
The future of productive life and environmental sustainability in dairy cattle
26th October 2023
45th ADSA Discover Conference
Harper Adams University
Source: Jude L. Capper, 2023

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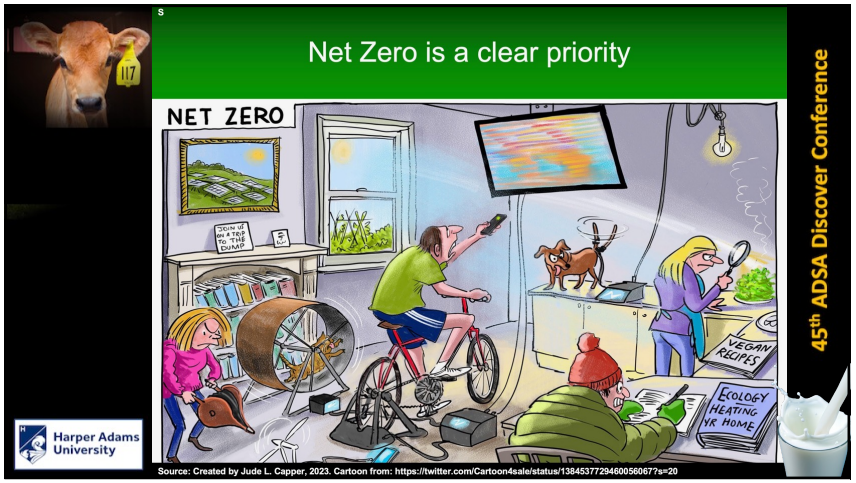
Net Zero is a clear priority
NET ZERO
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Source: Created by Jude L. Capper, 2023. Cartoon from: https://twitter.com/Cartoon4sale/status/1384537729460056067?s=20

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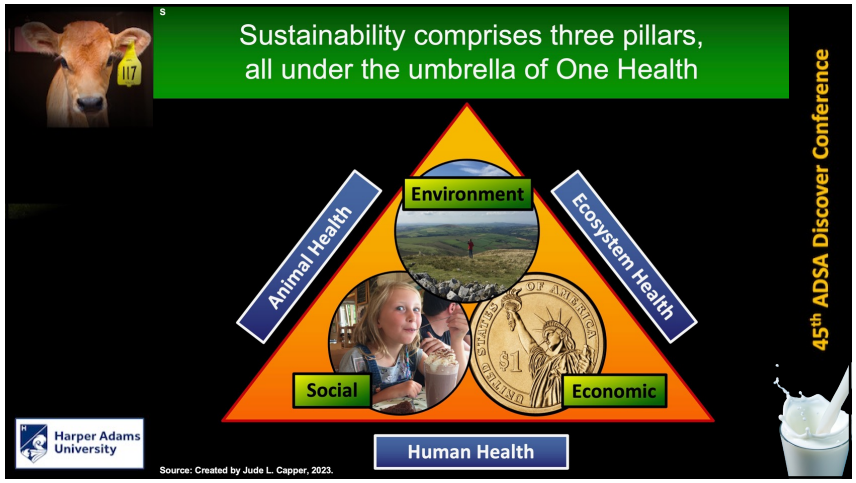
Sustainability comprises three pillars, all under the umbrella of One Health
Environment
Animal Health
Ecosystem Health
Social
Economic
Human Health
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Source: Created by Jude L. Capper, 2023.

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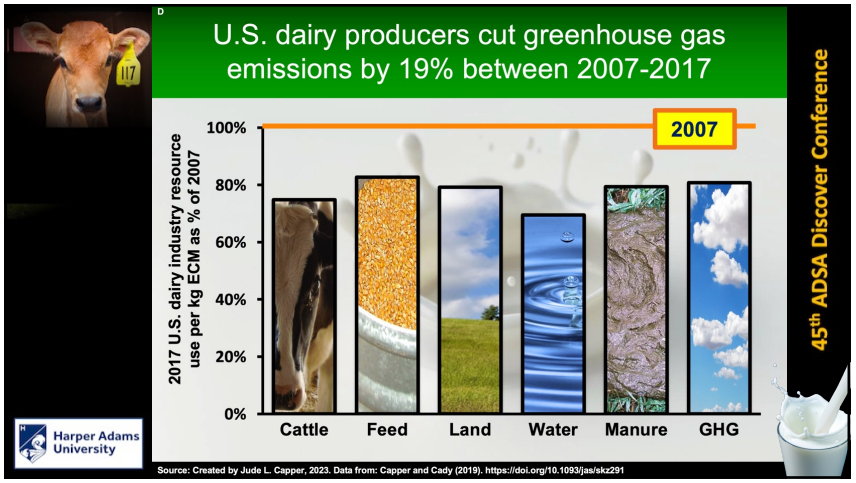
U.S. dairy producers cut greenhouse gas emissions by 19% between 2007-2017
2007
2017 U.S. dairy industry resource use per kg ECM as % of 2007
100%
80%
60%
40%
20%
0%
Cattle
Feed
Land
Water
Manure
GHG
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Source: Created by Jude L. Capper, 2023. Data from: Capper and Cady (2019). https://doi.org/10.1093/jas/skz291

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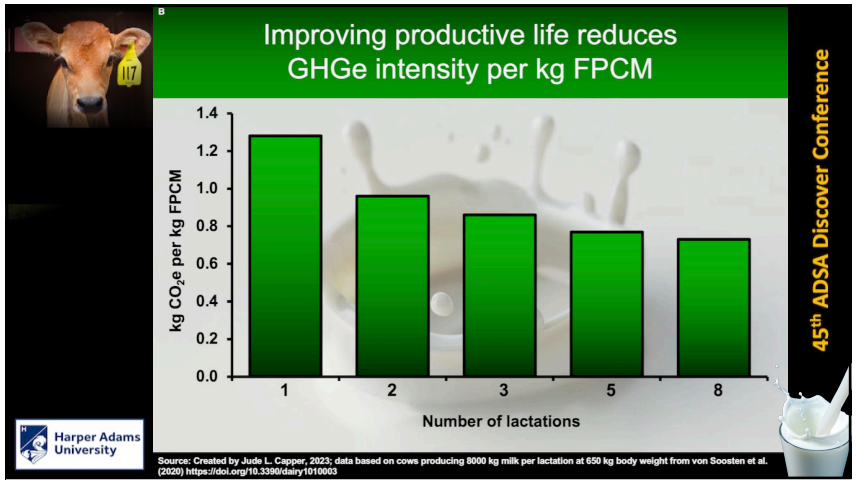
Improving productive life reduces GHGe intensity per kg FPCM
kg CO_2e per kg FPCM
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
5
8
Number of lactations
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Source: Created by Jude L. Capper, 2023; data based on cows producing 8000 kg milk per lactation at 650 kg body weight from von Soosten et al. (2020) https://doi.org/10.3390/dairy1010003

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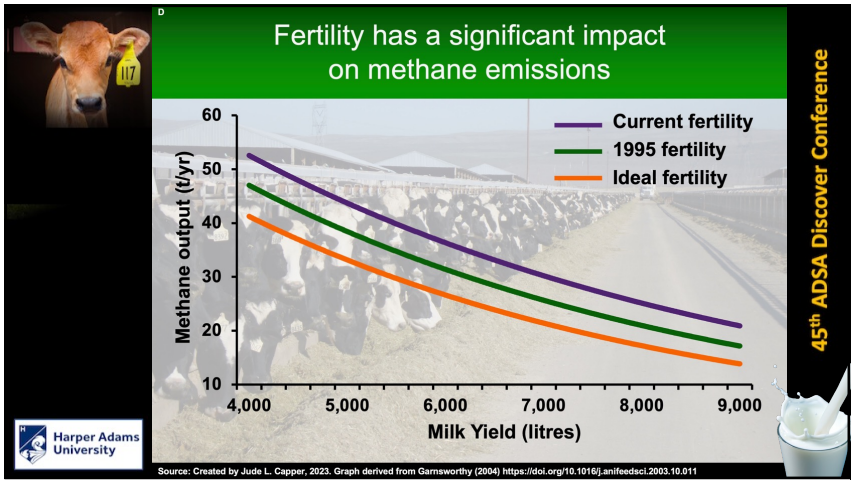
Fertility has a significant impact on methane emissions
Methane output (t/yr)
60
50
40
30
20
10
Current fertility
1995 fertility
Ideal fertility
4,000
5,000
6,000
7,000
8,000
9,000
Milk Yield (litres)
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Source: Created by Jude L. Capper, 2023. Graph derived from Garnsworthy (2004) https://doi.org/10.1016/j.anifeedsci.2003.10.011

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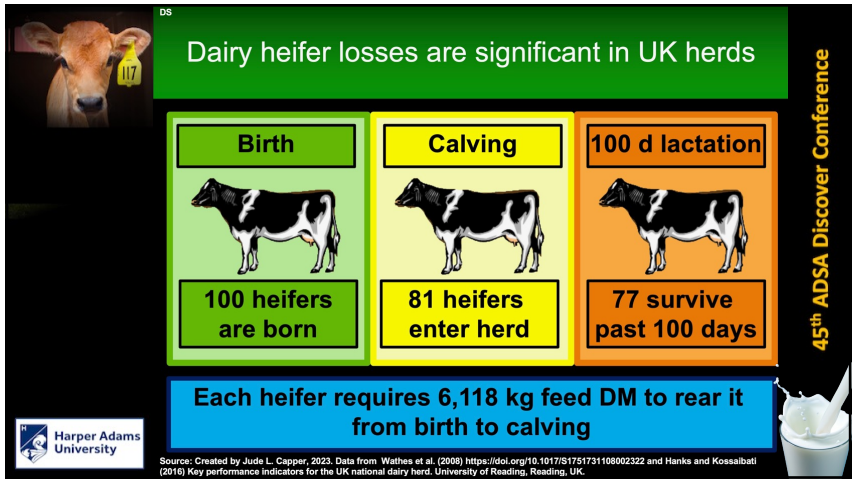
Dairy heifer losses are significant in UK herds
Birth
100 heifers are born
Calving
81 heifers enter herd
100 d lactation
77 survive past 100 days
Each heifer requires 6,118 kg feed DM to rear it from birth to calving
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Source: Created by Jude L. Capper, 2023. Data from Wathes et al. (2008) https://doi.org/10.1017/S1751731108002322 and Hanks and Kossaibati (2016) Key performance indicators for the UK national dairy herd. University of Reading, Reading, UK.

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Disease losses are significant and preventable, but the sustainability impacts aren't quantified
Lost: 20%
Harvested: 80%
At the worldwide level, average losses due to animal diseases are more than 20% (OIE, 2008)
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Source: Created by Jude L. Capper, 2023. Data from: World Organization for Animal Health. 2008. http://www.oie.int/for-the-media/editorials/detail/article/feeding-the-world-better-by-controlling-animal-diseases

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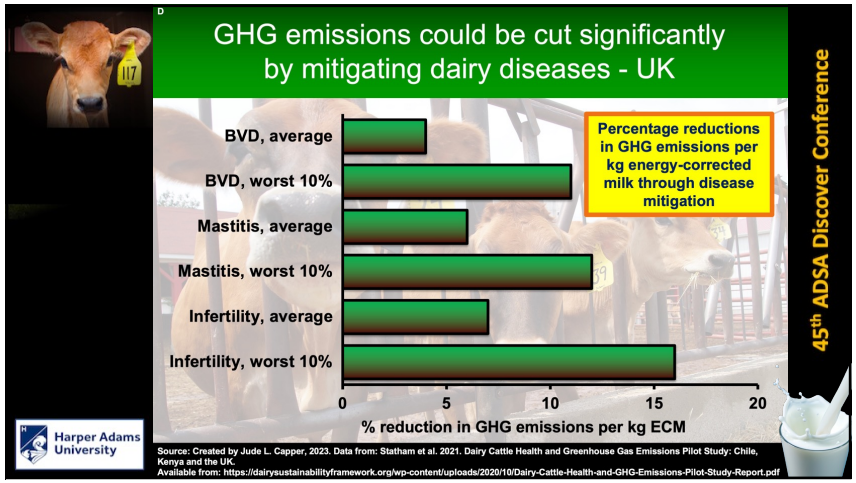
GHG emissions could be cut significantly by mitigating dairy diseases - UK
BVD, average
BVD, worst 10%
Mastitis, average
Mastitis, worst 10%
Infertility, average
Infertility, worst 10%
Percentage reductions in GHG emissions per kg energy-corrected milk through disease mitigation
0 5 10 15 20
% reduction in GHG emissions per kg ECM
Source: Created by Jude L. Capper, 2023. Data from: Statham et al. 2021. Dairy Cattle Health and Greenhouse Gas Emissions Pilot Study: Chile, Kenya and the UK.
Available from: https://dairysustainabilityframework.org/wp-content/uploads/2020/10/Dairy-Cattle-Health-and-GHG-Emissions-Pilot-Study-Report.pdf
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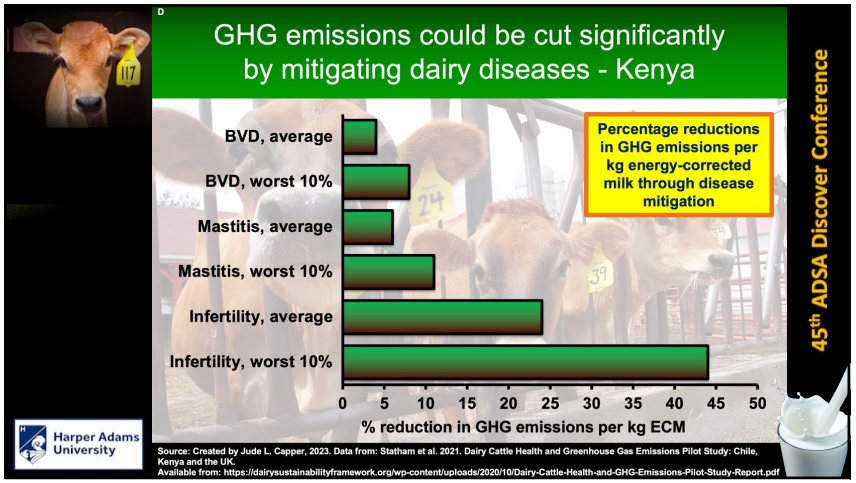
GHG emissions could be cut significantly by mitigating dairy diseases - Kenya
BVD, average
BVD, worst 10%
Mastitis, average
Mastitis, worst 10%
Infertility, average
Infertility, worst 10%
Percentage reductions in GHG emissions per kg energy-corrected milk through disease mitigation
0 5 10 15 20 25 30 35 40 45 50
% reduction in GHG emissions per kg ECM
Source: Created by Jude L. Capper, 2023. Data from: Statham et al. 2021. Dairy Cattle Health and Greenhouse Gas Emissions Pilot Study: Chile, Kenya and the UK.
Available from: https://dairysustainabilityframework.org/wp-content/uploads/2020/10/Dairy-Cattle-Health-and-GHG-Emissions-Pilot-Study-Report.pdf
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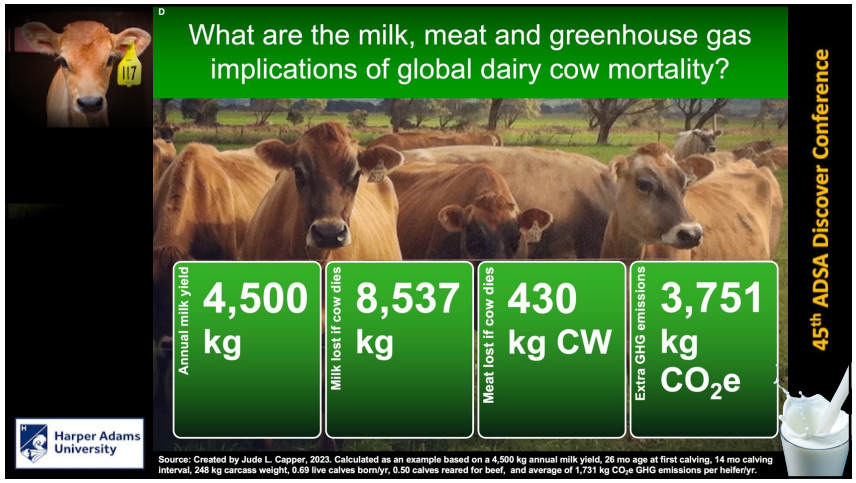
What are the milk, meat and greenhouse gas implications of global dairy cow mortality?
Annual milk yield
4,500 kg
Milk lost if cow dies
8,537 kg
Meat lost if cow dies
430 kg CW
Extra GHG emissions
3,751 kg CO_2e
Source: Created by Jude L. Capper, 2023. Calculated as an example based on a 4,500 kg annual milk yield, 26 mo age at first calving, 14 mo calving interval, 248 kg carcass weight, 0.69 live calves born/yr, 0.50 calves reared for beef, and average of 1,731 kg CO_2e GHG emissions per heifer/yr.
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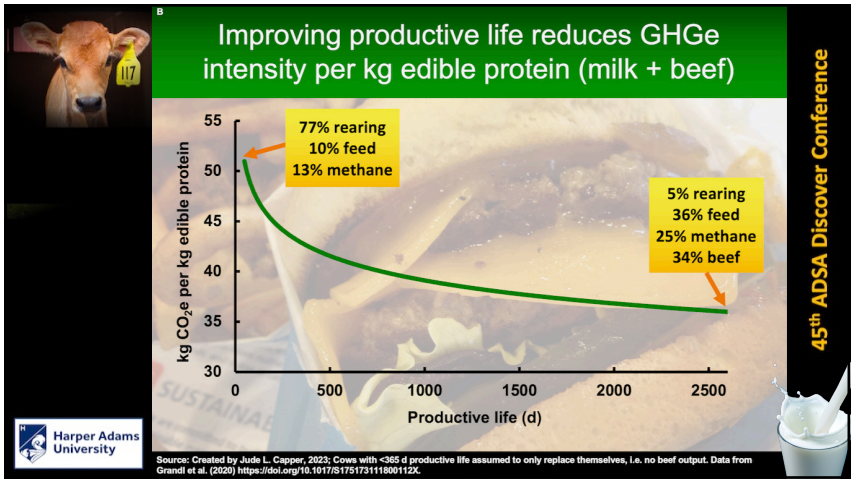
Improving productive life reduces GHGe intensity per kg edible protein (milk + beef)
kg CO_2e per kg edible protein
55 50 45 40 35 30
77% rearing
10% feed
13% methane
5% rearing
36% feed
25% methane
34% beef
0 500 1000 1500 2000 2500
Productive life (d)
Source: Created by Jude L. Capper, 2023; Cows with <365 d productive life assumed to only replace themselves, i.e. no beef output. Data from Grandl et al. (2020) https://doi.org/10.1017/S1751731111800112X.
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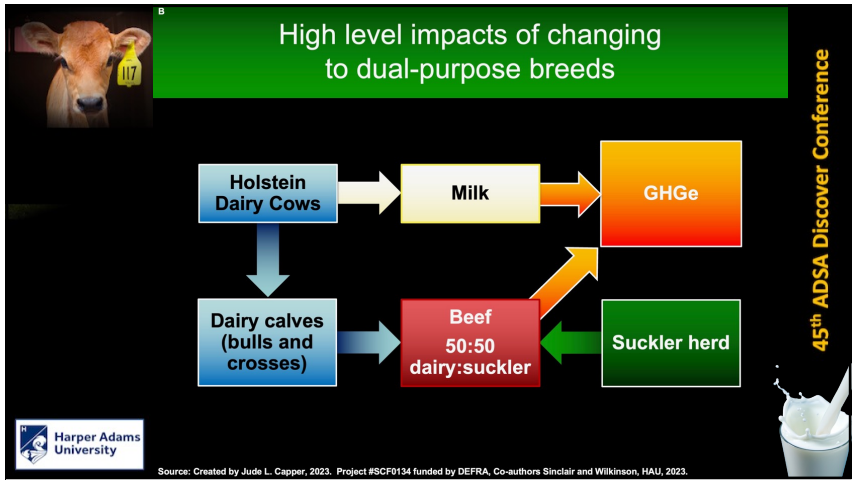

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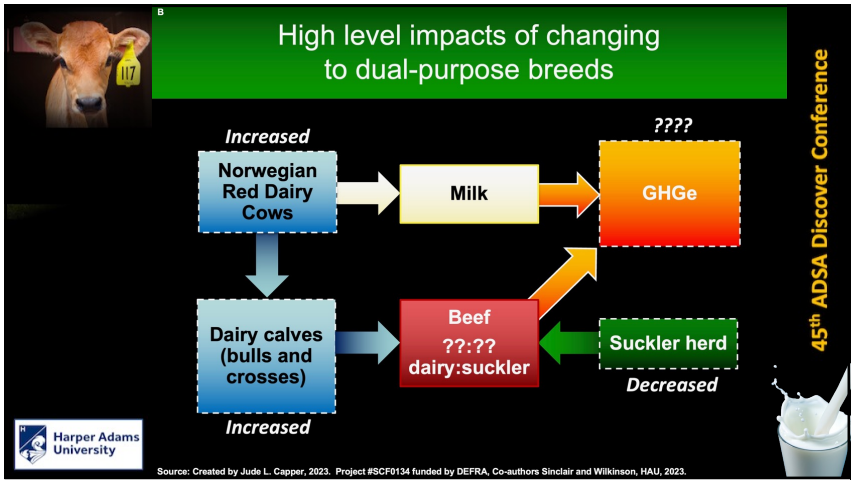

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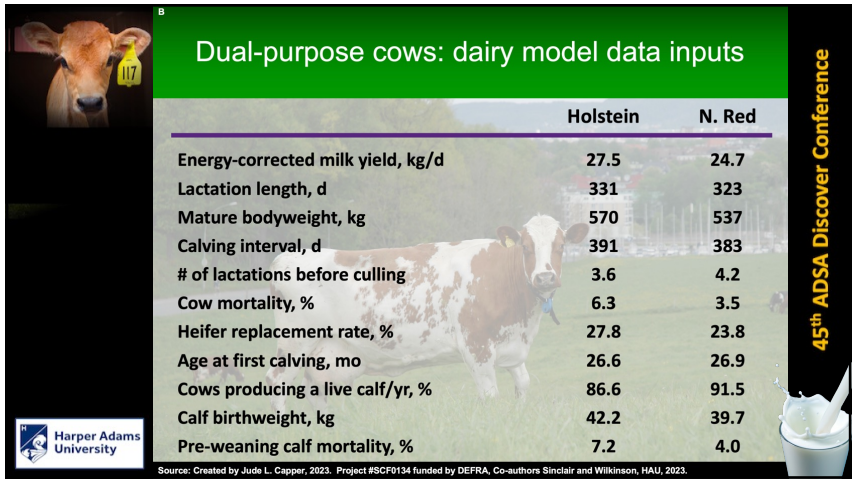

	Holstein	N. Red
Energy-corrected milk yield, kg/d	27.5	24.7
Lactation length, d	331	323
Mature bodyweight, kg	570	537
Calving interval, d	391	383
# of lactations before culling	3.6	4.2
Cow mortality, %	6.3	3.5
Heifer replacement rate, %	27.8	23.8
Age at first calving, mo	26.6	26.9
Cows producing a live calf/yr, %	86.6	91.5
Calf birthweight, kg	42.2	39.7
Pre-weaning calf mortality, %	7.2	4.0

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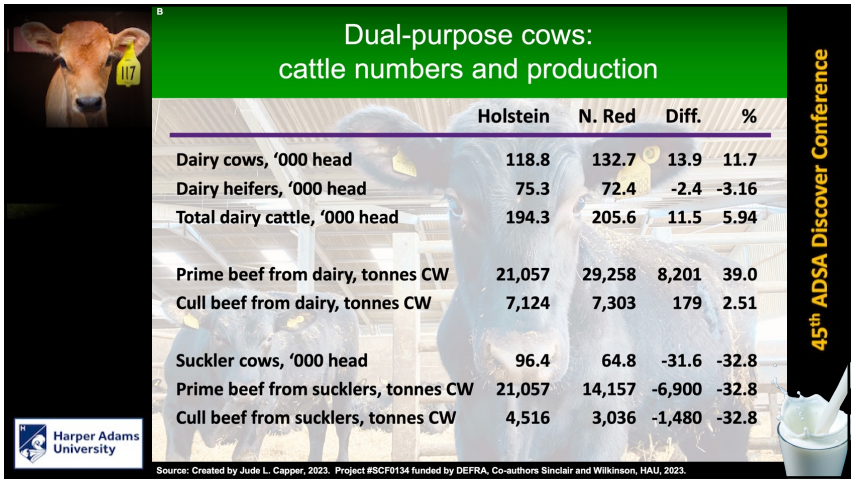

	Holstein	N. Red	Diff.	%
Dairy cows, '000 head	118.8	132.7	13.9	11.7
Dairy heifers, '000 head	75.3	72.4	-2.4	-3.16
Total dairy cattle, '000 head	194.3	205.6	11.5	5.94
Prime beef from dairy, tonnes CW	21,057	29,258	8,201	39.0
Cull beef from dairy, tonnes CW	7,124	7,303	179	2.51
Suckler cows, '000 head	96.4	64.8	-31.6	-32.8
Prime beef from sucklers, tonnes CW	21,057	14,157	-6,900	-32.8
Cull beef from sucklers, tonnes CW	4,516	3,036	-1,480	-32.8

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Dual-purpose cows: GHGe from beef and dairy

	Holstein	N. Red	Diff.	%
Emissions intensity, kg CO_2e/kg				
Dairy GHGe/kg ECM	1.478	1.512	0.034	2.29
Dairy beef GHGe/kg CW	17.2	17.7	0.48	2.81
Suckler beef GHGe/kg CW	32.4	32.4	-	-
Total GHGe, tonnes CO_2e				
Dairy GHGe	1,477,819	1,511,690	33,871	2.29
Dairy beef GHGe	361,446	516,304	154,858	42.8
Suckler beef GHGe	783,477	526,746	-256,731	-32.77
Total beef GHGe	1,144,923	1,043,050	-101,873	-8.90
Total cattle industry GHGe	2,622,742	2,554,740	-68,002	-2.59

Source: Created by Jude L. Capper, 2023. Project #SCF0134 funded by DEFRA, Co-authors Sinclair and Wilkinson, HAU, 2023.

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Sexed semen – beef environmental responsibility 1

Modelling effects of sexed semen and moving from 50:50 to 78:22 dairy:suckler beef in Ireland

Economic value of dairy beef to the industry improved by 60.4%

GHG emissions per tonne beef reduced by 24.6% assuming dairy herd expands to maintain supply

Source: Created by Jude L. Capper, 2023. Data from: Holden and Butler (2018) https://doi.org/10.1017/S1751731118000721

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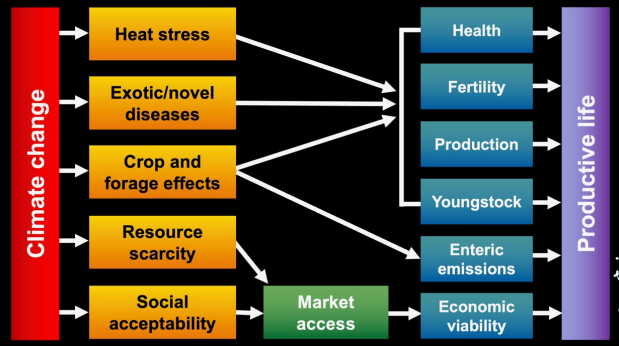
How will the changing climate affect productive life?



Source: Created by Jude L. Capper, 2023.

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Our biggest challenge is to keep meat and dairy in the diets of future food purchasers

Source: Created by and photo from Jude L. Capper, 2023.

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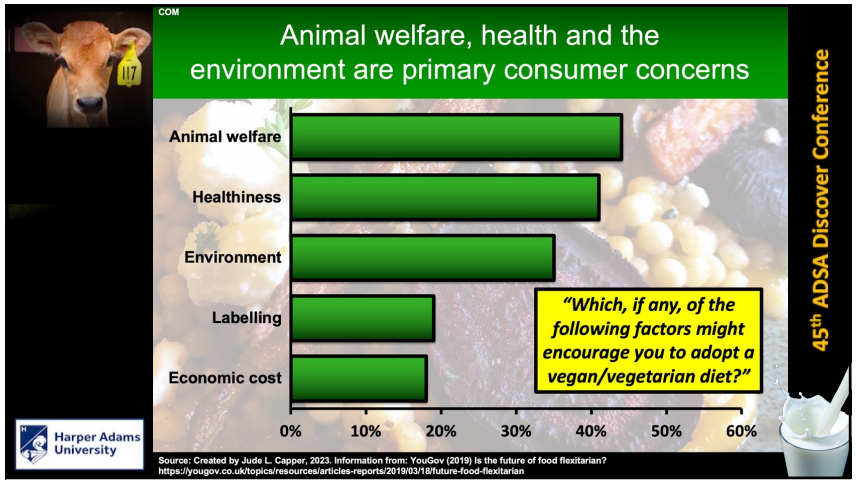
COM
Animal welfare, health and the environment are primary consumer concerns
Animal welfare
Healthiness
Environment
Labelling
Economic cost
0%
10%
20%
30%
40%
50%
60%
"Which, if any, of the following factors might encourage you to adopt a vegan/vegetarian diet?"
Source: Created by Jude L. Capper, 2023. Information from: YouGov (2019) Is the future of food flexitarian? https://yougov.co.uk/topics/resources/articles-reports/2019/03/18/future-food-flexitarian
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D
Does this farm have good welfare?
Source: Created and photo by Jude L. Capper, 2023.
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D
Does this farm have good welfare?
Source: Created and photo by Jude L. Capper, 2023.
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23


D
Does this farm have good welfare?
Source: Created and photo by Jude L. Capper, 2023.
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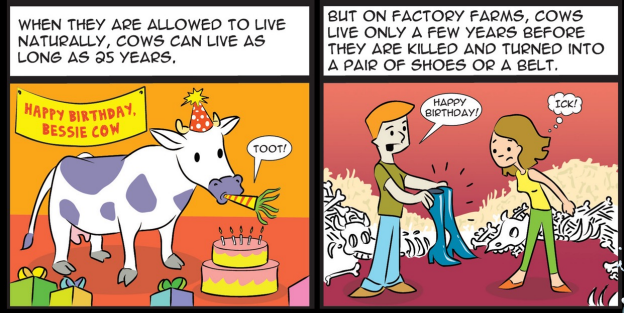
Do welfare and productive life compliment or conflict? Should cows live for 25 years?



Source: Created by Jude L. Capper, 2023. Infographic from PETA (2023) "A Cow's Life" comic book: https://www.petakids.com/comics/cows-life/

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Where do we go from here?

- Urgent need to fill the knowledge gaps
- Focus on individual health components of PL
- Expand analyses to include beef production
- Are other environmental metrics impacted?
- How will climate change affect PL?
- Where does welfare fit in?
- How do we communicate this beyond our sphere?

Source: Created by Jude L. Capper, 2023.

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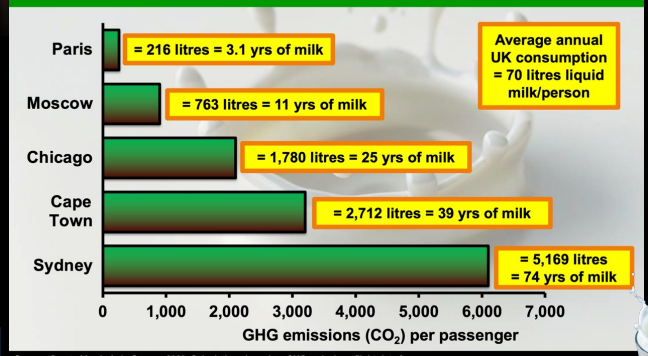
International flights emit considerable quantities of carbon compared to dairy production



Source: Created by Jude L. Capper, 2023. Calculations based on GHG emissions flight data from: https://co2.myclimate.org/en/flight_calculators/new, and on a carbon footprint per litre of milk of 1.18 kg CO2-eq (under GWP100) from AHDB: https://dairy.ahdb.org.uk/non_umbraco/download.aspx?media=17338

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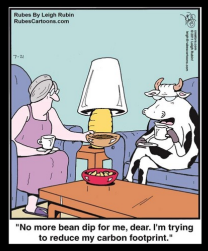
Thank you!

JCapper@harper-adams.ac.uk

http://bovidiva.com/presentationlinks



Questions?

Source: Created by Jude L. Capper, 2023. Cartoon from: http://RubesCartoons.com

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