

Herbivore nutrition, ecosystems and nature-based solutions - what are the sustainability opportunities and trade-offs?

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Professor Jude L. Capper

6th June 2023

There is no definitively sustainable breed or system



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



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Ruminants are criticized for greenhouse gas emissions

IF THE WORLD REDUCED MEAT CONSUMPTION BY



15%

{BY DOING MEATLESS MONDAY}

IT WOULD HAVE THE SAME IMPACT
ON GREENHOUSE GAS EMISSIONS AS



TAKING 240 MILLION CARS
OFF THE ROAD EACH YEAR

Source: Created by Jude L. Capper, 2023. Image from Meatless Monday:
https://www.colorado.edu/ecenter/sites/default/files/styles/large/public/callout/mm_1.png?itok=pt2h2qDr



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Grazing livestock are criticised by vocal activists

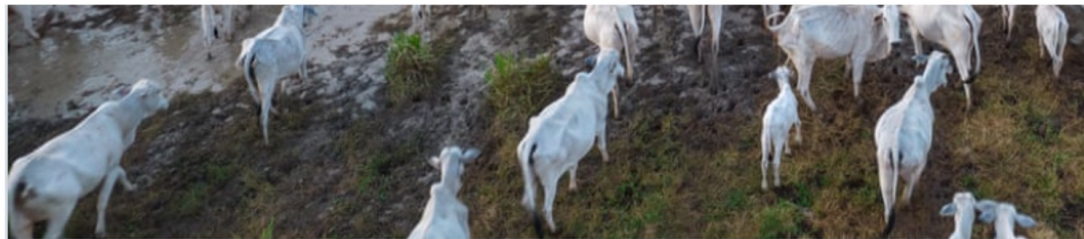


George Monbiot
@GeorgeMonbiot



When foodies, celebrity chefs and even some environmentalists say we should eat "pasture-fed" or "grass-fed" meat, this is what it means in practice.

The most damaging of all food products, it cannot feed more than a tiny number without causing ecocide.



**The
Guardian**

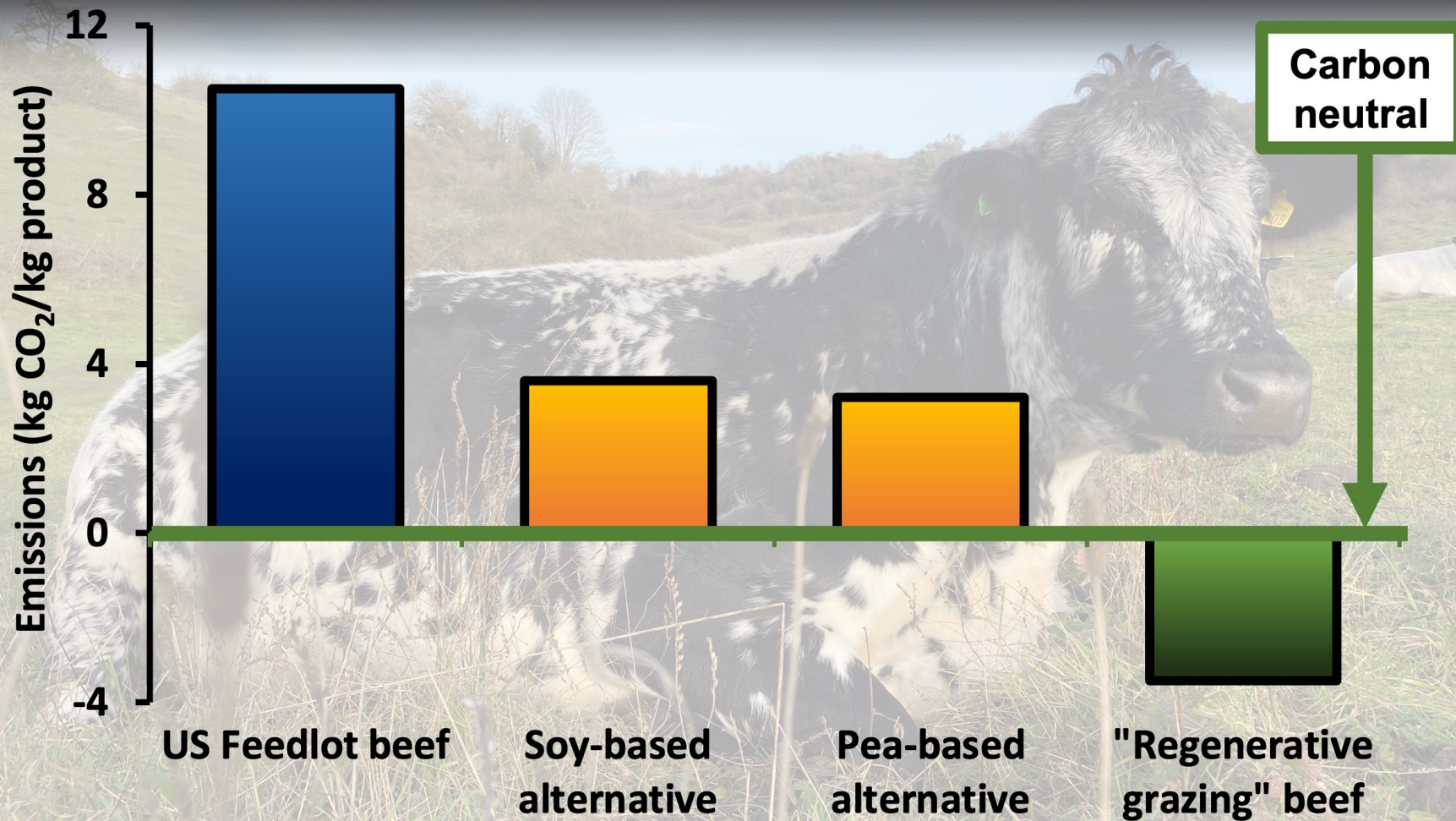
More than 800m Amazon trees felled in six years to meet beef demand
Investigation involving Guardian shows systematic and vast forest loss linked to cattle farming in Brazil

Source: Created by Jude L. Capper, 2023. Screenshot from Twitter

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Meat alternatives do not necessarily have lower emissions



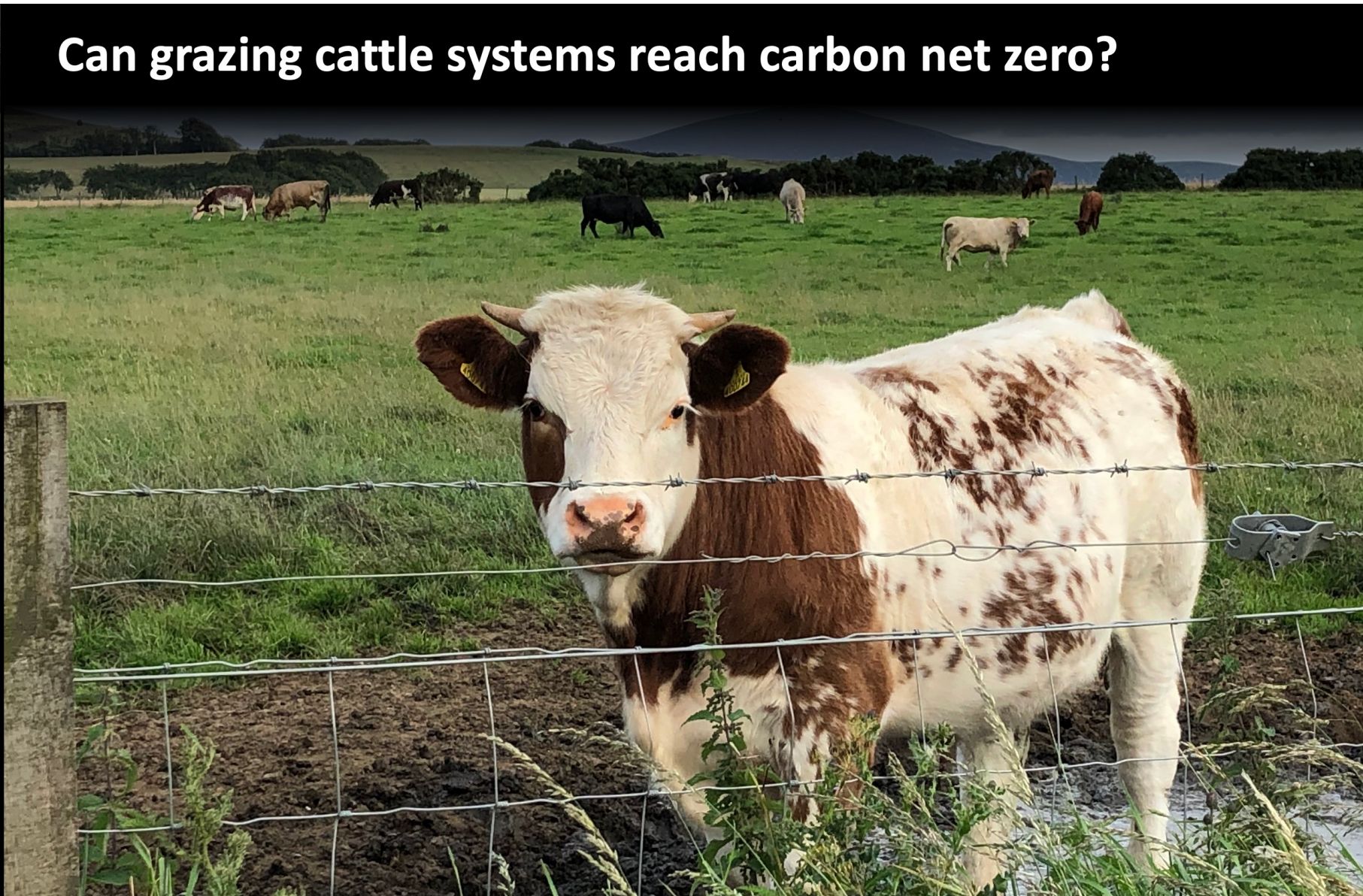
Source: Created by and photo from Jude L. Capper, 2023. data from van Vliet et al. (2020) <https://doi.org/10.3389/fsufs.2020.00128>

Can grazing cattle systems reach carbon net zero?

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

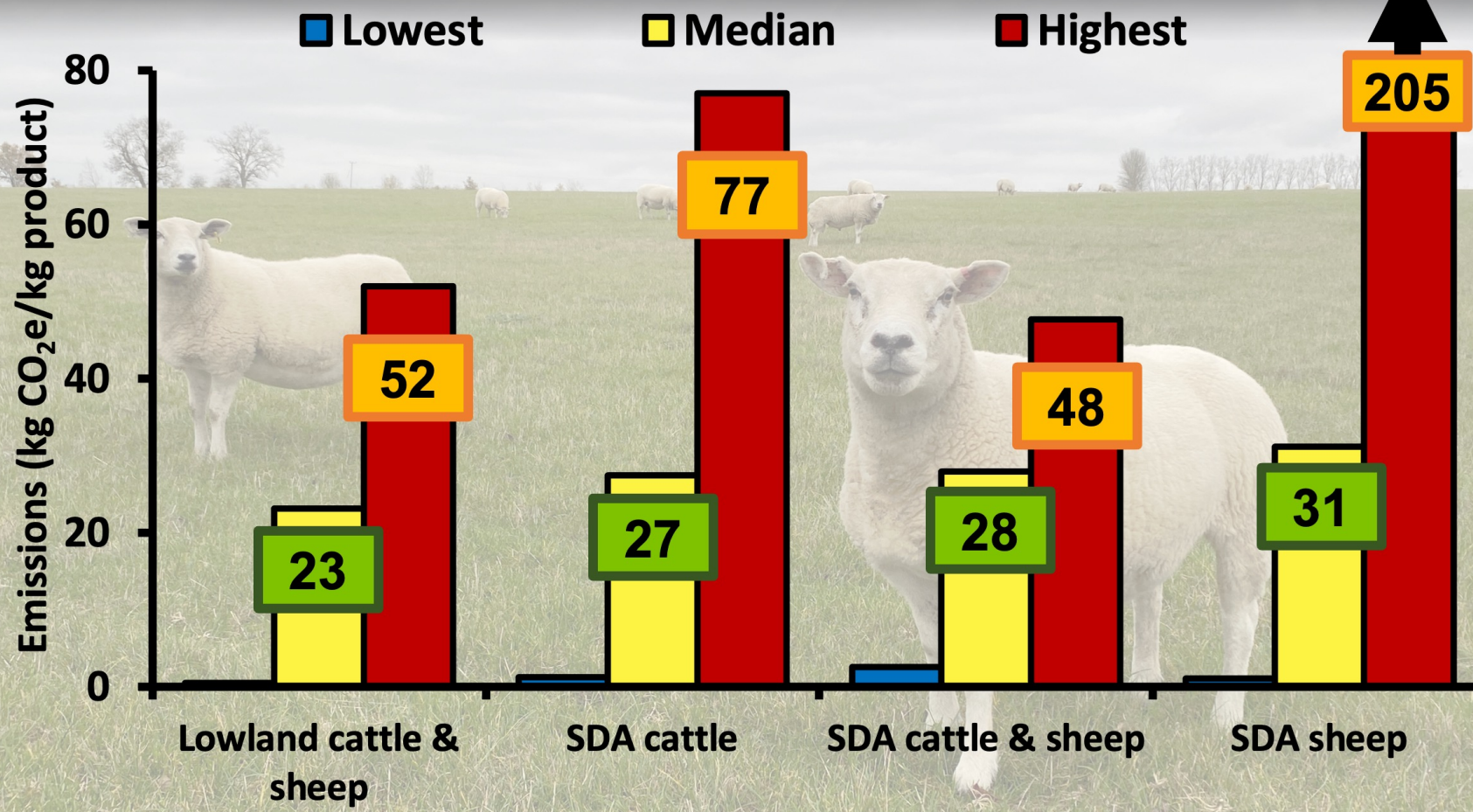




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Carbon footprints of Scottish systems vary considerably



Source: Created by Jude L. Capper, 2023. Data from: Barnes (2022) <https://pure.sruc.ac.uk/en/publications/exploring-the-emissions-intensity-of-scottish-sheep-and-cattle-li>

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Suckler (cow-calf) cattle will have to justify their ecosystem role

Annual requirements of one suckler cow:

- 3,954 kg feed DM
- 20,047 litres water
- 2,459 kg CO₂

Need to justify these impacts vs. beef from dairy.

Source: Created by and photo from Jude L. Capper, 2023. Calculation based on feed and water requirements of one Angus cow weighing 544 kg producing 7.8 kg of milk per day, with calf weaned at 207 days of age.

Can we grow human food and fibre crops everywhere?



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

Can we grow human food and fibre crops everywhere?

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

Can we grow human food and fibre crops everywhere?



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

65% of UK land is unsuitable for growing arable crops



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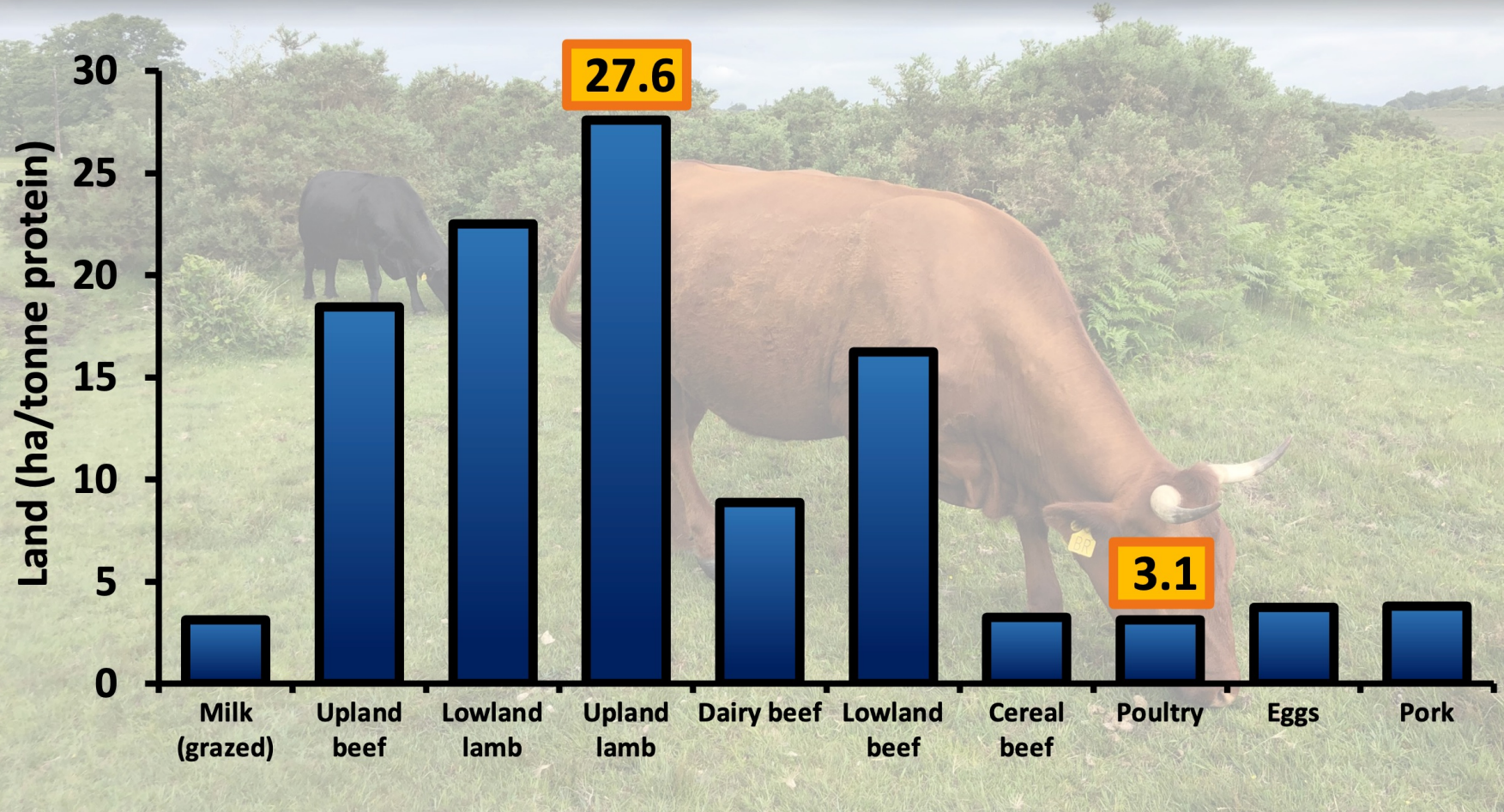
Source: Created by and photos from Jude L. Capper, 2023. Grazing land includes temporary grass on arable land (6% of total), land used for outdoor pigs or non-agricultural purposes not shown (1.7% of total). Data from DEFRA. 2019. Farming statistics - provisional crop areas, yields and livestock populations at 1 June 2019 – United Kingdom. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/837834/structure-jun2019prov-UK-10oct19.pdf



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Grazing ruminant systems use considerable quantities of land



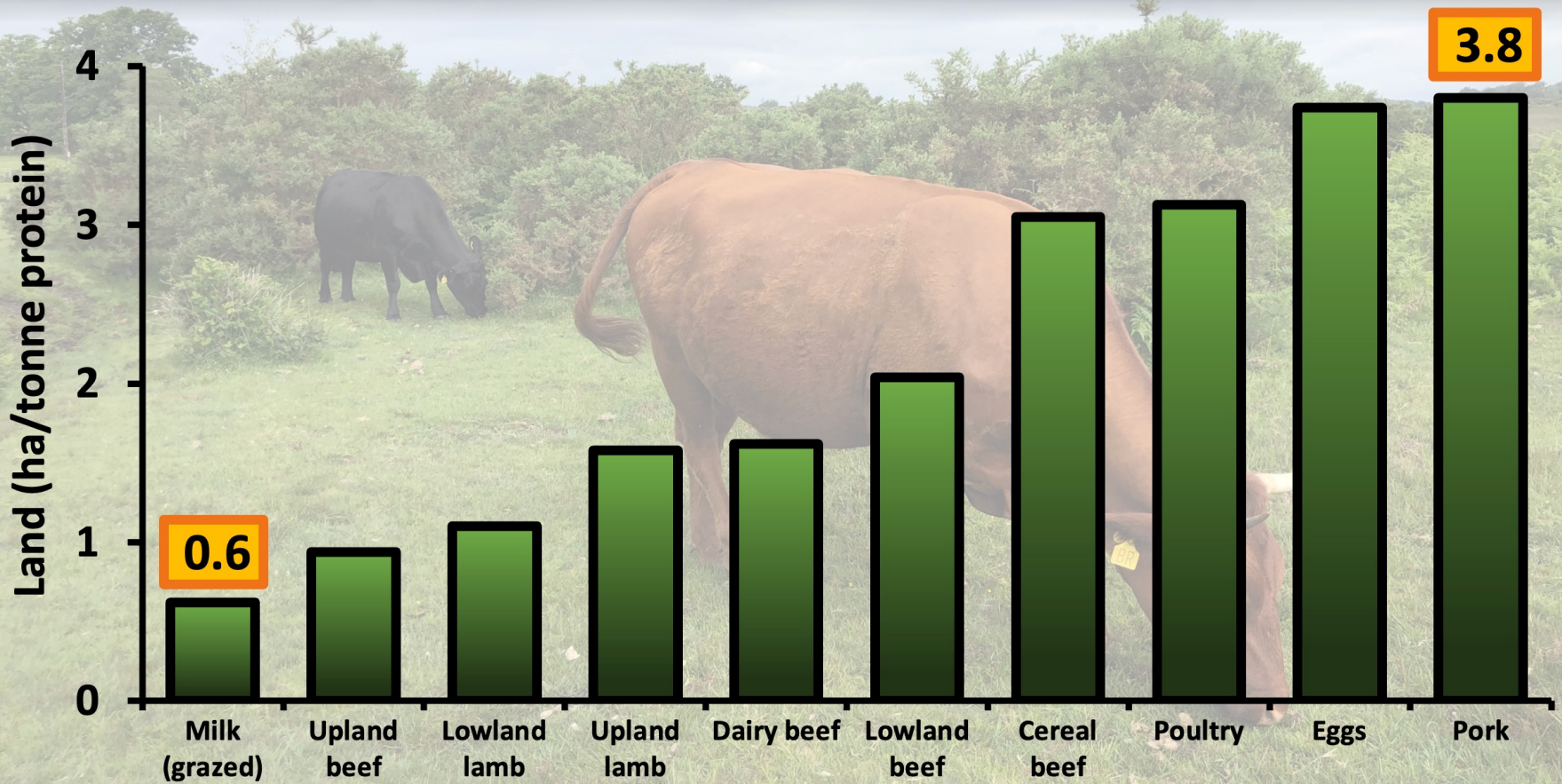
Source: Created by and photo from Jude L. Capper, 2023. Data from Wilkinson and Lee (2018) <https://doi.org/10.1017/S175173111700218X>



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Arable land use is considerably lower in grazing ruminant than monogastric systems



Source: Created by and photo from Jude L. Capper, 2023. Data from Wilkinson and Lee (2018) <https://doi.org/10.1017/S175173111700218X>



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Feed efficiency is one of the principal issues used to denigrate animal agriculture

IF EVERY AMERICAN STOPPED EATING MEAT THERE WOULD BE ENOUGH GRAIN TO FEED 1.4 BILLION PEOPLE

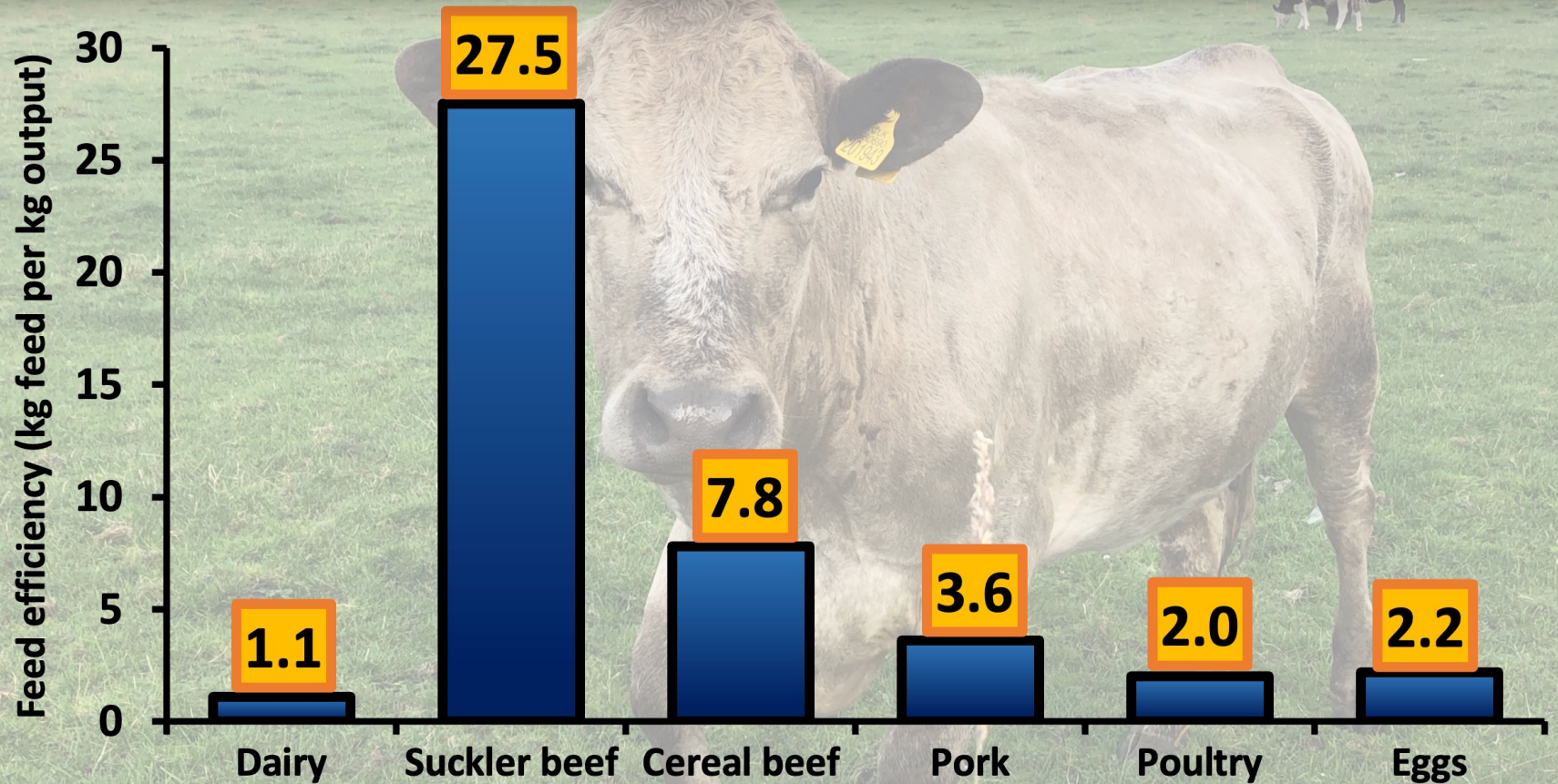
#IMAGREENMONSTER

Source: Created by and photo from Jude L. Capper, 2023. Picture from: <http://www.onegreenplanet.org/animalsandnature/eat-for-the-planet-meat-and-the-environment/>

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Traditional feed efficiency metrics put grazing ruminants at a disadvantage

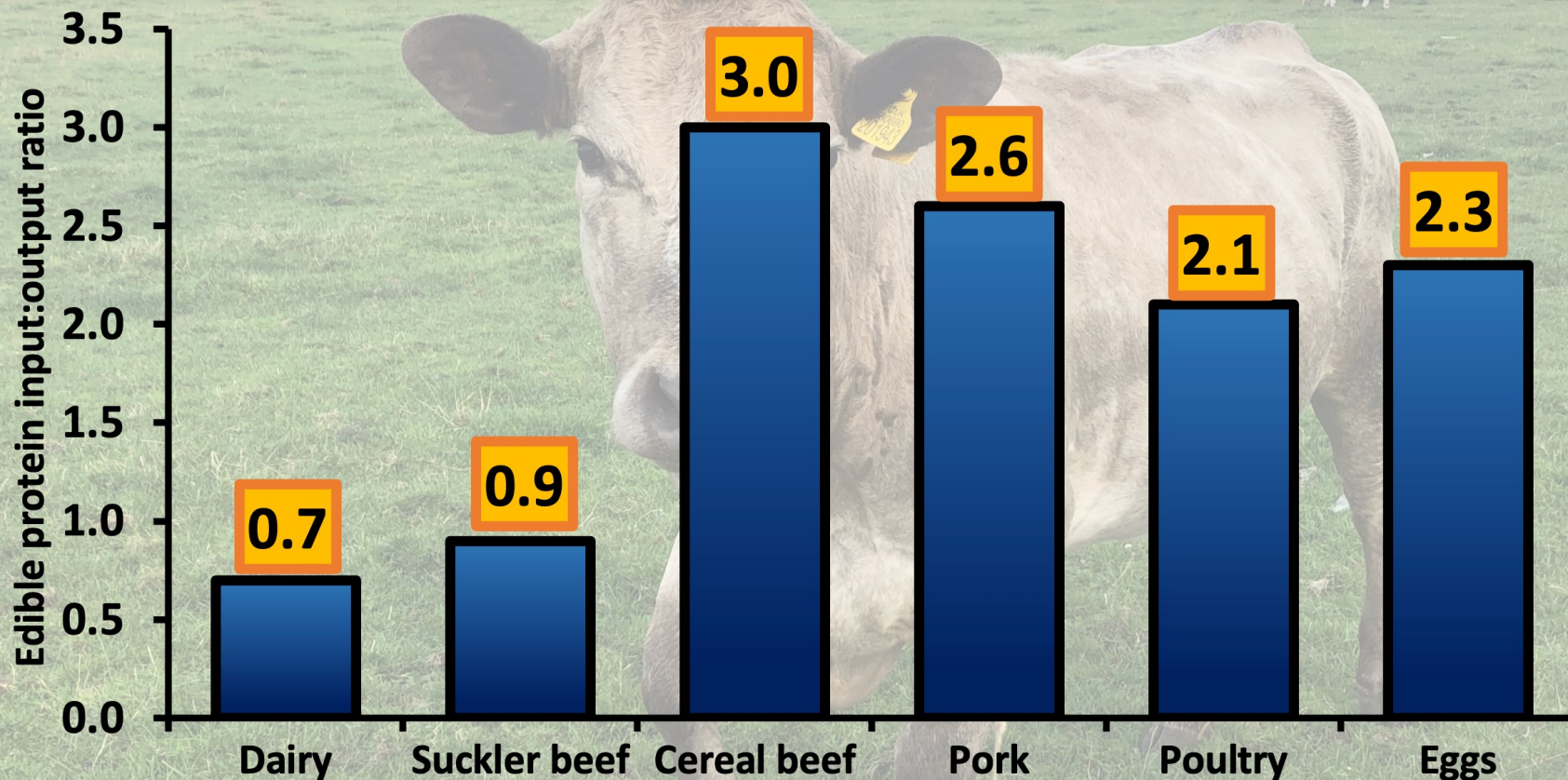


Source: Created by and photo from Jude L. Capper, 2023. Data from Wilkinson (2011) <https://doi.org/10.1017/S175173111100005X>

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Grazing cattle systems produce more human-edible protein than they consume



Source: Created by and photo from Jude L. Capper, 2023. Data from Wilkinson (2011) <https://doi.org/10.1017/S175173111100005X>

Grazed land provides much more than food

- Landscape maintenance
- Carbon sequestration
- Wildlife biodiversity
- Water filtration
- Silviculture
- Recreation
- Tourism

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



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The UK government is focusing on “public goods”

Farmers paid for providing public goods – items that anybody can enjoy without reducing the amount available to others

Improved
water
quality

Biodiversity

Climate
change
mitigation

Animal
health and
welfare

Should result in reduced costs of production,
increased efficiency, improved natural environment

Nature-based solutions can provide multiple benefits



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

All food ultimately comes from the soil



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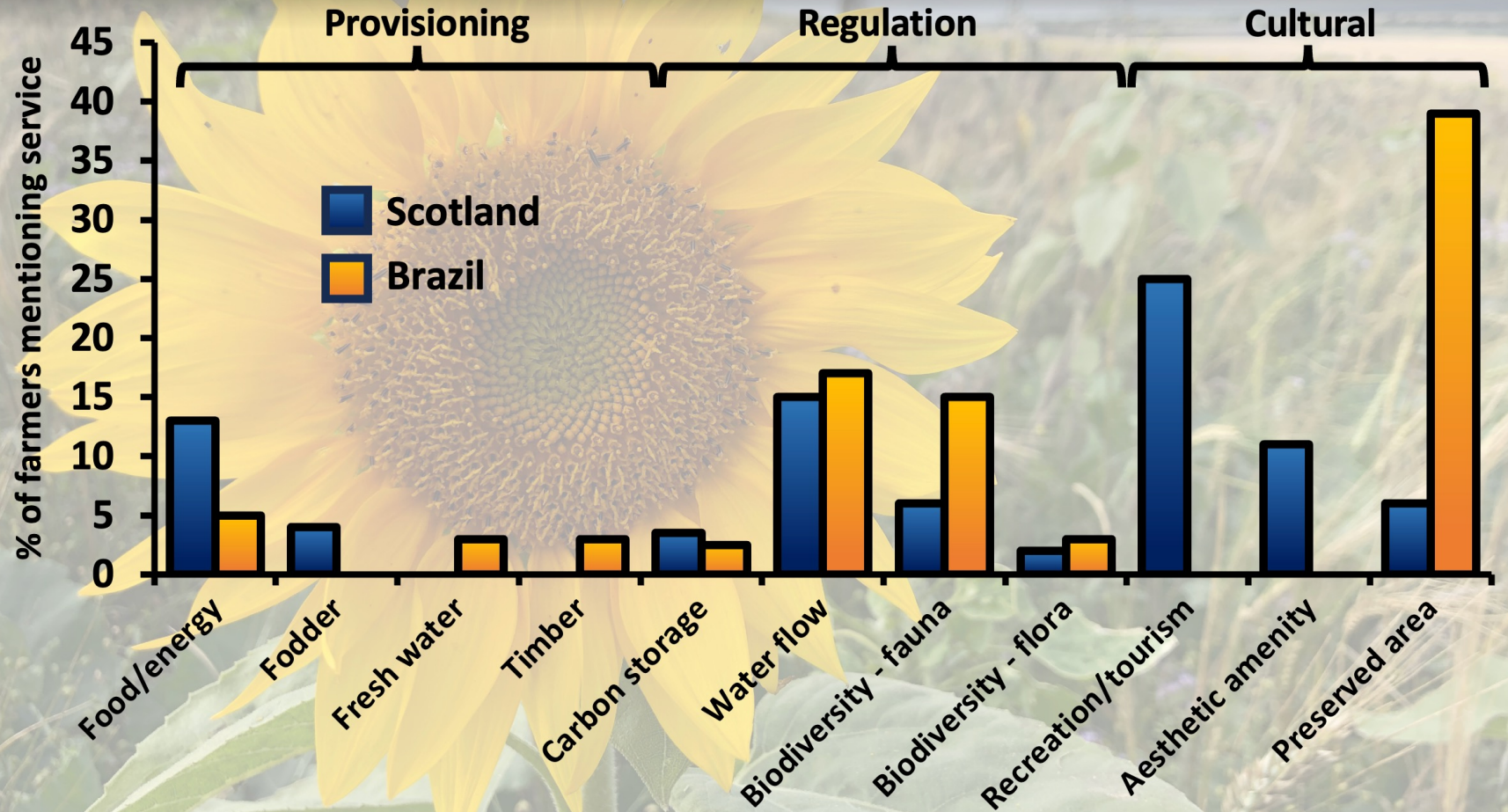
Source: Created by and photos from Jude L. Capper, 2023.



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Farmers regard their farms as providing ecosystem services



Source: Created by and photo from Jude L. Capper, 2023. Data from Canova et al. (2019) <https://doi.org/10.1016/j.ecoser.2018.10.005>



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Crofting is a cultural tradition in the North Highlands of Scotland



Source: Created by Jude L. Capper, 2023. Photo from Neil Williamson from Dundee, Scotland, CC BY-SA 2.0 <<https://creativecommons.org/licenses/by-sa/2.0/>>, via Wikimedia Commons

The Flow Country is a fragile and highly valuable ecosystem



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Source: Created by Jude L. Capper, 2023. Photo from George Bayliss. <https://www.flickr.com/photos/57608438@N08/7329024530>

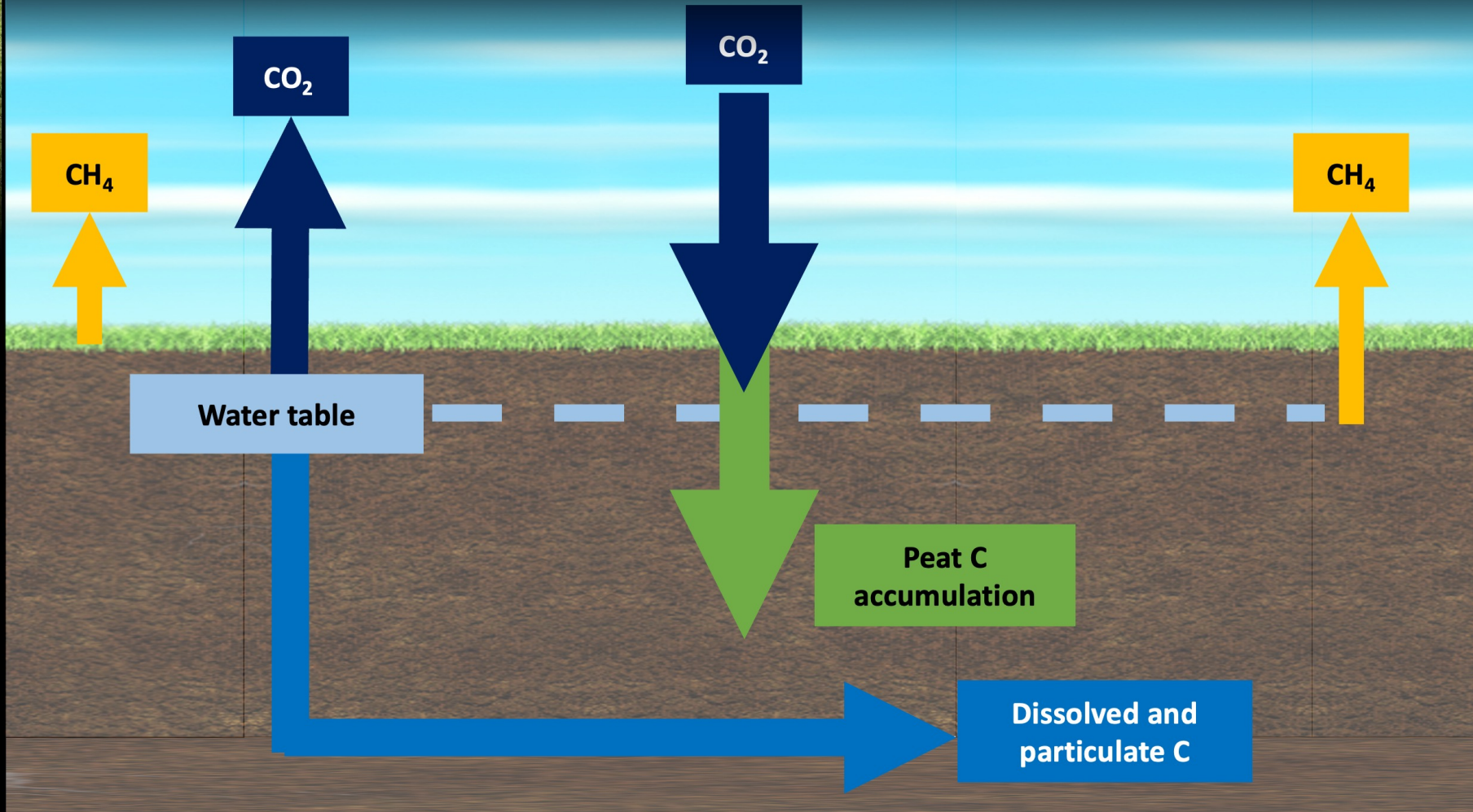




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Healthy peatland acts as a considerable carbon sink



Source: Created by Jude L. Capper, 2023. Figure adapted from Sloan et al. 2018. <https://doi.org/10.19189/MaP.2017.OMB.315>

Degraded peatland emits considerable quantities of carbon



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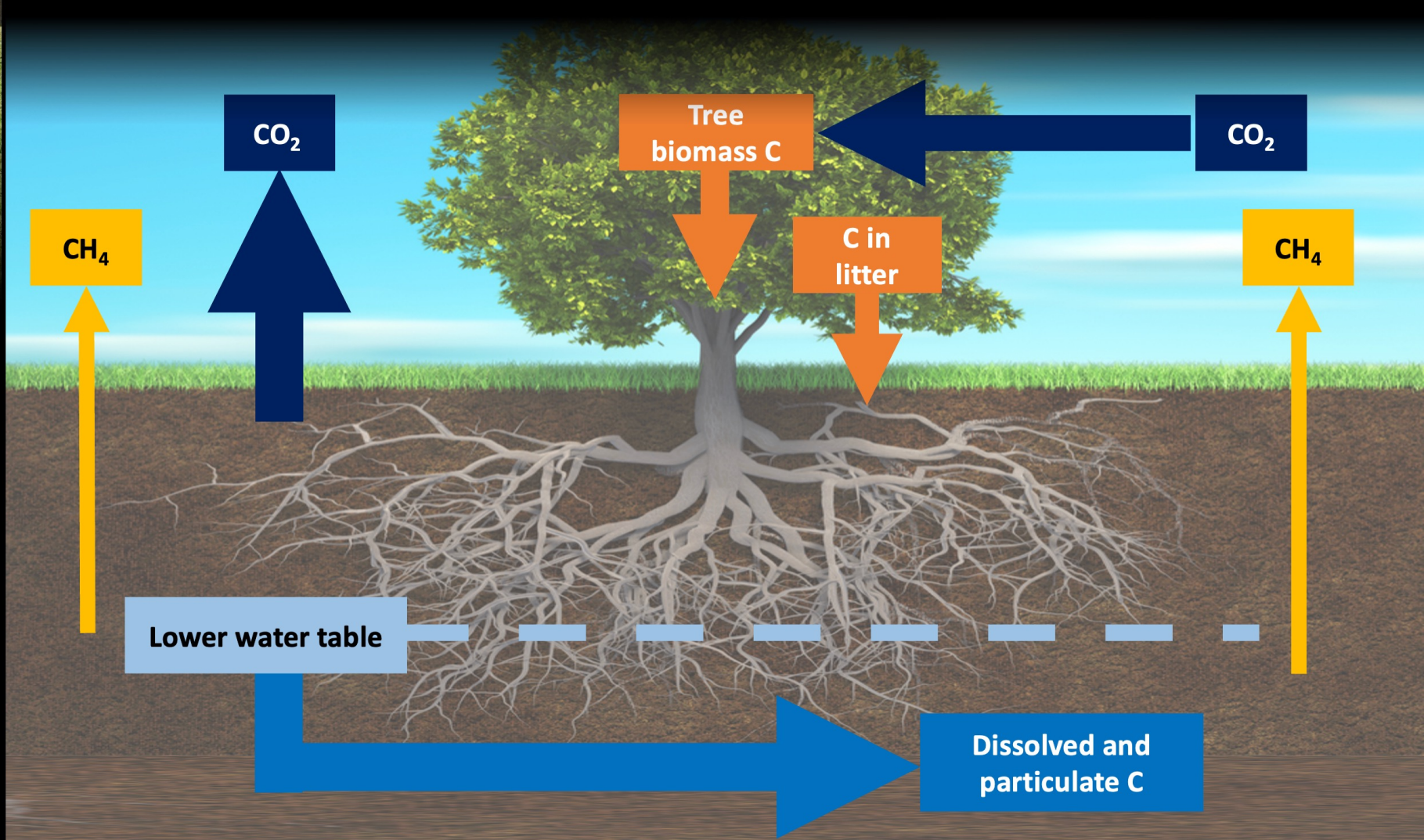
Source: Created by Jude L. Capper, 2023.



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Afforestation has negative impacts on peatland



Source: Created by Jude L. Capper, 2023. Figure adapted from Sloan et al. 2018. <https://doi.org/10.19189/MaP.2017.OMB.315>

All birds like trees..... Or do they?



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Source: Created by Jude L. Capper, 2023.

Removing cattle disadvantages ground-nesting birds



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Source: Created by and image from Jude L. Capper, 2023. Photo from: Odd Falch <https://www.pexels.com/photo/brown-bird-on-brown-grass-12084162/>

Livestock trampling has mixed ecosystem impacts



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Source: Created by Jude L. Capper, 2023.

Dung beetles have myriad ecosystem benefits



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Source: Created by Jude L. Capper, 2023.

Great yellow bumble bees thrive in mixed grazing



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Source: Created by Jude L. Capper, 2023. Photo by David Wood <https://friendsoftiree.org.uk/tirees-great-yellow-bumblebee-project/>

What synergistic opportunities exist for optimal land use?



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Source: Created by Jude L. Capper, 2023.

Silvopasture may provide improve overall productivity



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Source: Created by Jude L. Capper, 2023. Photo from David Parker, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons

Changing behaviour is one of the biggest challenges



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



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Peer-to-peer learning, discussion groups and farmer incentives aid behavioural change



Metrics – defining the population by weight

- Adopt or adapt standard weight metrics from elsewhere (e.g. France, Denmark, Netherlands)
- Use what data we have from the UK, e.g. livestock markets/slaughterhouse data
- Factorial calculations based on Livestock Units (LSU)

Denmark Day	Denmark	Denmark	Denmark	Denmark
100kg	1.0	1.0	1.0	1.0
75kg	0.75	0.75	0.75	0.75
50kg	0.5	0.5	0.5	0.5
25kg	0.25	0.25	0.25	0.25

The number of days from
of activation on release
animal receives vaccine
as defined by the standard.

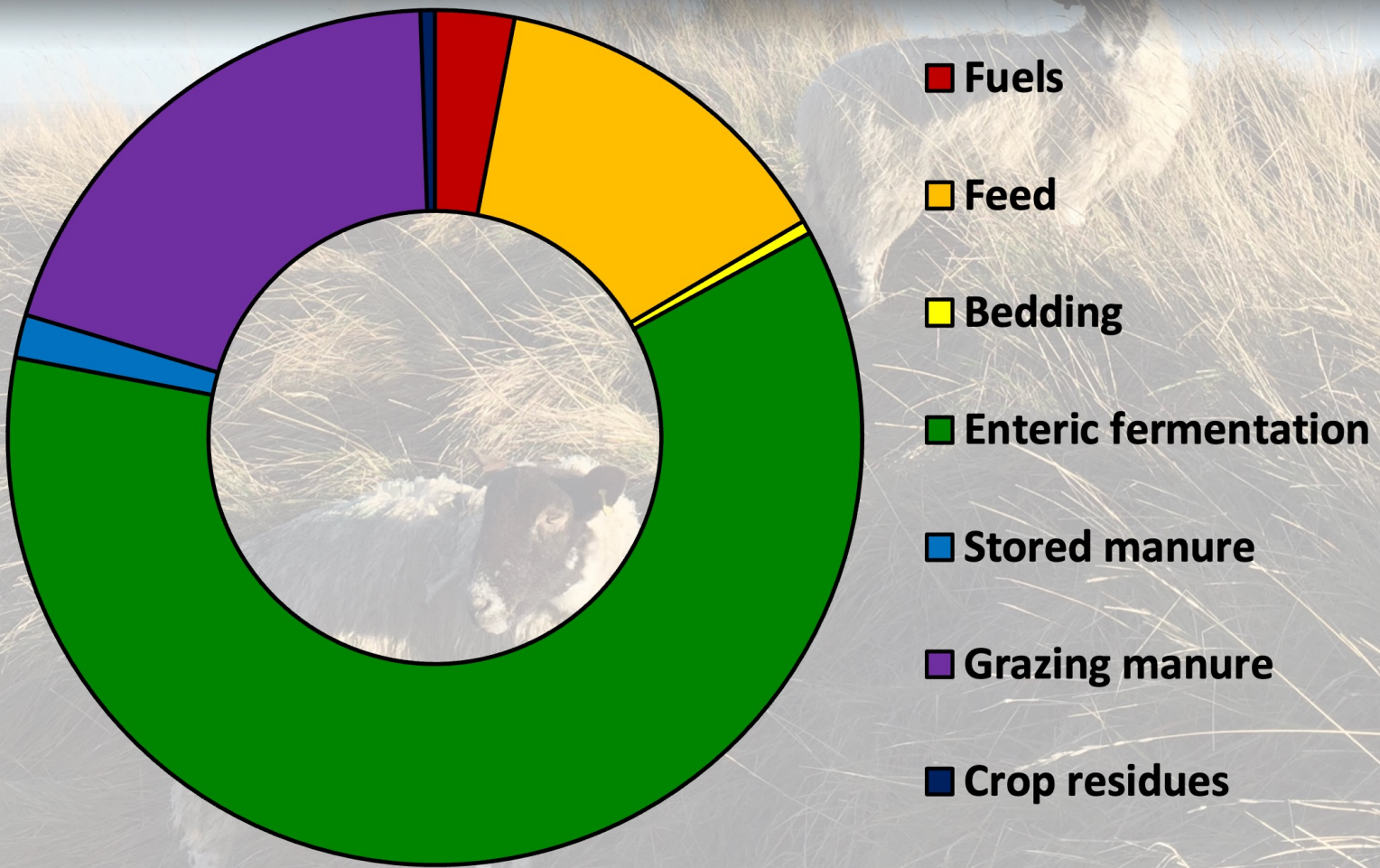
Source: Created by and photos from Jude L. Capper, 2023.



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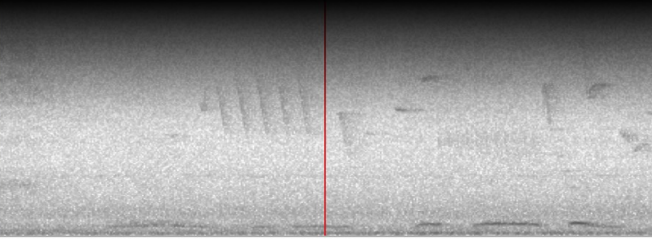


Accurate and applicable metrics and tools are required for all environmental parameters



Source: Created by and photo from Jude L. Capper, 2023. GHGe depicted are for a late lambing ewe operation using no inorganic fertilizer.

Merlin app is a great example of ecosystem data gathering



00:04.55

Anna Kerruish @ManxShepherdess · May 31

Slightly addicted to the [#merlin app](#), to the point that there's an on farm competition. Whoever gets most **birds** by 14/6 gets a box of French Fancies 🍰

Now leaving my phone at the gate of each field while I drive the quad round checking sheep, because I'm that competitive 😂

BEST MATCHES

	Common Chaffinch	✓
	Common Wood-Pigeon	✓
	Eurasian Wren	✓
	European Goldfinch	✓
	Eurasian Blackbird	✓
	Eurasian Collared-Dove	✓
	European Robin	✓

	Common Buzzard 7 May 2023 - Scotland, United Kingdom		Herring Gull 29 May 2023 - Scotland, United Kingdom
	Willow Warbler 25 7 May 2023 - Scotland, United Kingdom		Eurasian Oystercatcher 17 29 May 2023 - Isle of Man, Isle of Man
	House Sparrow 24 7 May 2023 - Scotland, United Kingdom		Ring-necked Pheasant 5 31 May 2023 - Meadow
	Bank Swallow 29 May 2023 - Isle of Man, Isle of Man		Common House-Martin 4 31 May 2023 - Home
	Eurasian Wren 11 29 May 2023 - Isle of Man, Isle of Man		Mistle Thrush 3 31 May 2023 - Magher Breck
	European Starling 10 29 May 2023 - Isle of Man, Isle of Man		

Manx Wildlife Trust

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Source: Created by Jude L. Capper, 2023. Screenshots from Merlin app and Twitter.

Most crucial ecosystem services action – defining the baseline

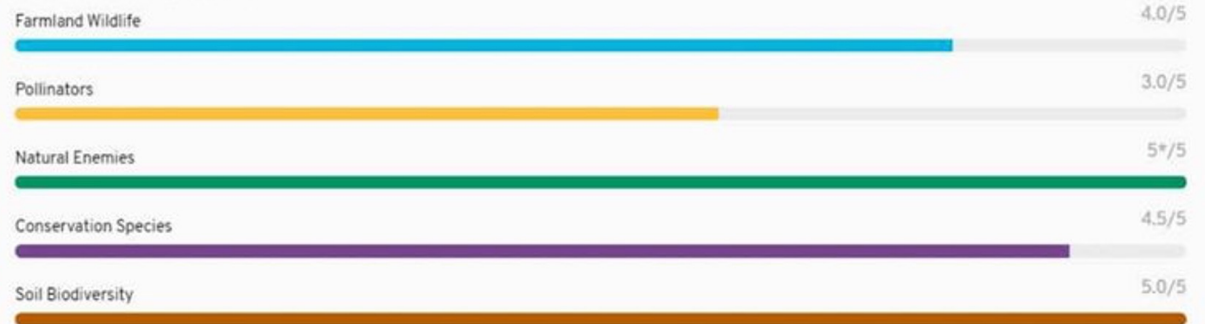


Field Biodiversity Score (out of 5)

4.5

→ No change from this time last year

Field Biodiversity Metrics



Biodiversity Map

Farmed Area: 22.1 ha
Non-Farmed Area: 0.3 ha
Performance Zones



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Source: Created by and photo from Jude L. Capper, 2023. Screenshots from <https://www.trinityagtech.com/farm-biodiversity>

Is there always a trade-off between ecosystem services and efficiency?



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

Will consumers pay for ecosystem services?



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

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Conclusions



Opportunities to improve ecosystem services vary across species, systems, regions and climates



Trade-offs are equally variable, but must not outweigh potential gains



Data collection benchmarking and metrics are key



Changing farmer behaviour may depend on co-benefits



Unanswered question – who should pay?



Obrigada!

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<http://bovidiva.com/presentationlinks>

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Questions?

