Living labs and demonstration farms: approaches to improve the sustainability of livestock farming systems globally

A session organised by:

EAAP's Livestock Farming Systems study commission

GLOBAL FARM PLATFORM

Towards Sustainable Ruminant Production

The European network of living labs (ENoLL) defines them as “user-centred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings”.

Living labs are initiatives in which experimentation is conducted on real farms, in specific territorial and community contexts, with farmers and other actors involved from the beginning as equal partners in proposing ideas, testing them, improving them and promoting them further.

Demonstration farms, as described in the context of AgriDemo-F2F, are integral components of on-farm demonstration activities aimed at enriching farmer-to-farmer learning. These farms serve as focal points for showcasing diverse agricultural practices, technologies, and techniques. They distinguish between commercial farms and those affiliated with research institutions, universities, or private companies.

THIS PROJECT HAS RECEIVED FUNDING FROM **THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME** UNDER GRANT AGREEMENT Nº 101000250

Living labs and demonstration farms: approaches to improve the sustainability of livestock farming systems globally

	Theatre Session 94	Book of Abstracts page
14:00	Innovative approaches to assessing sustainability: A case study of sheep and beef systems at North Wyke Farm Platform *invited* *M. J. Rivero, M. R. Lee*	1007
14:30	Choreoraphed interactions with cows on a demonstration farm to rethinking livestock subjectivity and Human-animal collaborations *M. F. De Torrez, A. Farruggia, L. Daranlot, S. Mouret, P. Roux, M. Prieur, C. Sébastien*	1007
14:45	Future sustainable grazing systems at the UCD Lyons Farm Long Term Grazing Platform *T. Boland, H. Sheridan, F. Monahan, P. Murphy, Z. C. Mckay, O. Schmidt, F. Godwin, A. Evans, A. Kelly*	1008
15:00	Impact of temperature on milk yield: a multiyear analysis from Harper Adams University Future Farm *J. Onyango, K. Robinson, E. Harris, M. Lee*	1008
15:15	Living labs concept towards GHG emissions reduction targets, growing market access and creating industry value in Australia *P. Vercoe, Z. Durmic, B. Hayes*	1009
15:30	A grazing living lab in Northern Sweden a case study *M. Hetta, J. Chagas, H. Lindgren*	1009

15:45	Coffee Break	
16:15	Katanning Research Farm Demonstration of Carbon Neutral by 2030 and Natural Capital Accounting *M. Curnow, J. Hardy, D. Devos*	1010
16:30	The living lab approach in the ecological transition of livestock farming: the case of the Abruzzo mountains *F. Di Iacovo, L. Forzoni, S. Righi, C. Vincenzina, F. Riccioli, M. Moretti*	1010
16:45	Living labs for assessing the overall sustainability of livestock systems through Life Cycle Assessment - SOLSTICE *M. Birolo, M. Petracci, N. Lacetera, M. Marconi, F. Di Iacovo, F. Bonavolontà, M. T. Verde, G. Provolo, A. Cartoni Mancinelli, E. Sturaro*	1011
17:00	INnovative Tools for Assessment and Authentication of chicken meat, beef and dairy products' QualiTies: a living lab approach *R. C. Eppenstein, C. Berri, D. Berry, A. Cartoni Mancinelli, C. Couzy, C. Laithier, F. Leiber, B. Martin, E. Sturaro*	1011
17:15	The "Cheese Valley" Initiative: co-design innovations in the Pecorino Toscano DOP Value Chain *M. Re, S. Burbi, P. Barberi, M. Mele, A. Mantino*	1012
17:30	Co-designing livestock-based circular agri-food systems in developing countries rural areas: The CLiMiT living lab approach *T. Teixeira Da Silva Siqueira, J. M. Sadaillan, M. Feillet, M. Vigne, A. Benoist, M. Miralles-Bruneau, J. Vuattoux, M. Allix, P. Yoan, T. Donnah Razafinarivo, L. Rasolofo Irintsoa, M. Hanitriniaina Razafimahatratra, A. Barimalala, G. Parizet, J. Vayssières*	1012
17:45	LivingLab - Effluents and coproducts of the livestock activity *O. Moreira, I. Rehan, R. Fragoso, H. Trindade, V. Fitas Da Cruz, D. Fangueiro, E. Duarte*	1013

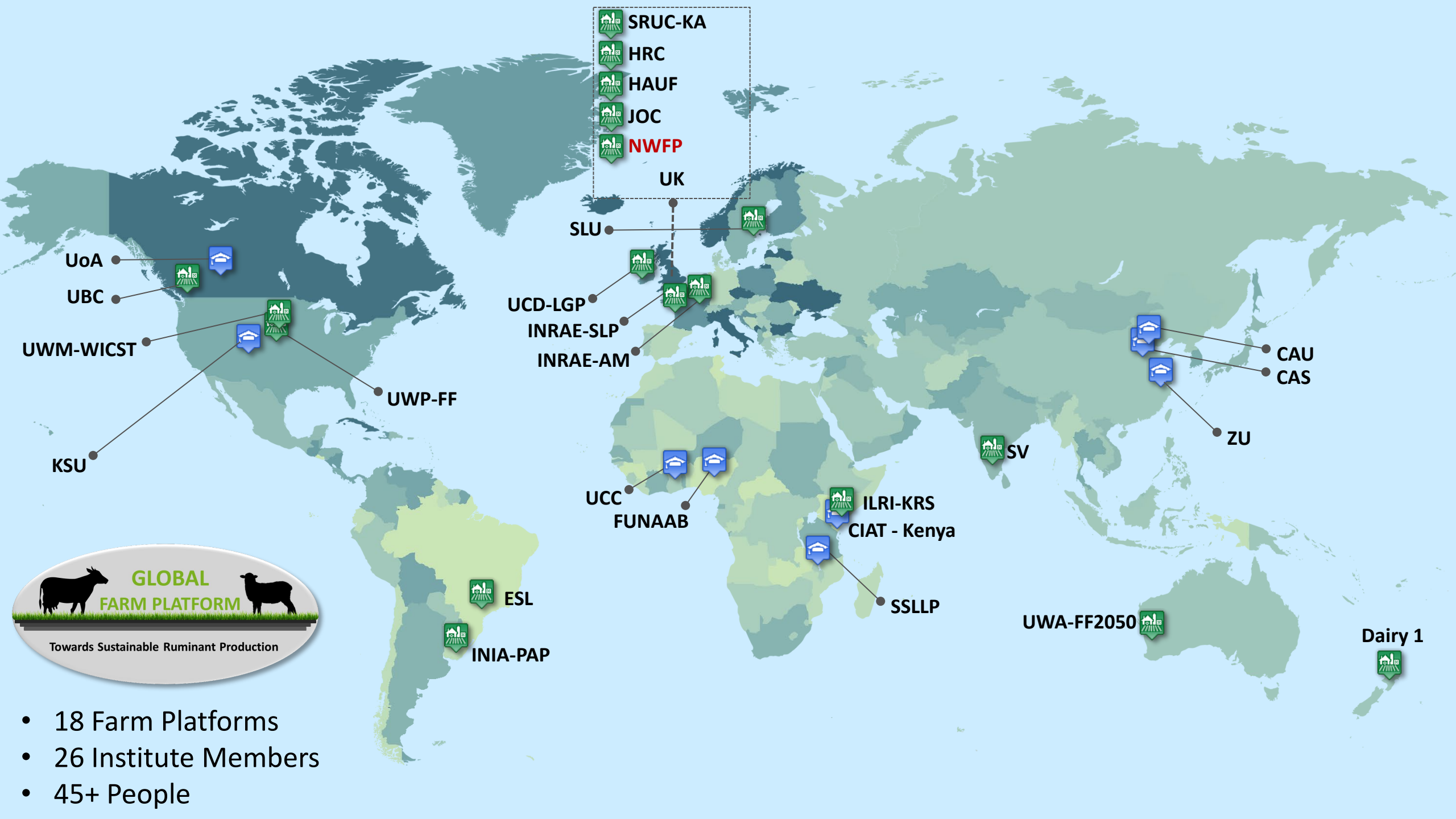
Innovative approaches to assessing sustainability: A case study of sheep and beef systems at the North Wyke Farm Platform

Jordana Rivero*, Micheal RF Lee

Rothamsted Research, Harper Adams University

**Chair of the Global Farm Platform*

jordanarivero



- 18 Farm Platforms
- 26 Institute Members
- 45+ People

www.globalfarmplatform.org

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Worldwide Universities Network

UKRI Biotechnology and Biological Sciences Research Council

Newton Fund

bsas
british society of animal science

USDA United States Department of Agriculture

Eisler et al, Nature 2014

Domestic goats and sheep can graze marginal lands, such as those in the Gobi Desert in Mongolia.

Steps to sustainable livestock

10 YEAR ANNIVERSARY

35 Workshops, 15+ Projects, £3M+ Value Grants

CSIRO PUBLISHING

Reproduction, Fertility and Development, 2021, **33**, 1–19
https://doi.org/10.1071/RD20205

Key traits for ruminant livestock across diverse production systems in the context of climate change: perspectives from a global platform of research farms

M. Jordana Rivero[A], Nicolas Lopez-Villalobos[B], Alex Evans[C], Alexandre Berndt[D], Andrew Cartmill[E], Andrew L. Neal[A], Ann McLaren[F], Anne Farruggia[G], Catherine Mignolet[H], Dave Chadwick[I], David Styles[I], Davy McCracken[F], Dennis Busch[E], Graeme B. Martin[J], Hannah Fleming[A], Helen Sheridan[C], James Gibbons[I], Lutz Merbold[K], Mark Eisler[L], Nicola Lambe[F], Pablo Rovira[M], Paul Harris[A], Paul Murphy[C], Philip E. Vercoe[J], Prysor Williams[I], Rui Machado[D], Taro Takahashi[A,L], Thomas Puech[H], Tommy Boland[C], Walter Ayala[M] and Michael R. F. Lee[A,L,N]

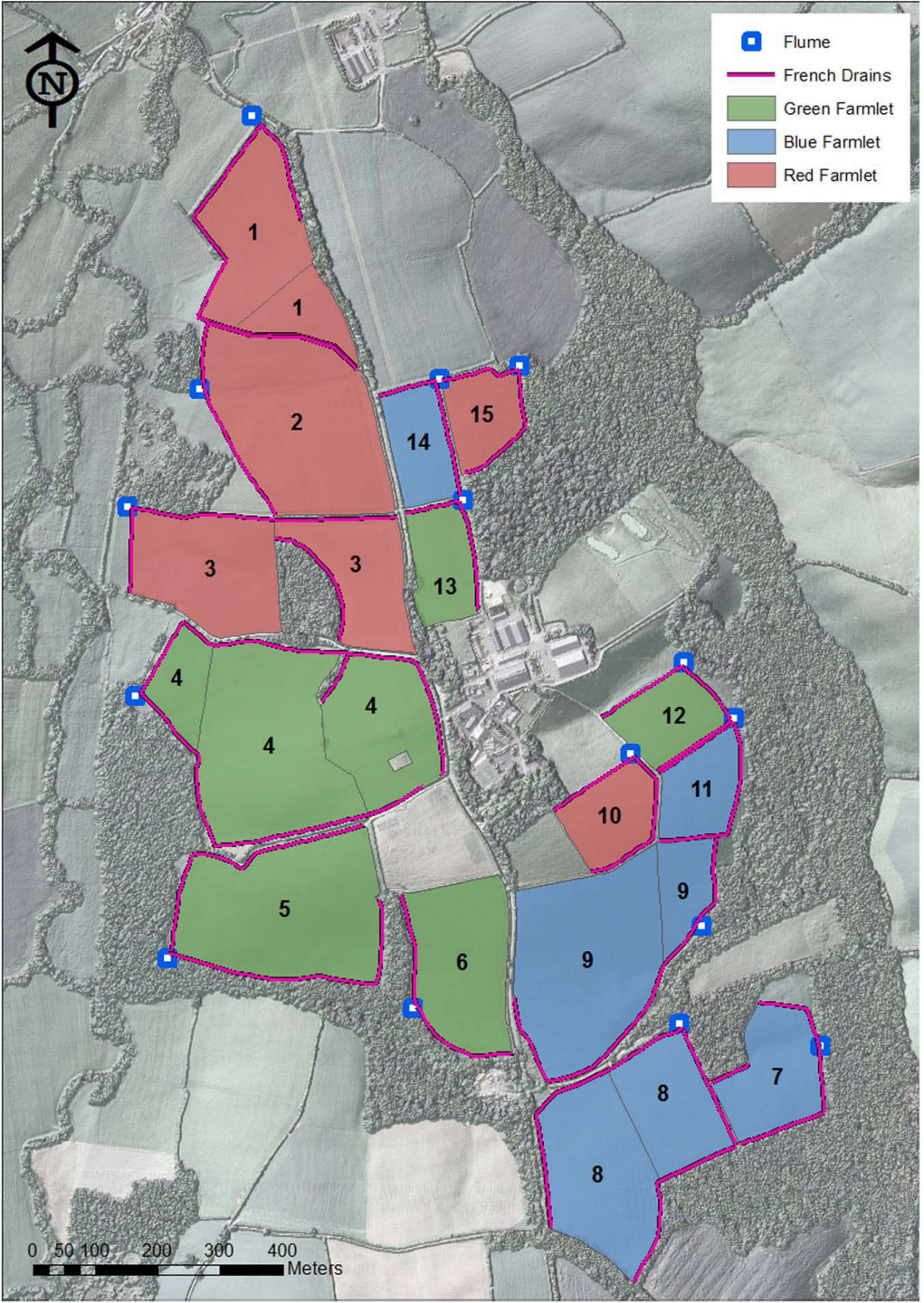
Rivero et al, Animal Frontiers 2021

Perspectives

Taking the steps toward sustainable livestock: our multidisciplinary global farm platform journey

M. Jordana Rivero,[†] Alex C. O. Evans,[‡] Alexandre Berndt,[||] Andrew Cartmill,[§] Andrew Dowsey,[¶] Anne Farruggia,[**] Catherine Mignolet,[††] Daniel Enriquez-Hidalgo,[†,¶] Dave Chadwick,[‡‡] Davy I. McCracken,[||||] Dennis Busch,[§] Fabiana Pereyra,[§§] Graeme B. Martin,[¶¶] Gregg R. Sanford,[***] Helen Sheridan,[‡] Iain Wright,[†††] Laurent Brunet,[††] Mark C. Eisler,[¶] Nicolas Lopez-Villalobos,[‡‡‡] Pablo Rovira,[§§] Paul Harris,[†] Paul Murphy,[‡] A. Prysor Williams,[‡‡] Randall D. Jackson,[***] Rui Machado,[||] Suraj P.T.,[|||||||] Thomas Puech,[††] Tommy M. Boland,[‡] Walter Ayala,[§§] and Michael R.F. Lee[§§§]

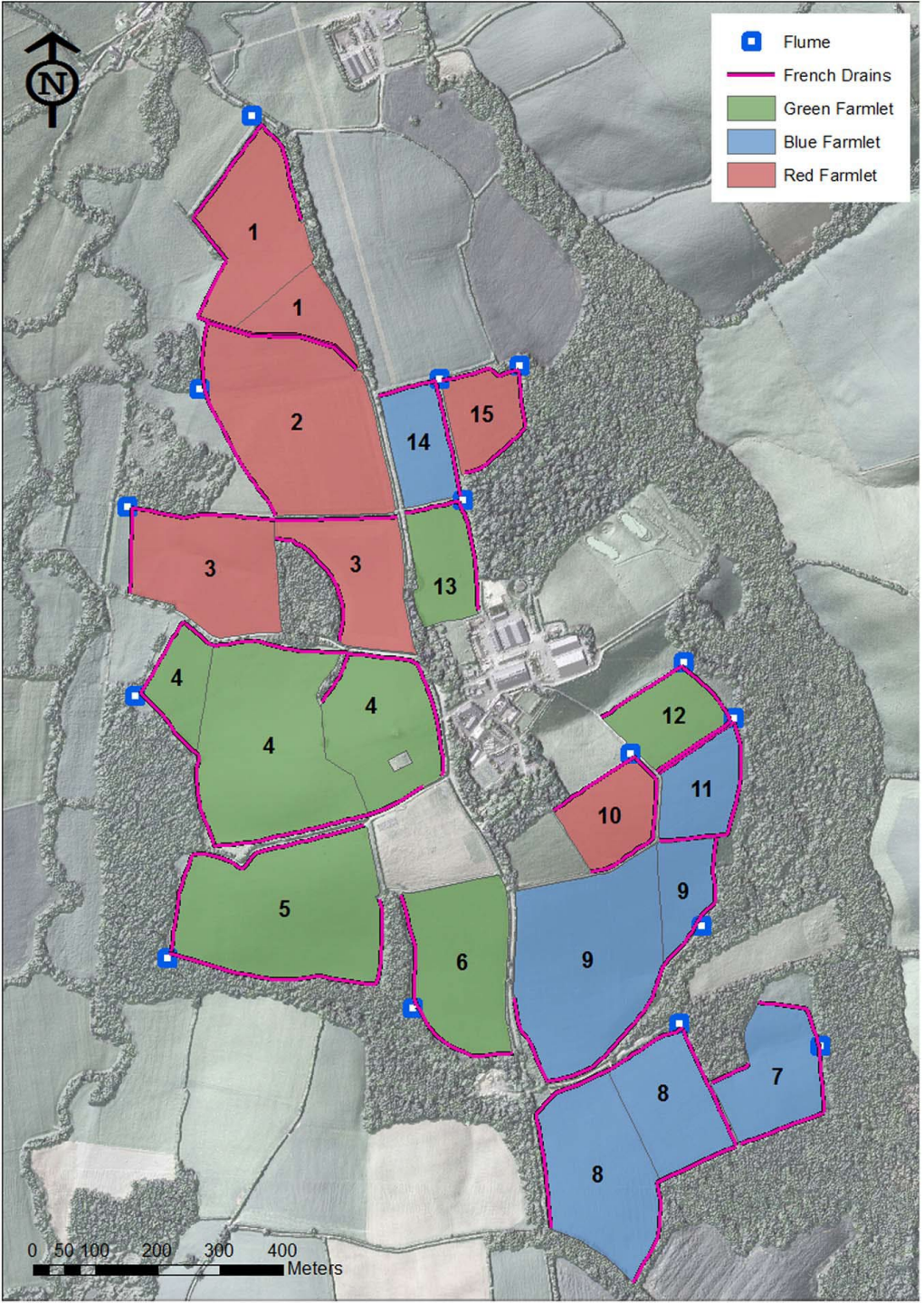
Sustainable Farming Systems



The North Wyke Farm Platform

2011	2012	2013	2014	2015	2016	2017	2018	2019-

- ✓ All data collected are publicly available at the **NWFP Data Portal**
- ✓ All papers are **Open Access**



Objective:

This abstract explores into a series of studies conducted at the North Wyke Farm Platform (NWFP, Devon, UK), spanning from 2018 to 2023, offering valuable insights into the sustainability of ruminant (sheep and beef) livestock systems.

agronomy

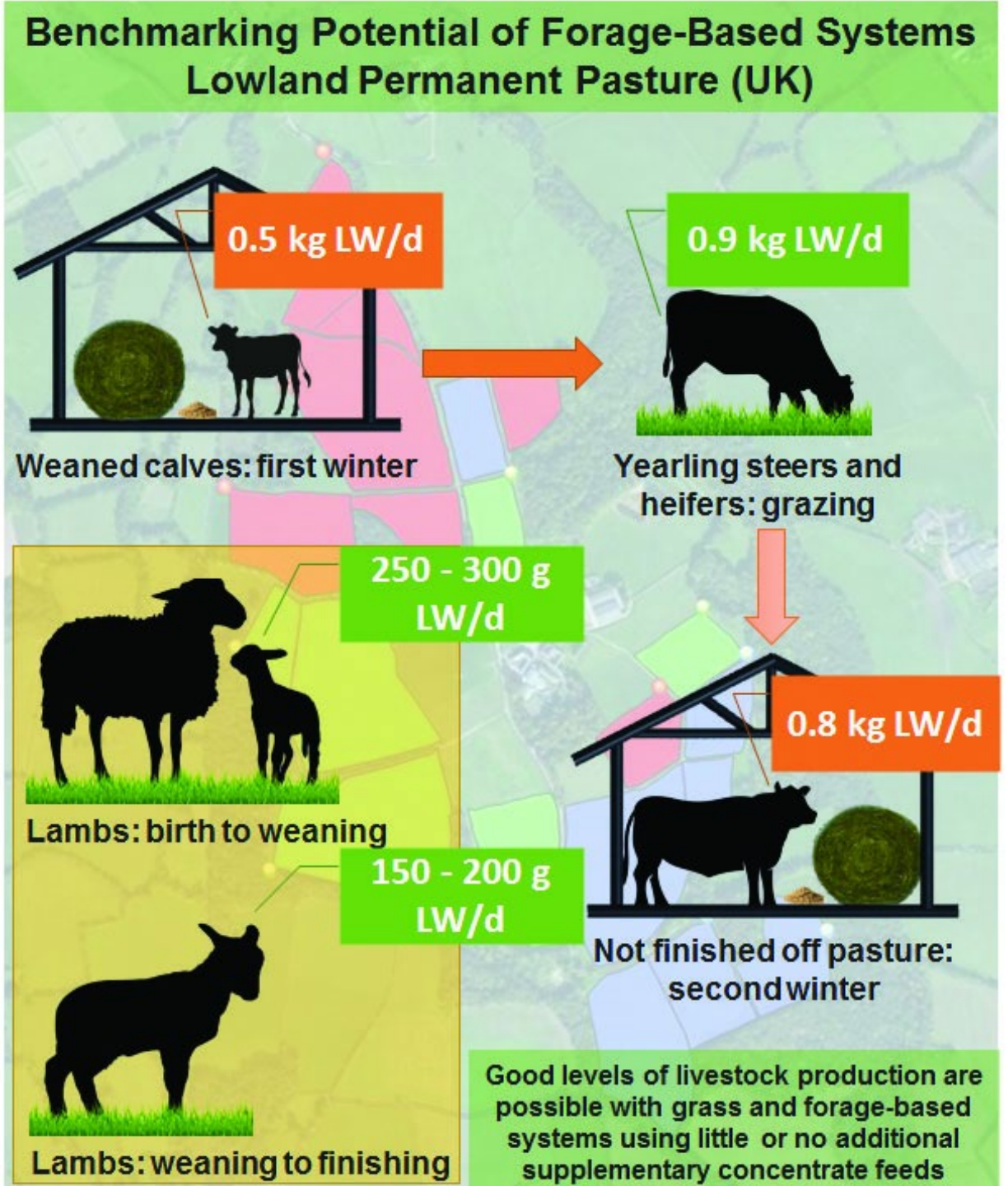
MDPI

Article

Livestock Performance for Sheep and Cattle Grazing Lowland Permanent Pasture: Benchmarking Potential of Forage-Based Systems

Robert J. Orr [1], Bruce A. Griffith [1], M. Jordana Rivero [1,*] and Michael R. F. Lee [1,2]

It provides practical recommendations for stocking rates, live weight gains in different seasons and herbage dry matter production, **emphasising the potential of grass and forage-based systems with minimal supplementary feeding for sustainable livestock production**.



Animal (2018), 12:8, pp 1766–1776
doi:10.1017/S1751731118000502

animal

Roles of instrumented farm-scale trials in trade-off assessments of pasture-based ruminant production systems

T. Takahashi[1,2†], P. Harris[1], M. S. A. Blackwell[1], L. M. Cardenas[1], A. L. Collins[1], J. A. J. Dungait[1], J. M. B. Hawkins[1], T. H. Misselbrook[1], G. A. McAuliffe[1,2], J. N. McFadzean[1,3], P. J. Murray[1], R. J. Orr[1], M. J. Rivero[1], L. Wu[1] and M. R. F. Lee[1,2]

Table 3 *Correlation matrix between economic, environmental and ecological variables*

	Environmental/ecological indicators						Managerial decisions			Economic performance			
	SOC	HET	BOT	WAT	TIN	SED	CWC	CWS	CW	SIL	LGC	LGS	LG
SOC	1												
HET	0.131	1											
BOT	−0.306	−0.342	1										
WAT	−0.383	0.097	−0.111	1									
TIN	0.059	0.059	0.231	0.517	1								
SED	−0.535	0.159	0.142	0.400	0.056	1							
CWC	0.077	0.588	0.184	0.042	0.245	0.075	1						
CWS	0.434	−0.650	0.326	−0.502	−0.311	−0.303	−0.431	1					
CW	0.476	−0.048	0.603	−0.427	−0.057	−0.210	0.545	0.522	1				
SIL	0.047	0.125	−0.282	−0.422	−0.104	0.113	−0.454	−0.162	−0.524	1			
LGC	−0.074	0.676	0.111	0.175	0.380	0.194	0.907	−0.671	0.234	−0.397	1		
LGS	0.275	−0.692	0.228	−0.342	−0.330	−0.104	−0.589	0.910	0.288	0.176	−0.820	1	
LG	0.376	−0.469	0.558	−0.387	−0.167	0.020	−0.077	0.829	0.697	−0.082	−0.363	0.830	1

SOC = soil organic carbon; HET = SOC heterogeneity; BOT = botanical β-diversity; WAT = water discharge; TIN = TIN discharge; SED = sediment discharge; CWC = cumulative weight (cattle); CWS = cumulative weight (sheep); CW = cumulative weight; SIL = silage production; LWC = liveweight gain (cattle); LWS = liveweight gain (sheep); LG = liveweight gain.

This work utilised the platform's rich datasets to propose an innovative information-driven approach **to assess economic-environmental trade-offs within pasture-based cattle and sheep production systems.**

… **environmental performances are positively correlated with economic profitability** with a systematic interaction between soil health, biodiversity, and livestock grazing.

Journal of Cleaner Production 171 (2018) 1672–1680

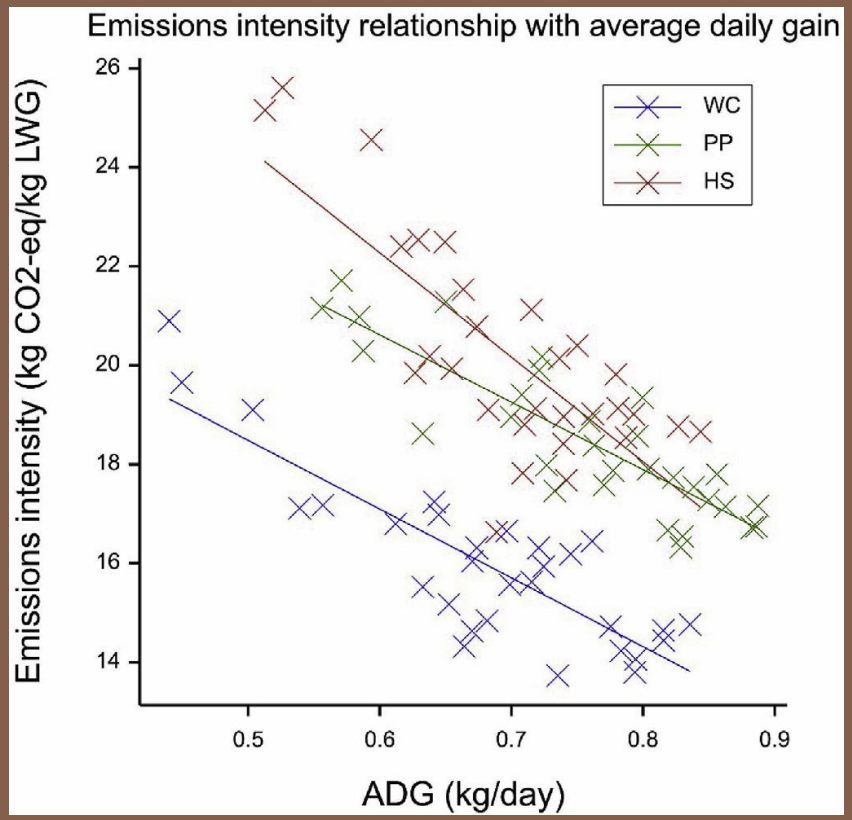
Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Distributions of emissions intensity for individual beef cattle reared on pasture-based production systems

G.A. McAuliffe [a, b], T. Takahashi [a, b, *], R.J. Orr [a], P. Harris [a], M.R.F. Lee [a, b]



Relationship between global warming potential (GWP) and average daily gains (ADG) under each system. PP: permanent pasture; WC: white clover/high sugar grass mix; HS: high sugar grass monoculture.

This novel life cycle assessment (LCA) study explored the **impact of individual animal and seasonal variabilities on livestock-originated emissions intensity**.

- ✓ Potential underestimation of environmental impacts when using representative animal approaches
- ✓ Great potential to reduce emissions by removing the bottom 10% of performing animals

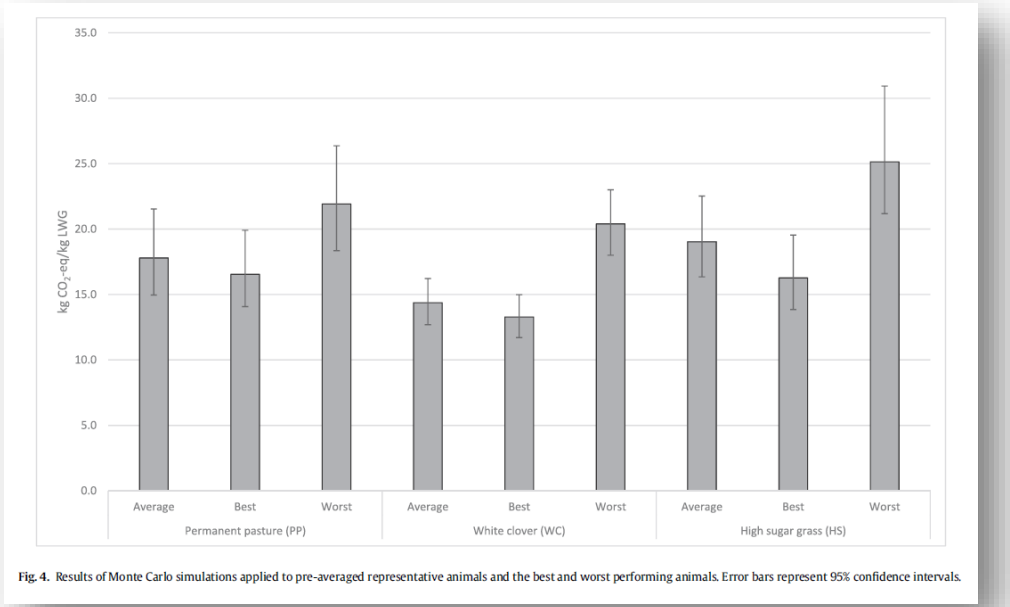
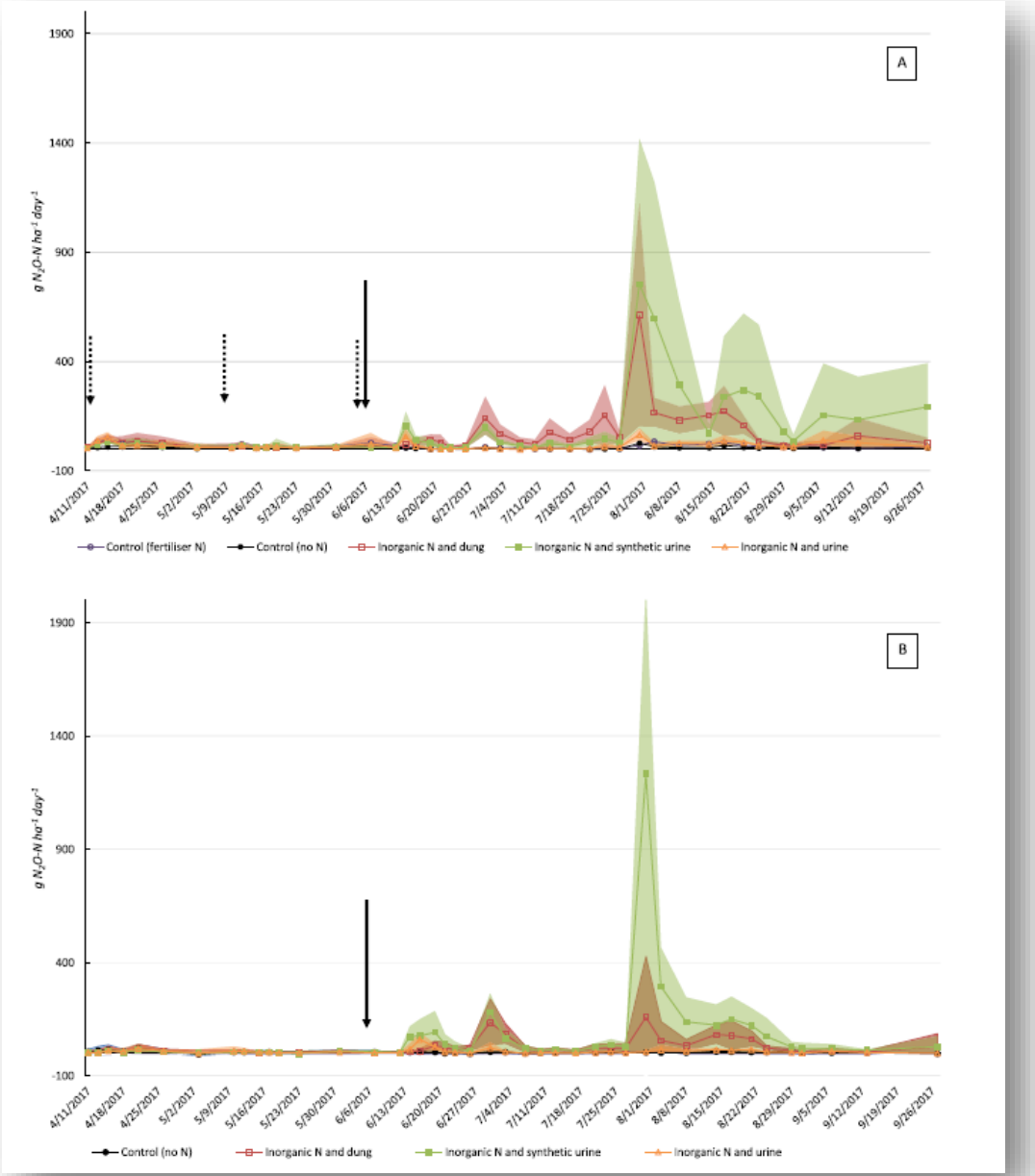


Fig. 4. Results of Monte Carlo simulations applied to pre-averaged representative animals and the best and worst performing animals. Error bars represent 95% confidence intervals.



Daily N2O-N fluxes for each farmlet. A: permanent pasture (PP); B: white clover/high sugar grass mix (WC); C: High sugar grass monoculture (HS). Treatments were applied on 6th June (see large black arrow). Smaller dotted arrows denote inorganic fertiliser application (40 kg N/ha/application). Shaded areas signify standard deviation.

Agriculture, Ecosystems and Environment 300 (2020) 106978

Contents lists available at ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Elucidating three-way interactions between soil, pasture and animals that regulate nitrous oxide emissions from temperate grazing systems

G.A. McAuliffe[a], M. López-Aizpún[a,*], M.S.A. Blackwell[a], A. Castellano-Hinojosa[b], T. Darch[a], J. Evans[a], C. Horrocks[a], K. Le Cocq[a], T. Takahashi[a,c], P. Harris[a], M.R.F Lee[a,c], L. Cardenas[a]

This work on N_2O emissions challenged traditional methods by considering different pasture types.

- ✓ It highlights that N_2O emission factors needed greater refinement to better predict across contrasting grassland systems.

Journal of Soils and Sediments (2021) 21:1875–1889
https://doi.org/10.1007/s11368-021-02909-y

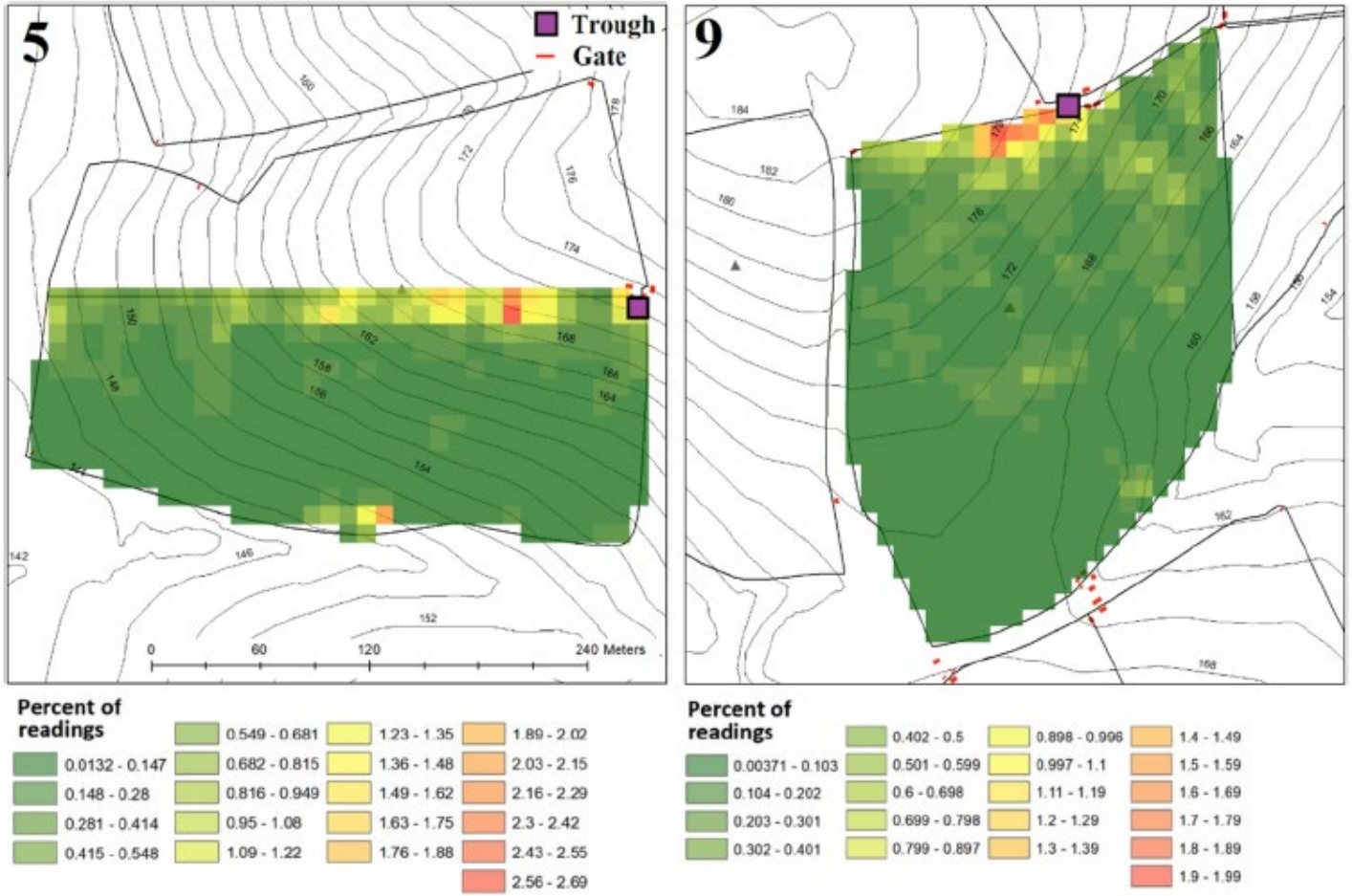
SEDIMENTS, SEC 3 • HILLSLOPE AND RIVER BASIN SEDIMENT DYNAMICS • RESEARCH ARTICLE

Does cattle and sheep grazing under best management significantly elevate sediment losses? Evidence from the North Wyke Farm Platform, UK

S. Pulley[1] • L. M. Cardenas[1] • P. Grau[1] • S. Mullan[2] • M. J. Rivero[1] • A. L. Collins[1]

This study harnesses the state-of-the art capability to monitor hydrological aspects of the NWFP.

It investigated the relationship between livestock stocking rates and sediment losses, **providing insights into the effectiveness of mitigation options**



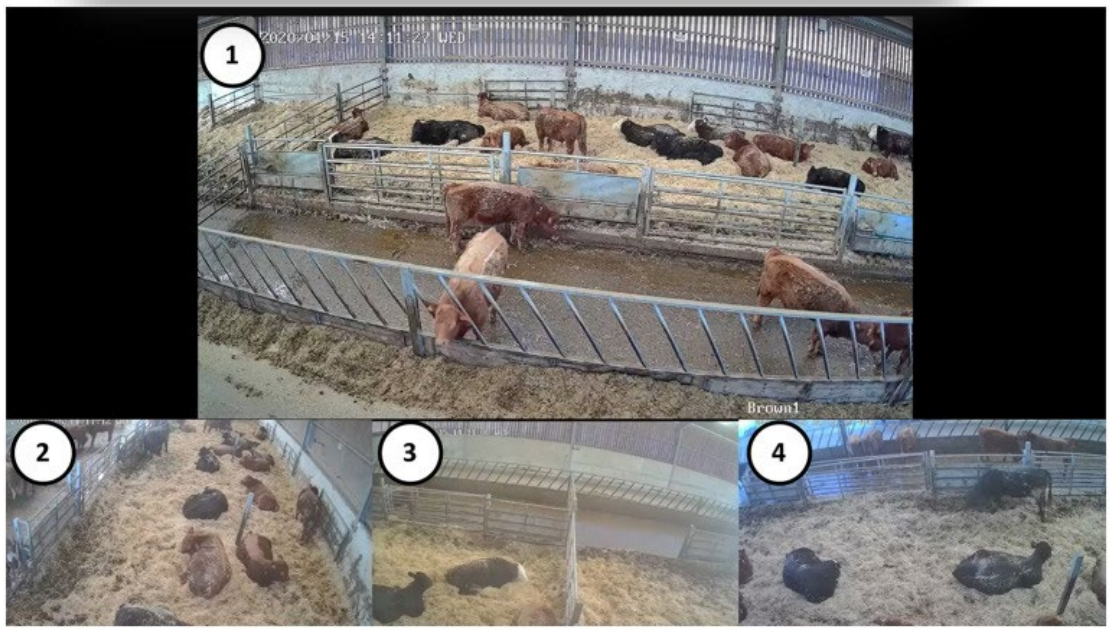
The percentage of cattle GPS readings recorded in each 10 m× 10mcell of catchments 5 and 9

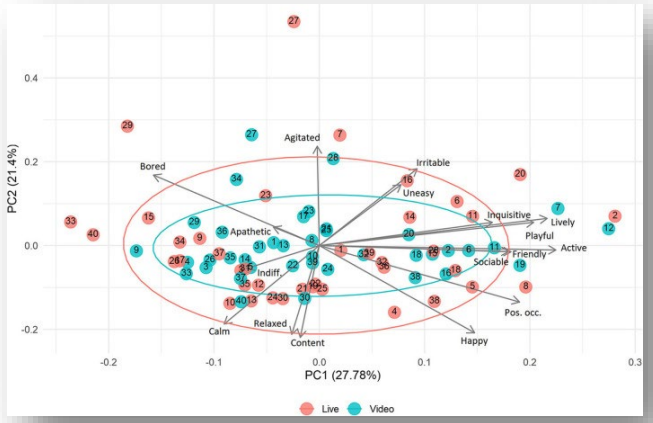
frontiers in Veterinary Science

ORIGINAL RESEARCH
published: 16 March 2022
doi: 10.3389/fvets.2022.832239

V-QBA vs. QBA—How Do Video and Live Analysis Compare for Qualitative Behaviour Assessment?

A. S. Cooke[1], S. M. Mullan[2], C. Morten[1], J. Hockenhull[3], M. R. F. Lee[4], L. M. Cardenas[1] and M. J. Rivero[1]*





PCA analysis QBA results from live and video assessments, determined by 17 terms.

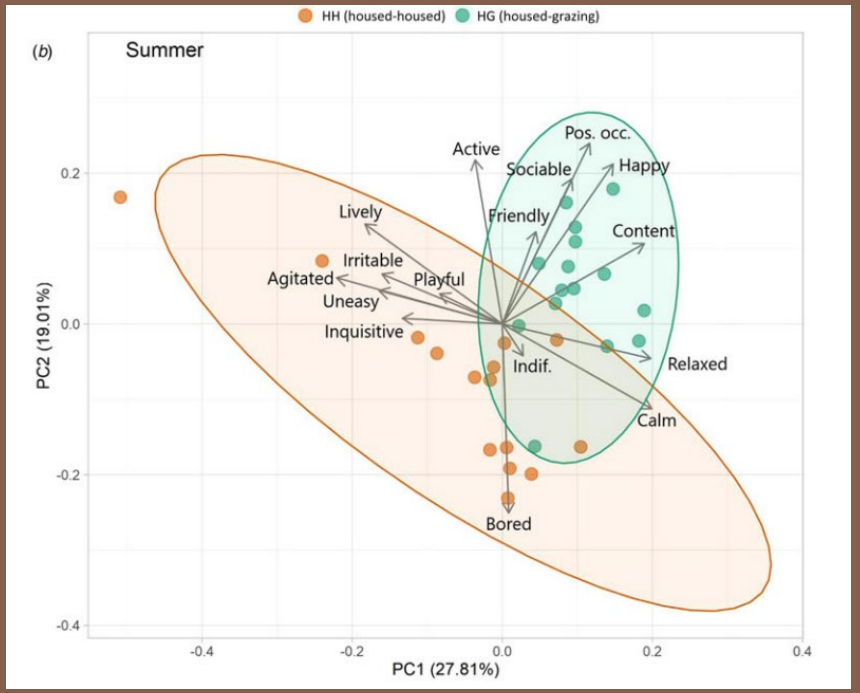
The Journal of Agricultural Science

cambridge.org/ags

Animal Research Paper

Comparison of the welfare of beef cattle in housed and grazing systems: hormones, health and behaviour

Andrew S. Cooke[1,2], Siobhan Mullan[3,4], Charlie Morten[2], Joanna Hockenhull[4], Phil Le-Grice[2], Kate Le Cocq[2,5], Michael R. F. Lee[2,4,5], Laura M. Cardenas[2] and M. Jordana Rivero[2]



Biplots of PCA results from winter (a) and summer (b) QBA results, showing distribution of data for each herd. Ellipses represent 95% confidence

Animal 15 (2021) 100018

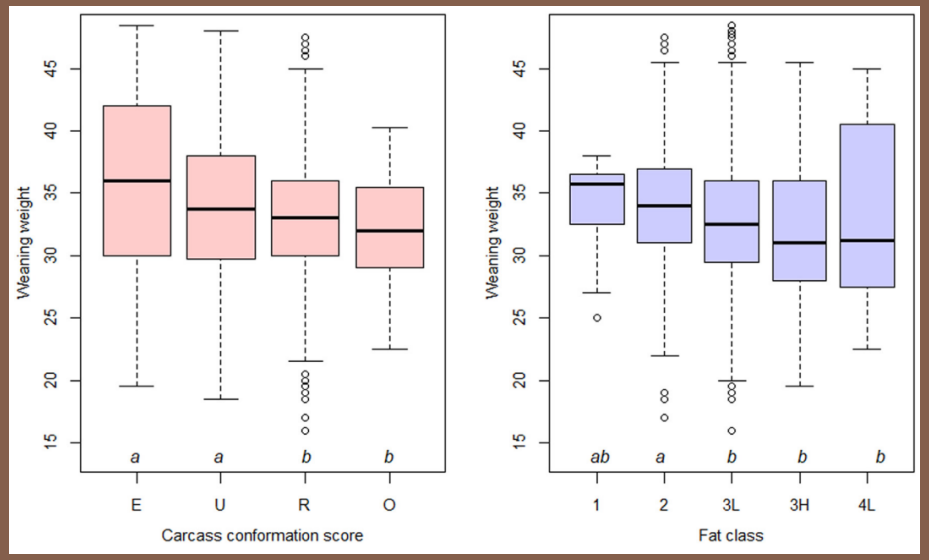
Contents lists available at ScienceDirect

Animal
The international journal of animal biosciences

Using a lamb's early-life liveweight as a predictor of carcass quality

A.G. Jones [a,b], T. Takahashi [a,b,*], H. Fleming [a], B.A. Griffith [a], P. Harris [a], M.R.F. Lee [a,b]

This work assessed the feasibility of using early-life liveweight to predict carcass quality in offering a practical tool for predicting carcass quality early in the production cycle.



Conditional boxplots for lamb weaning weight. A significant difference in weaning weight (kg) was observed between different carcass conformation score groups ($p < .001$) (left) and between different fat class groups ($p < .001$) (right) at slaughter. Groups with the same letter are not significantly different with each other ($p > .05$) based on Tukey's honestly significant difference (HSD) test.

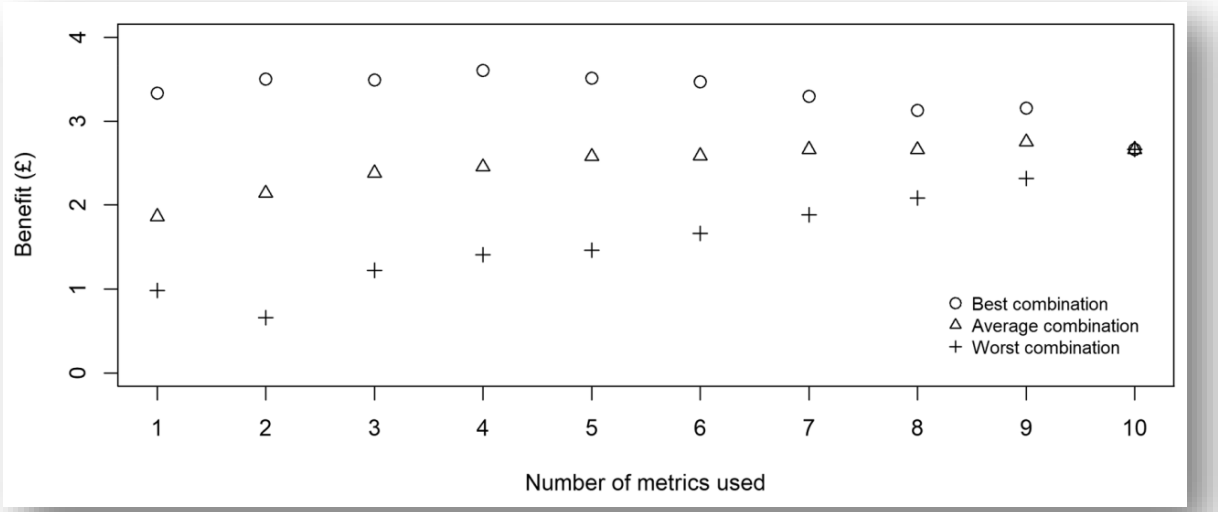
scientific reports

OPEN

Quantifying the value of on-farm measurements to inform the selection of key performance indicators for livestock production systems

Andy Jones[1,2], Taro Takahashi[1,2✉], Hannah Fleming[1], Bruce Griffith[1], Paul Harris[1] & Michael Lee[3]

This study proposed a novel framework for quantifying the information value of industry-recommended Key Performance Indicators.



Combined gross information value of multiple predictors. A considerable variability in information value is observed even when the same number of predictors is used, demonstrating the importance of selecting key performance indicators based on quantitative evidence.

Journal of Environmental Management 324 (2022) 116418

Contents lists available at ScienceDirect

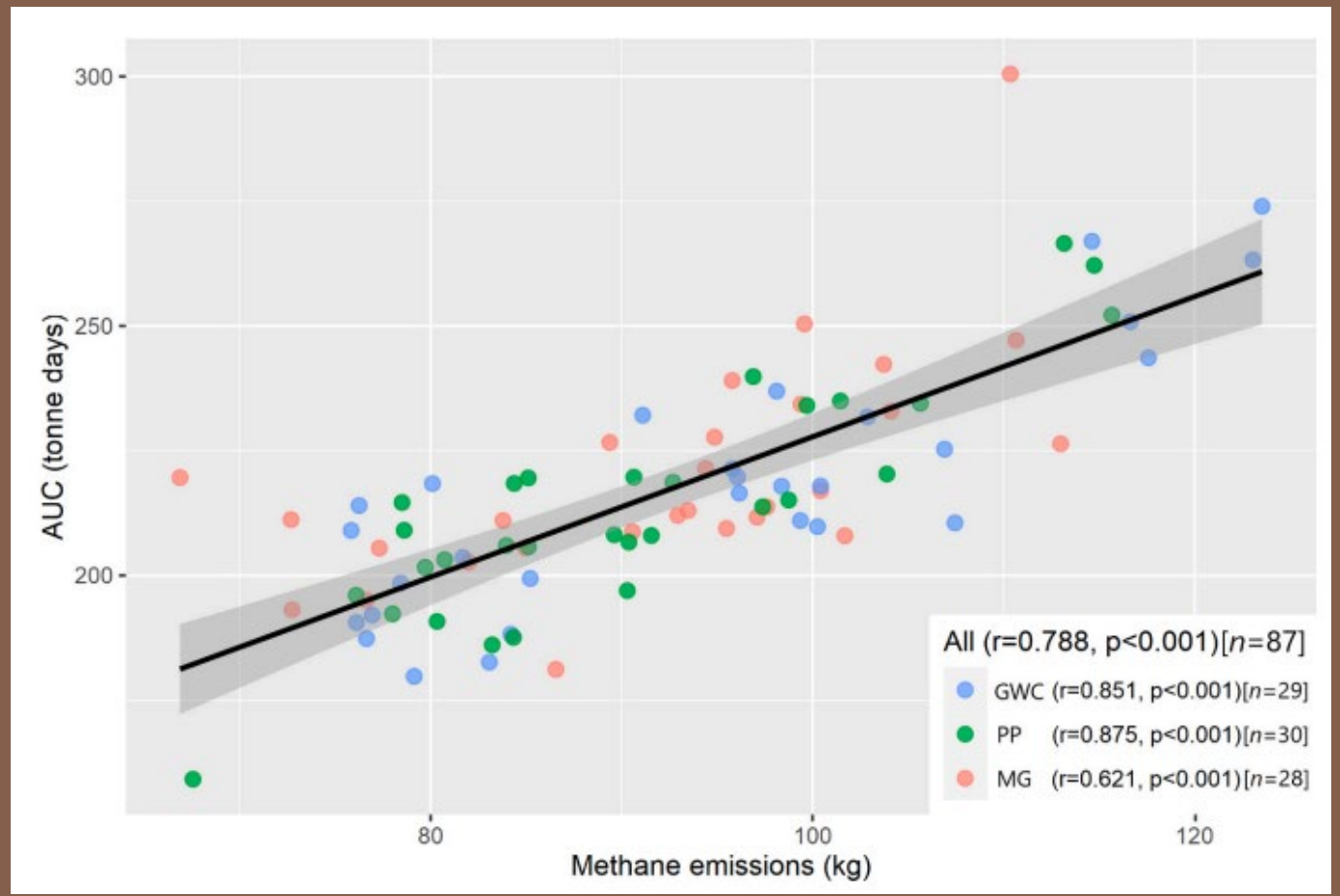
Journal of Environmental Management

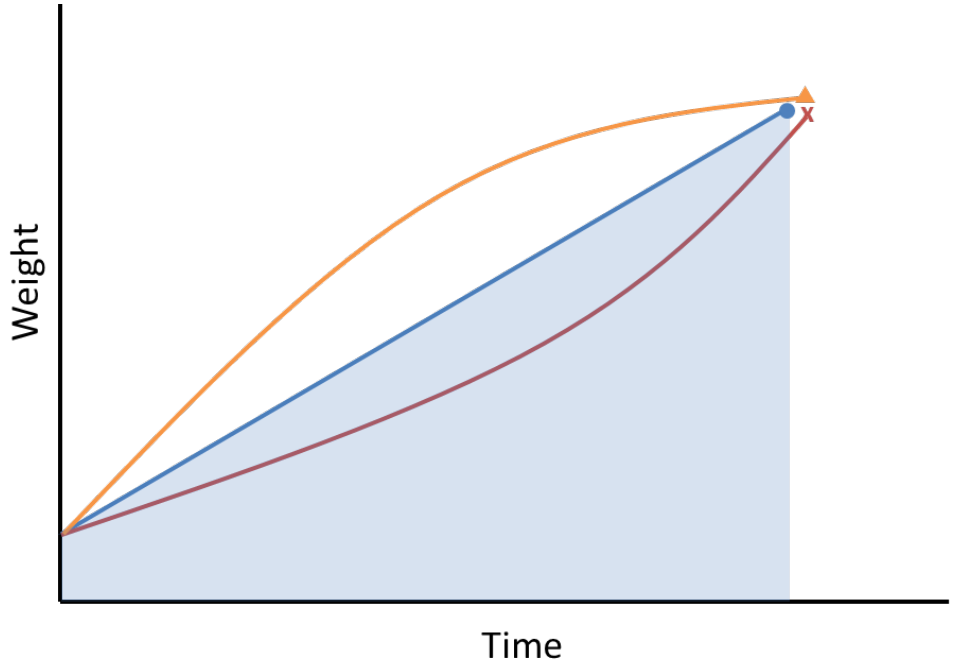
journal homepage: www.elsevier.com/locate/jenvman

Research article

Rethinking efficiency: Growth curves as a proxy for inputs and impacts in finishing beef systems

Andrew S. Cooke [a,b,*], Phil Le-Grice [a], Graham A. McAuliffe [a], Michael R.F. Lee [a,c,d], M. Jordana Rivero [a,**]





Working with cattle datasets, this study **introduced the Area Under the (growth) Curve (AUC) as a metric for assessing efficiency in beef systems** challenging the industry standard of liveweight gain per day.

Scatterplot showing correlation between AUC (tonne days) and total methane emissions (kg). Each point represents one animal. Farmlets are differentiated by point colour. Shading represents 99% confidence interval.

Animal 15 (2021) 100257

Contents lists available at ScienceDirect

Animal

The international journal of animal biosciences

Nutritional value of suckler beef from temperate pasture systems

M.R.F. Lee [a,b,*], G.A. McAuliffe [a], J.K.S. Tweed [c], B.A. Griffith [a], S.A. Morgan [a], M.J. Rivero [a], P. Harris [a], T. Takahashi [a,b], L. Cardenas [a]

The nutritional value of a food item should be used in defining its environmental cost (e.g. carbon footprint) to make **fair comparisons** across different food groups (e.g. protein sources).

- ✓ Pasture-based beef has a nutrient indexed carbon footprint of between 0.19 and 0.23 **Kg CO_2-eq/1% RDI of key nutrients.**

Environ. Res. Lett. **18** (2023) 084014 https://doi.org/10.1088/1748-9326/ace204

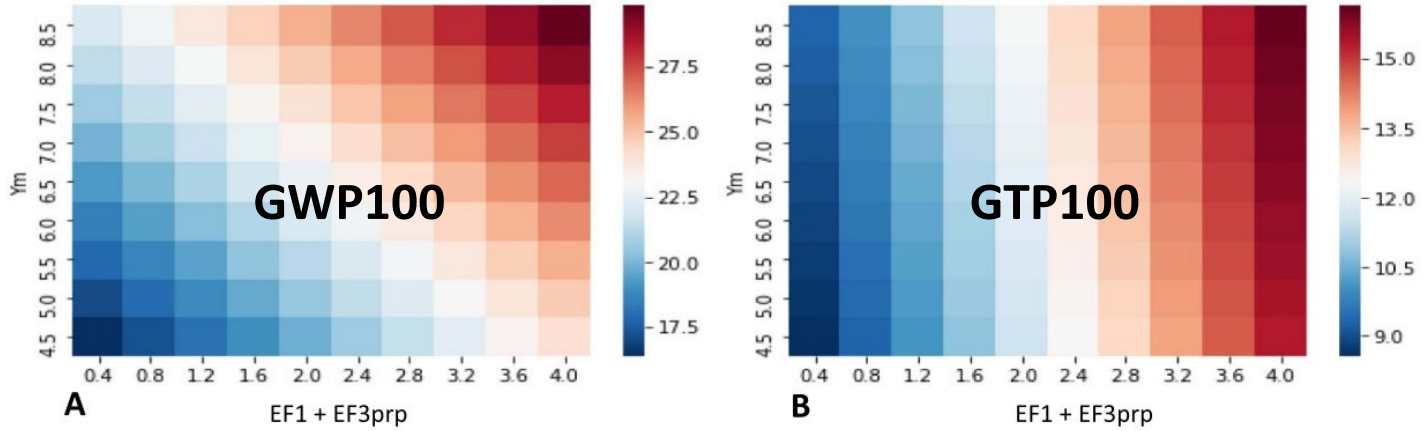
ENVIRONMENTAL RESEARCH
LETTERS

LETTER

Are single global warming potential impact assessments adequate for carbon footprints of agri-food systems?

Graham A McAuliffe[1,*], John Lynch[2], Michelle Cain[3], Sarah Buckingham[4], Robert M Rees[4], Adrian L Collins[1], Myles Allen[5], Raymond Pierrehumbert[5], Michael R F Lee[6] and Taro Takahashi[1,7,8]

Comparing different climate impact assessments… This work emphasises the **importance of considering dynamic metrics**, such as GWP*, for a **more accurate representation** of the temporal evolution of temperature change.



Heatmaps of all 90 scenarios described in section 2.2. Please note that the x-axis only displays EF3prp emission factors (EF); however, EF1 ranges are also included (0.2% to 2.0% in steps of 0.2%) to represent total N applied and deposited on pasture but are not displayed for simplicity. Figure 2(A) displays impacts under GWP100 whilst figure 2(B) reports impacts under GTP100.

Journal of Animal and Feed Sciences, 32, 4, 2023, 427–437, https://doi.org/10.22358/jafs/166079/2023
The Kielanowski Institute of Animal Physiology and Nutrition, Polish Academy of Sciences, Jabłonna

Comparison of lipid profiles in the faeces of beef cattle fed three common temperate grass silage diets and their relevance to dietary composition

M. Elayadeth-Meethal[1,2,*], M. Jordana Rivero[2], A. Mead[3], M.R.F. Lee[1,4] and T.H. Misselbrook[1]

Parasitology

cambridge.org/par

The latest FAD – Faecal antibody detection in cattle. Protocol and results from three UK beef farms naturally infected with gastrointestinal nematodes

Research Article

Cite this article: Cooke AS, Watt KA, Morgan

A. S. Cooke[1,2], K. A. Watt[3], E. R. Morgan[2,4] and J. A. J. Dungait[1]

Animal 17 (2023) 100726

Contents lists available at ScienceDirect

Animal
The international journal of animal biosciences

Performance and enteric methane emissions from housed beef cattle fed silage produced on pastures with different forage profiles

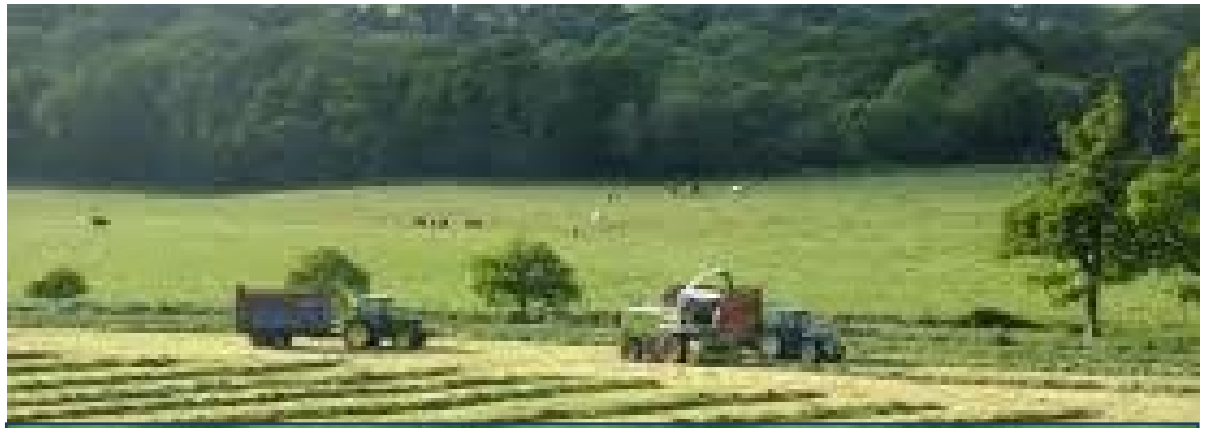
P. Meo-Filho [a,*], J. Hood [b], M.R.F. Lee [a,1], H. Fleming [a], M.E. Meethal [a,2], T. Misselbrook [a]

SCIENTIFIC REPORTS
nature research

Corrected: Author Correction

Insights into *Pasteurellaceae* carriage dynamics in the nasal passages of healthy beef calves

A. C. Thomas[1,2,4], M. Bailey[1], M. R. F. Lee[1,2], A. Mead[3], B. Morales-Aza[4,5], R. Reynolds[6], B. Vipond[7], A. Finn[4,5,6] & M. C. Eisler[1]



Thanks for your attention.

Questions?

GLOBAL FARM PLATFORM

Towards Sustainable Ruminant Production

Living labs and demonstration farms: approaches to improve the sustainability of livestock farming systems globally

A session organised by:

EAAP's Livestock Farming Systems study commission

GLOBAL FARM PLATFORM

Towards Sustainable Ruminant Production