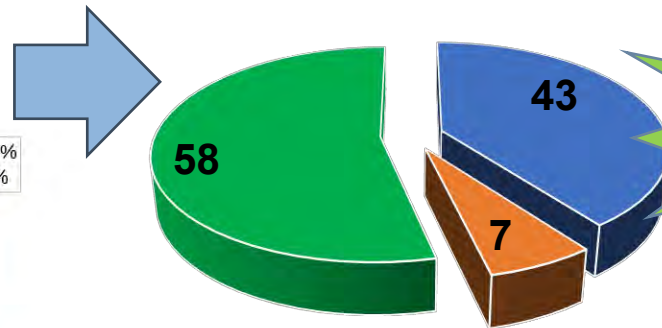
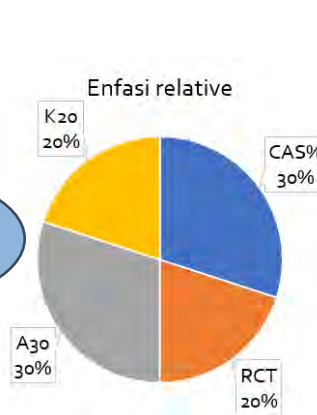
Functionality

- Longevity **21%**
- Fertility **18%**
- Somatic cells **6%**
- Calving easy **3%**
- BCS **3%**

Sustainability and cheese-making capacities Index– Parmigiano Reggiano (2018) vs 3.0



IQC 6% index



Award K-Cas B

Penalty K-Cas E

- Fertility **15%**
- Somatic sells **14%**
- Longevity **11%**
- Calving easy **5%**
- Mastitis **5%**

BB +0,10 euro/d of milk lifetime
 B +0,05 euro/d of milk lifetime

Meeting Florence, Italy

EE -0,050 euro/d of milk lifetime
 E -0,025 euro/d of milk lifetime

Australia



Australia's three indices

4

Australia's three breeding indices take the hard work out of breeding for more than one trait at once. The difference is in the emphasis given to specific traits. Choose the index that best matches your breeding priorities. Indices have a base of zero.



Balanced Performance Index (BPI)

- Economic index
- Blends production, type and health traits according to their economic values
- In line with farmer preferences



Health Weighted Index (HWI)

- Fast track fertility, mastitis resistance and feed saved
- Modelled on a strictly seasonal calving system



Sustainability Index (SI)

- Fast track genetic gain for lower emissions
- Continue gains for important economic traits



Australia



Australia's three indices

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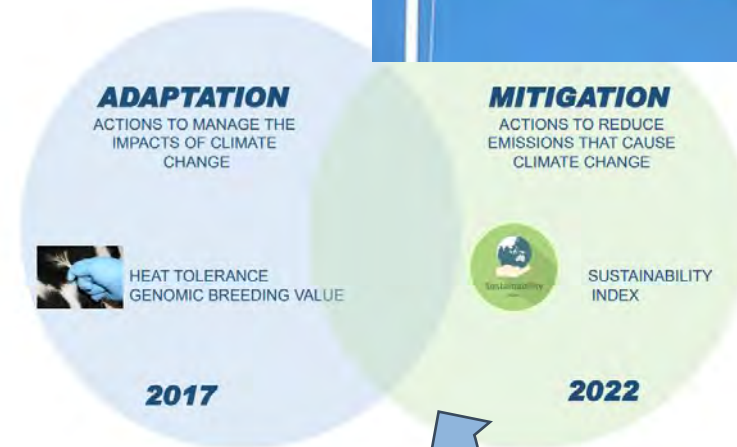
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Jennie Pryce presentation
15th World Conference, 2023 –France





New Zealand

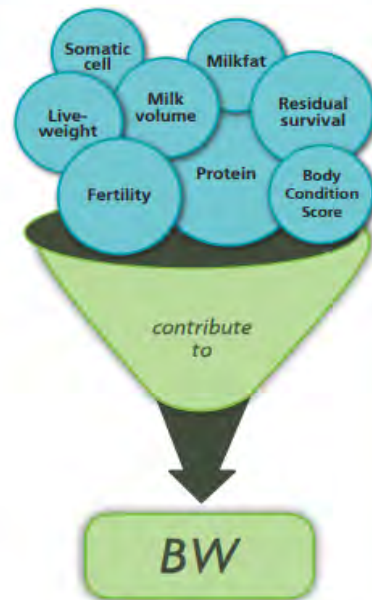


Breeding Worth explained

This guide is brought to you by New Zealand Animal Evaluation Ltd (NZAE), a wholly owned subsidiary of DairyNZ, which is owned by you, the New Zealand dairy farmer. NZAE sets the National Breeding Objective and determines the traits included in Breeding Worth.

For the best bulls consult the RAS list.
dairynz.co.nz/nzael

Eight traits of a highly efficient cow



How to use Breeding Worth, Production Worth and Lactation Worth

	BW	PW	LW
Meaning	Genetic ability for breeding replacements	Lifetime performance	Current season performance
Use for	Selecting bulls and replacements and purchasing heifers	Culling and purchasing cows	Culling
\$ terms	+68 = expected to breed daughters that are \$34 more profitable than daughters of a 0 BW cow	+78 = expected to generate \$78 more profit, in each of her lactations, than a cow with a PW of 0	+98 = expected to generate \$98 more profit, in the current season, than a cow with a LW of 0
Traits	Milkfat, protein, milk volume, liveweight, fertility, somatic cell, residual survival and body condition score	Milkfat, protein, milk volume, liveweight, SCC	Milkfat, protein, milk volume, liveweight



National breeding objective (BW):

"Animals whose progeny will be the most efficient converters of feed into farmer profit."

- The **Breeding Worth** ranks male and female animals for their genetic ability for breeding replacements
- The **Production Worth** ranks female animals for their lifetime performance.
- The **Lactation Worth** ranks female animals for their current season performance.

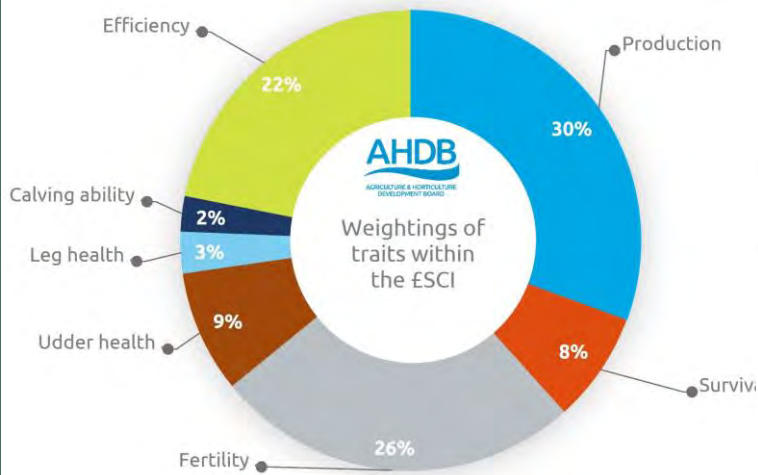
Genetic gain contributes \$45 million annually to the national economy which compounds over time.

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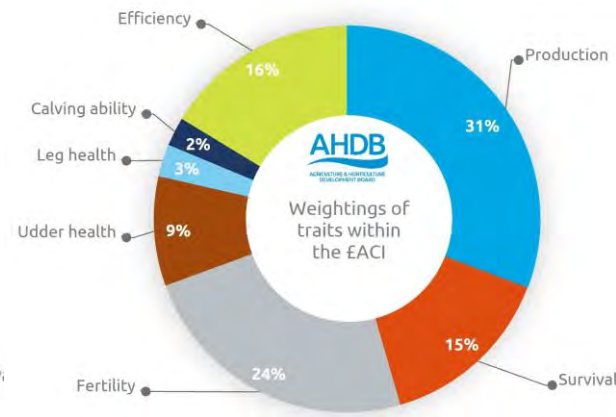
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United Kingdom

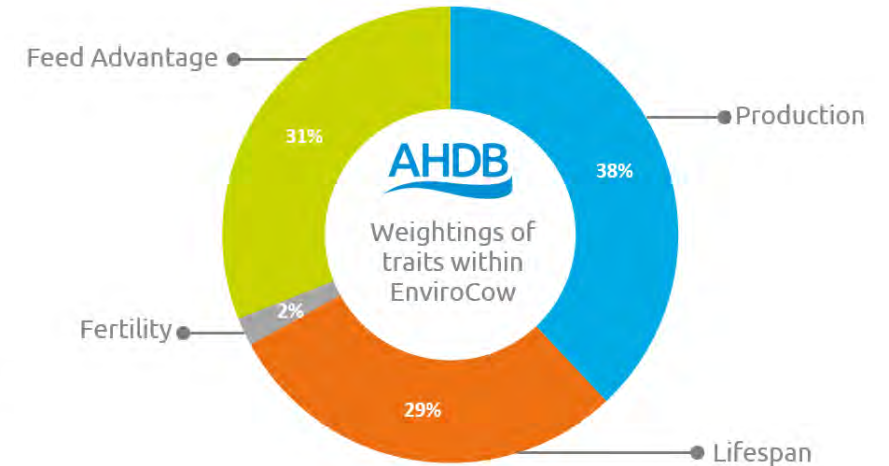


Spring Calving herds



Autumn calving herds

ranking bulls across breeds



EnviroCow index

environmental weighted index

Breeding Services for farmers

- All the indexes developed and implemented
- The genetic progress reached
- Without the farmers progress would not be reached
- Each country has developed and implemented several management tools which help the farmers to take any decision



New Farmers Tool Modules

- To optimize dairy herd replacements combining conventional, sexed and beef semen
 - Support farmers to identify annual female replacement needs
 - Based on herd performance level and combination of semen type (conventional, sex-sorted and beef semen) in order to optimized farmer economic outcome
- To calculate «Global Warming Potential» at farm level
 - A simplified method for the estimation of the carbon footprint of cow milk. To be used by farmers, both as a self-assessment system, and to simulate what would happen if more indicators varied.





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EFFAB has developed a certification that proves the use of sustainable, responsible and balanced farming practices that can improve animal welfare and contribute to food safety.



CERTIFICATE



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ANAFIBJ new farmers service

- ANAFIBJ offers the Code EFABAR to its members acting as a **'bridge'** between the breeder and EFFAB.
- In order to obtain THE certification, ANAFIBJ prepares, on behalf of the farmer, a template with information on the farm accompanied by reports developed by **HerdUP** and **PGA** applications



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Conclusions

- Genetic improvement has been VERY successeful impacting positively
 - Profitability
 - Health and Welfare
- Genomic Selection allow accurate genetic progress for all economically important traits



Material provided by

- Filippo Miglior  Lactanet
CANADIAN NETWORK FOR DAIRY EXCELLENCE
- Rasmus Bak Stephansen  CENTER FOR QUANTITATIVE GENETICS AND GENOMICS CCG
- Marco Winters  AHDB
- Stephanie Minery  INSTITUT DE L'ELEVAGE idele
- Nouredine Charfeddine  FEDERACION DE ASOCIACIONES DE PRODUCTORES DE LEITE CONAPE
- Mathijs van Pelt  150 YEARS CRV
BETTER COWS > BETTER LIFE
- Jutta Jaitner  vit
Service & Daten aus einer Quelle
- Ezequiel Nicolazzi  CDCB
COUNCIL ON DAIRY CATTLE BREEDING

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FOR YOUR HELP**





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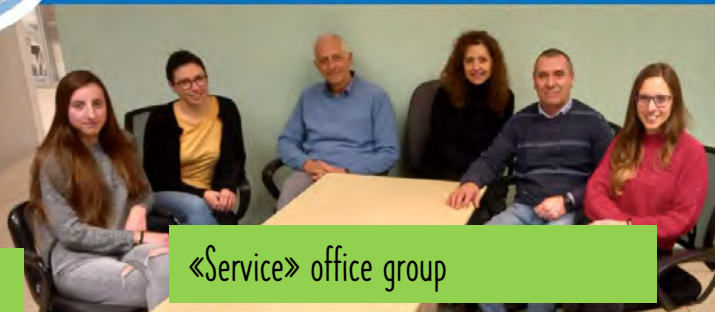
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