What Is the Right Way to Produce? Leveraging Data Science to Guide Us

Luiz Gustavo Ribeiro Pereira

Associate professor, IVH-KU SUND

Tuesday, April 14, 2026

KØBENHAVNS UNIVERSITET

CPH Cattle Seminar 2026

AGENDA

- What Is the Right Way to Produce?
- A Journey of Transformation From Dairy 1.0 to 4.0
- Can Data Science Guide Us to the Right Way?

What Is the Right Way to Produce?

“Fremtidens landbrug med nutidens forventninger.”

“The agriculture of the future, shaped by today’s expectations.”

Future Milk

Incredible Food
Unthinkable
Milk Remains Milk

FUTURE MILK

Economic Impact

Global milk production = **$348 billion annually** *(FAO)*

Social Impact

600 million people depend on dairy for their livelihoods, including **80 million women farmers** *(IDF)*

Dairy sustains rural economies and contributes to **poverty reduction and food security** *(Global Dairy Platform)*

Health Benefits

Provides **protein, energy, calcium, protein, and vitamin D**

Milk associated a **lower risk of cardiovascular disease**

AGENDA

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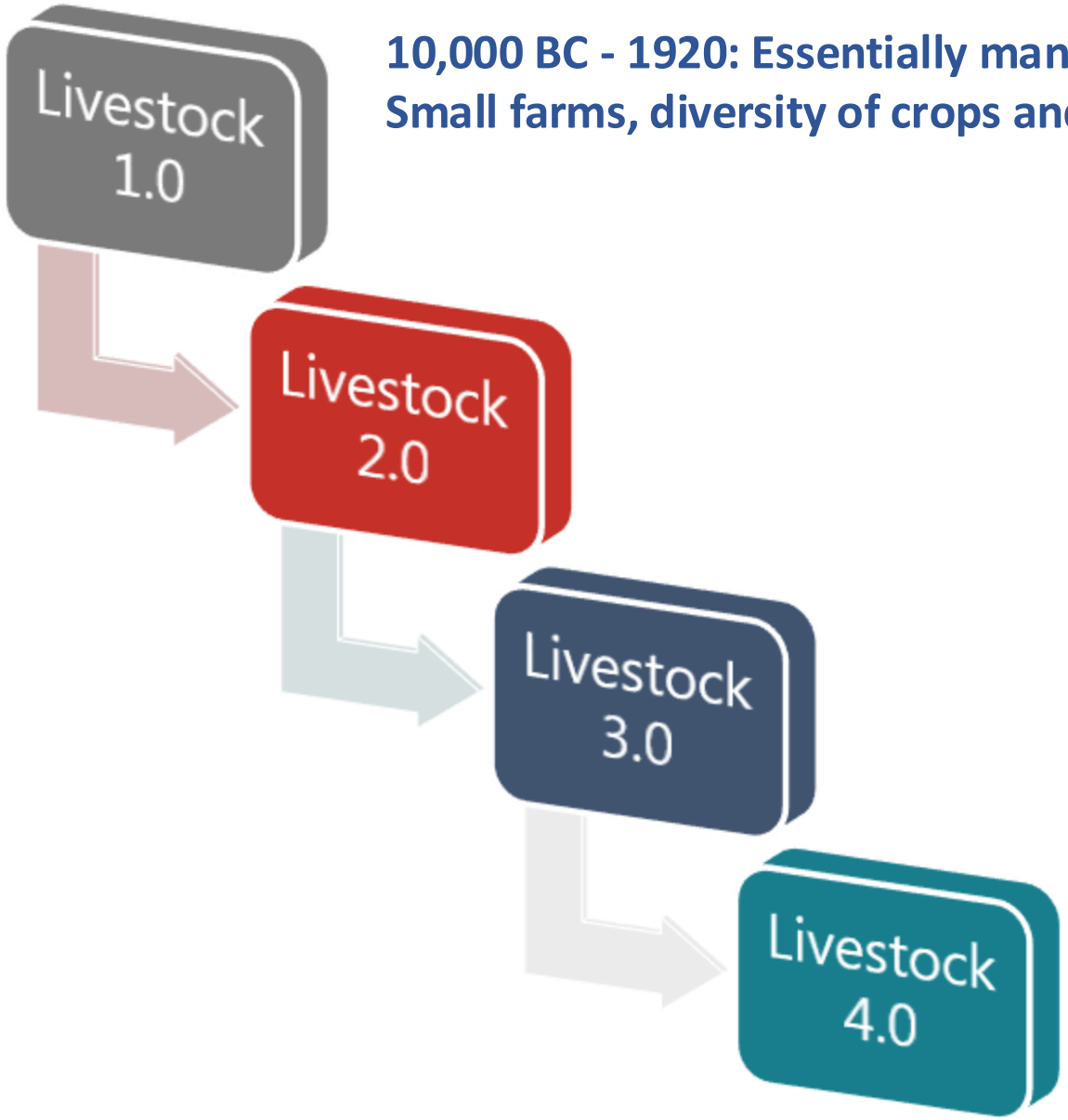
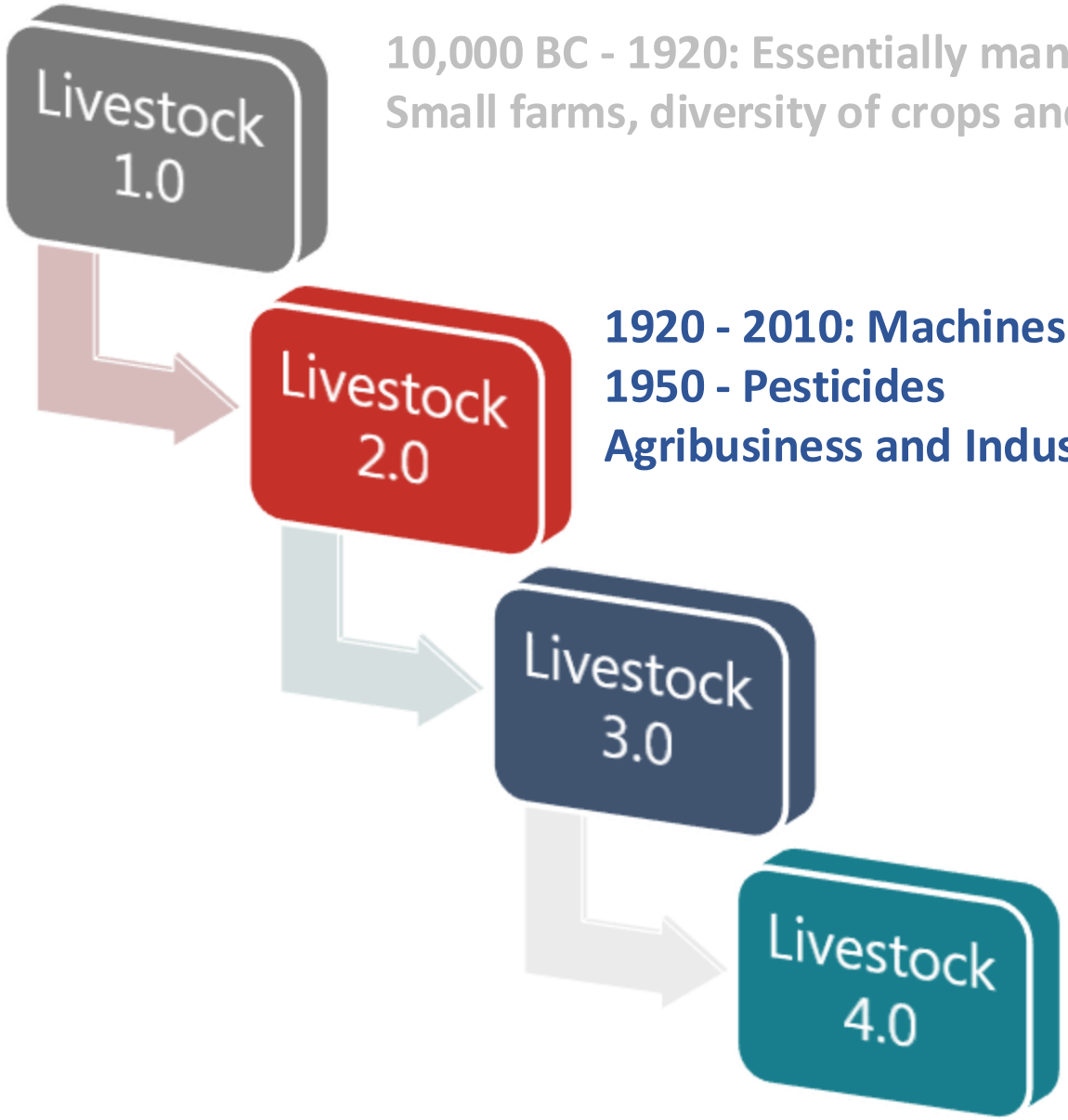
- **A Journey of Transformation From Dairy 1.0 to 4.0**
- Can Data Science Guide Us to the Right Way?

Newtonian transformation of livestock



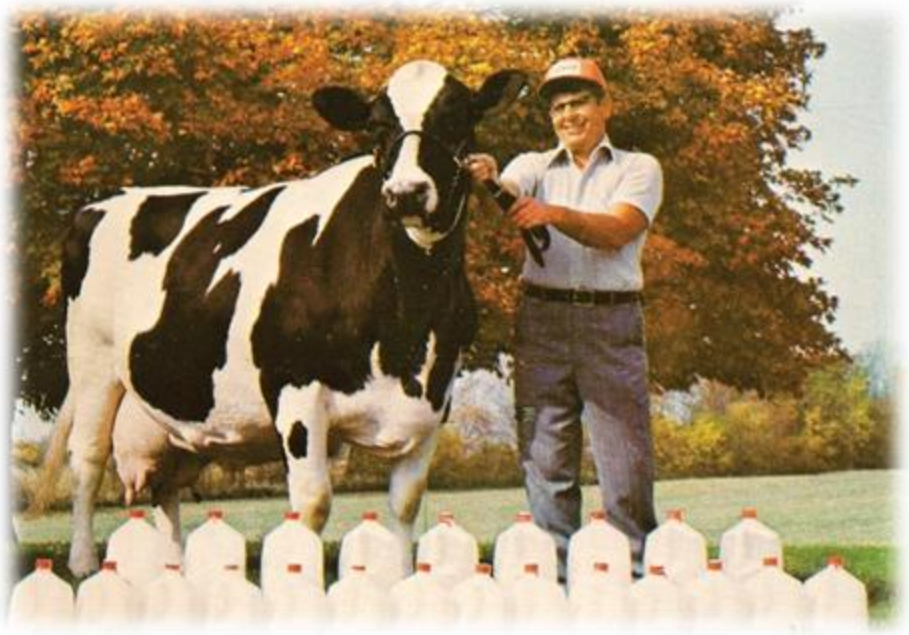
10,000 BC - 1920: Essentially manual and rooted in local traditions
Small farms, diversity of crops and animals

Newtonian transformation of livestock

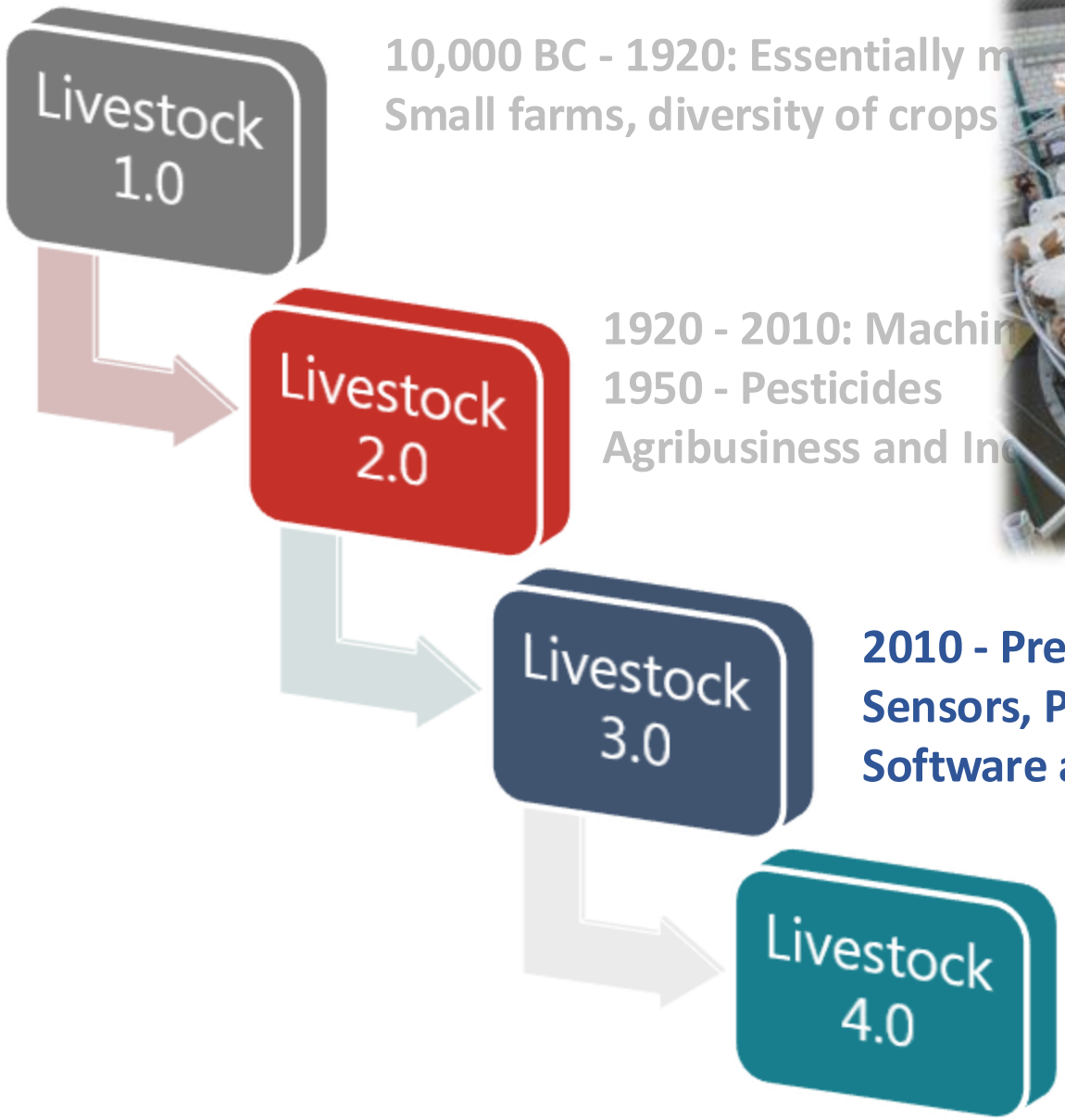


10,000 BC - 1920: Essentially manual and rooted in local traditions
Small farms, diversity of crops and animals

1920 - 2010: Machines and Science (Genetic Improvement and Fertilizers)
1950 - Pesticides
Agribusiness and Industrial Agriculture (Low-cost food production)



Newtonian transformation of livestock



10,000 BC - 1920: Essentially m
Small farms, diversity of crops

1920 - 2010: Machin Fertilizers)
1950 - Pesticides
Agribusiness and In tion)

2010 - Present: Automation and Sustainability
Sensors, Precision Livestock Farming, Cloud Computing, Software and Internet of Things

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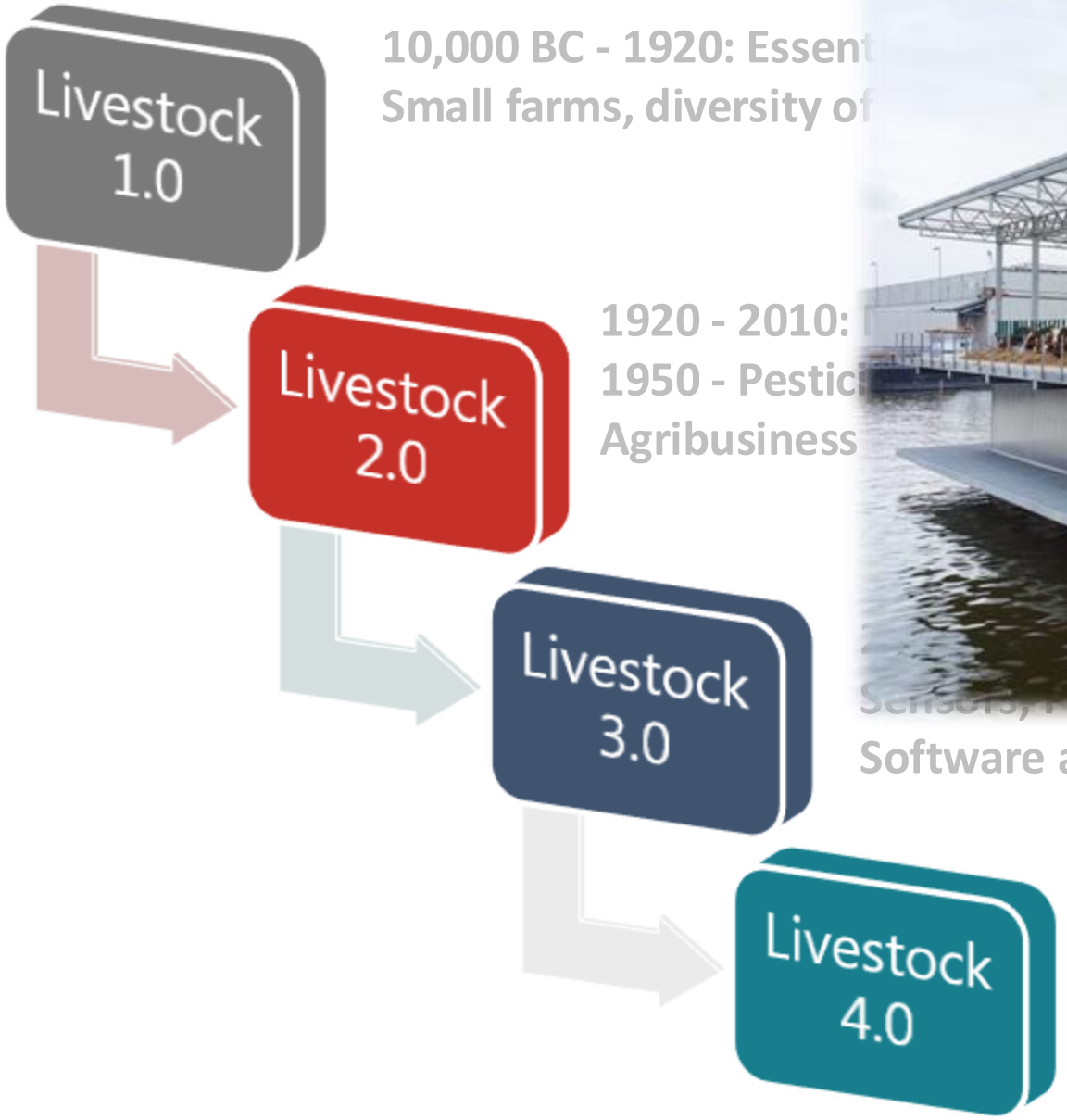

10,000 BC - 1920: Essent
Small farms, diversity of

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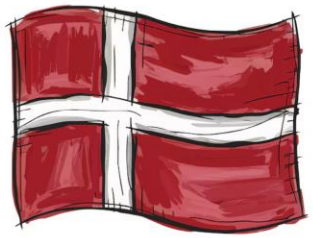
Sensors, Precision Livestock Farming, Cloud Computing, Software and Internet of Things

Present/Future: Producing differently
Disruptive Technologies.

Denmark's Dairy Evolution: A Story to Be Proud Of



After **WWII**, Dairy Sector was a cornerstone of **national recovery**

5.69 billion kg of milk/year - exports DKK 28 billion

Most audited dairy systems in the world, with mandatory, **centralized** milk **data reporting**, one of the most **competitive carbon footprints** in global dairy

Highly **educated farmers**, strong **co-operatives;** Danish farms feed the equivalent of 15 million people each year

TRADE-OFFS

That shape today's global challenges

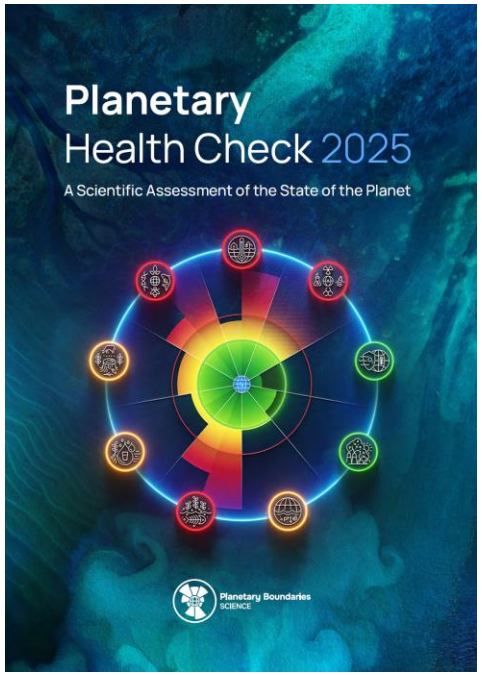
Ecological **Social** **Psychological Divide**

Ecological Trade-Off

Symptom of a deeper disconnection between our self and nature

Ecological

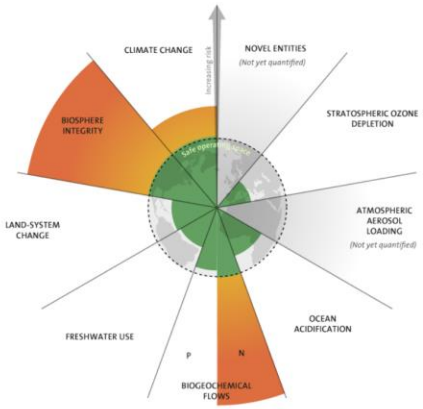
- 1.7 Earths consumed annually
- +1.1°C global warming
- 69% decline in wildlife since 1970
- 2 billion tons of waste yearly



🌊 We have crossed another planetary boundary: ocean acidification

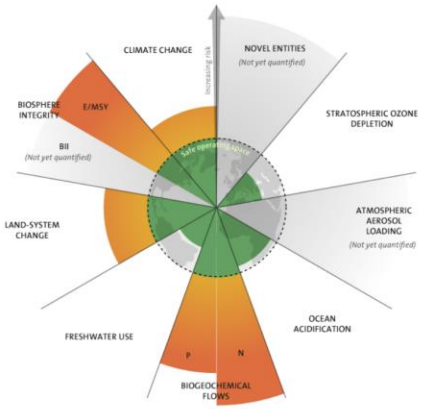
We are witnessing a reduction in the oceans' ability to regulate the climate and sustain life

2009



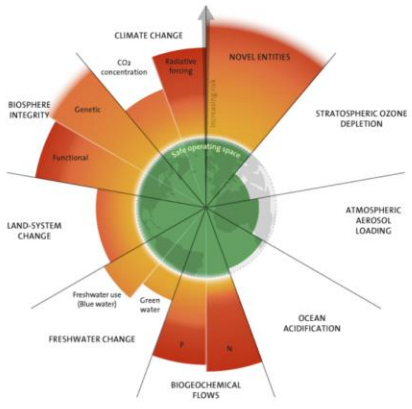
7 boundaries assessed,
3 crossed

2015



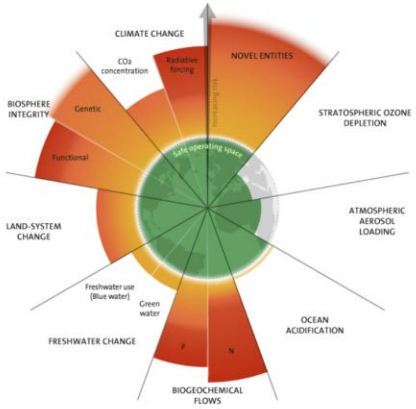
7 boundaries assessed,
4 crossed

2023



9 boundaries assessed,
6 crossed

2025



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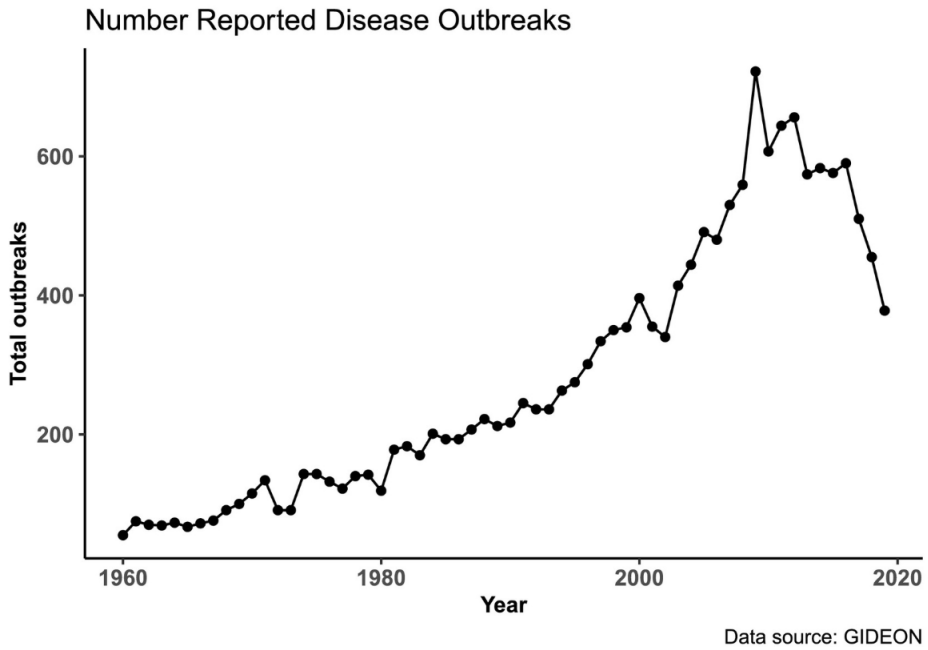

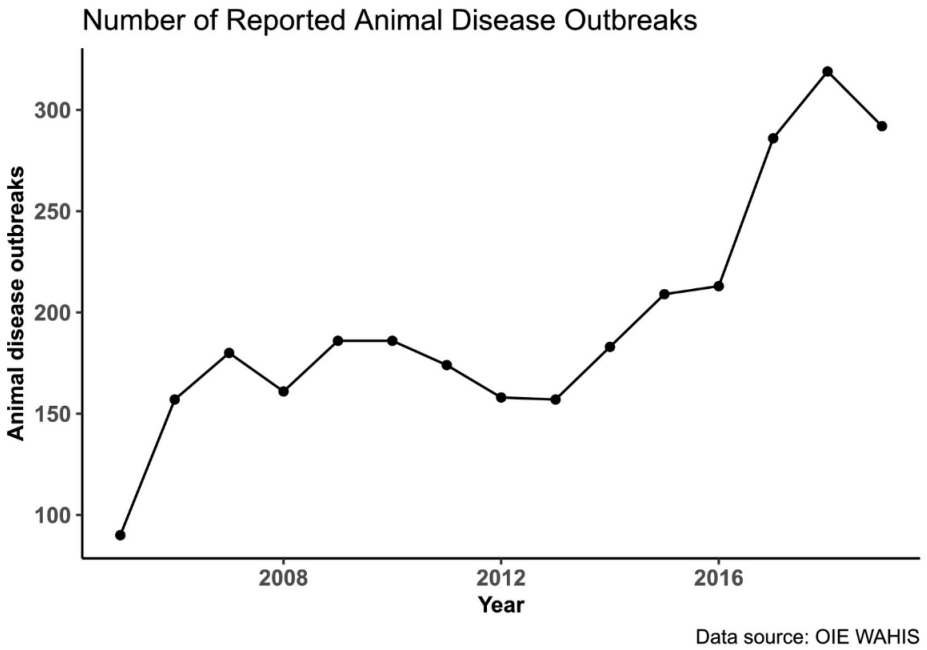

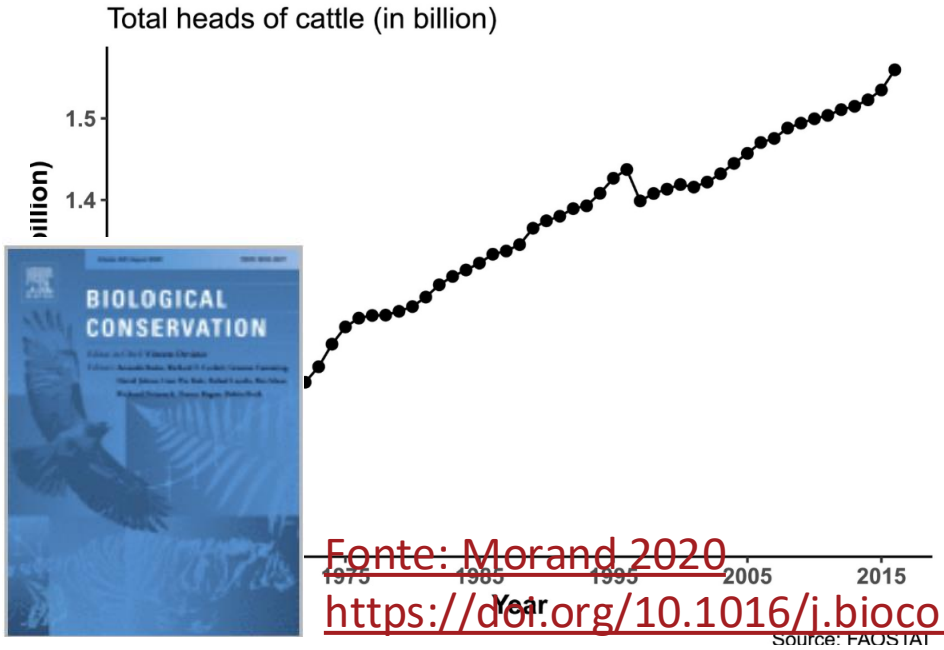

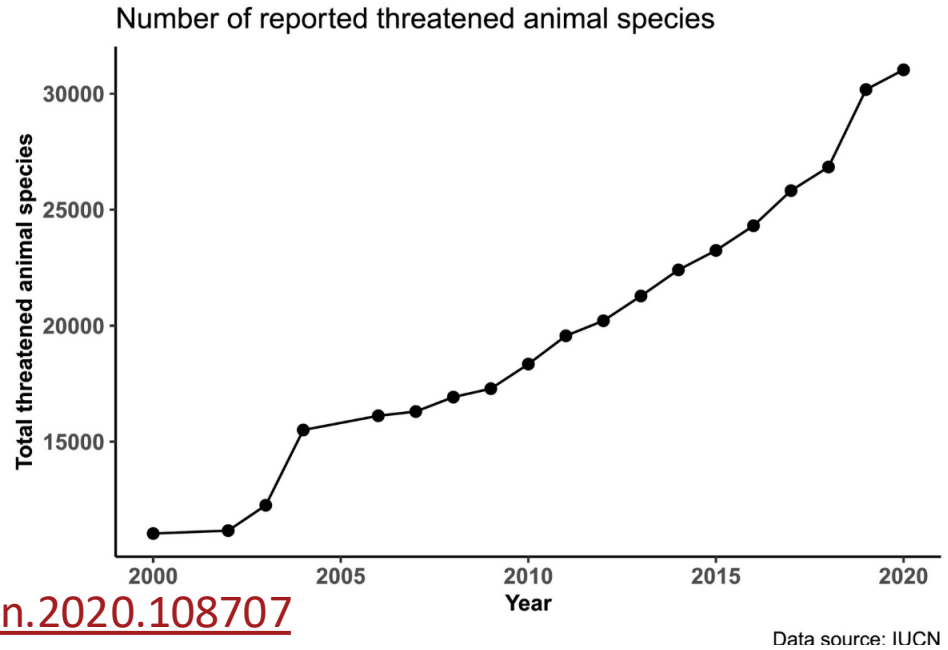

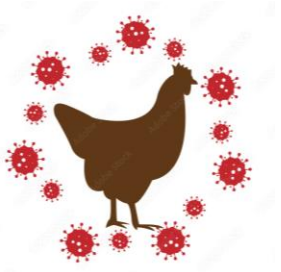

ELSEVIER
Biological Conservation
Volume 248, August 2020, 108707

Emerging diseases, livestock expansion and biodiversity loss are positively related at global scale

Fonte: Morand 2020
https://doi.org/10.1016/j.biocon.2020.108707

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The social Trade-Off

Reflects a breakdown in our relationships with others and society

💼 Over 700 million people live in extreme poverty

📉 Top 10% earn 52% of global income

🌐 More than 100 million people are forcibly displaced worldwide

Social

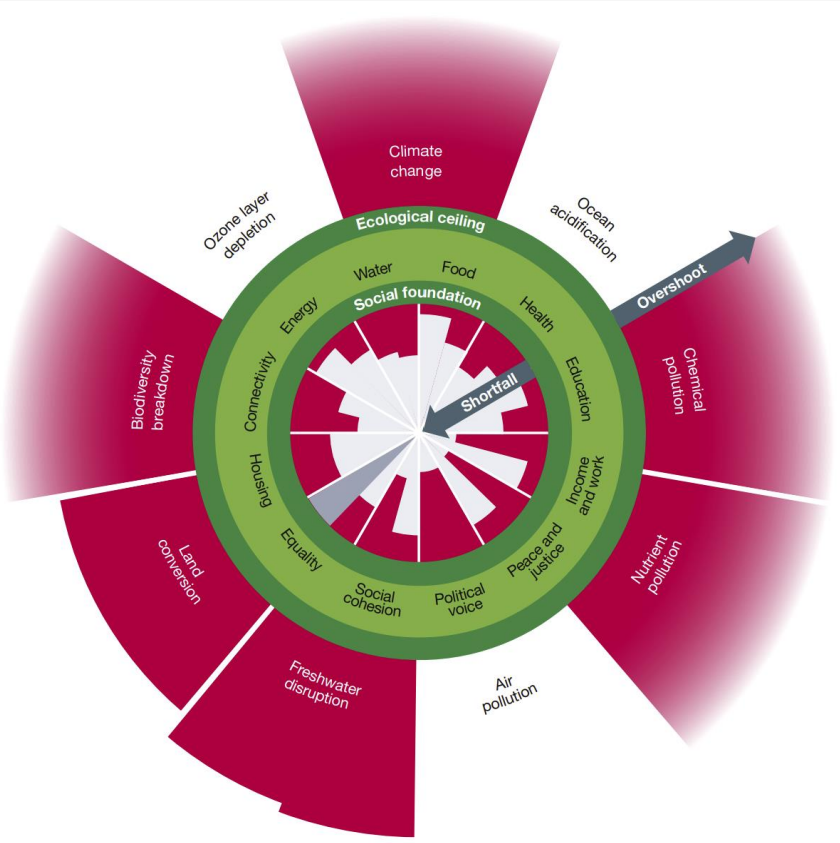
Analysis

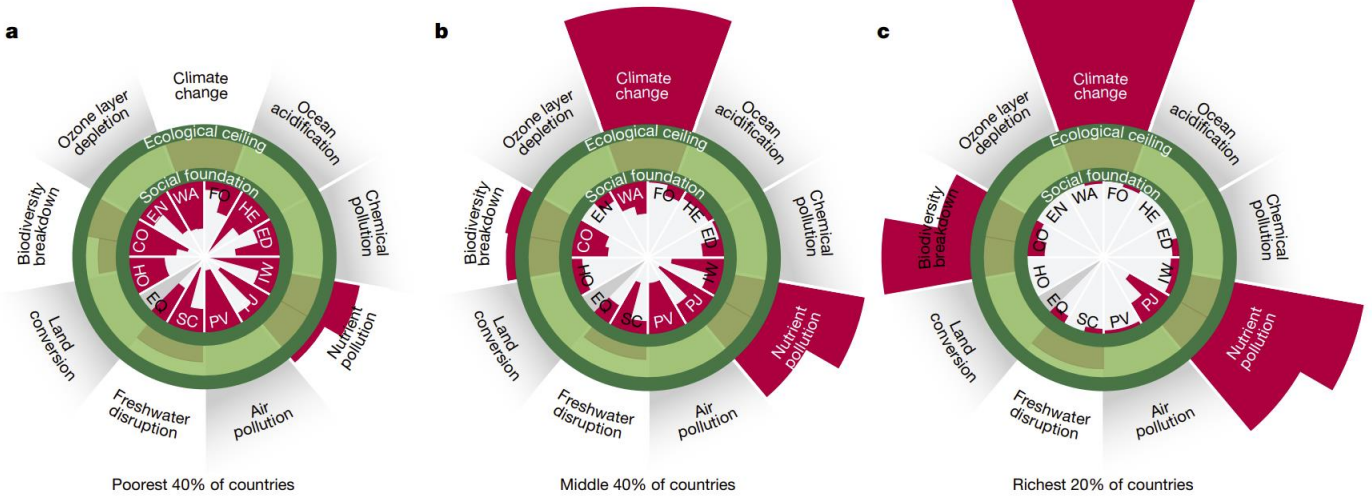
Doughnut of social and planetary boundaries monitors a world out of balance

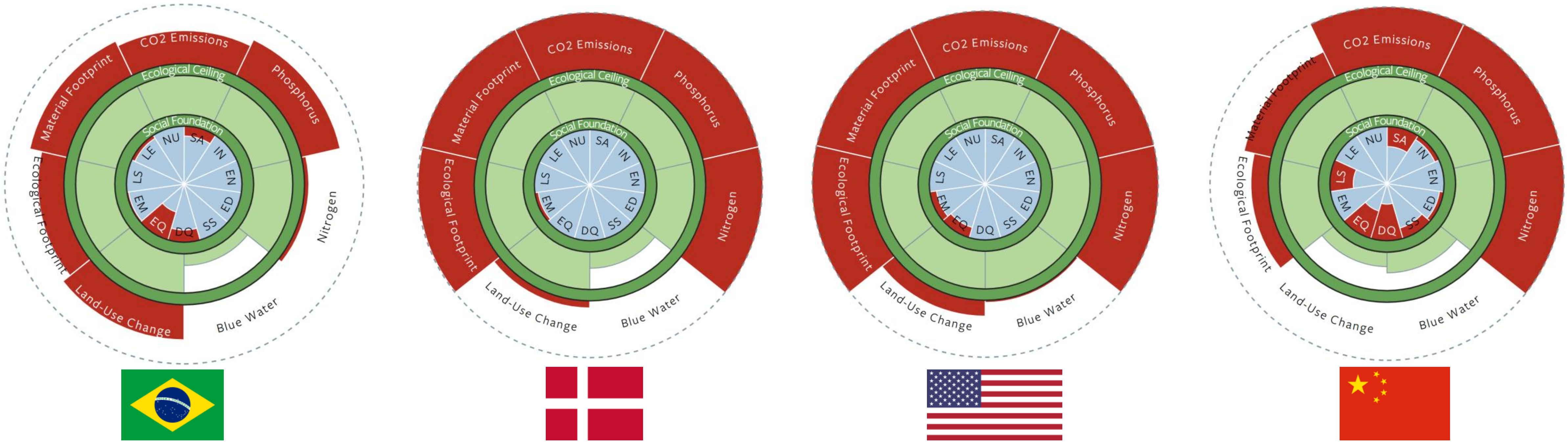
https://doi.org/10.1038/s41586-025-09385-1
Received: 28 May 2024
Accepted: 10 July 2025
Published online: 1 October 2025
Open access
Check for updates

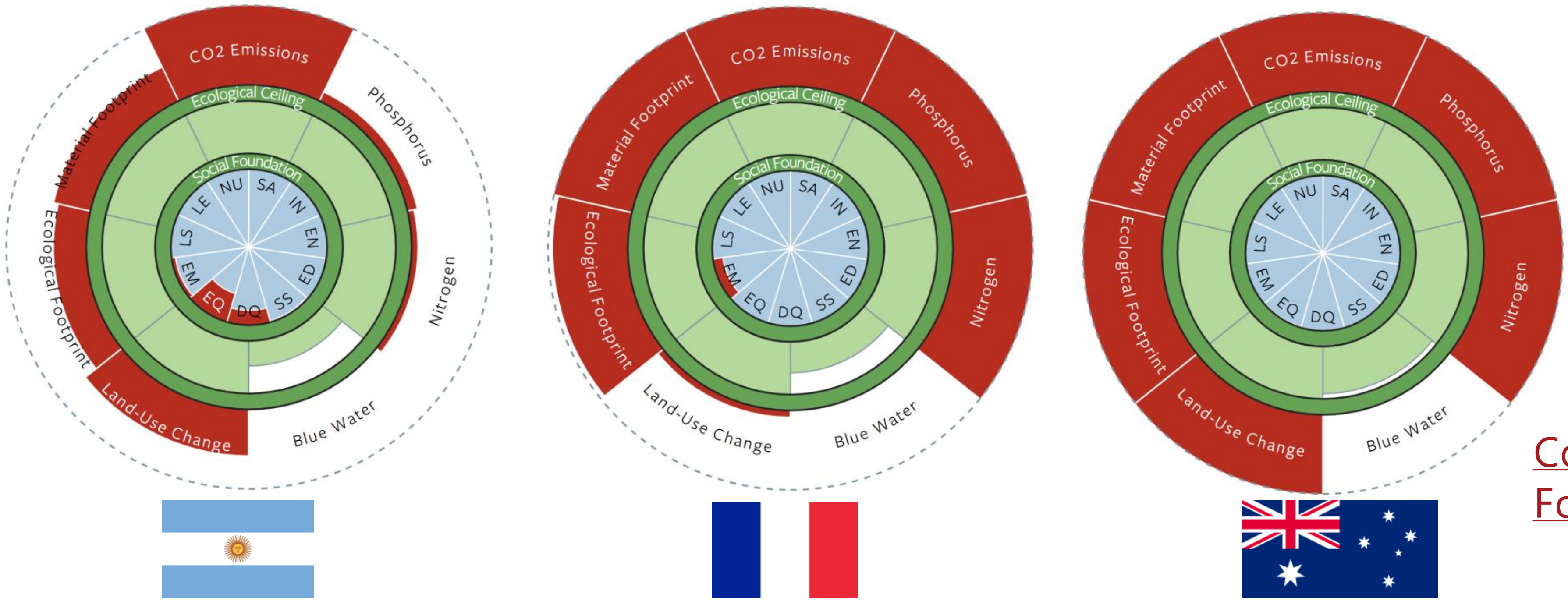
Andrew L. Fanning[1,2,3] & Kate Raworth[1,4,5]

The doughnut-shaped framework of social and planetary boundaries (the 'Doughnut') provides a concise visual assessment of progress towards the goal of meeting the needs of all people within the means of the living planet[1–3]. Here we present a renewed Doughnut framework with a revised set of 35 indicators that monitor trends in social deprivation and ecological overshoot over the 2000–2022 period. Although global gross domestic product (GDP) has more than doubled, our median results show a modest achievement in reducing human deprivation that would have to accelerate fivefold to meet the needs of all people by 2030. Meanwhile, the increase in ecological overshoot would have to stop immediately and accelerate nearly two times faster towards planetary boundaries to safeguard Earth-system stability by 2050. Disaggregating these global findings shows that the richest 20% of nations, with 15% of the global population, contribute more than 40% of annual ecological overshoot, whereas the poorest 40% of countries, with 42% of the global population, experience more than 60% of the social shortfall. These trends and inequalities reaffirm the case for overcoming the dependence of nations on perpetual GDP growth[4,5] and reorienting towards regenerative and distributive economic activity—within and between nations—that assigns priority to human needs and planetary integrity.









LS - Life Satisfaction
LE - Healthy Life Expect.
NU - Nutrition
SA - Sanitation
IN - Income
EN - Access to Energy
ED - Education
SS - Social Support
DQ - Democratic Quality
EQ - Equality
EM - Employment

Country Comparisons - A Good Life For All Within Planetary Boundaries

Psychological Trade-Offs

A deeper disconnection between who we are and whom we aspire to be

⚠️ **1 suicide every 40 seconds** worldwide (WHO)

💊 Antidepressant use has increased by 60% in the last decade

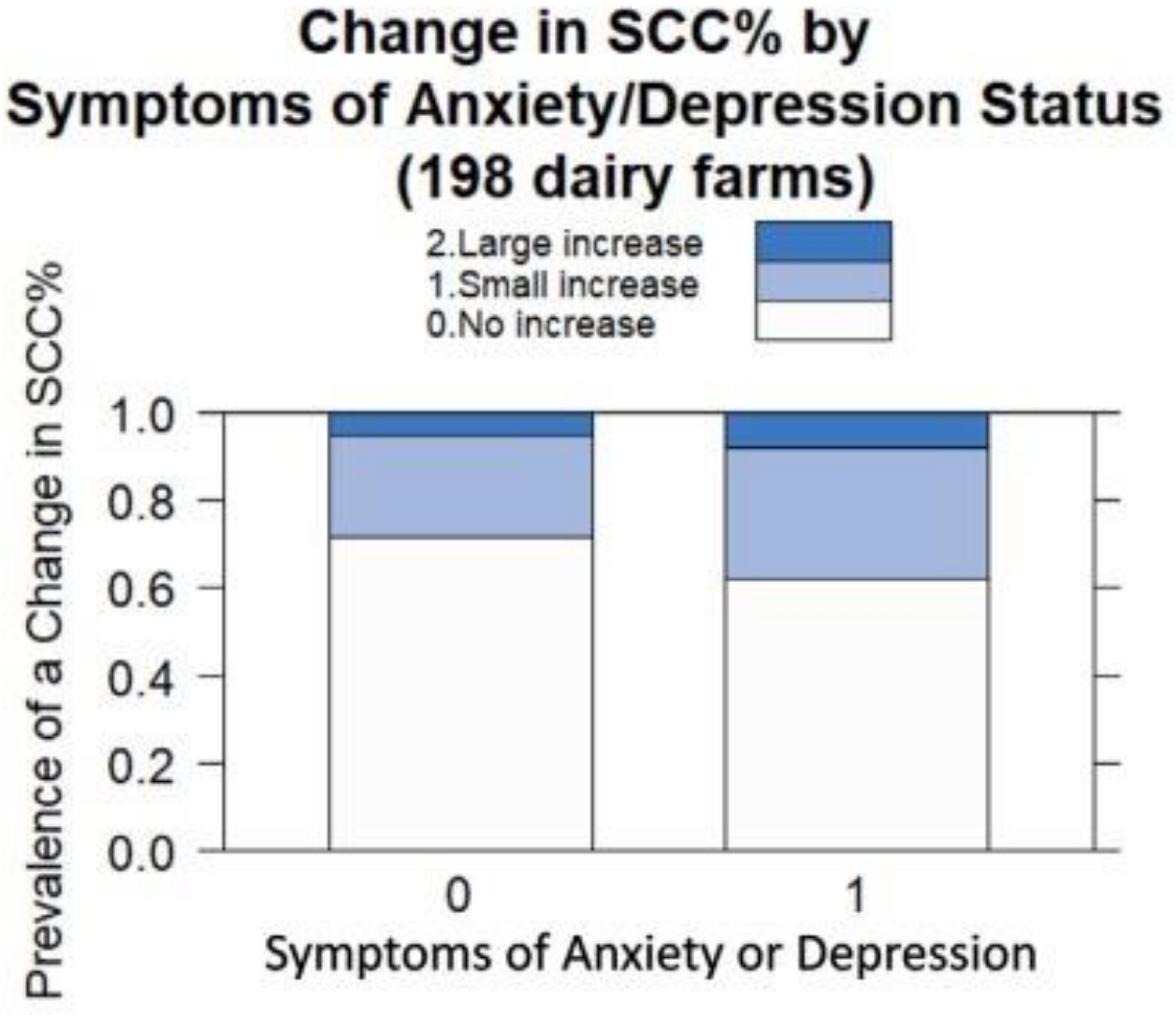
📱 Average screen time exceeds 6 hours per day, impacting well-being

Psychological

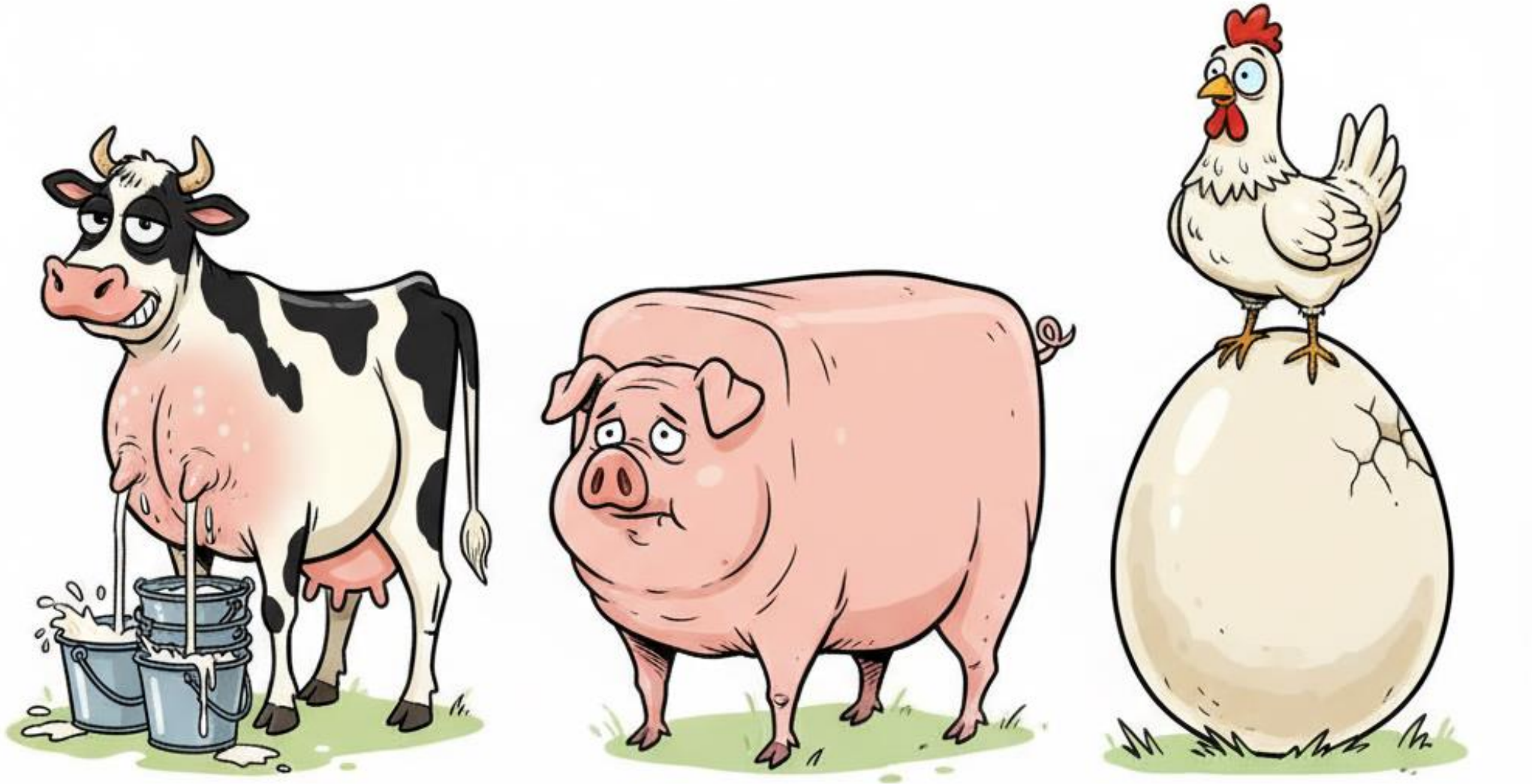
J. Dairy Sci. 108:868–884
https://doi.org/10.3168/jds.2024-24853

Exploring longitudinal associations between farmer health and well-being and dairy herd subclinical mastitis prevalence and productivity: The HUNT Study, Norway

N. A. Steen,* E. M. Rosvold, and M. O. Torske
Faculty of Biosciences and Aquaculture, Nord University, 8049 Bodø, Norway



Disproportionality in high-performing farm animals



Although **low IGF1** is important for **high GH and milk** production postpartum, this biology is **contrary** to most other **biological processes,** including maintaining muscle mass, immune function, and reproduction

↑GH, ↓IGF1, ↓INSULIN

Milk

Muscle, immunity, reproduction

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We learned to solve problems by creating new ones

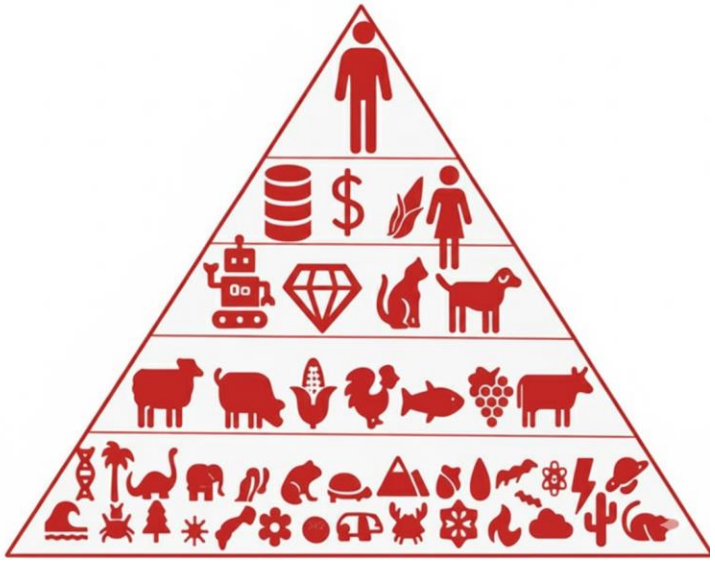
High-production cow = low fertility

Psychological stress and compromised animal health

Metabolic diseases, mastitis, and chronic reproductive issues

Expensive and Modern Drugs + Precision Technologies sold by the same company

The awakening of regenerative intent



Probably the Best of the World

EGOic
Conventional

Productivism
Consumerism
Interventionism

ECOic
Regenerativo

Integrative
Balanced
Conservationism

THE FUTURE WE CAN BUILD!

Probably the Best for the World

Transition from Newtonian (**Linear**) to **Holistic** (Quantum/Mystical) Thinking

Fonte: Provenza 2024, J Am Holist Vet Med Assoc. 2024;74:11–20, https://doi.org/10.56641/XIMO9887

AGENDA

- What Is the Right Way to Produce?
- A Journey of Transformation From Dairy 1.0 to 4.0
- **Can Data Science Guide Us to the Right Way?**

CPH Cattle seminar Tuesday the 14th of April 2026 in Svanebiblioteket
University of Copenhagen, Frederiksberg Campus, Grønnegårdsvej 7, 1st floor + Zoom (link below)

8:30-9:00 Arrival: Get your nametag, parking permit (if needed), registration and coffee

Time	Presenter	Title
9:00-9:10	**Kirstin Dahl-Pedersen** Associate professor, IKV-KU-SUND	Welcome - and short introduction to current challenges in cattle production
Session 1: Research on infections in calves and HPAI (chair: Nina Dam Otten, IVH-KU SUND)		
9:15-9:30	**Nicole Bakkegård Goecke** Assistant professor, IVH-KU SUND	Important viral infections in Danish calves
9:30-9:45	**Mattia Pirolo** Assistant professor, IVH-KU SUND	Nasopharyngeal microbiome distinguishes acute and chronic bovine respiratory disease
9:45-10:00	**Rosalina Molberg Rotovnik** PhD fellow, IVH-KU SUND	Shedding Light on Cryptosporidium in Calves: Epidemiology in Three Dairy Herds
10:00-10:30	**You Chang and Yangfan Liu** Postdocs, IVH-KU SUND	Modeling the spillover risk of highly pathogenic avian influenza from wild birds to cattle in Denmark and potential spatiotemporal risk of introduction through contaminated environment
10:30-10:45 Coffee break		
Session 2: Research on sustainability in cattle production (chair: Svenja Woudstra, IVH-KU SUND)		
10:45-11:00	**Helene Bruun Nielsen and Nicoline Dolmer Skov** Assistant professor, IVH-KU SUND	Dynamics of Social Relationships in Free Ranging Cattle Across the Calving Period
11:00-11:15	**Luiz Pereira** Associate professor, IVH-KU SUND	What Is the Right Way to Produce? Leveraging Data Science to Guide Us
11:15-11:30	**Dima Farra** PhD fellow, IVH-KU SUND	Variation in Greenhouse Gas Emission Estimates Across Dairy Farm Models Using Danish Farm Accountancy Data
11:30-12:00	**Peter Lund** Professor, AU	How to reduce enteric methane from dairy cows (Online)
12:00-12:30 Lunch break, sandwiches		
Session 3: Research on challenging production diseases in cows (chair: Mette Bisgaard Petersen, IKV-KU SUND)		
12:30-12:45	**Nynne Capion** Associate professor, IKV-KU SUND	Identifying digital dermatitis resistant dairy cows
12:45-13:00	**Sofie Kroman** Assistant professor, IVH-KU SUND	E. coli mastitis – who killed the cow
13:00-13:15	**Amalie Camilla Pedersen** PhD fellow, IVH-KU SUND	Longitudinal monitoring of parasite infections in beef cattle kept in large-scale grazing areas
13:15-13:25 Coffee break		
Session 4: Future perspectives on cattle farming - Right way to produce? (chair: Liza Rosenbaum Nielsen, IVH-KU SUND)		
13:25-14:05	**Niels Hedermann** Farmer	Fremtidens landbrug med nutidens forventninger
14:05-14:45	**Henrik Hagbard** DVM, PhD, Naturplejedyrlægen ApS	Livestock in Ecological Restoration in Denmark with a Focus on Cattle
14:45-15:00 Coffee break		
15:00-15:40	**Christian Gamborg** Professor, IFRO-KU SCIENCE	The acceptability of using cattle in rewilding projects - Results from a survey of the Danish public and the ethical challenges
15:40-15:50	**Liza Rosenbaum Nielsen** Professor, Head of CPH Cattle, IVH-KU SUND	Wrap up of discussion and CPH Cattle seminar
16:00-17:30 The exhibition 'Production animals: a gallery for the art of the possible' has a guided tour, but you need to register: https://vetschool.ku.dk/om/produktionsdyr/		


Infections

Respiratory Disease

Cryptosporidium

Influenza

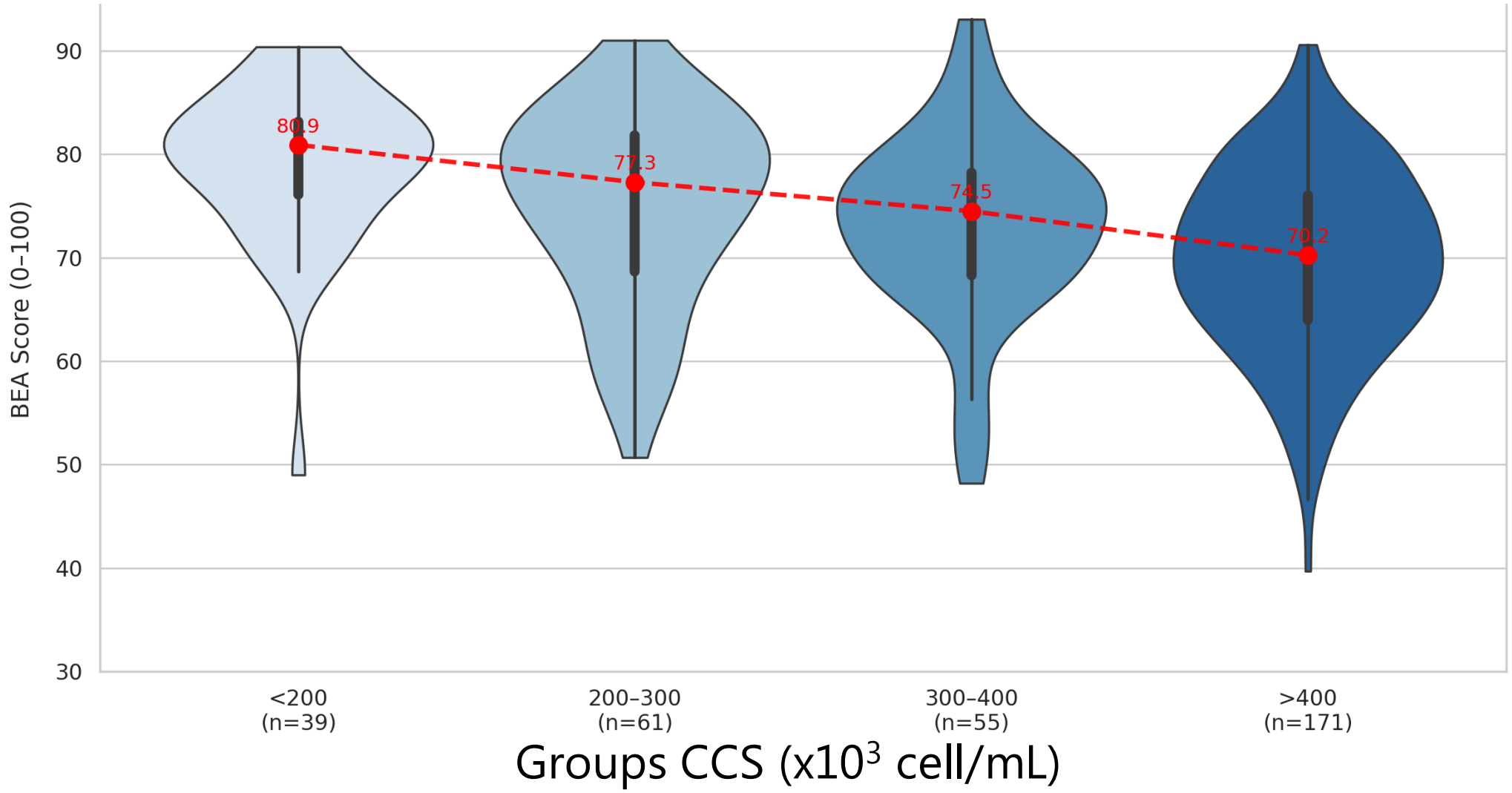

Digital dermatitis

E. Coli

Parasite

7  /14

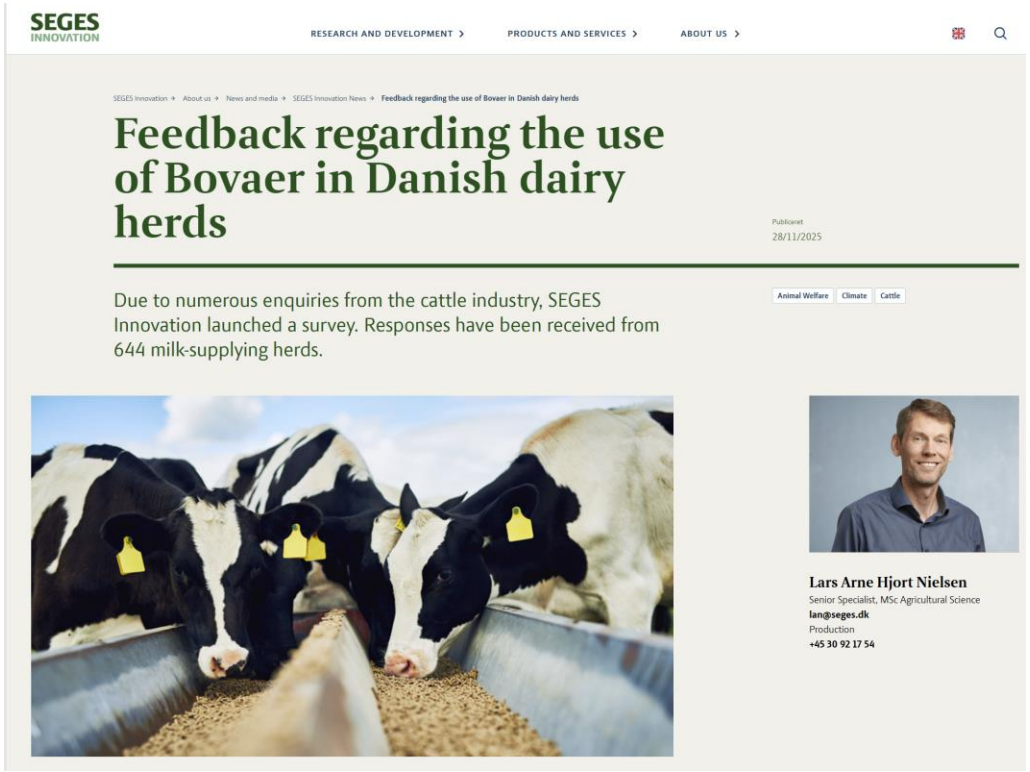
Wellfare and Milk Quality (n=376 farms) South America



Denmark 2025: Mandatory Additives - **Predictable Problems?**

First country to enforce additives nationally

First to face widespread animal and farm-level issues



What the Numbers Could Have Predicted?

Real dataset + Danish mean → 1,641-farm simulation

Variability modeled from real anonymized farms

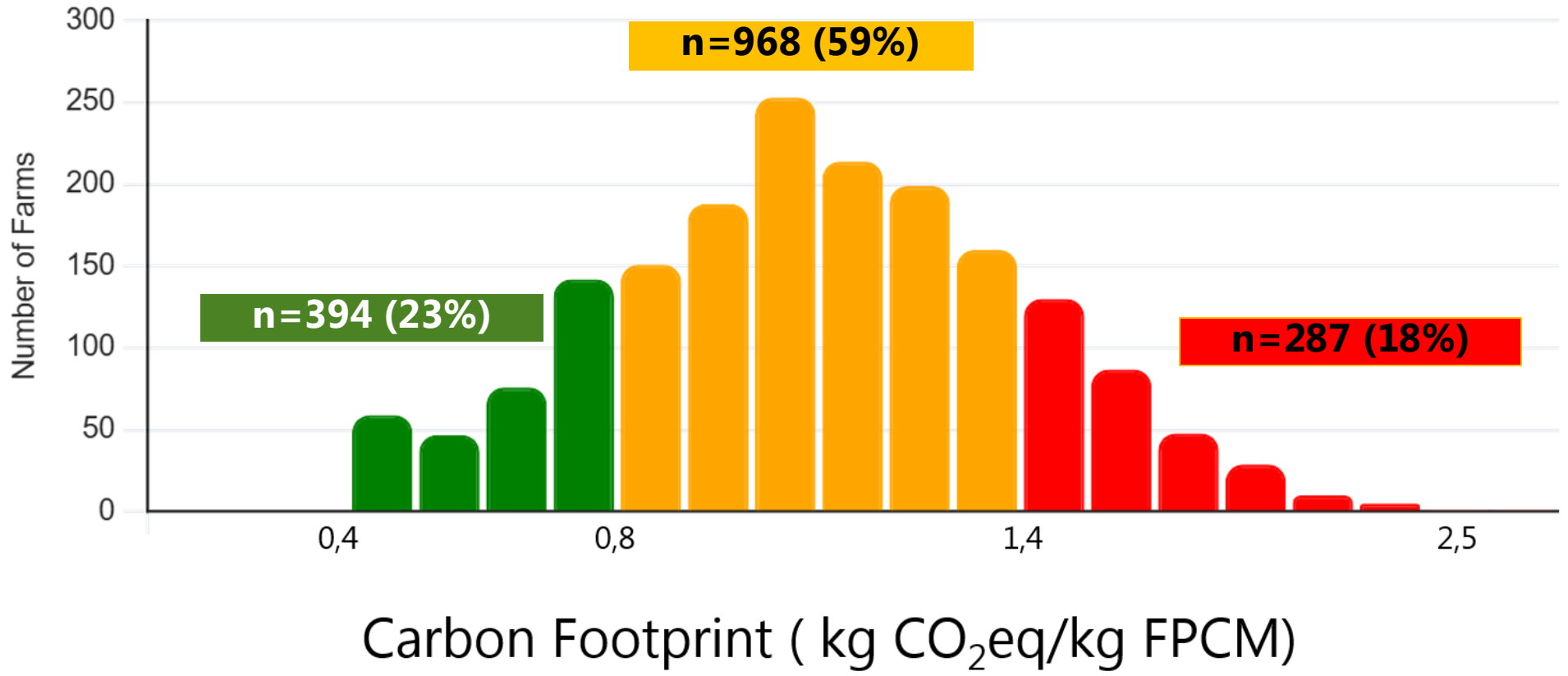
Three groups emerge:

- Green (<0.80)
- Orange (0.81–1.39)
- Red (≥1.40)

Number of Farms	**277**
Mean	**1.11**
Standard deviation	**0.3595**
Minimum	**0.39**
25th percentile (Q1)	**0.96**
Median (Q2)	**1.07**
75th percentile (Q3)	**1.25**
Maximum	**2.55**

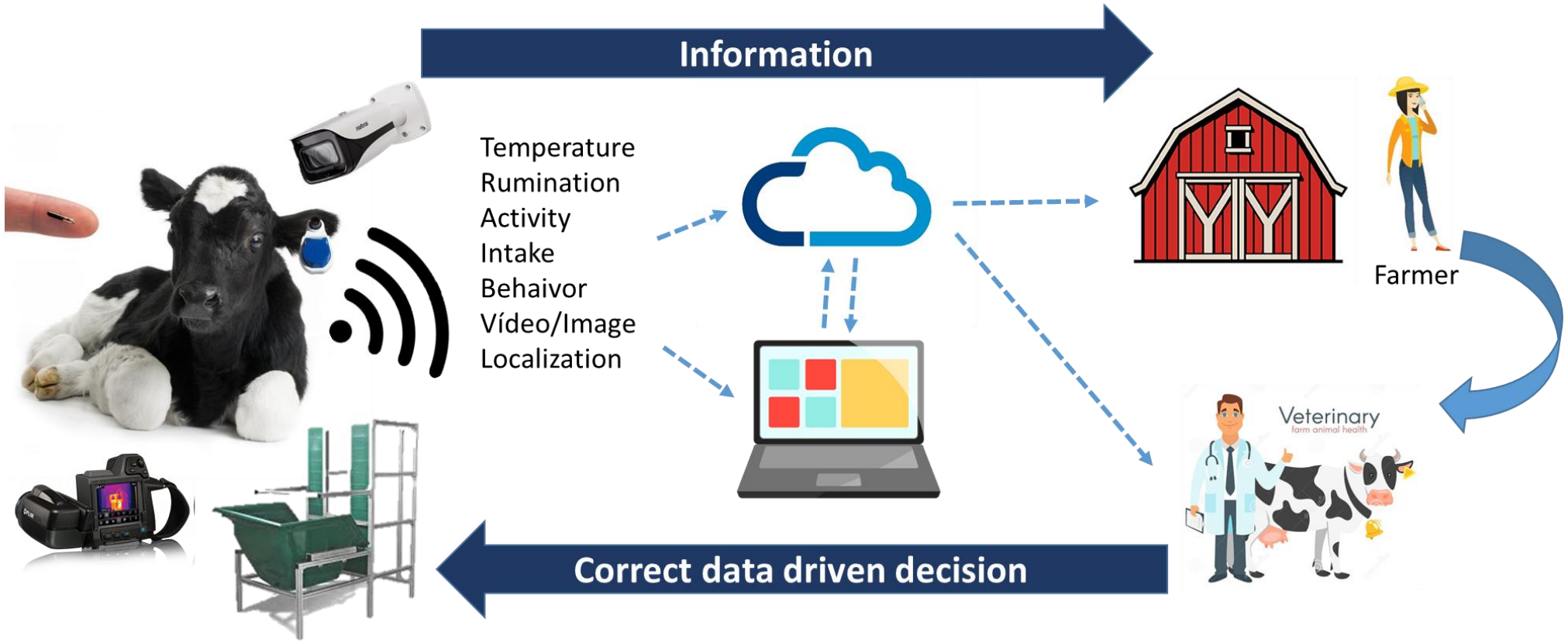
Avoidable emissions - the portion of farm's greenhouse-gas output that results from inefficiencies in nutrition, management, or productivity — emissions that can be reduced through better practices, without requiring feed additives

Distribution of Danish Farms by Carbon Footprint (n=641)



Using activity and rumination data for early detection of anaplasmosis disease in dairy heifer calves Teixeira et al. (2022)

Artificial Intelligence: Animal Health



Early treatment = ↓ Morbid = ↑Profitability

Figure 2: Effects of *Anaplasma marginale* inoculation on packed cell volume, rickettsemia and rectal temperature in dairy heifer calves according to days relative to sickness.

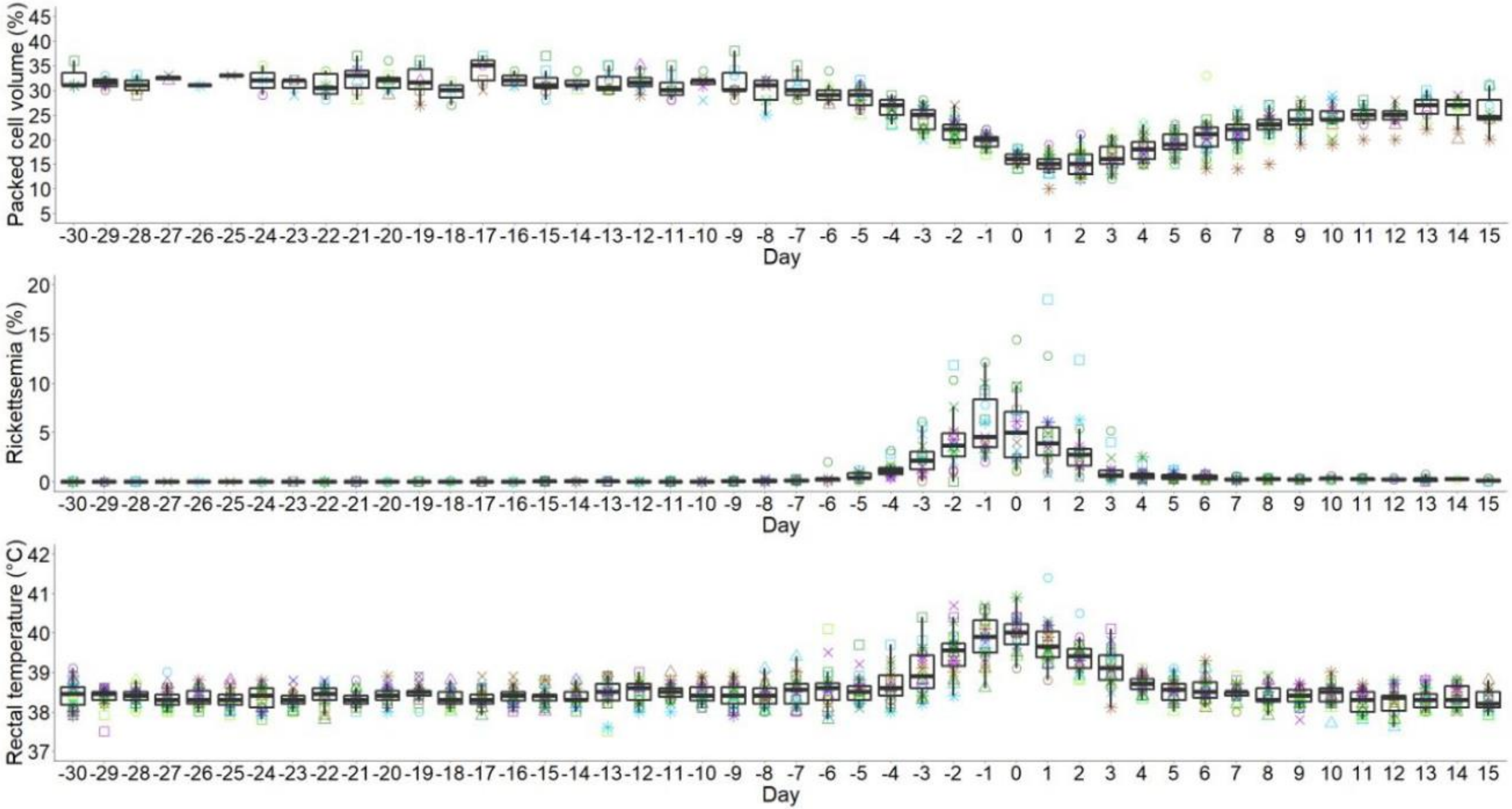
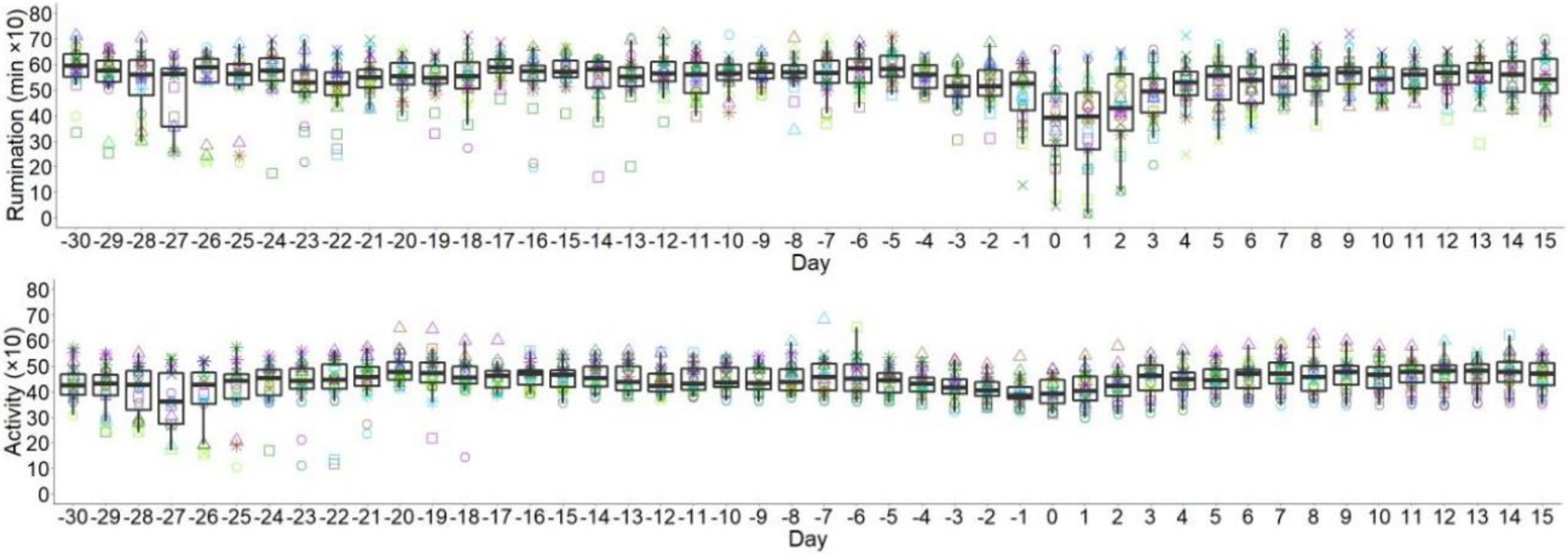


Figure 3: Effects of *Anaplasma marginale* inoculation on rumination time and activity index measured by SCR Heat time Hr® collars in dairy heifer calves according to days relative to sickness.



Using activity and rumination data for early detection of anaplasmosis disease in dairy heifer calves Teixeira et al. (2022)

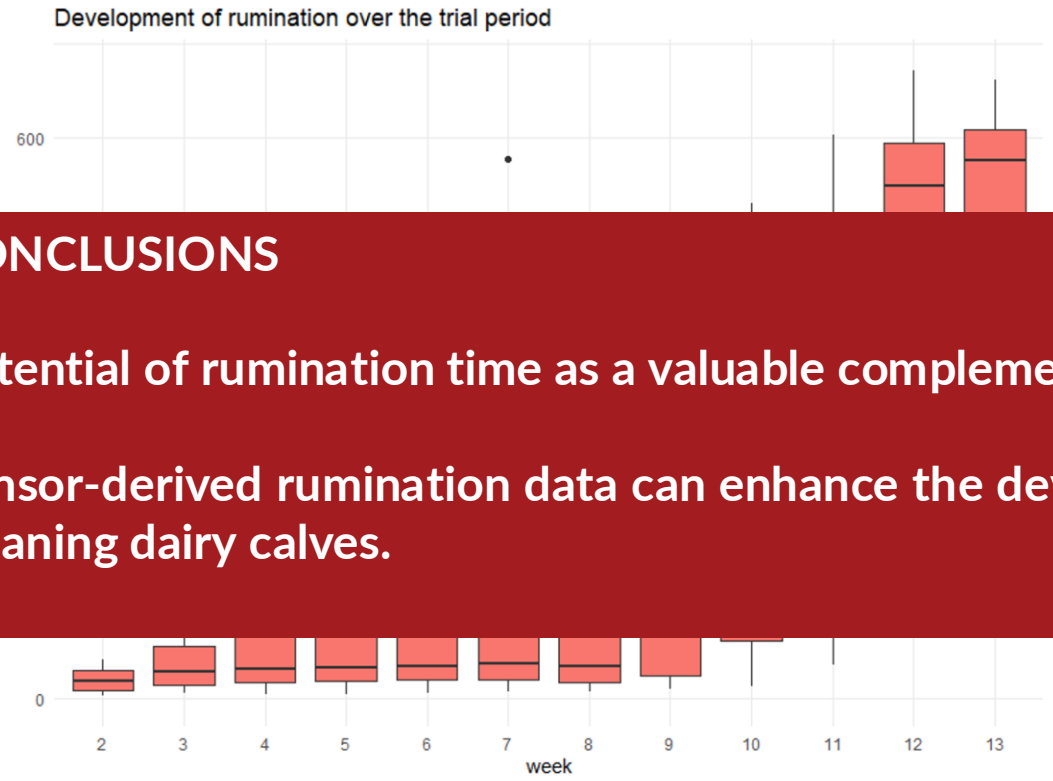
Artificial Intelligence: Animal Health

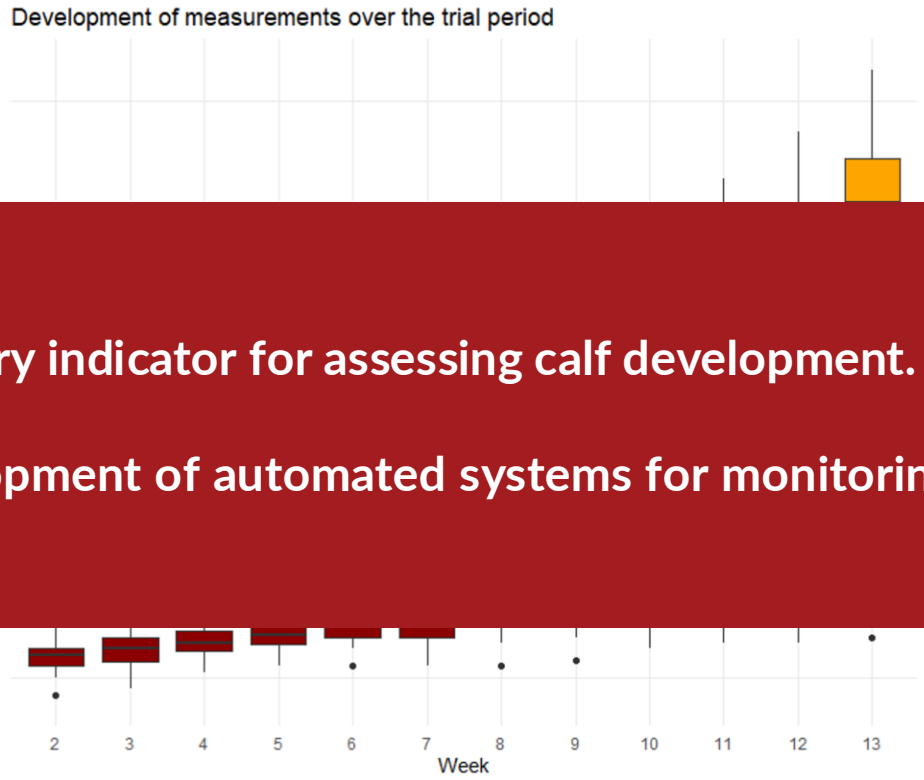
Using **Machine Learning** we were able to **predict** anaplasmosis **disease** with **3 days in advance** **(~90% ACC)**

University of Copenhagen - Department of Veterinary and Animal Sciences

Evaluating Sensor-Derived Rumination and Activity Data for Monitoring Pre-Weaning Dairy Calf: A Correlation Study with Traditional Metrics

Moritz Alexander Pfeiffer[1], Svenja Woudstra[1], Vanessa Amorin Teixeira[2], Leonardo Victor de Knegt[1], Gleiciele Mendes de Souza[3], Thierry Ribeiro Tomich[4], Mariana Magalhães Campos[4], Luiz Gustavo Ribeiro Pereira[1]





CONCLUSIONS

Potential of rumination time as a valuable complementary indicator for assessing calf development.

Sensor-derived rumination data can enhance the development of automated systems for monitoring pre-weaning dairy calves.

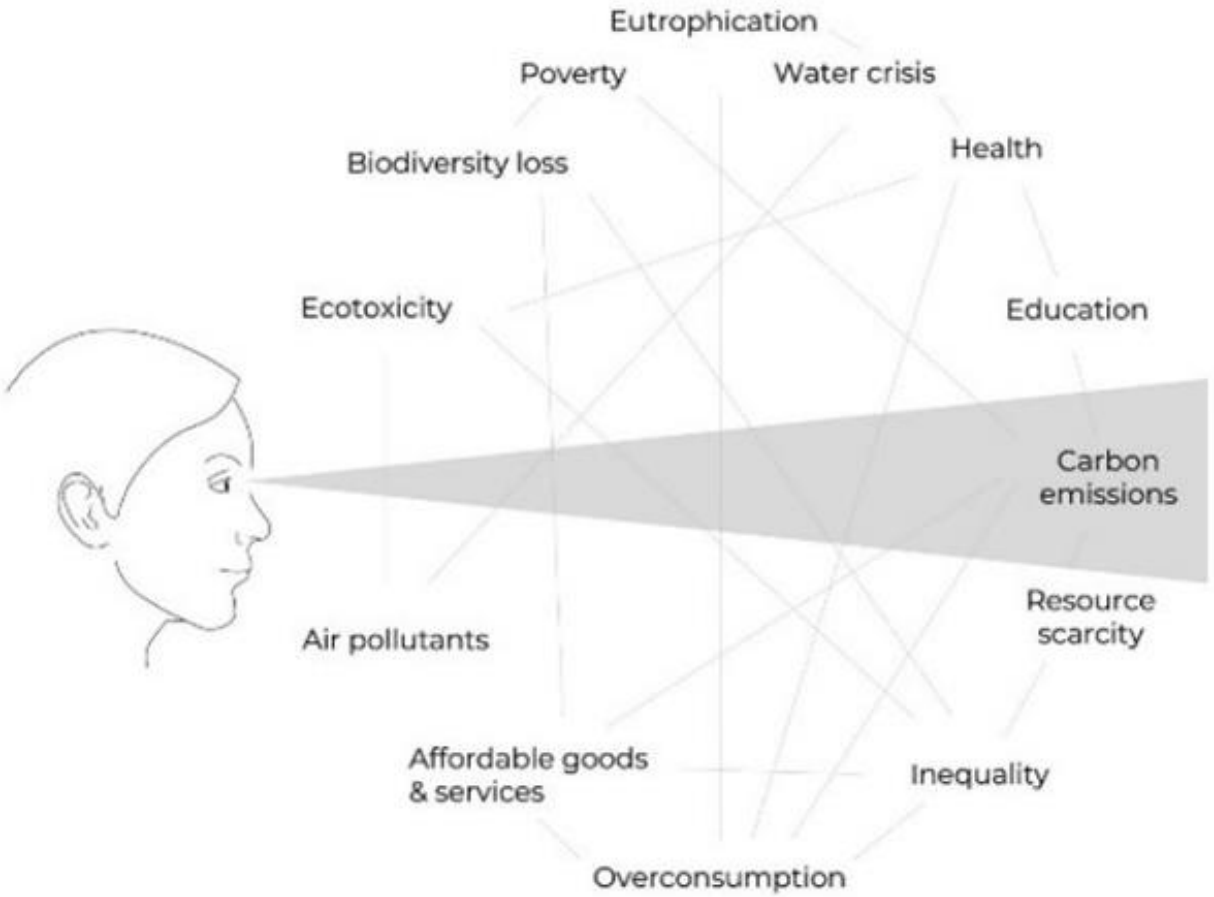

Back!!!
Forgot
Pre-dipping

DIMENSION	MATERIAL TECHNOLOGY	SUBTLE TECHNOLOGY
Focus	Hardware, devices, physical processes	Awareness, mental models, inner state
Impact	Efficiency, productivity	Relationships, decision quality
Examples	Precision collars, milking robots	Meditation, leadership practices

Future Milk X-ray

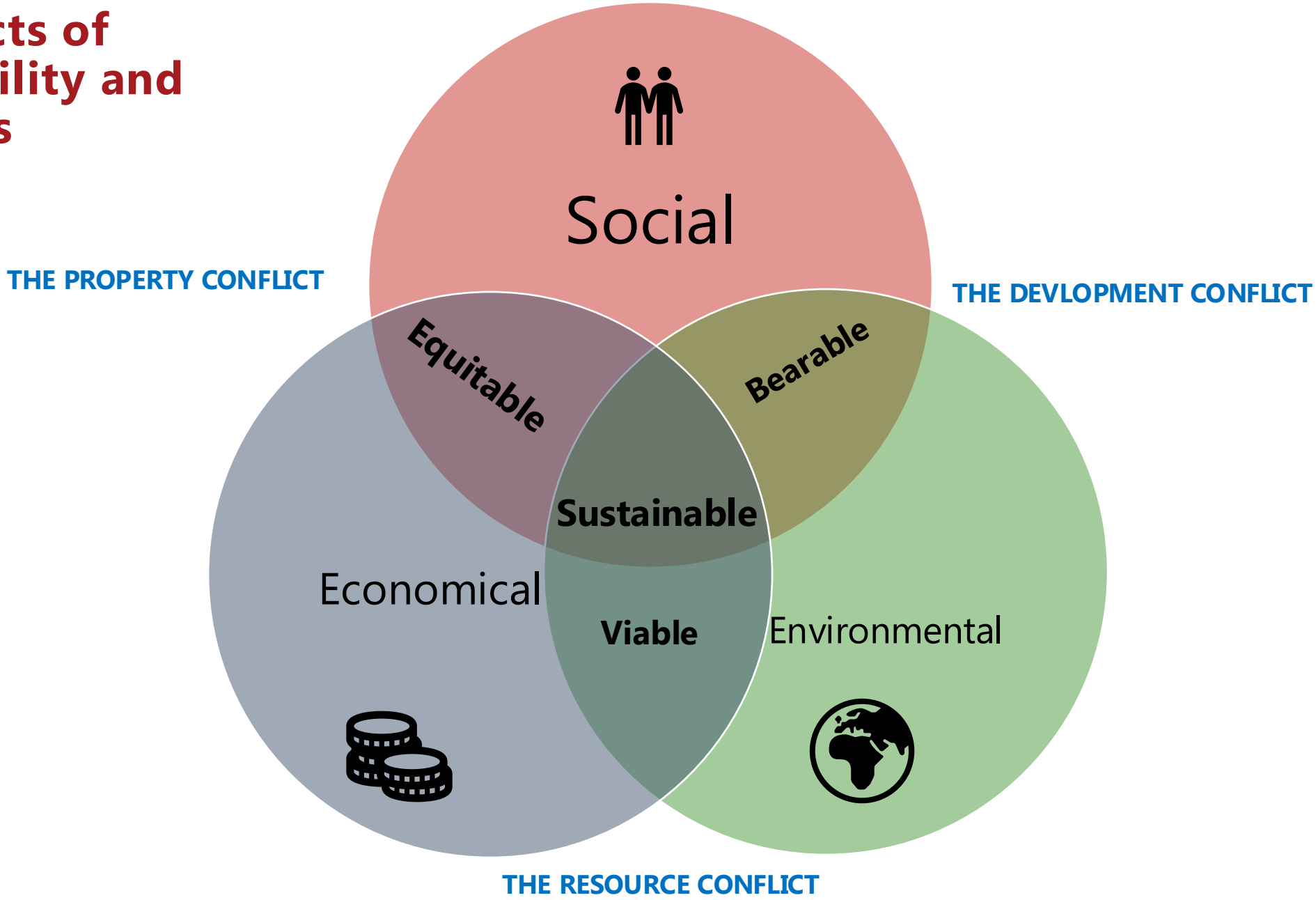
Regenerative Farm

Carbon Tunnel Vision

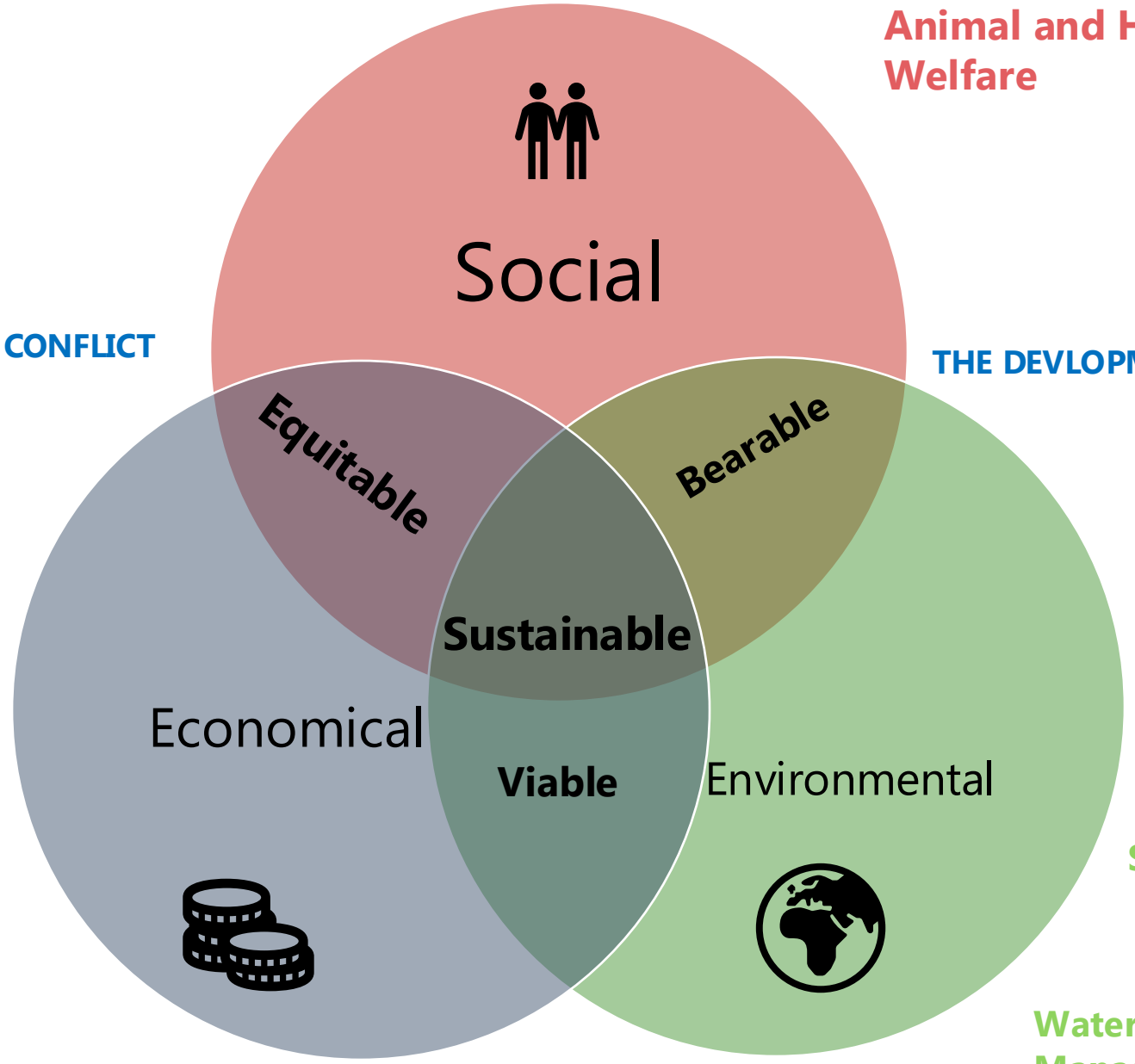


Graphic by Jan Konietzko

The Aspects of Sustainability and Trade-offs



The Aspects of Sustainability and Trade-offs



Animal and Human Welfare

Occupational health and safety

THE PROPERTY CONFLICT

THE DEVLOPMENT CONFLICT

Market Devlopment

Rural Economics

Product Quality and Safe

Carbon Footprint

Soil Quality and Retantion

Soil Nutrients

Biodiversity

Water Management

Waste

THE RESOURCE CONFLICT

Farms (n)

21

Lactation Cows (n)

9 085

Milk/year (kg)

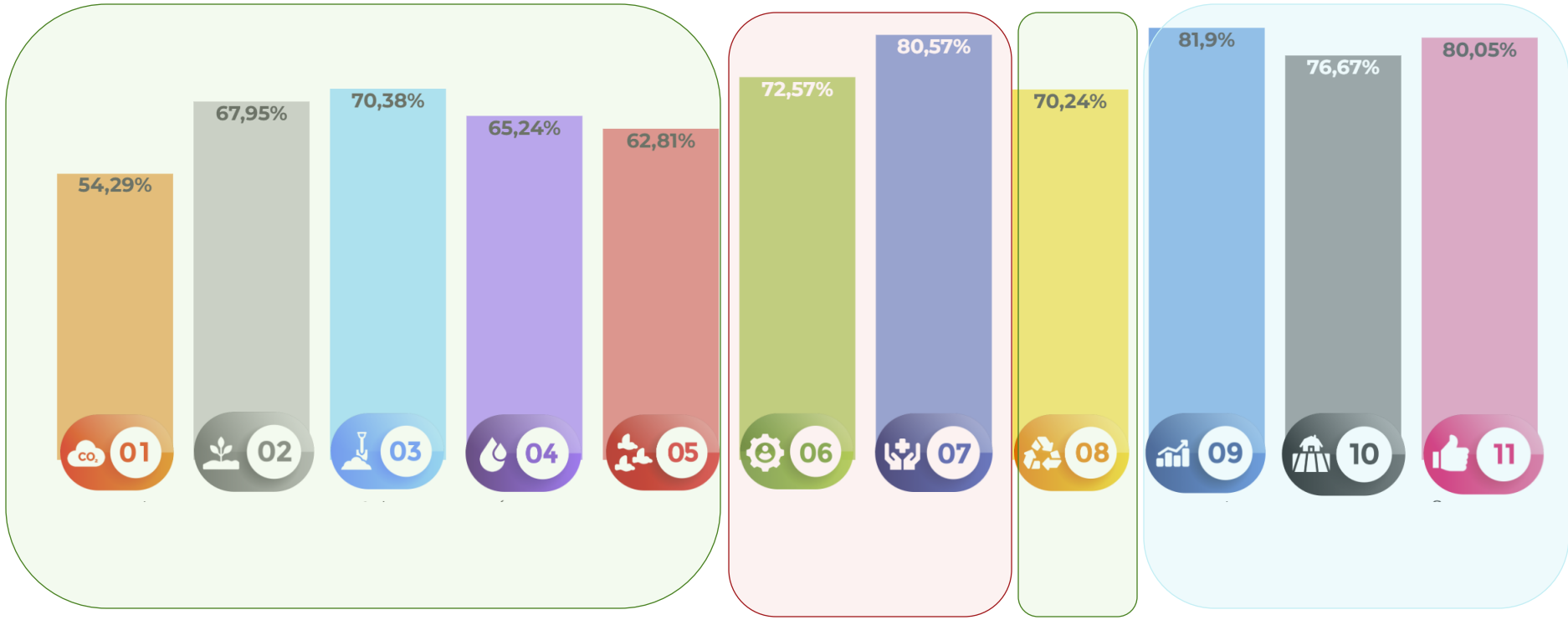
114 626 425

Milk Yield (kg/day)

27,11

ESG Farm Score

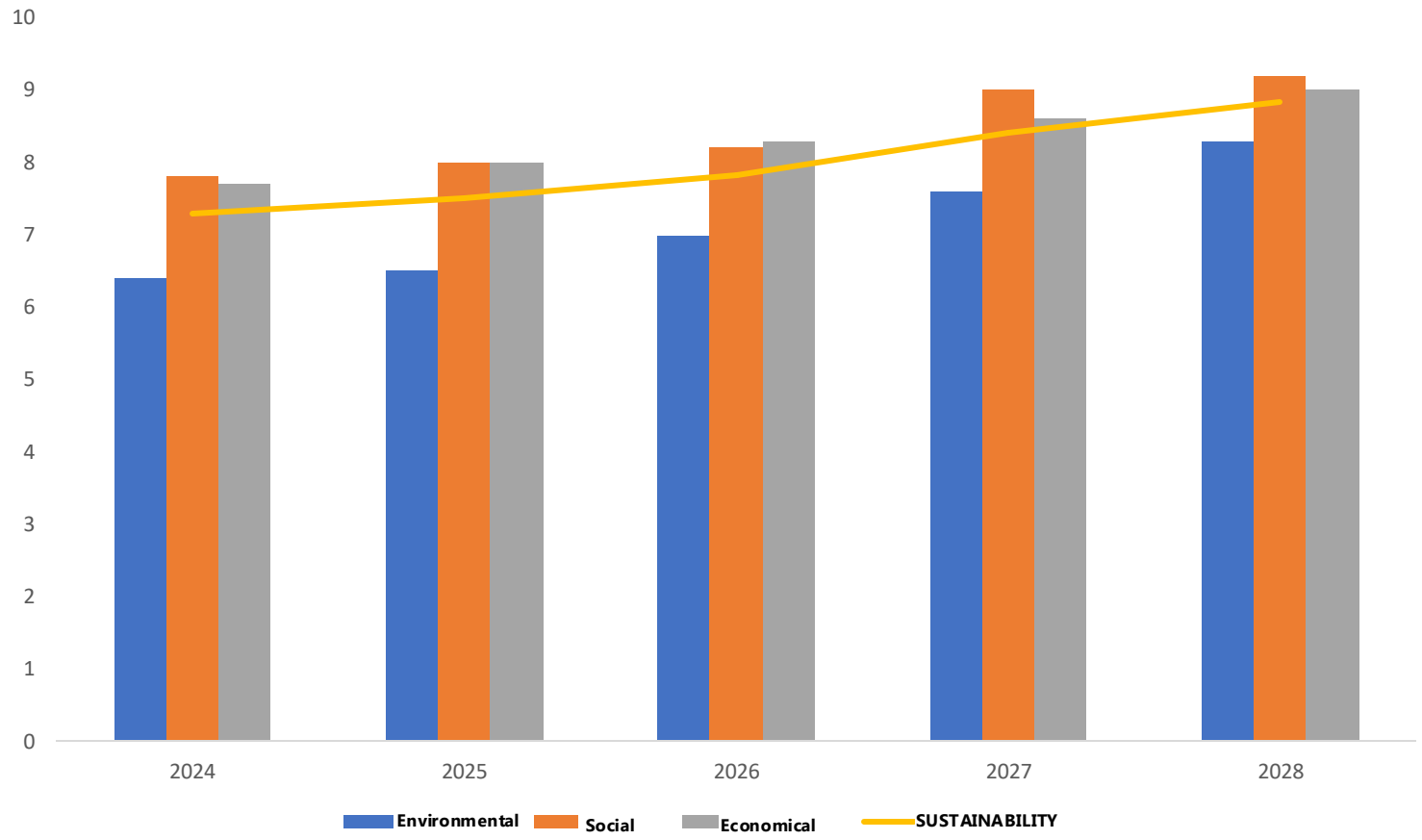
7,12



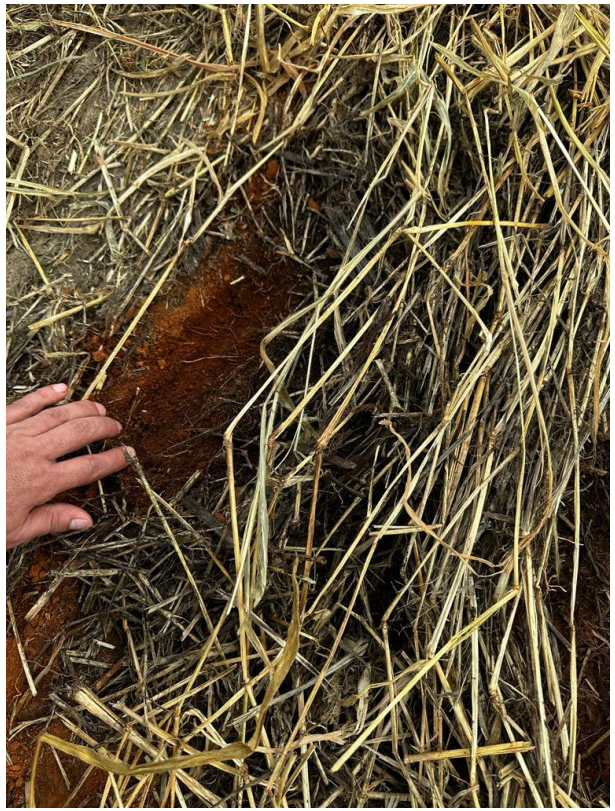
Environmental 6.4 **Social 7.8** **Economical 7,7**

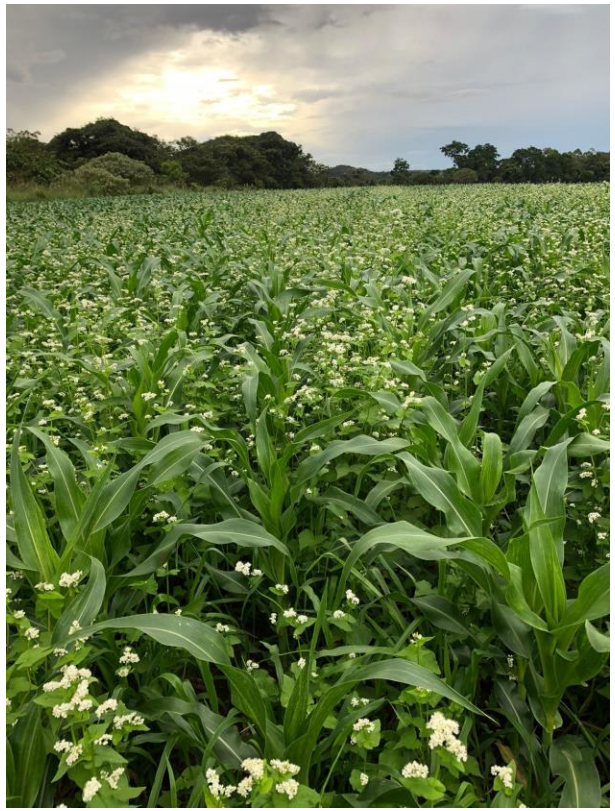
Regenerative Farm

Improvement in the three aspects of sustainability

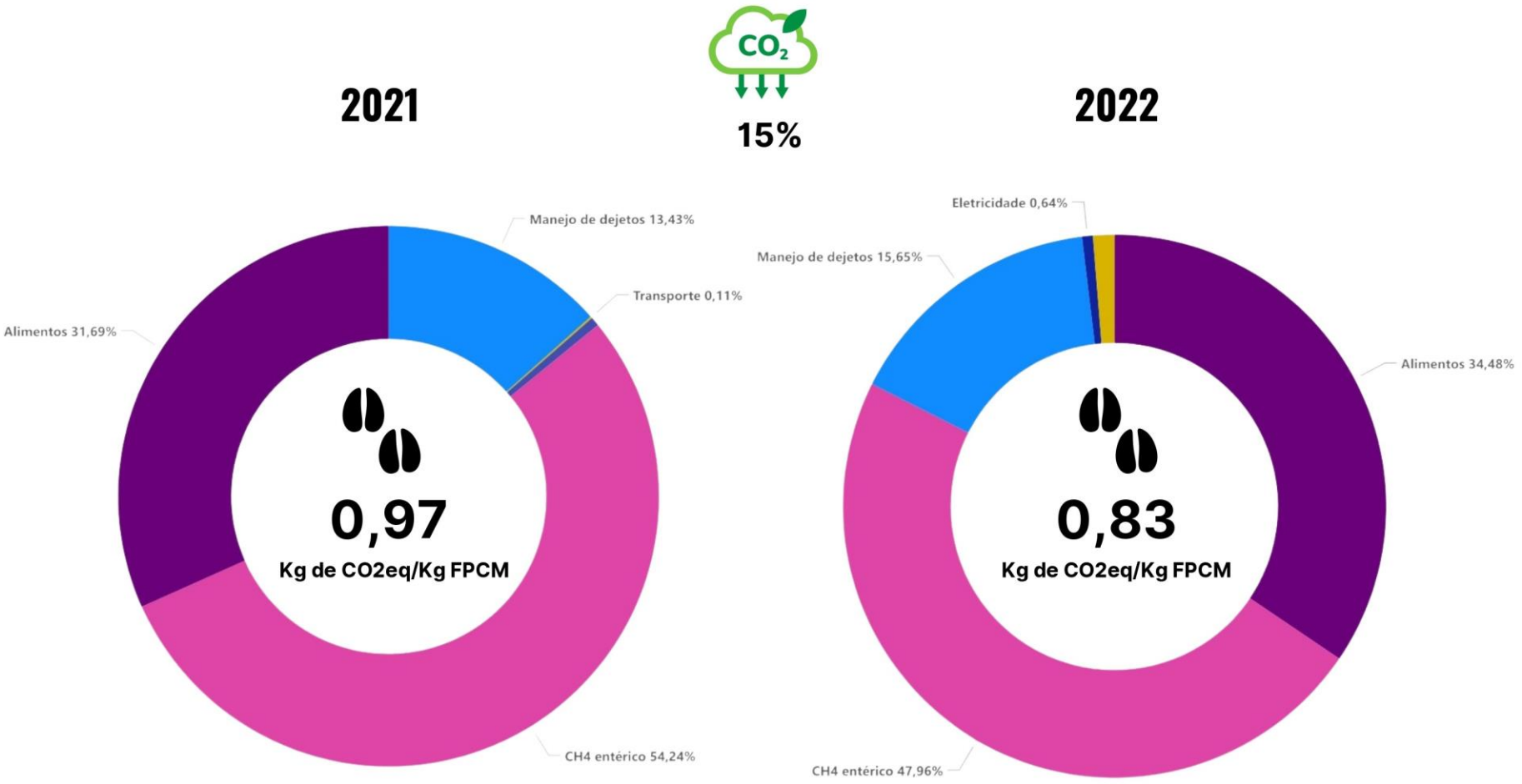


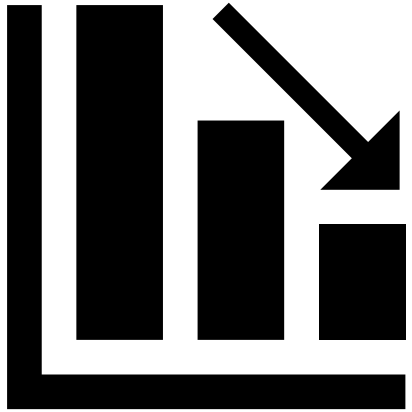
Science Supporting Practices





Beyond Milk - Regenerative Dairy Production





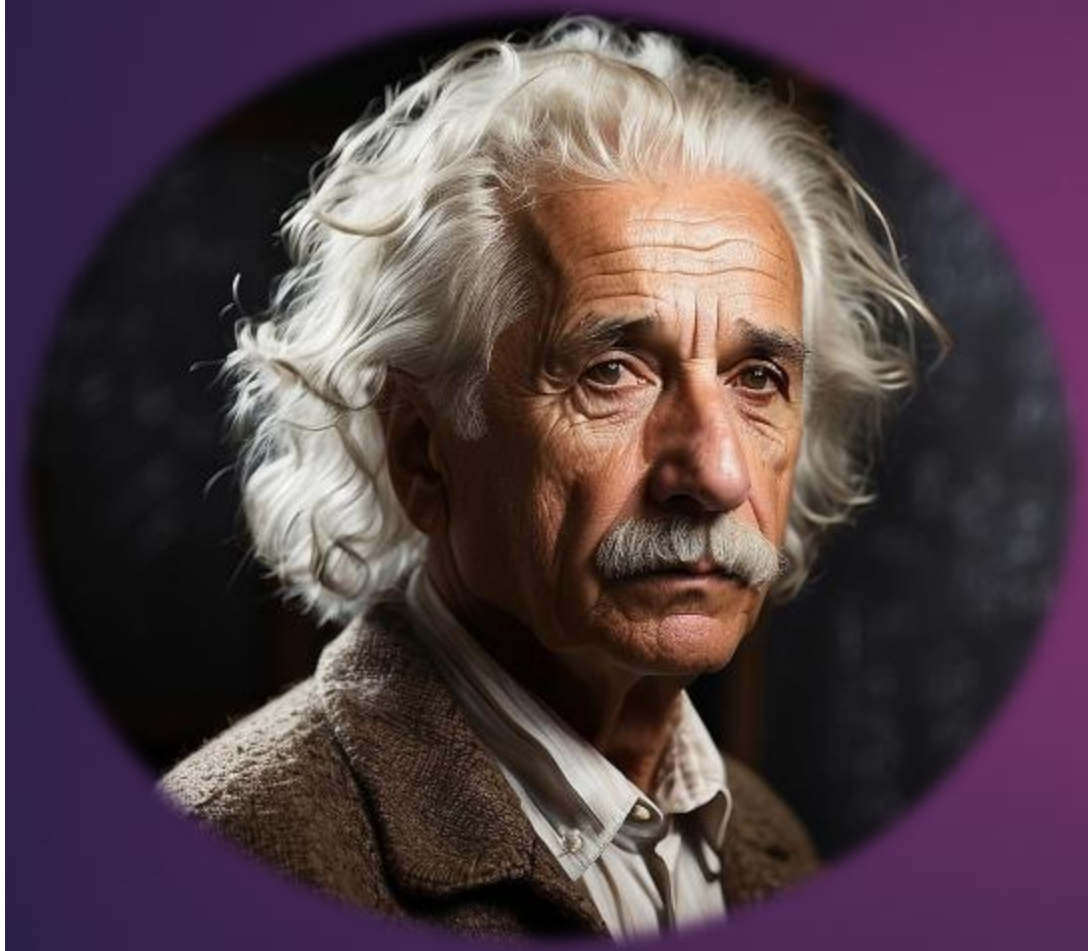
47%

0,51
Kg of CO2ep FPCM
2025

Beyond Milk

"The brown butterflies have returned"

Biodiversity



$E = mc^2$

Albert Einstein

Time and space are not absolute — they bend, dilate, and transform;
The impossible is only what we do not yet understand;
The future is not written — it is potential energy, waiting to be shaped.

The quality of our present state will deliver the Future Milk we truly deserve

Let growth prevail over the defensive mindset! Shift from interventionist practices to conservationist approaches! Together, let's co-create hope as a driving force to prosper and regenerate!

Mange Tak!

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Take-Home Messages for a Possible Future

The Milk of Tomorrow: Profitable, Resilient, with Happy People and Animals, producing more than milk—preserving, balanced, integrated, and rich in biodiversity;

Sustainability goes beyond carbon—it embraces environmental, social, and economic balance;

We need to (re)harmonize with nature's rhythms—integrating farms and nature benefits everyone. Embrace INTEGRATION, BALANCE, and BIODIVERSITY

Gratitude: Be thankful. You are on a farm—a dairy farm! You are producing milk—one of the most important sources of nutrients for humanity—and you are feeding countless families.

Prioritize your physical and mental health—your inner state shapes the quality of your decisions and relationships, defining the milk of the future