La sostenibilità climatica delle filiere lattiero-casearie: cosa sappiamo, cosa possiamo fare

Giuseppe Pulina

Professore Ordinario di Etica e Sostenibilità degli Allevamenti

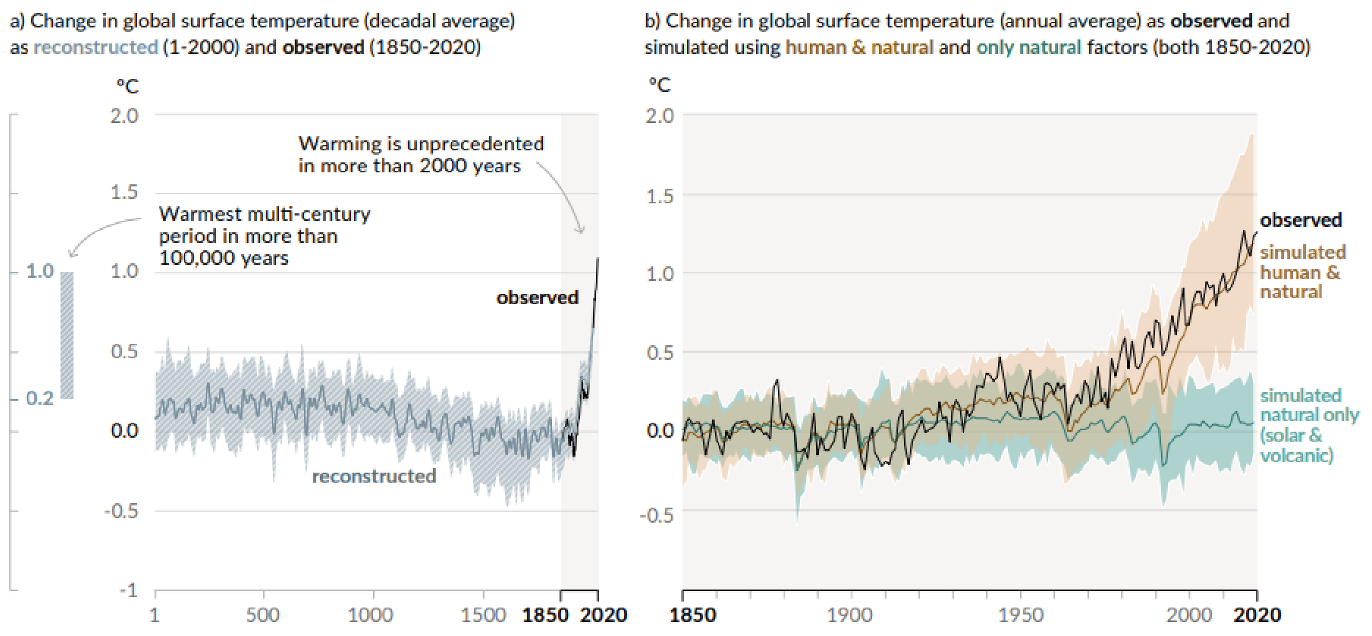
UNISS
UNIVERSITÀ DEGLI STUDI DI SASSARI

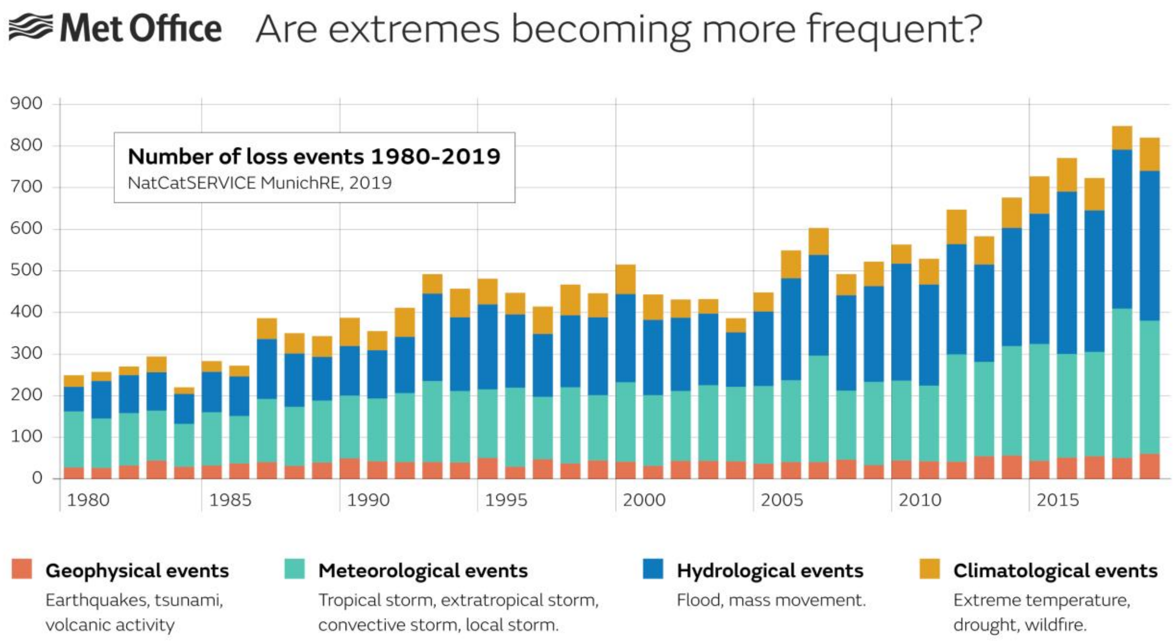
A quali domande risponderemo?

- Impatti climalteranti, quanto conta l’allevamento animale?
- Come riduciamo le emissioni degli allevamenti?
- Gli allevamenti intensivi sono un male?
- Le metriche utilizzate (standard IPCC) sono corrette?

1. Impatti climalteranti, quanto conta l’allevamento animale?

La temperatura media terrestre è aumentata di 1,2°C dal 1850





ANNUAL REVIEWS

Annual Review of Environment and Resources

Net Zero: Science, Origins, and Implications

Myles R. Allen,[1,4] Pierre Friedlingstein,[2,3] Cécile A.J. Girardin,[1] Stuart Jenkins,[4] Yadvinder Malhi,[1,5] Eli Mitchell-Larson,[1] Glen P. Peters,[6] and Lavanya Rajamani[7]

[1]Environmental Change Institute, School of Geography and the Environment, University of Oxford, Oxford, United Kingdom; email: myles.allen@ouce.ox.ac.uk

[2]College of Engineering, Mathematics and Physical Sciences, University of Exeter, Exeter, United Kingdom

[3]Laboratoire de Météorologie Dynamique, Institut Pierre-Simon Laplace, CNRS-ENS-UPMC-X, Paris, France

[4]Department of Physics, University of Oxford, Oxford, United Kingdom

[5]Leverhulme Centre for Nature Recovery, University of Oxford, Oxford, United Kingdom

[6]CICERO Center for International Climate Research (CICERO), Oslo, Norway

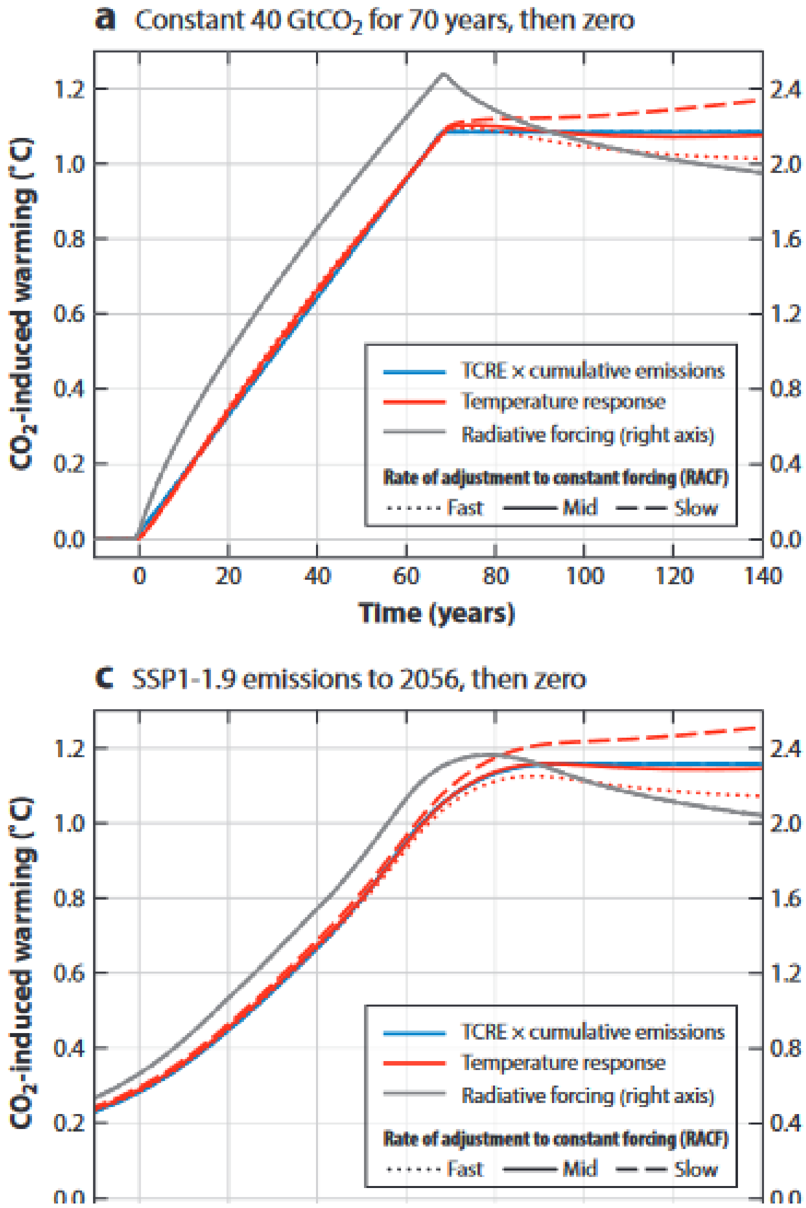
[7]Faculty of Law, University of Oxford, Oxford, United Kingdom

Annu. Rev. Environ. Resour. 2022. 47:849–87

First published as a Review in Advance on August 26, 2022

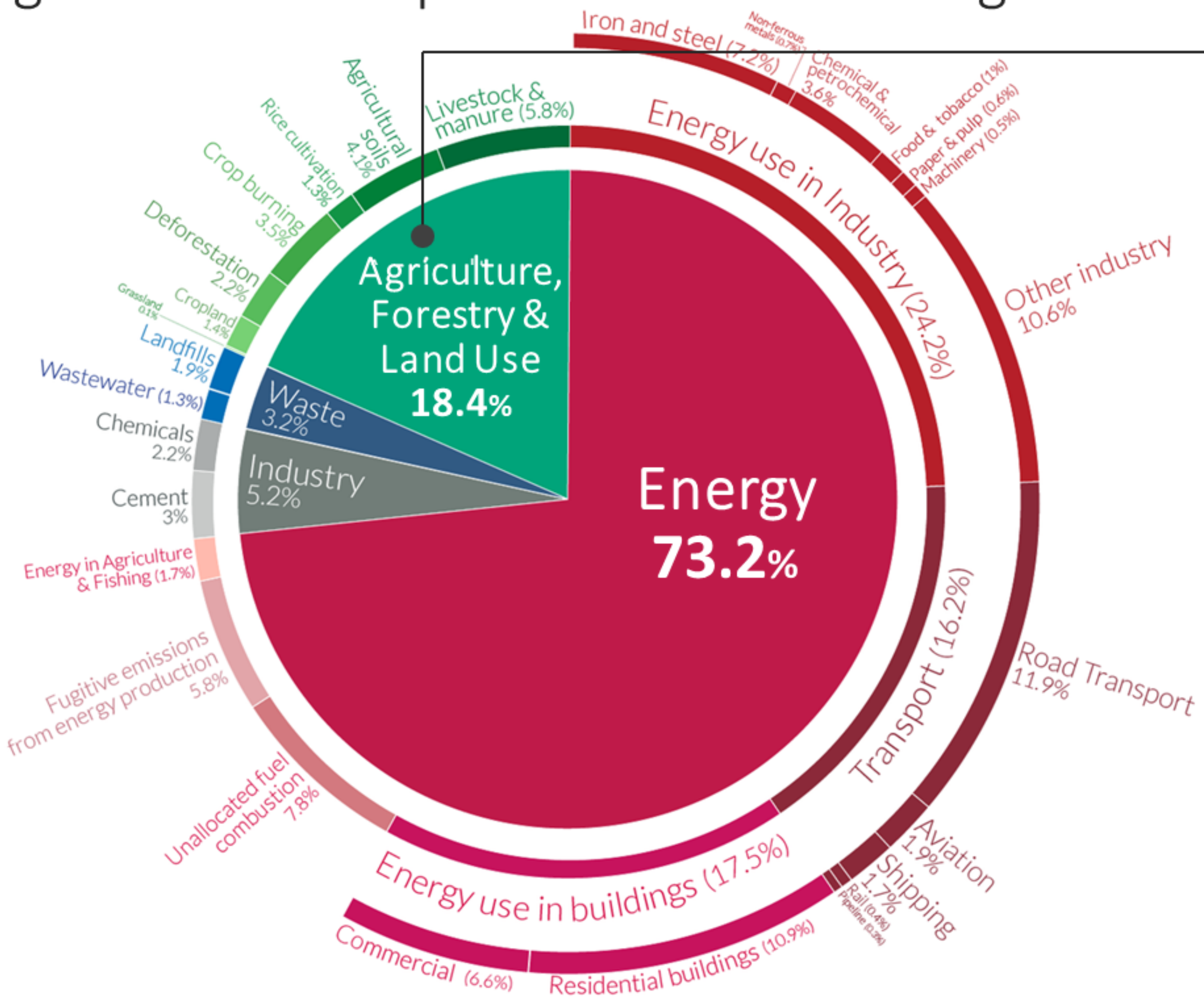
Keywords

carbon budget, net zero, climate neutrality, nature-based solutions,

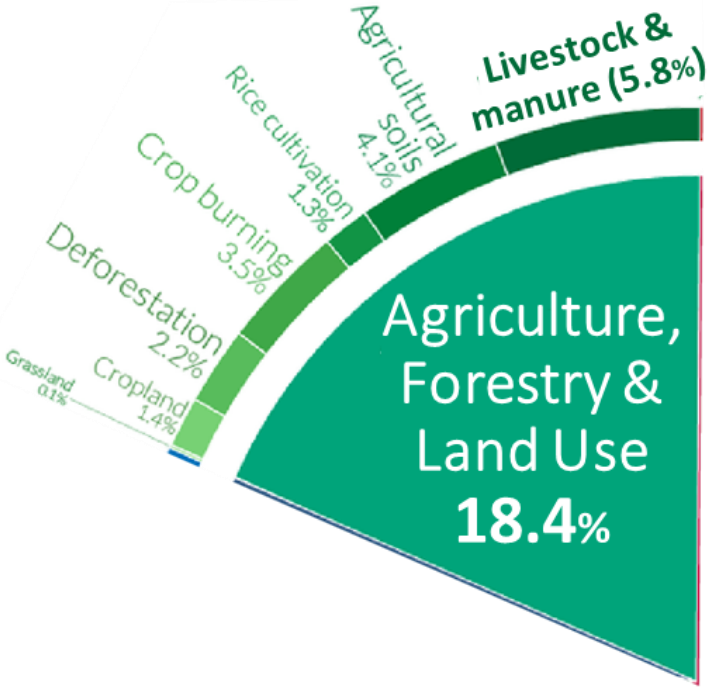


Global GHG emissions by sector

Agriculture is responsible for **18.4%** of global GHG emission



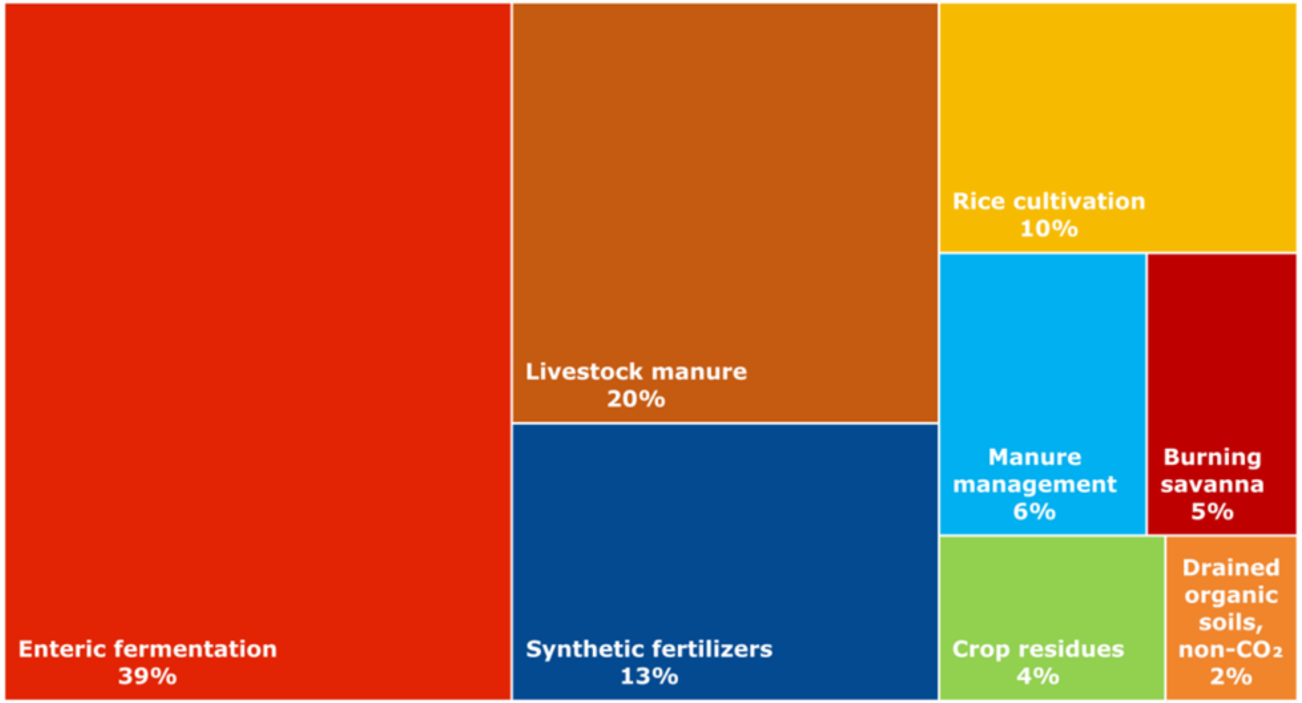
Livestock direct GHG emissions accounts for less **6%**



Source: FAOSTAT Analytical Brief 31; Our World in Data.

Sfortunatamente l’alevamento animale è responsabile della maggiore quota di emissioni non CO_2 dell’agricoltura

Figure 2. Contribution of crops and livestock activities to total non-CO_2 emissions from agriculture in 2018 (5.3 Gt CO_2eq)



Source: FAOSTAT 2020.

Ma, eliminare il bestiamo è un buon affare?

npj | climate and atmospheric science

www.nature.com/npjclimatsci

BRIEF COMMUNICATION OPEN

Check for updates

Comparable GHG emissions from animals in wildlife and livestock-dominated savannas

Pablo Manzano[1,2,3,4], Agustín del Prado[3,4] and Guillermo Pardo[3]

Fig. 1- Location map of the Serengeti ecosystem and Loliondo Game Controlled Area (GCA)

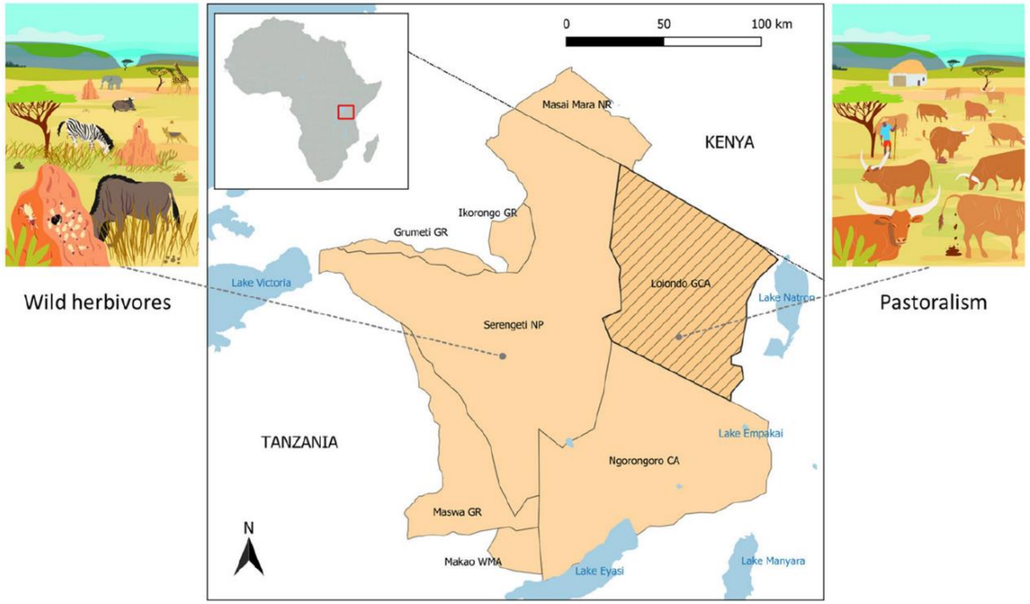
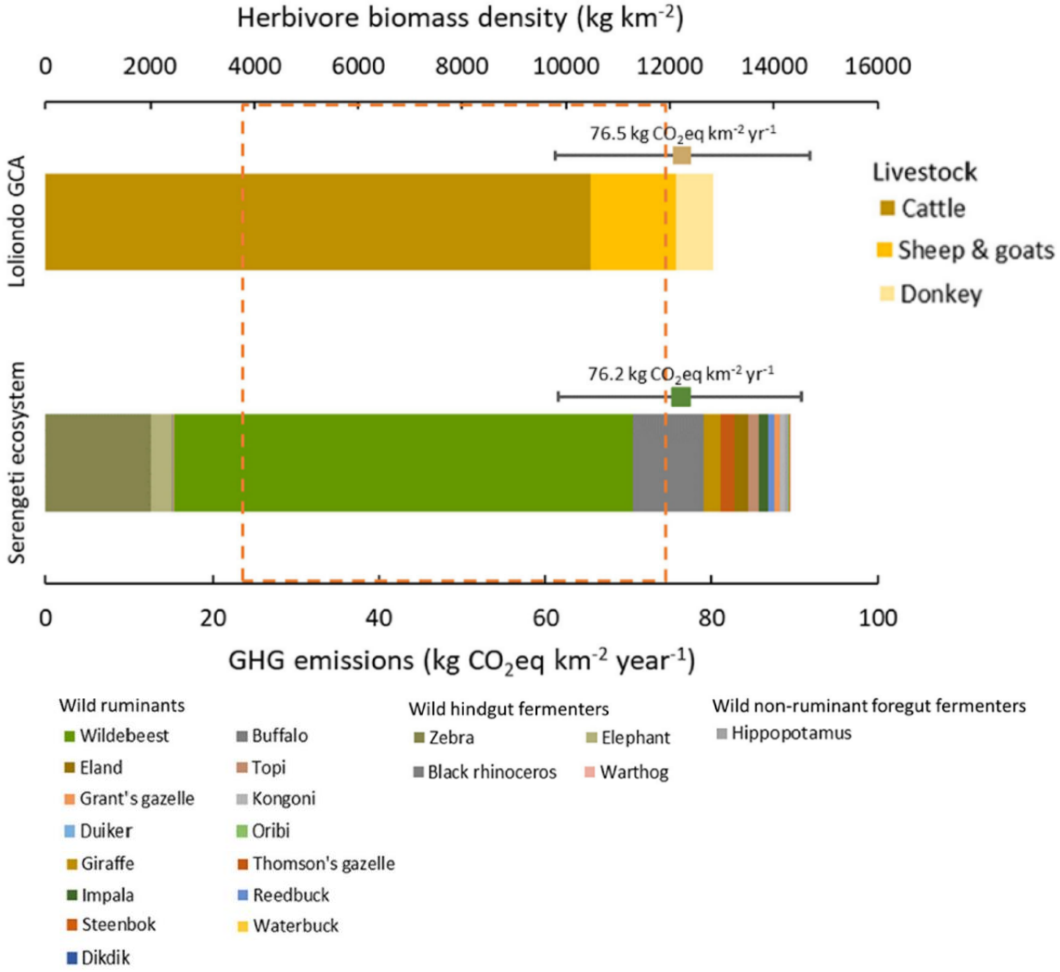


Fig. 2 - Herbivore biomass density and GHG emissions per area in wildlife-dominated Serengeti ecosystem and pastoralism-dominated



Risultati simili sono stati trovati in USA

ELSEVIER

Agricultural and Forest Meteorology

Volume 150, Issue 3, 15 March 2010, Pages 473-477

Short communication

Methane emissions from bison—An historic herd estimate for the North American Great Plains

Francis M. Kelliher [a b], Harry Clark [c]

72 kg CH_4 head^{-1} year^{-1}, respectively. The historic herd's emissions were 2.2 Tg CH_4 year^{-1}. On 1 January 2008, 36.5 M cattle were located in 10 American states occupying the historic bison range. Cattle emissions were 2.5 Tg CH_4 year^{-1}, estimated using an IPCC Tier 1 method, adjusted by

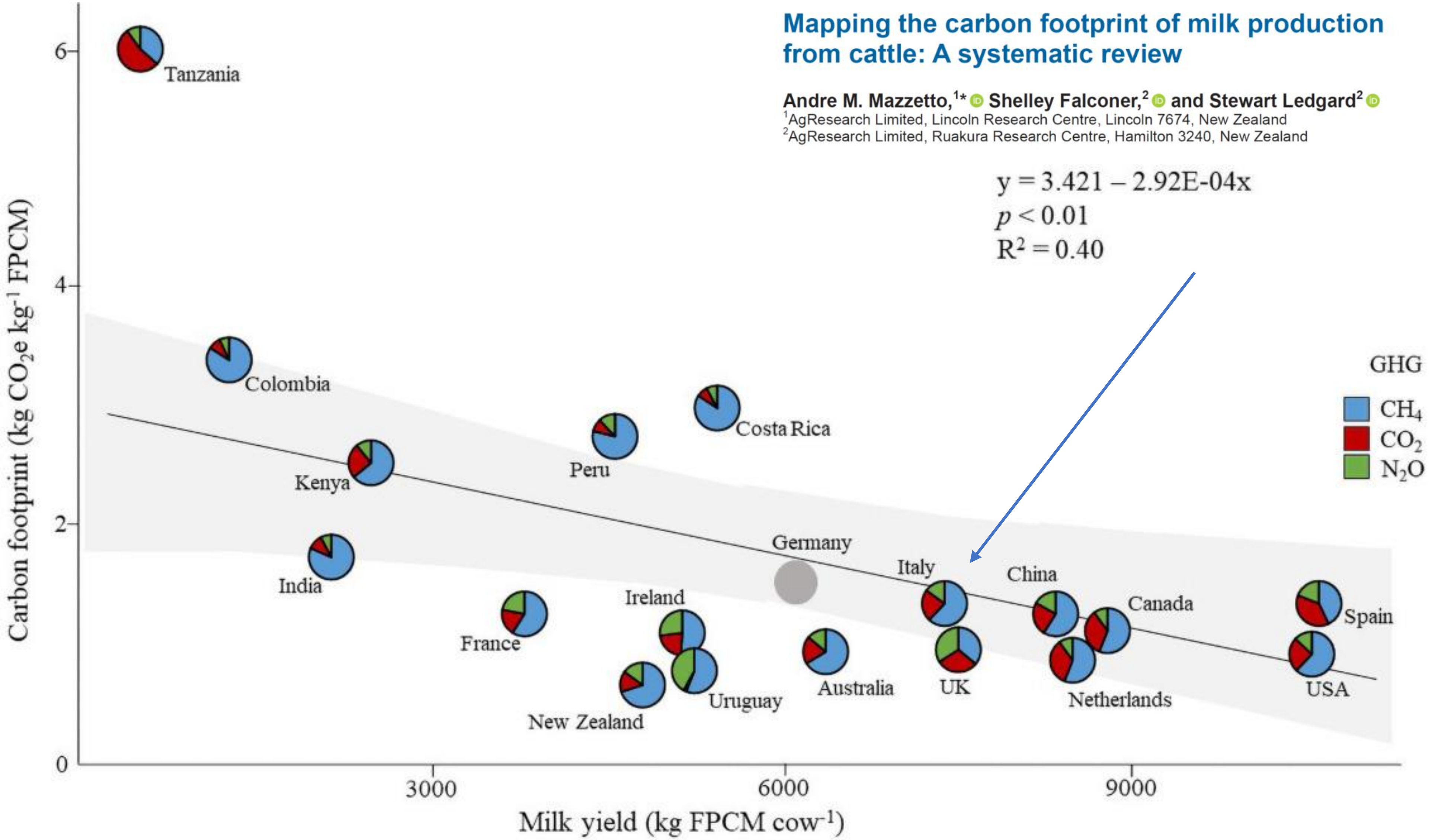
2. Come riduciamo le emissioni degli allevamenti?

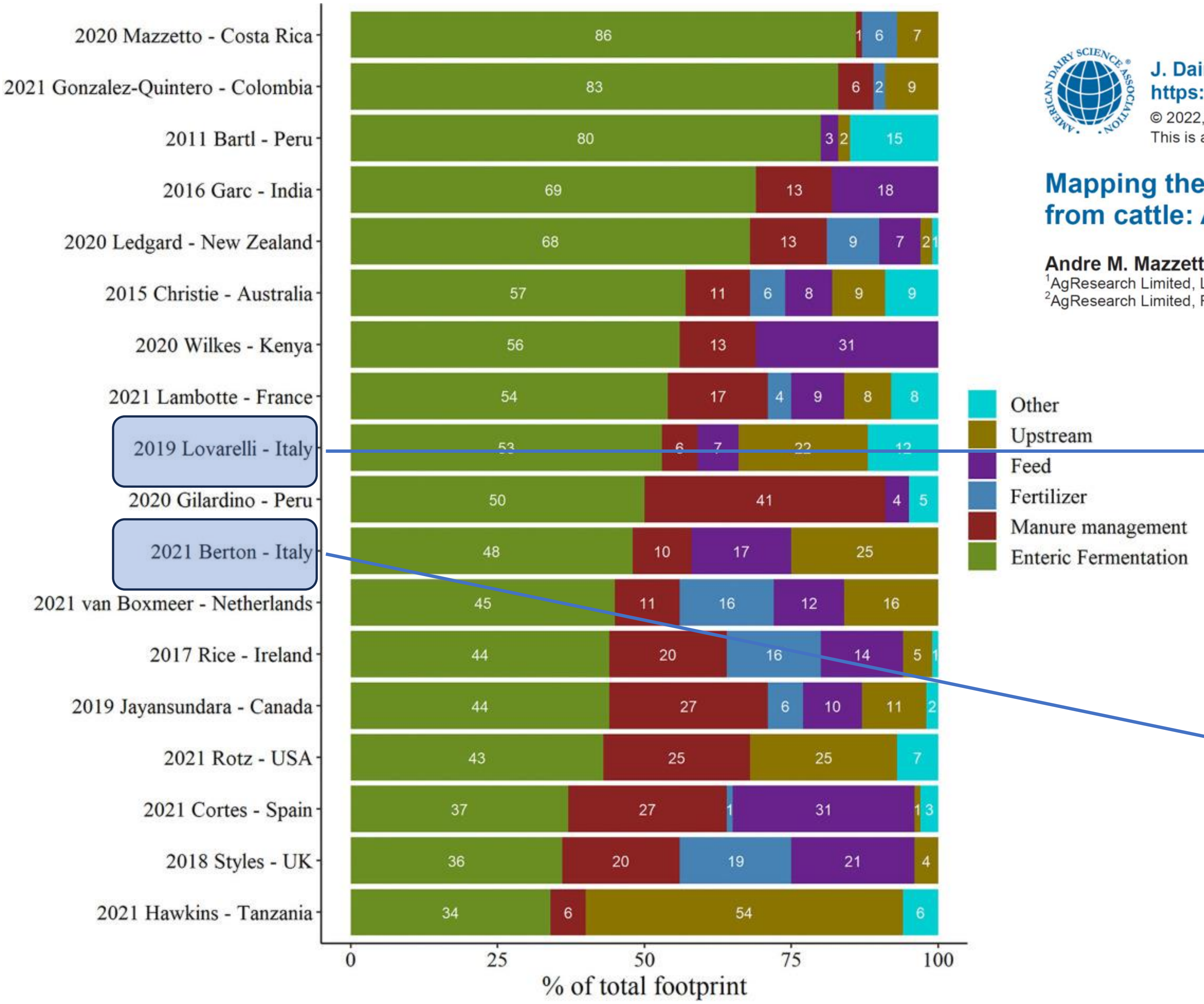
Più si produce, meno si impatta per unità [funzionale] di prodotto

J. Dairy Sci. 105:9713–9725
https://doi.org/10.3168/jds.2022-22117

Mapping the carbon footprint of milk production from cattle: A systematic review

Andre M. Mazzetto,[1]* Shelley Falconer,[2] and Stewart Ledgard[2]
[1]AgResearch Limited, Lincoln Research Centre, Lincoln 7674, New Zealand
[2]AgResearch Limited, Ruakura Research Centre, Hamilton 3240, New Zealand





J. Dairy Sci. 105:9713–9725
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Mapping the carbon footprint of milk production from cattle: A systematic review

Andre M. Mazzetto,[1]* Shelley Falconer,[2] and Stewart Ledgard[2]
[1]AgResearch Limited, Lincoln Research Centre, Lincoln 7674, New Zealand
[2]AgResearch Limited, Ruakura Research Centre, Hamilton 3240, New Zealand

Grana Padano e Parmigiano Reggiano

Sistemi alpini est-Italia

Più produzione, meno impatto

ITALIAN JOURNAL OF ANIMAL SCIENCE
2020, VOL. 19, NO. 1, 865–879
https://doi.org/10.1080/1828051X.2020.1805370

Taylor & Francis
Taylor & Francis Group

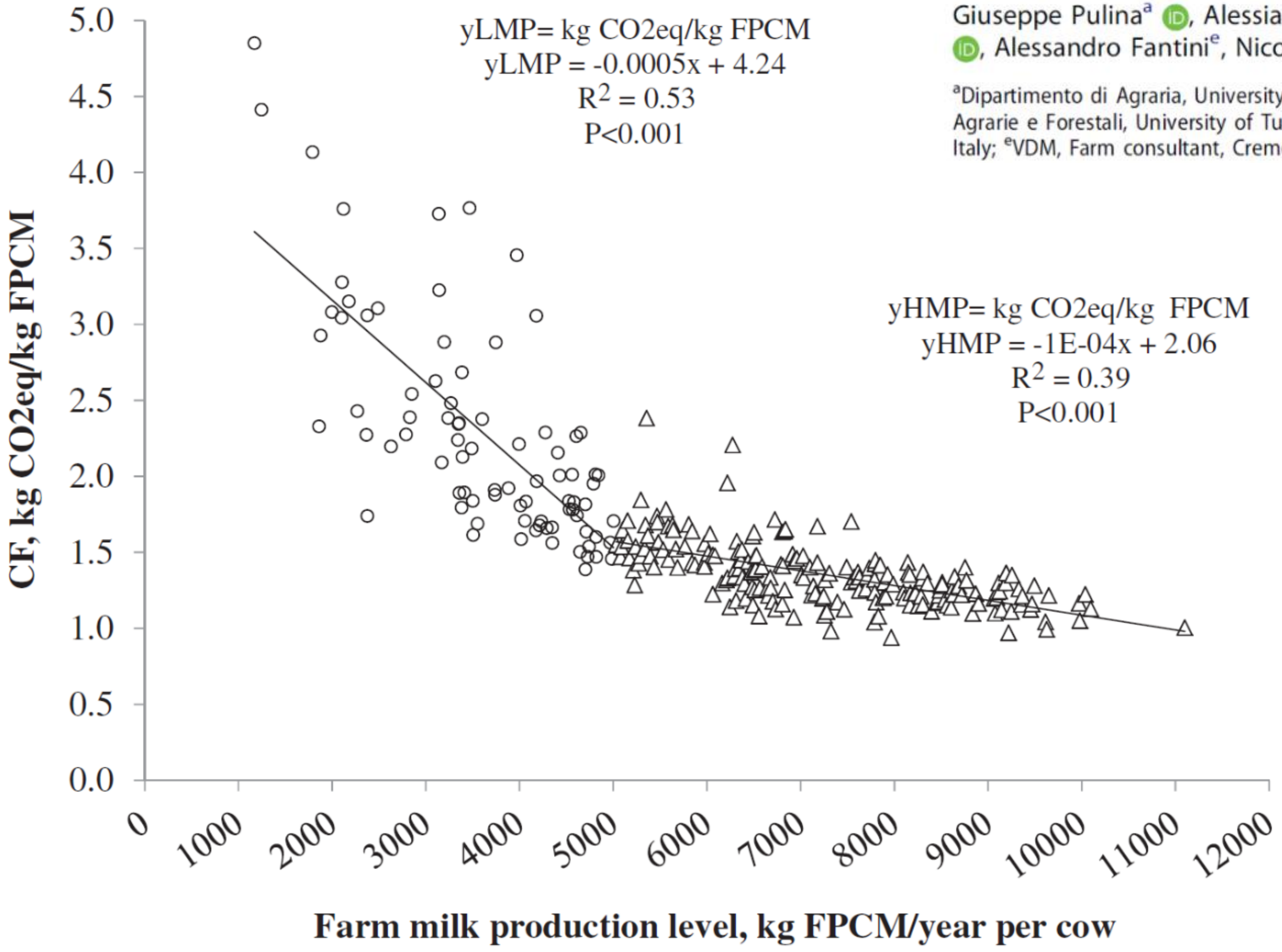
PAPER

OPEN ACCESS Check for updates

How to manage cows yielding 20,000 kg of milk: technical challenges and environmental implications

Giuseppe Pulina[a], Alessia Tondo[b], Pier Paolo Danieli[c], Riccardo Primi[c], Gianni Matteo Crovetto[d], Alessandro Fantini[e], Nicolò Pietro Paolo Macciotta[a] and Alberto Stanislao Atzori[a]

[a]Dipartimento di Agraria, University of Sassari, Sassari, Italy; [b]Associazione Italiana Allevatori, Roma, Italy; [c]Dipartimento di Scienze Agrarie e Forestali, University of Tuscia, Viterbo, Italy; [d]Dipartimento di Scienze Agrarie e Ambientali, University of Milano, Milano, Italy; [e]VDM, Farm consultant, Cremona, Italy



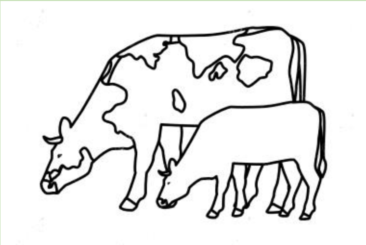
Dairy cattle, Italian case

Table 4. Predicted reduction in CO_{2eq} emissions and Nitrogen and Phosphorus excretions by high yielding cows in 2030 in comparison with actual cows in 1990.

Year	Milk/y per head (kg)	Italian milk yield (t)	Concentration (g/kg of milk)	Total (t)	%
Carbon footprint					
1990	4,210	11,120,700	2,135	23,744,986	100
2018	7,136	12,084,030	1,346	16,269,643	69
2030*	8,672	12,084,030	1,193	14,413,536	61
2030**	15,307	12,084,030	0,529	6,395,865	27
Nitrogen excretion					
1990	4,210	11,120,700	21.9	243,810	100
2018	7,136	12,084,030	15.2	183,817	75
2030*	8,672	12,084,030	13.7	165,298	68
2030**	15,307	12,084,030	9.6	116,483	48
Phosphorus excretion					
1990	4,210	11,120,700	3.2	36,056	100
2018	7,136	12,084,030	2.3	27,518	76
2030*	8,672	12,084,030	1.9	23,096	64
2030**	15,307	12,084,030	1.1	12,828	36

*Current phenotypic trend; **20t milk production level for the high yielding dairy farms.

Il problema dell'allocazione



200 kg/a PV

+

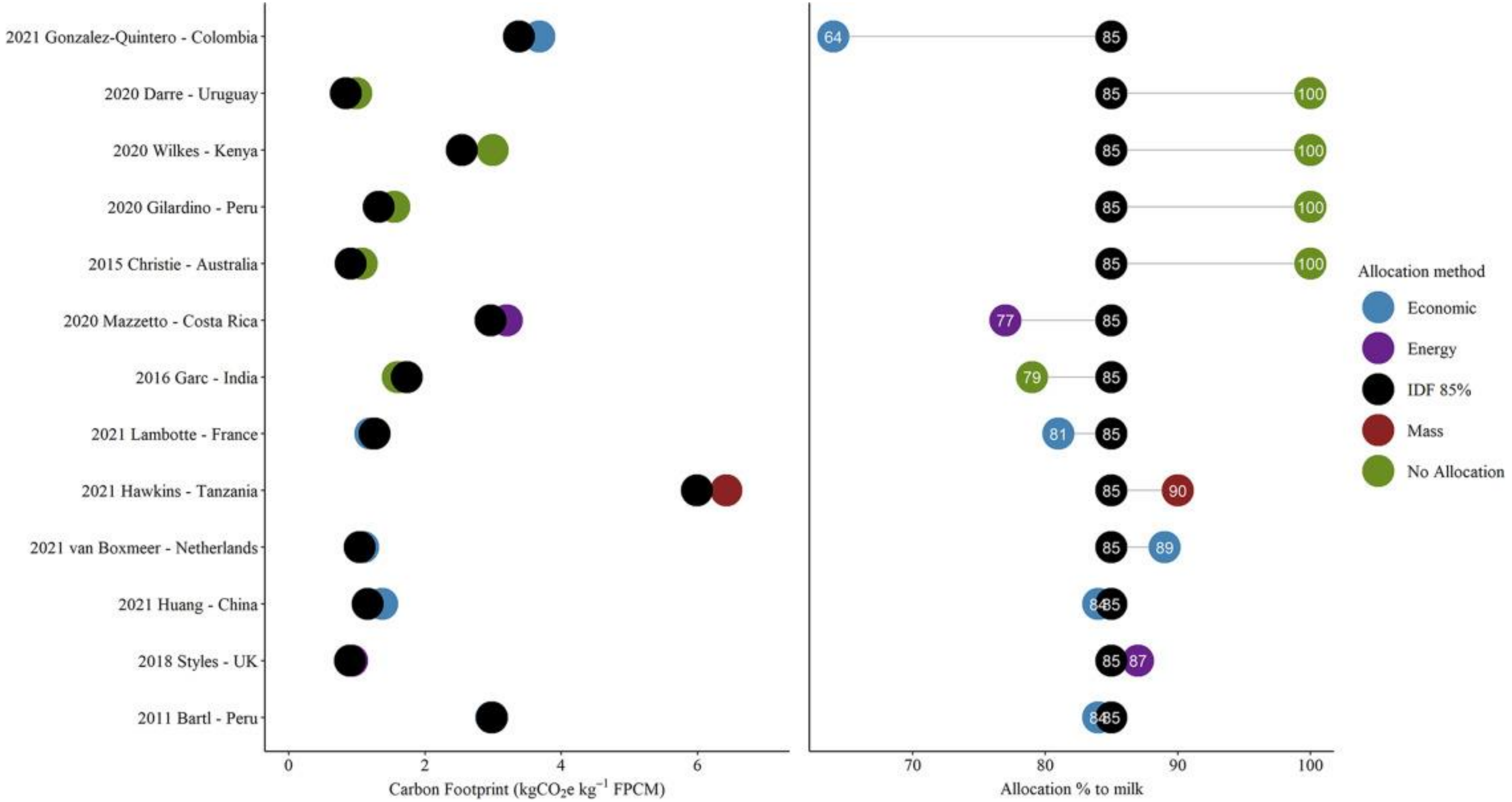
10.000 L/a

= 13,800 kg CO_2e

1,22 kg CO_2e/litro

8,0 kg CO_2e/kg PV

Diversa allocazione rispetto allo standard FIL-IDF della CFP fra latte e carne non cambia di molto i valori (Mazzetto et al., 2022)



Anche la CFP della carne da allevamenti da latte dipende dalla produzione

Contents lists available at ScienceDirect

Agricultural Systems

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

Effectiveness of climate change mitigation options considering the amount of meat produced in dairy systems

T.V. Vellinga*, M. de Vries

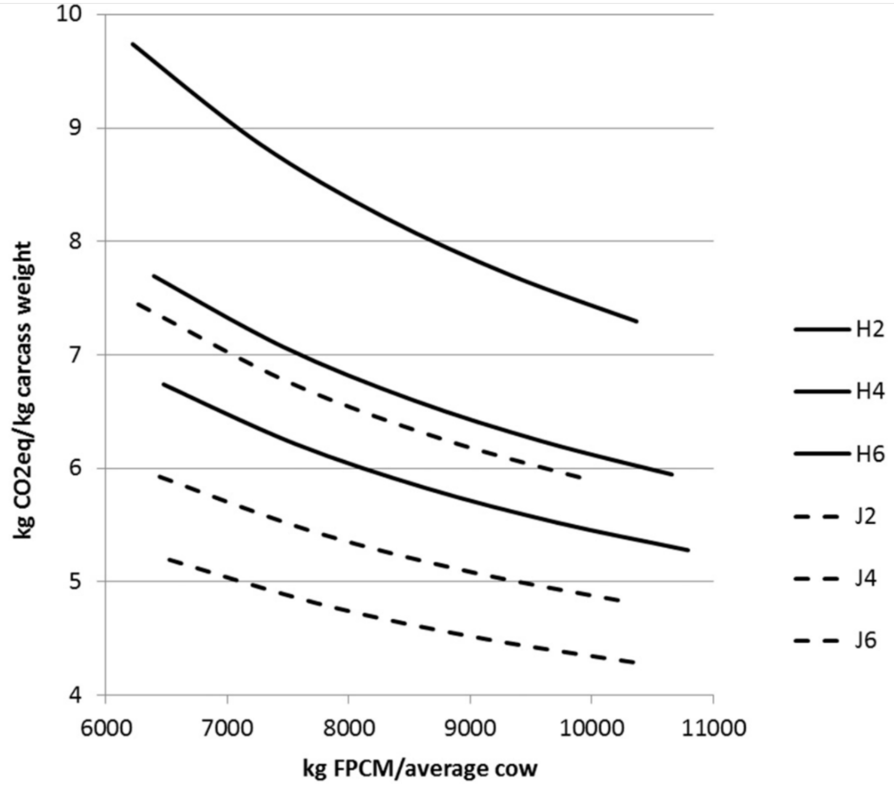


Fig. 4. Greenhouse gas emissions per kg carcass weight of culled animals for Holstein (H) and Jersey (J) breeds and life spans of 2, 4 and 6 years for a range of fat and protein corrected milk (FPCM) production from 6300 to 10,700 kg.

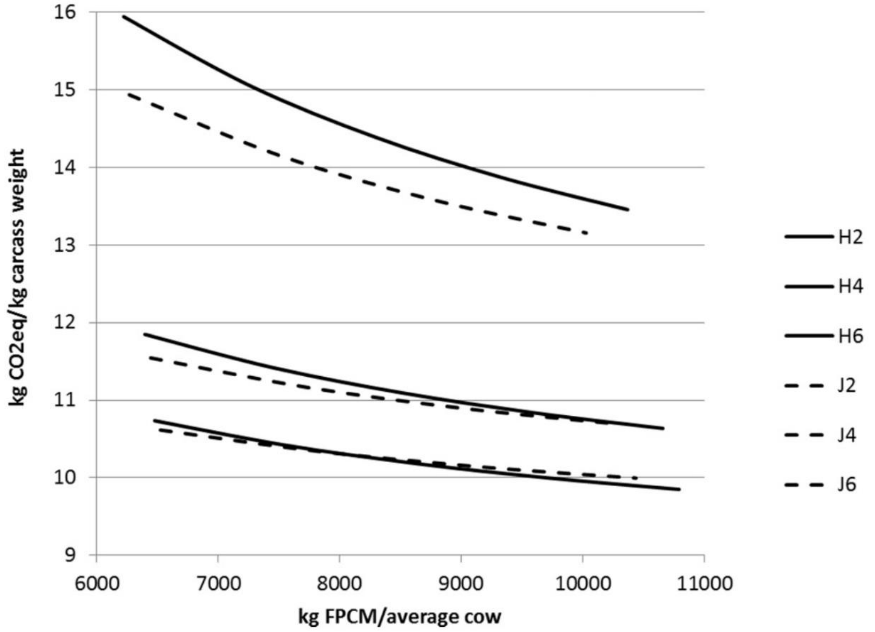
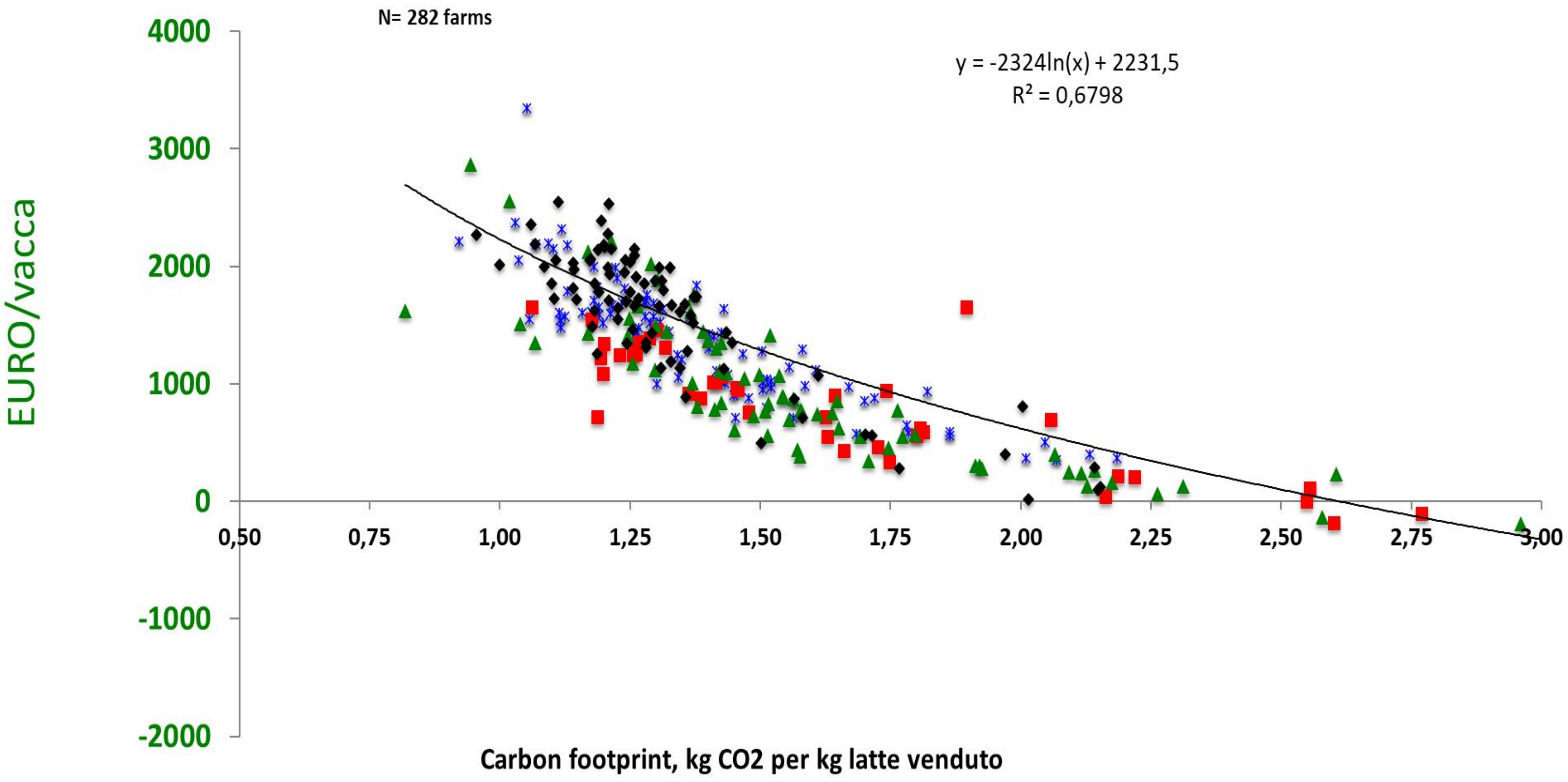


Fig. 5. Greenhouse gas emissions per kg of carcass weight for fattening dairy calves for Holstein (H) and Jersey (J) breeds and life spans of 2, 4 and 6 years for a range of fat and protein corrected milk (FPCM) production from 6300 to 10,700 kg.

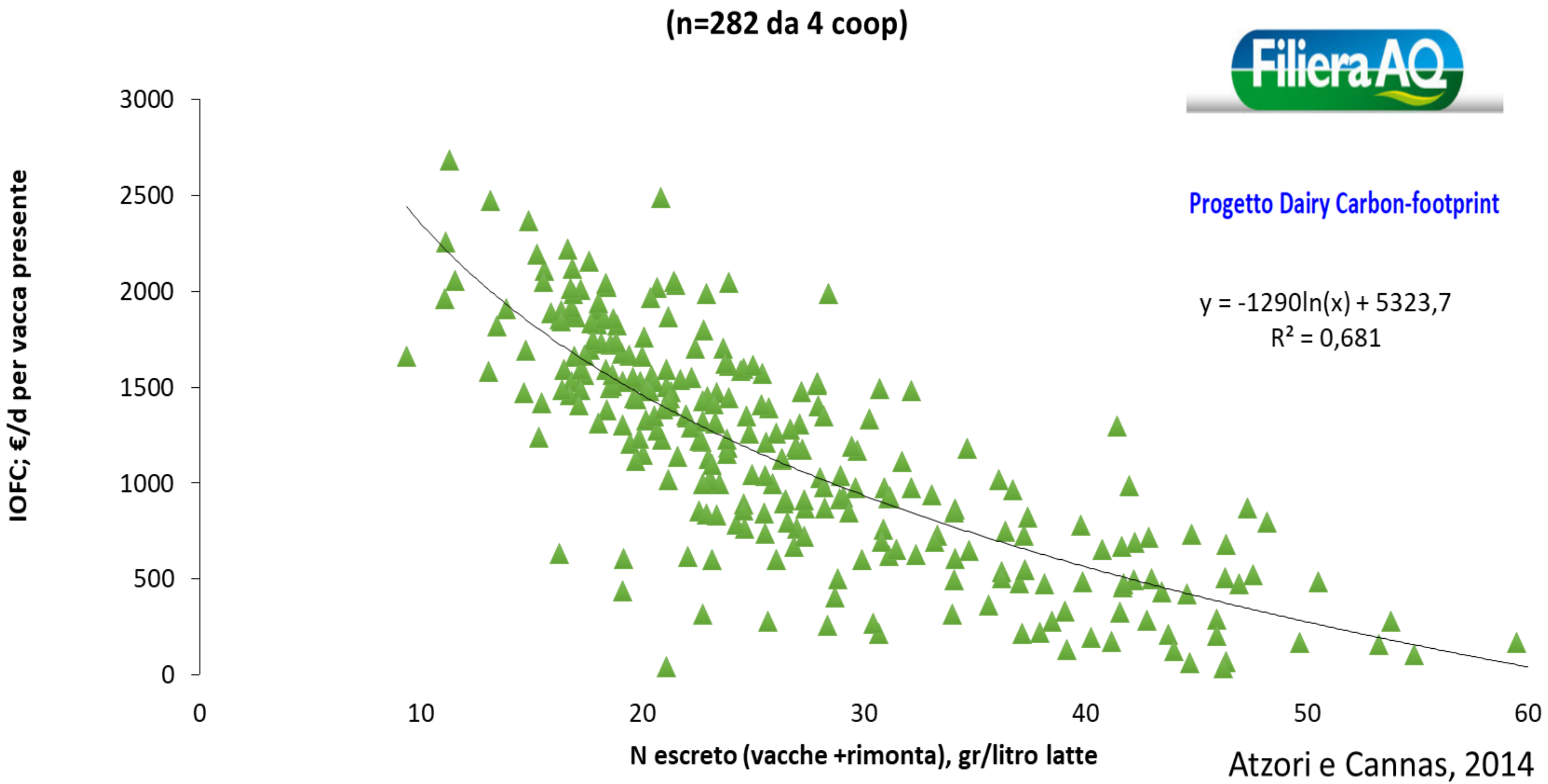
Meno si impatta, più si guadagna

Chi impatta meno guadagna di più: ***CFP/L*** e IOFC (ricavi meno costi alimentari) vacca da latte



(Atzori e Cannas, 2014)

Chi impatta meno guadagna di più: ***N-escreto/L*** e IOFC (ricavi meno costi alimentari) vacca da latte



Atzori e Cannas, 2014

3. Gli allevamenti intensivi sono un male?

nature sustainability

ARTICLES

https://doi.org/10.1038/s41893-018-0138-5

Corrected: Author Correction

NATURE SUSTAINABILITY | VOL 1 | SEPTEMBER 2018 | 477–485 | www.nature.com/natsustain

The environmental costs and benefits of high-yield farming

Andrew Balmford[1]*, Tatsuya Amano[1,2], Harriet Bartlett[1], Dave Chadwick[3], Adrian Collins[4], David Edwards[5], Rob Field[6], Philip Garnsworthy[7], Rhys Green[1], Pete Smith[8], Helen Waters[1], Andrew Whitmore[9], Donald M. Broom[10], Julian Chara[11], Tom Finch[1,6], Emma Garnett[1], Alfred Gathorne-Hardy[12,13,14], Juan Hernandez-Medrano[15], Mario Herrero[16], Fangyuan Hua[1], Agnieszka Latawiec[17,18], Tom Misselbrook[4], Ben Phalan[1,19], Benno I. Simmons[1], Taro Takahashi[4,20], James Vause[21], Erasmus zu Ermgassen[1] and Rowan Eisner[1]

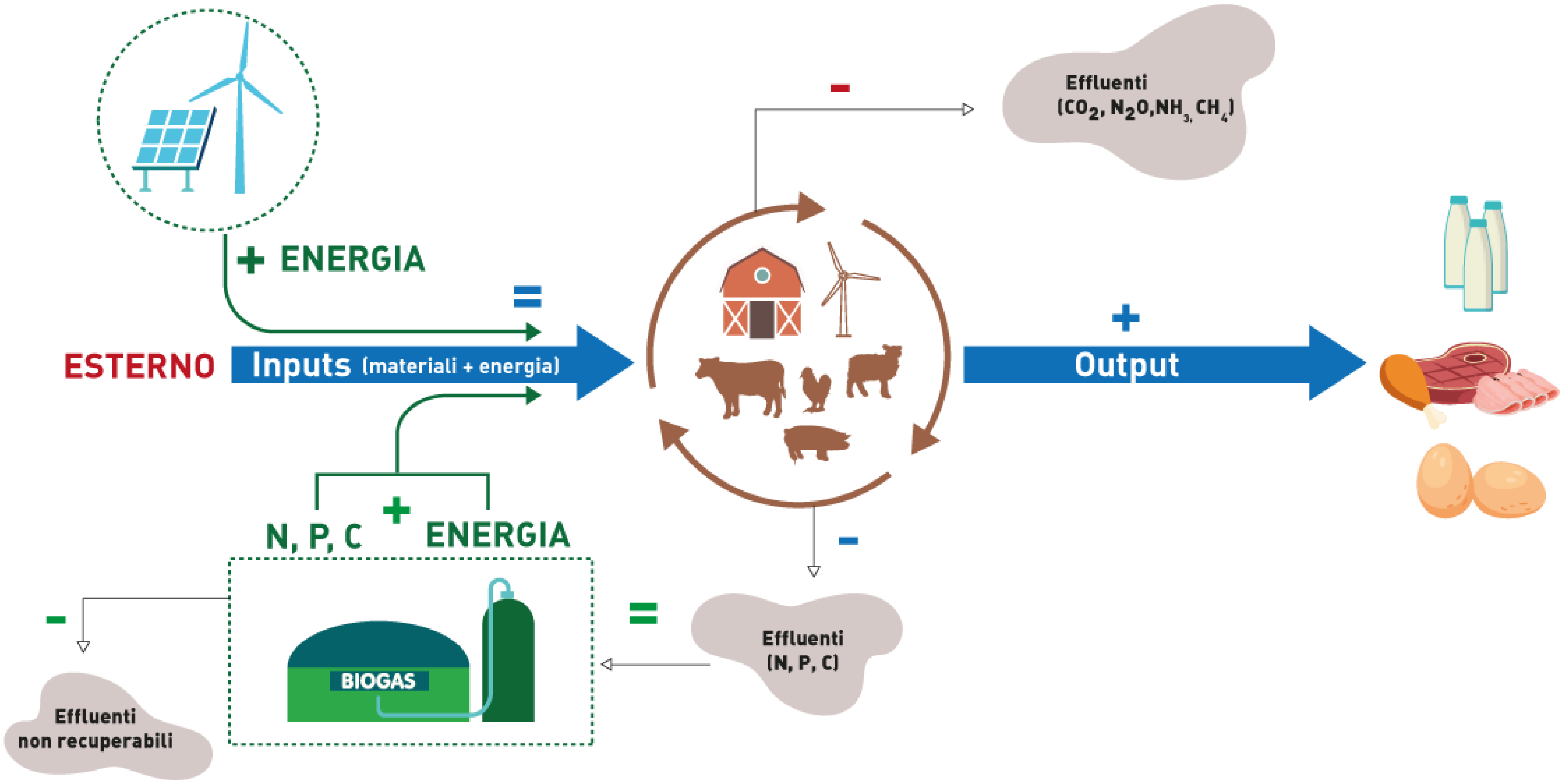
NATURE SUSTAINABILITY | VOL 1 | SEPTEMBER 2018 | 477–485 | www.nature.com/natsustain

Incorporating land use

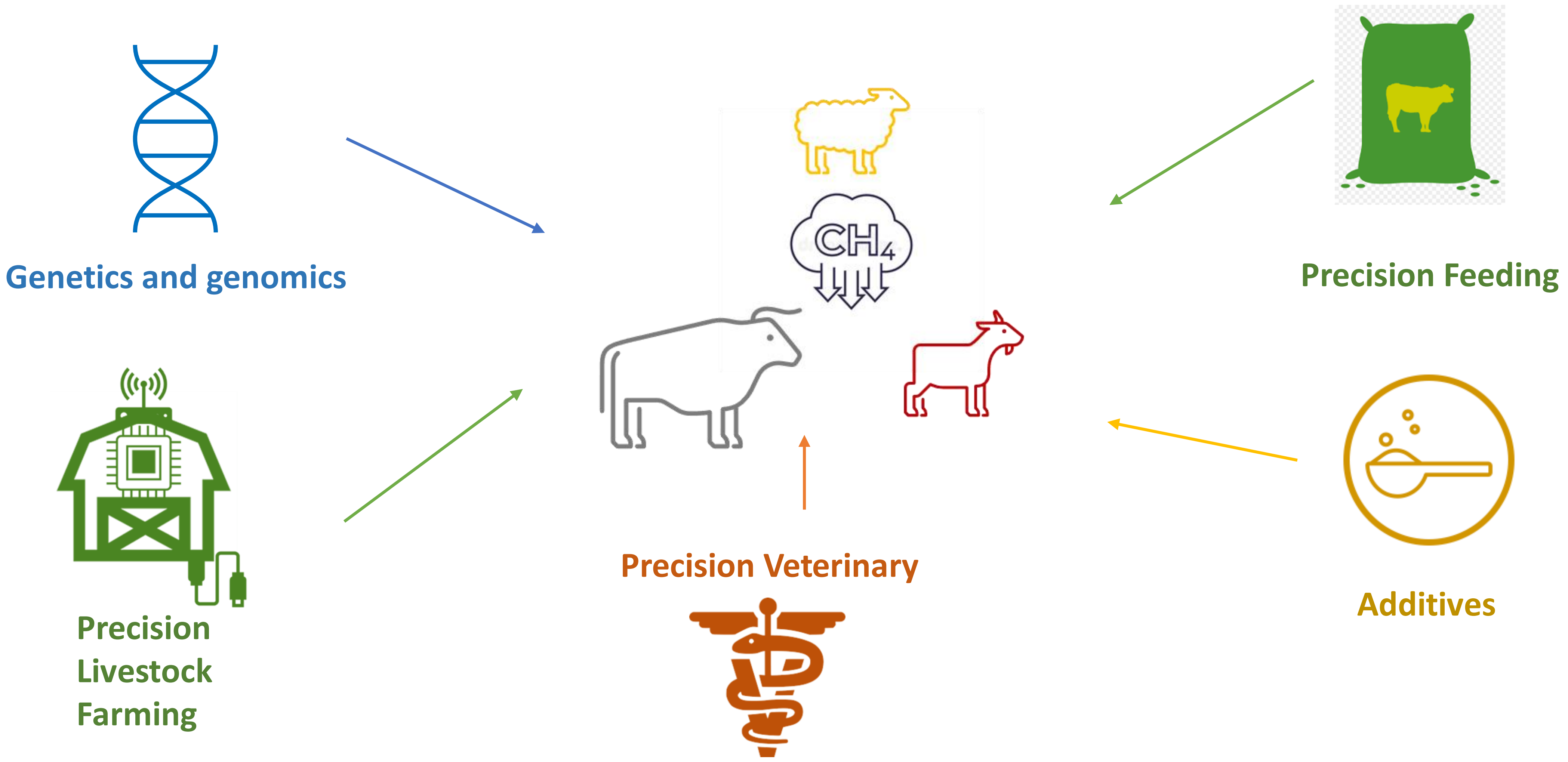
As a final analysis, we examined the additional externalities resulting from the different land requirements of contrasting systems. To generate the same quantity of agricultural product, low-yield systems require more land, allowing less to be retained or restored as natural habitat. This is in turn likely to increase GHG emissions and soil

These findings thus confirm recent suggestions[32,33] that high-yield farming has the potential, provided land not needed for production is largely used for carbon sequestration, to make a substantial contribution to mitigating climate change.

INTENSIFICAZIONE DEI SISTEMI ZOOTECNICI



La Smart Farming, intesa come knowledge intensive è in grado di ridurre le emissioni complessive e unitarie.



Nei ruminanti

Additives

- **108 papers** (dal 2000 al 2020)
- Additivi testati in pecore e **bovini da latte** e da carne

Animal Nutrition 7 (2021) 1219–1230

Contents lists available at ScienceDirect

Animal Nutrition

journal homepage: http://www.keaipublishing.com/en/journals/aninu/

Original Research Article

Meta-analysis quantifying the potential of dietary additives and rumen modifiers for methane mitigation in ruminant production systems

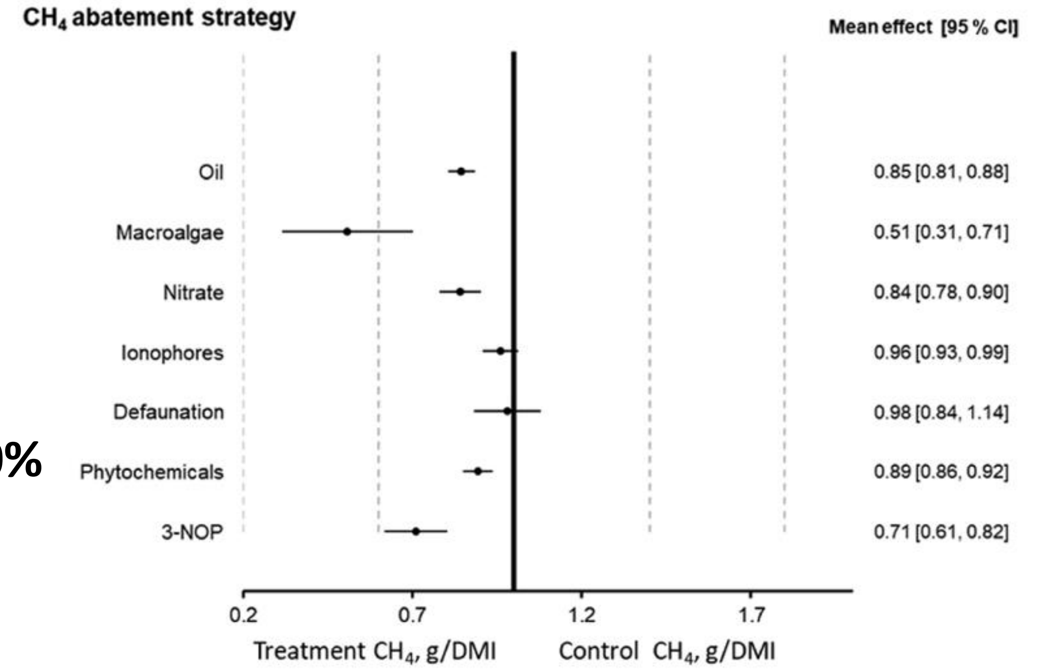
Amelia K. Almeida [a,*], Roger S. Hegarty [a], Annette Cowie [a,b]

[a] School of Environmental and Rural Science, University of New England, Armidale, NSW, 2351, Australia
[b] NSW Department of Primary Industries, Trevenna Rd, Armidale, NSW, 2351, Australia

- ✓ Oils
- ✓ Macroalgae
- ✓ Nitrate
- ✓ Ionophores
- ✓ Protozoal control
- ✓ Phytochemicals (tannin-rich feeds, essential oils, and saponins)
- ✓ Nitrooxypropanol (3-NOP)

Media riduzione CH_4

Oil: -15%
Macroalgae: -49%
Nitrate: -15.7%
Ionophores: -4%
Defaunation: -2%
Phytochemicals: -10%
3-NOP: -23%



Macroalgae e **3-NOP hanno mostrato la maggiore efficacia nel ridurre la produzione di CH_4** (g CH4/kg of DMI)

Riduzione delle emissioni per via alimentare: peggiore scenario con adattamento ruminale

J. Dairy Sci. 106:7336–7340
https://doi.org/10.3168/jds.2023-23461

***Perspective:* Could dairy cow nutrition meaningfully reduce the carbon footprint of milk production?**

Alexander N. Hristov*
Department of Animal Science, The Pennsylvania State University, University Park, PA 16802

Precision Feeding

→ 0% miglioramento foraggi e razione

Dal 10% al 20 %

Additives

→ 10 – 15 % primo additivo +
0 – 5 % secondo additivo
= 10 – 20%

Riduzione delle emissioni di metano per via alimentare: migliore scenario senza adattamento ruminale

J. Dairy Sci. 106:7336–7340
https://doi.org/10.3168/jds.2023-23461

***Perspective:* Could dairy cow nutrition meaningfully reduce the carbon footprint of milk production?**

Alexander N. Hristov*
Department of Animal Science, The Pennsylvania State University, University Park, PA 16802

Precision Feeding

5 – 10% miglioramento foraggi e razione

Dal 35% al 60 %

Additives

20 – 30% primo additivo +
10 – 20% secondo additivo
= 30 – 50%

4. Le metriche utilizzate (standard IPCC) sono corrette?

L'emivita del CH_4 è di 8 anni e dopo 50 anni è praticamente scomparso; quella della CO_2 è di 42 anni, ma questa non scompare mai dall'atmosfera

(*Muller RA, Muller EA (2017) Fugitive Methane and the Role of Atmospheric Half-Life. Geoinfor Geostat: An Overview 5:3. doi: 10.4172/2327-4581.1000162)*

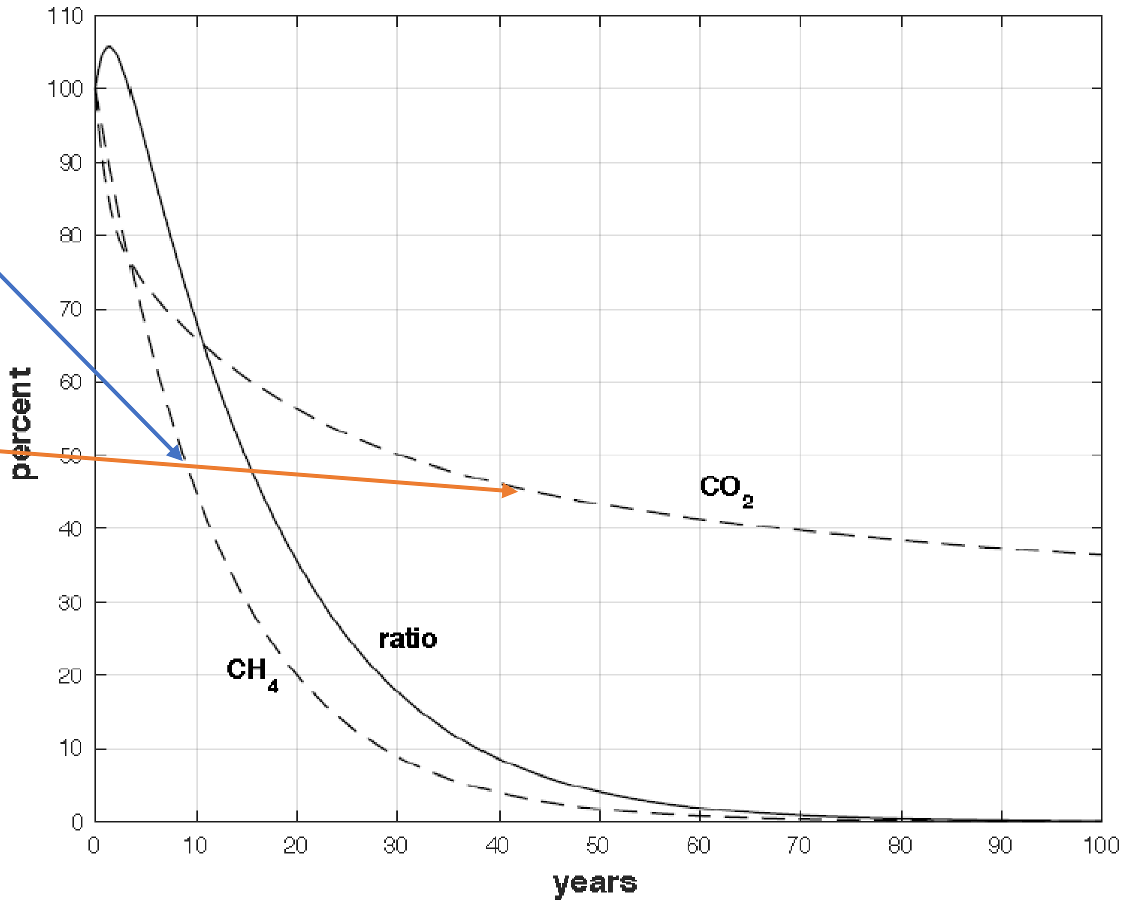
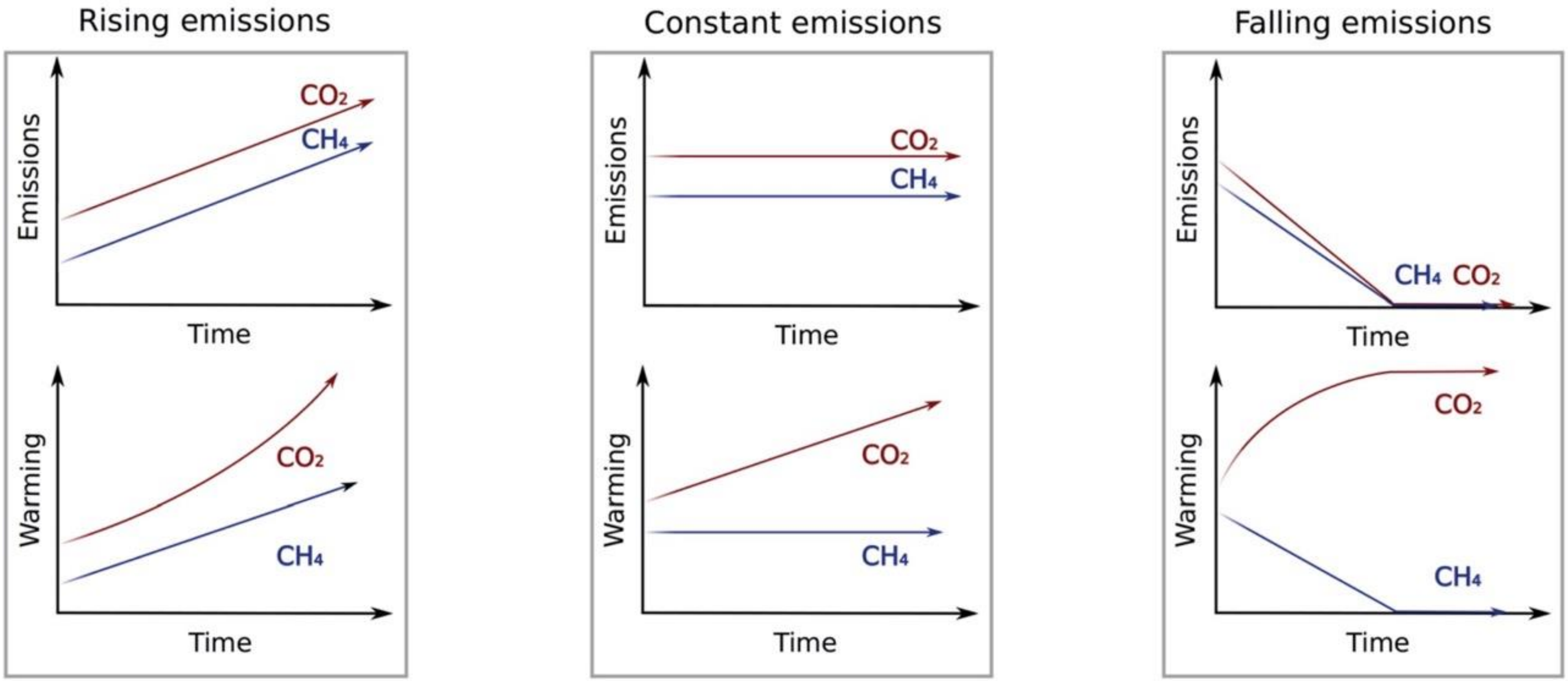


Figure 1: The persistence of carbon dioxide and methane in the atmosphere as a function of time. The chart begins when a pulse of the gas is injected into the atmosphere. The legacy effect of methane is miniscule compared to that of carbon dioxide.

Debolezza dello [Standard] Global Warming Potential



Source: Oxford Martin, Climate Metrics for Ruminant Livestock, July 2018, https://www.oxfordmartin.ox.ac.uk/downloads/reports/Climate-metrics-for-ruminant-livestock.pdf%C2%A0

C'è bisogno di nuove metriche

Gli scienziati stanno iniziando a prendere in considerazione **queste nuove metriche** per le stime delle emissioni di gas serra da metano

La comunità scientifica dei fisici dell'atmosfera chiede una **nuova metrica** per gli LLCP e SLCP

Given its dynamic nature and previously proven strong correspondence with climate models, out of the three assessments covered, GWP* provides the most complete coverage of the temporal evolution of temperature change for different greenhouse gas emissions. We extend previous discussions on the limitations of static emission metrics and encourage LCA practitioners to consider due care and attention where additional information or dynamic approaches may prove superior, scientifically speaking, particularly in cases of decision support.

npj Climate and Atmospheric Science www.nature.com/npjclimatsci

COMMENT OPEN Check for updates

Indicate separate contributions of long-lived and short-lived greenhouse gases in emission targets

Myles R. Allen[1], Glen P. Peters[2], Keith P. Shine[3], Christian Azar[4], Paul Balcombe[5], Olivier Boucher[6], Michelle Cain[7], Philippe Ciais[8], William Collins[9], Piers M. Forster[10], Dave J. Frame[11], Pierre Friedlingstein[12], Claire Fyson[13], Thomas Gasser[14], Bill Hare[13], Stuart Jenkins[15], Steven P. Hamburg[16], Daniel J. A. Johansson[4], John Lynch[15], Adrian Macey[11], Johannes Morfeldt[4], Alexander Nauels[13], Ilissa Ocko[16], Michael Oppenheimer[17], Stephen W. Pacala[17], Raymond Pierrehumbert[15], Joeri Rogelj[18], Michiel Schaeffer[13], Carl F. Schleussner[13], Drew Shindell[19], Ragnhild B. Skeie[2], Stephen M. Smith[15] and Katsumasa Tanaka[8]

npj Climate and Atmospheric Science (2022)5:5 ; https://doi.org/10.1038/s41612-021-00226-2

CABI Agriculture and Bioscience CABI

RESEARCH Open Access

Rethinking methane from animal agriculture

Shule Liu, Joe Proudman and Frank M. Mitloehner*

IOP Publishing Environ. Res. Lett. 18 (2023) 084014

ENVIRONMENTAL RESEARCH LETTERS

LETTER

OPEN ACCESS

RECEIVED 5 October 2022

REVISED 9 May 2023

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PUBLISHED 18 July 2023

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

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

1 Net Zero and Resilient Farming, Rothamsted Research, North Wyke, Okehampton, Devon EX20 2SB, United Ki
2 Nature-based Solutions Initiative, Department of Biology, University of Oxford, Oxford OX1 3SZ, United Kingd
3 Cranfield University, Cranfield Environment Centre, Bedfordshire MK43 0AL, United Kingdom
4 Scotland's Rural College, West Mains Road, Edinburgh EH9 3JG, United Kingdom
5 Department of Physics, University of Oxford, Oxford OX1 3PJ, United Kingdom
6 Harper Adams University, Newport, Shropshire TF10 8NB, United Kingdom
7 University of Bristol, Bristol Veterinary School, Langford, Somerset BS40 5DU, United Kingdom
8 Agri-Food and Biosciences Institute, AFBI, Large Park, Hillsborough, Belfast, Northern Ireland BT26 6DR, United Kingdom
* Author to whom any correspondence should be addressed.

E-mail: gm.scienceprofile@gmail.com

Keywords: life cycle assessment, climate change, agriculture, greenhouse gas emissions, sensitivity analysis, uncertainty

Supplementary material for this article is available online

ELSEVIER

Animal
The international journal of animal biosciences

animal

Implementing an appropriate metric for the assessment of greenhouse gas emissions from livestock production: A national case study

S.J. Hörtenhuber[a,*], M. Seiringer[a], M.C. Theurl[b], V. Größbacher[a], G. Piringer[c], I. Kral[a,d], W.J. Zollitsch[a]

a Department of Sustainable Agricultural Systems, BOKU – University of Natural Resources and Life Sciences, Vienna, Austria
b Department of Economics and Social Sciences, BOKU – University of Natural Resources and Life Sciences, Vienna, Austria
c Fachhochschule Burgenland GmbH, Pinkafeld, Austria
d Denkstatt GmbH, Vienna, Austria

J. Dairy Sci. 105:8558–8568
https://doi.org/10.3168/jds.2021-21413

Symposium review: Defining a pathway to climate neutrality for US dairy cattle production*

S. E. Place,[1] C. J. McCabe,[2] and F. M. Mitloehner[2]†
[1]Elanco Animal Health, Greenfield, IN 46140
[2]Department of Animal Science, University of California–Davis, One Shields Ave., Davis 95616-8521

LE NUOVE METRICHE

GWP and GWP*

Evolution of Global Warming Potential [GWP (E_{CO_2}-e) vs GWP* (E_{CO_2}-ew)]

GWP	$E_{CO_2\text{-}e} = E \times GWP_H$	IPCC, 1990
GWP*	$E_{CO_2\text{-}ew} = (\Delta E_{SLCP}/\Delta t) \times GWP_H \times H$	Allen et al., 2018
Evolution of GWP*	$E_{CO_2\text{-}ew} = GWP_H \times [r \times (\Delta E_{SLCP}/\Delta t) \times H + s \times E_{SLCP}]$	Cain et al., 2019

- *E* is the mass emission for a GHG and *H* is the forward time horizon and GWP*H* is the GWP for a GHG as according to IPCC (1990) over time horizon *H*.
- *ΔESLCP* is the variation of emission rate of a SLCP over the time interval *Δt*, *H* is the forward time horizon.
- *r* and *s*: weight of the cumulation (*s*, stock) and emission rate (*r*, rate) for a given time *H*. Calculated using a multiple linear regression onto the response to methane emissions in commonly used scenarios, focusing on the time period 1900–2100. r = 0.75, s = 0.25.

npj | Climate and Atmospheric Science www.nature.com/npjclimatsci

ARTICLE OPEN

A solution to the misrepresentations of CO_2-equivalent emissions of short-lived climate pollutants under ambitious mitigation

Myles R. Allen[1,2], Keith P. Shine[3], Jan S. Fuglestvedt[4], Richard J. Millar[1], Michelle Cain[1,5], David J. Frame[6] and Adrian H. Macey[7]

npj | Climate and Atmospheric Science www.nature.com/npjclimatsci

ARTICLE OPEN

Improved calculation of warming-equivalent emissions for short-lived climate pollutants

Michelle Cain[1,2], John Lynch[3], Myles R. Allen[1,3], Jan S. Fuglestvedt[4], David J. Frame[5] and Adrian H Macey[6,7]

ENVIRONMENTAL RESEARCH
LETTERS

LETTER • OPEN ACCESS

Stable climate metrics for emissions of short and long-lived species—combining steps and pulses

William J Collins[4,1], David J Frame[2], Jan S Fuglestvedt[3] and Keith P Shine[1]

Confronto fra vecchie e nuove metriche: stima dell GWP e del GWP* cumulativo a 20 anni di 1 kt di metano emesso per anno

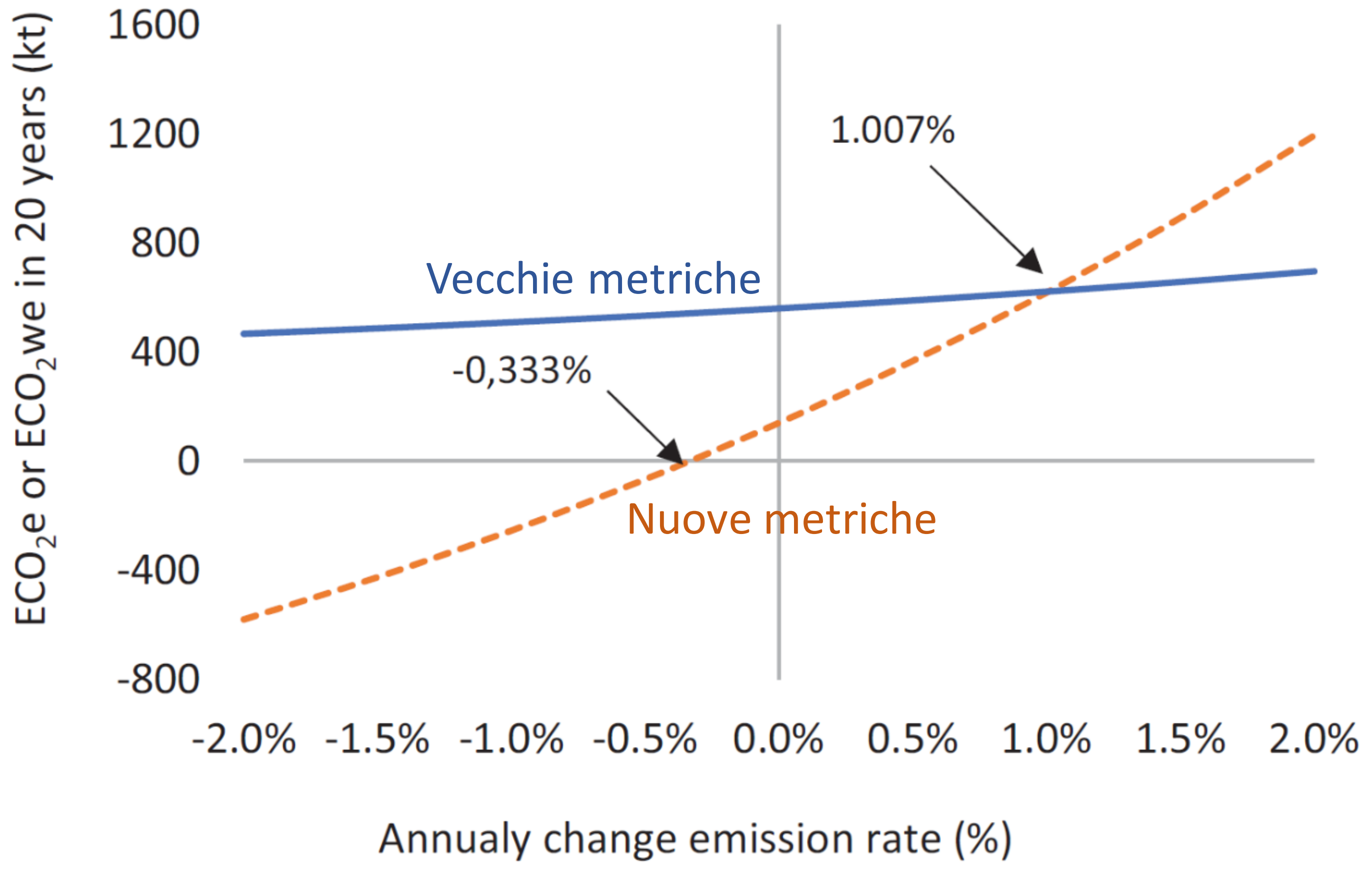
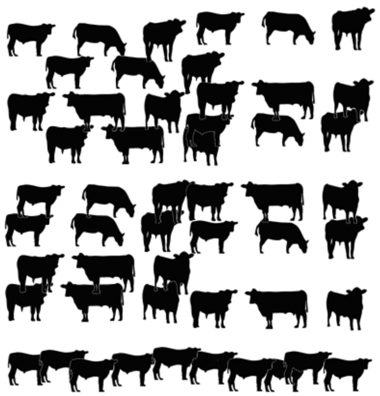


Figure 1. Estimated twenty-year cumulative CO_2 equivalents (ECO_2e) and twenty-year cumulative CO_2 warming equivalents (ECO_2*we*), calculated applying the global warming potential (GWP) and the global warming potential star (GWP*), respectively, on twenty-year methane emissions. Starting emission was 1 kt of CH_4/year. (Adapted from Cady (2020), with recal-



t_i: 100 vacche

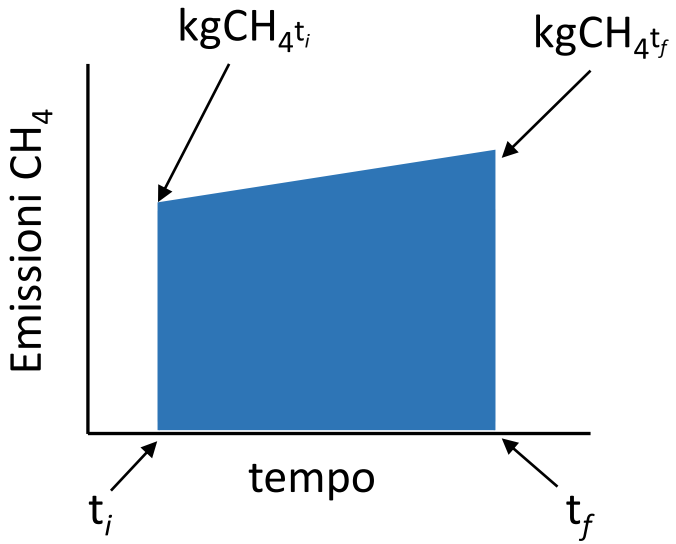
Emissioni per vacca/anno = 100 kg CH_4

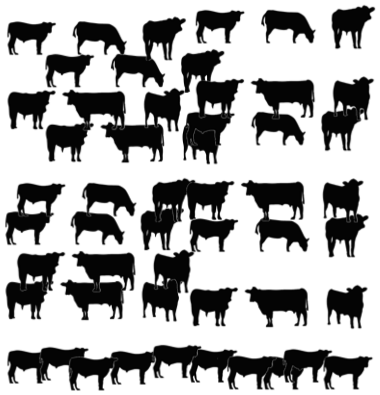
Emissioni mandria t_i = 10000 kg CH_4

t_f: 110 vacche

Emissioni mandria t_f = 11000 kg CH_4

Tempo = 10 anni





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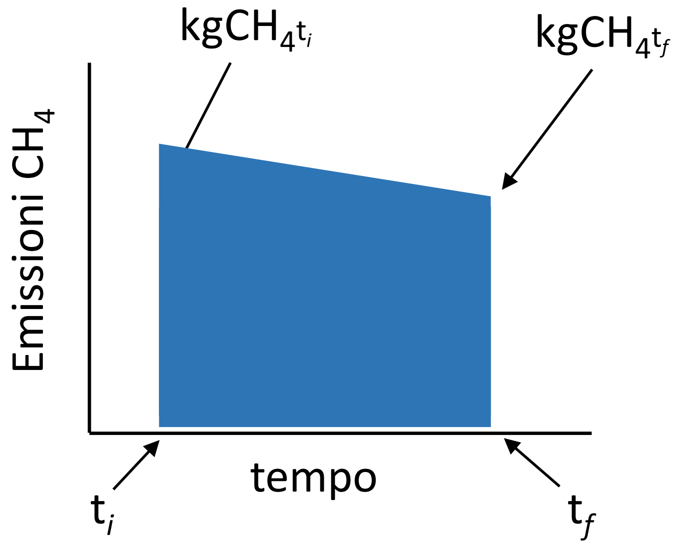
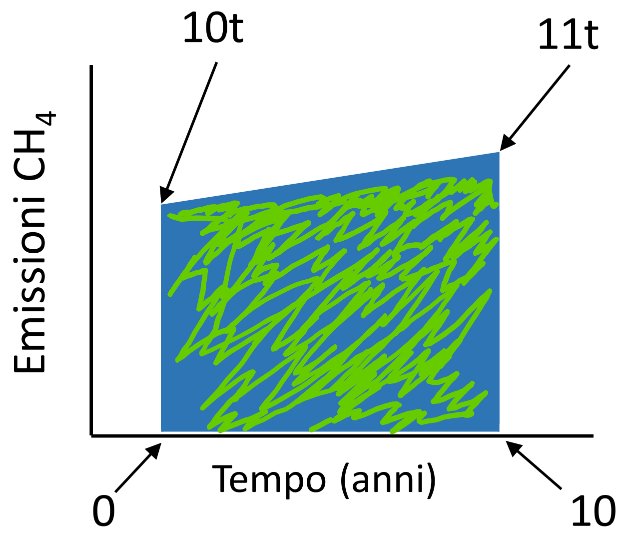


Calcolo delle emissioni CH_4 in 10 anni = $\int_i^f (mx + c)dx = \ldots$



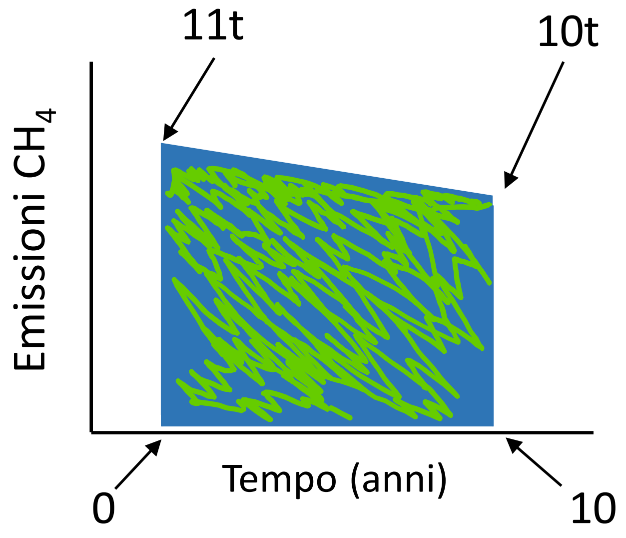
CH_4 (t) in 10 anni = $[(10 + 11) \times 10]/2 =$ 105t

$GWP_{100}: ECO_2e = E \times GWP_H$

$GWP_{100}: CH_{4(CO_2eq)} = 105t \times 28 =$ 2.940t

$GWP^*: ECO2\text{-}e^* = GWP_H \times [r \times (\Delta ESLCP/\Delta t) \times H + s \times ESLCP]$

$GWP^*: CH_4(CO_2eq^*) = 28 \times [0.75 \times (11 - 10)) \times 100 + 0.25 \times 105] =$ **2.835 t**



CH_4 (t) in 10 anni = $[(11 + 10) \times 10]/2 =$ 105t

$GWP_{100}: ECO_2e = E \times GWP_H$

$GWP_{100}: CH_{4(CO_2eq)} = 105t \times 28 =$ 2940t

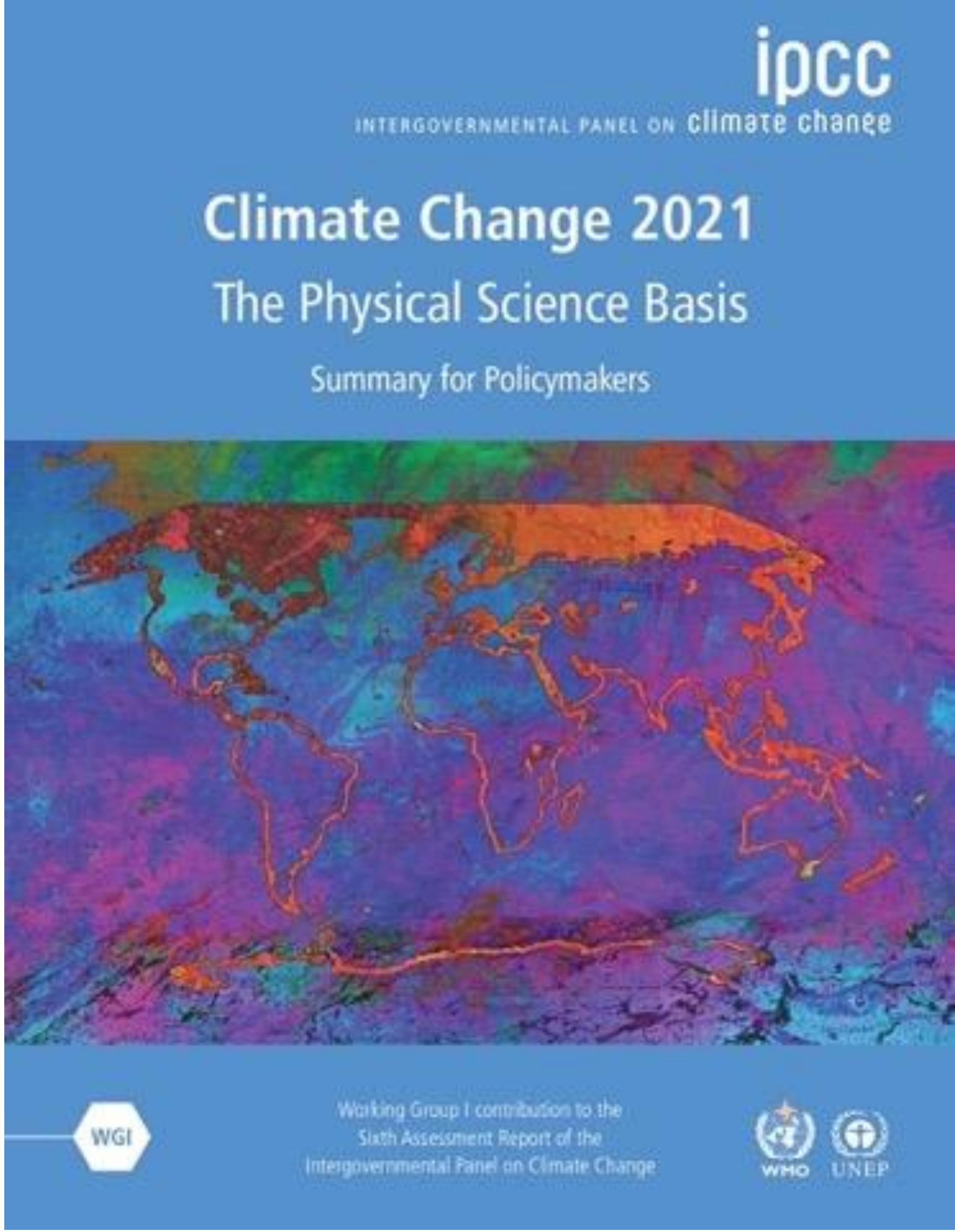
$GWP^*: ECO2\text{-}e^* = GWP_H \times [r \times (\Delta ESLCP/\Delta t) \times H + s \times ESLCP]$

$GWP^*: CH_4(CO_2eq^*) = 28 \times [0.75 \times (10 - 11)) \times 100 + 0.25 \times 105] =$ **-1.365 t**

IPCC ha iniziato a considerare le nuove metriche :

In summary, new emissions metric approaches such as GWP* and CGTP are designed to relate emissions changes in short-lived GHGs to emissions of CO_2 as they better account for the different physical behaviours of short- and long-lived gases. Through scaling the corresponding cumulative CO_2 equivalent emissions by the TCRE, the GSAT response from emissions over time of an aggregated set of

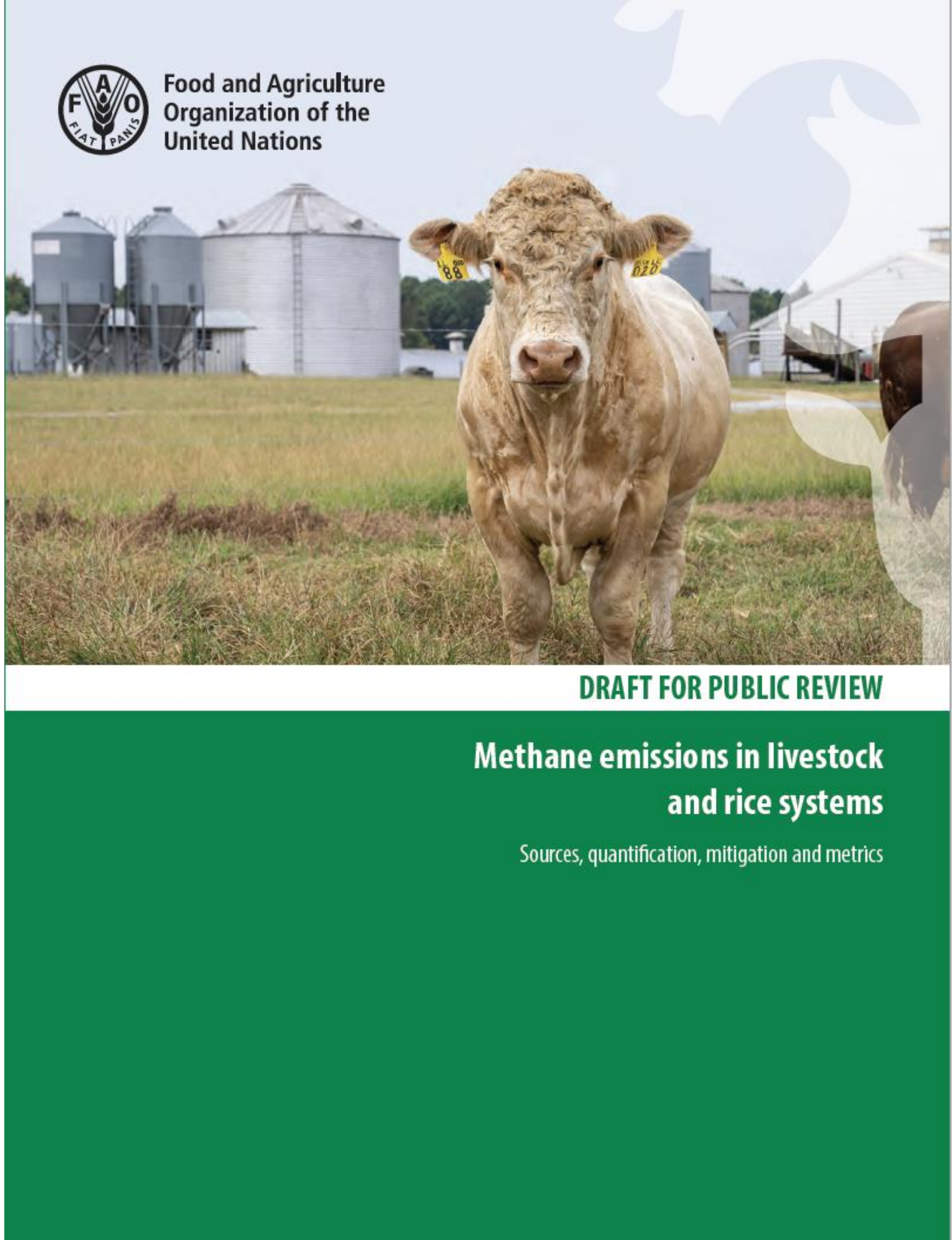
https://www.ipcc.ch/report/ar6/wg1/



E anche la FAO nel report sul metano pubblicato a Settembre 2023

GWP* is a useful metric if a time-series of emissions is being evaluated, or compared to another emission scenario, based on impact on temperature e.g. comparison of benefits from several competing mitigation pathways.

https://www.fao.org/3/cc2468en/cc2468en.pdf



Anche l’uso dell’altra nuova metrica (GTP, Global Temperature Potential*) cambia lo scenario

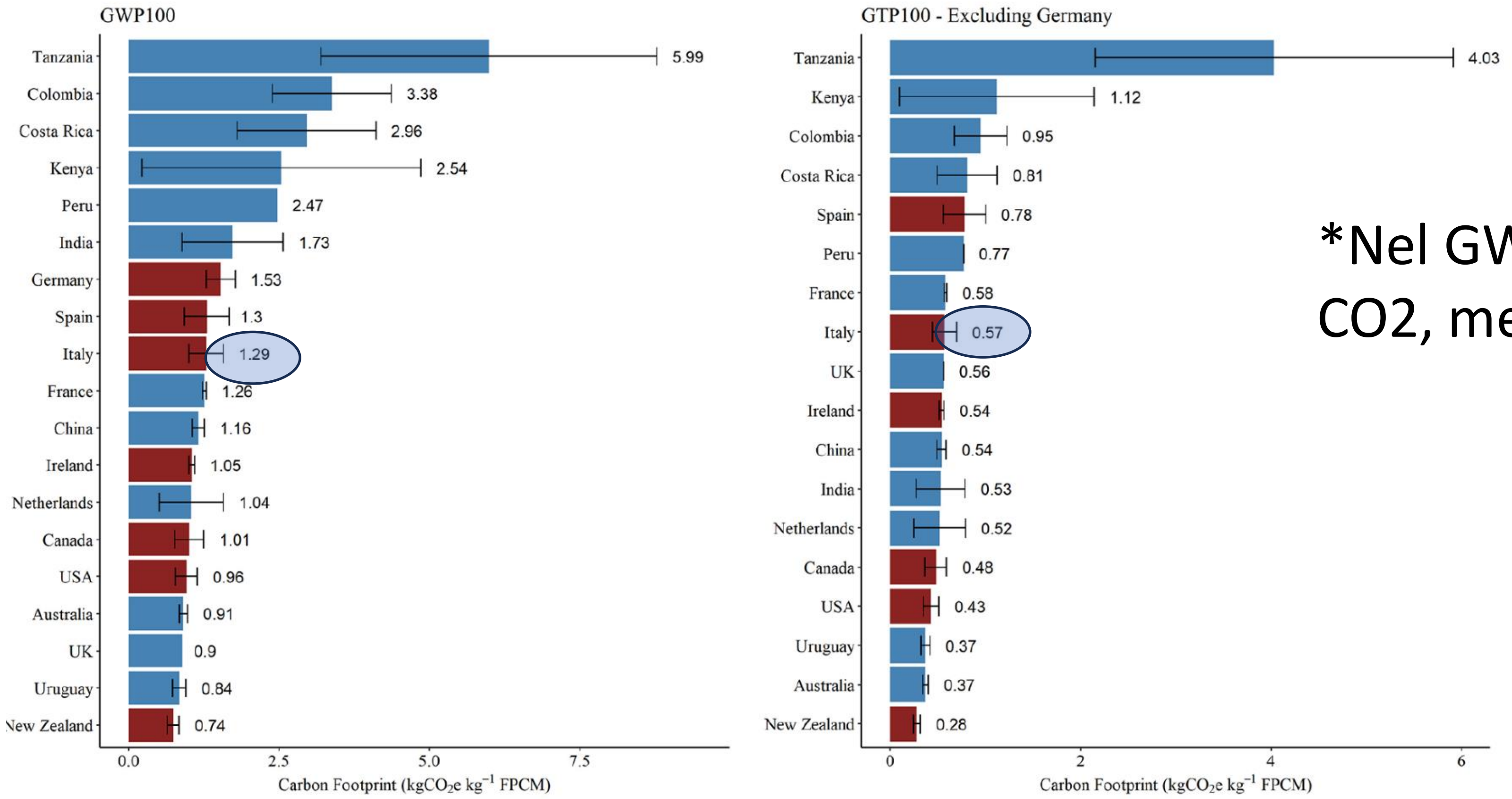


Figure 4. Carbon footprint of milk [kg of CO_2 equivalents (CO_2e) per kg of fat- and protein-corrected milk (FPCM)] in different countries after correction to common global warming potential (GWP), functional unit, and allocation methodology]. Red bars represent studies that used the International Dairy Federation (biophysical) allocation. Blue bars represent studies that used a different type of allocation than recommended by the International Dairy Federation. Error bars denote the standard deviation, calculated as a weighted standard deviation when more than one study was selected per country or extracted from the study when only one study was considered. GTP: global temperature potential.

*Nel GWP il metano vale 28 volte la CO2, mentre nel GTP vale 4 volte

Liu *et al. CABI Agric Biosci* (2021) 2:22
https://doi.org/10.1186/s43170-021-00041-y

CABI Agriculture and Bioscience

RESEARCH **Open Access**

Rethinking methane from animal agriculture

Shule Liu, Joe Proudman and Frank M. Mitloehner*

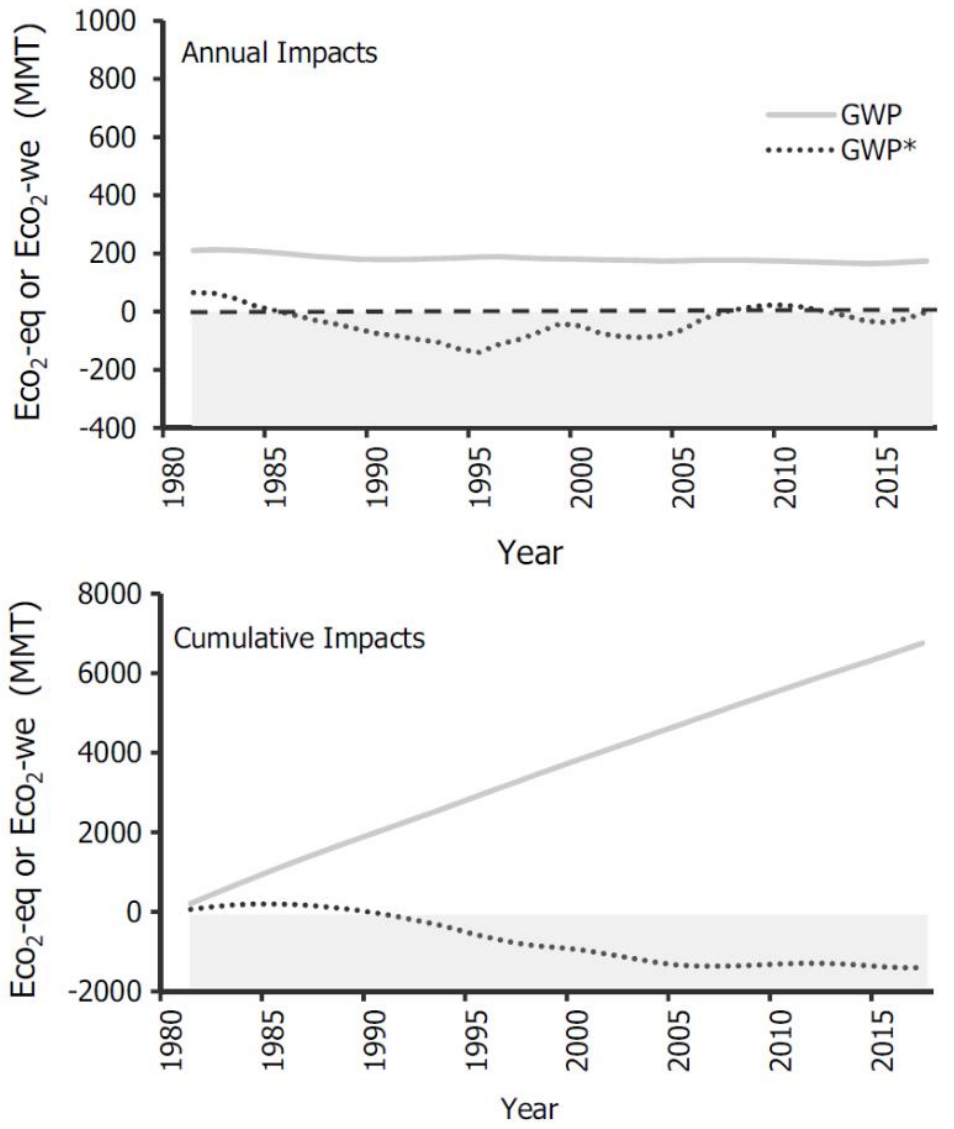


Fig. 3 Climate impacts of the methane from U.S. non-dairy (i.e., beef) and dairy cattle production. Solid line represents GWP results and dashed line represents GWP* results

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Symposium review: Defining a pathway to climate neutrality for US dairy cattle production*

S. E. Place,[1] C. J. McCabe,[2] and F. M. Mitloehner[2]†
[1]Elanco Animal Health, Greenfield, IN 46140
[2]Department of Animal Science, University of California–Davis, One Shields Ave., Davis 95616-8521

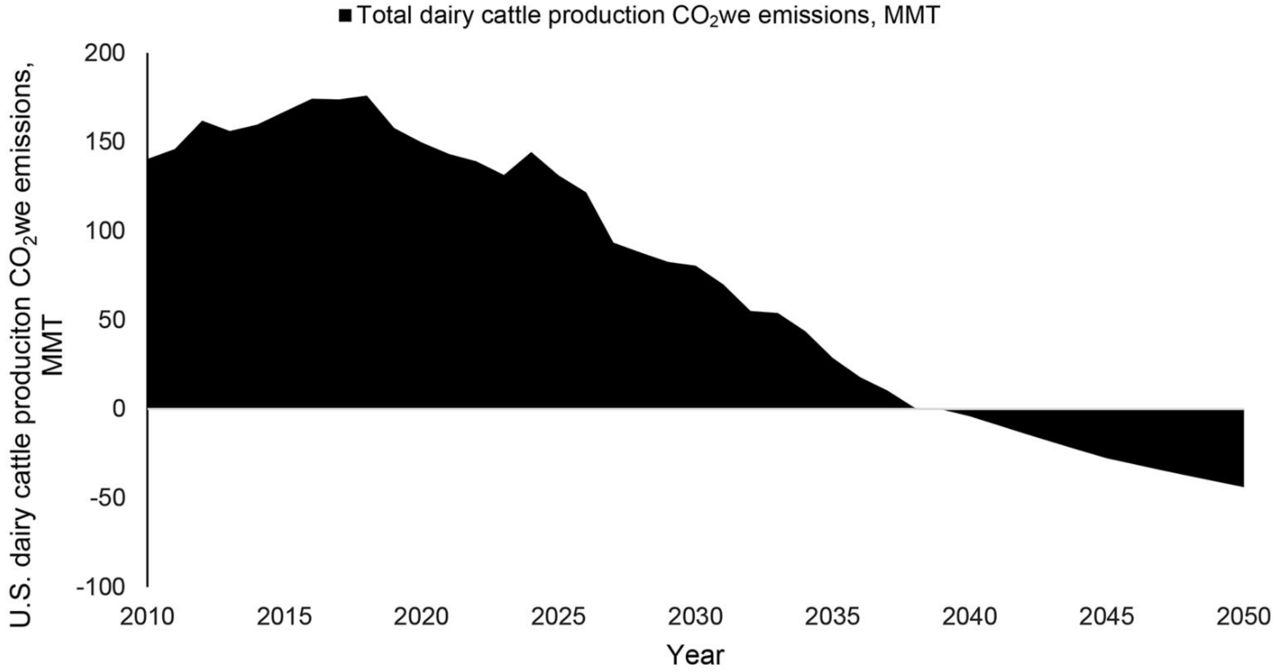
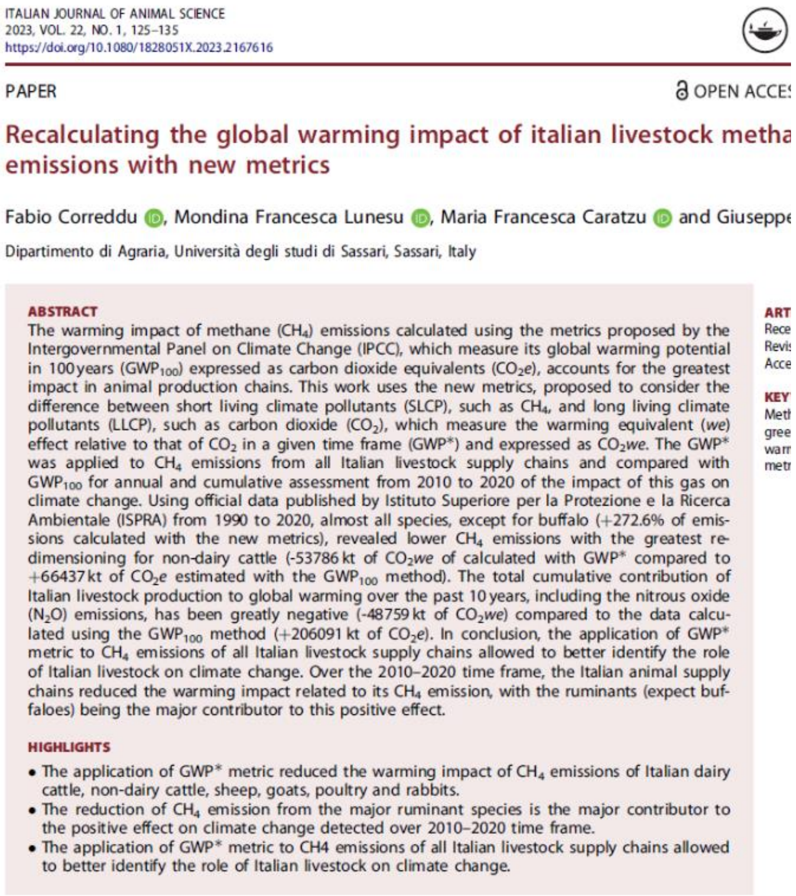


Figure 4. Annual US dairy cattle production cradle-to-farm gate carbon dioxide warming equivalent (CO_2we) emissions expressed as million metric tonnes (MMT) from 2010 (reference year) to 2050 for the case study scenarios. This figure demonstrates achieving reductions in emissions as outlined in Figure 5 in 2050 emissions from US dairy cattle production of −89 MMT of CO_2we, meaning that no additional warming would occur from dairy production activities in that year.

La sfida climatica della zootecnia Italiana

LE NUOVE METRICHE



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PAPER OPEN ACCES

Recalculating the global warming impact of italian livestock metha emissions with new metrics

Fabio Correddu, Mondina Francesca Lunesu, Maria Francesca Caratzu and Giuseppe
Dipartimento di Agraria, Università degli studi di Sassari, Sassari, Italy

ABSTRACT
The warming impact of methane (CH_4) emissions calculated using the metrics proposed by the Intergovernmental Panel on Climate Change (IPCC), which measure its global warming potential in 100 years (GWP_{100}) expressed as carbon dioxide equivalents (CO_2e), accounts for the greatest impact in animal production chains. This work uses the new metrics, proposed to consider the difference between short living climate pollutants (SLCP), such as CH_4, and long living climate pollutants (LLCP), such as carbon dioxide (CO_2), which measure the warming equivalent (*we*) effect relative to that of CO_2 in a given time frame (GWP*) and expressed as CO_2we. The GWP* was applied to CH_4 emissions from all Italian livestock supply chains and compared with GWP_{100} for annual and cumulative assessment from 2010 to 2020 of the impact of this gas on climate change. Using official data published by Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) from 1990 to 2020, almost all species, except for buffalo (+272.6% of emissions calculated with the new metrics), revealed lower CH_4 emissions with the greatest redimensioning for non-dairy cattle (-53786 kt of CO_2we of calculated with GWP* compared to +66437 kt of CO_2e estimated with the GWP_{100} method). The total cumulative contribution of Italian livestock production to global warming over the past 10 years, including the nitrous oxide (N_2O) emissions, has been greatly negative (-48759 kt of CO_2we) compared to the data calculated using the GWP_{100} method (+206091 kt of CO_2e). In conclusion, the application of GWP* metric to CH_4 emissions of all Italian livestock supply chains allowed to better identify the role of Italian livestock on climate change. Over the 2010–2020 time frame, the Italian animal supply chains reduced the warming impact related to its CH_4 emission, with the ruminants (expect buffaloes) being the major contributor to this positive effect.

HIGHLIGHTS

- The application of GWP* metric reduced the warming impact of CH_4 emissions of Italian dairy cattle, non-dairy cattle, sheep, goats, poultry and rabbits.
- The reduction of CH_4 emission from the major ruminant species is the major contributor to the positive effect on climate change detected over 2010–2020 time frame.
- The application of GWP* metric to CH4 emissions of all Italian livestock supply chains allowed to better identify the role of Italian livestock on climate change.

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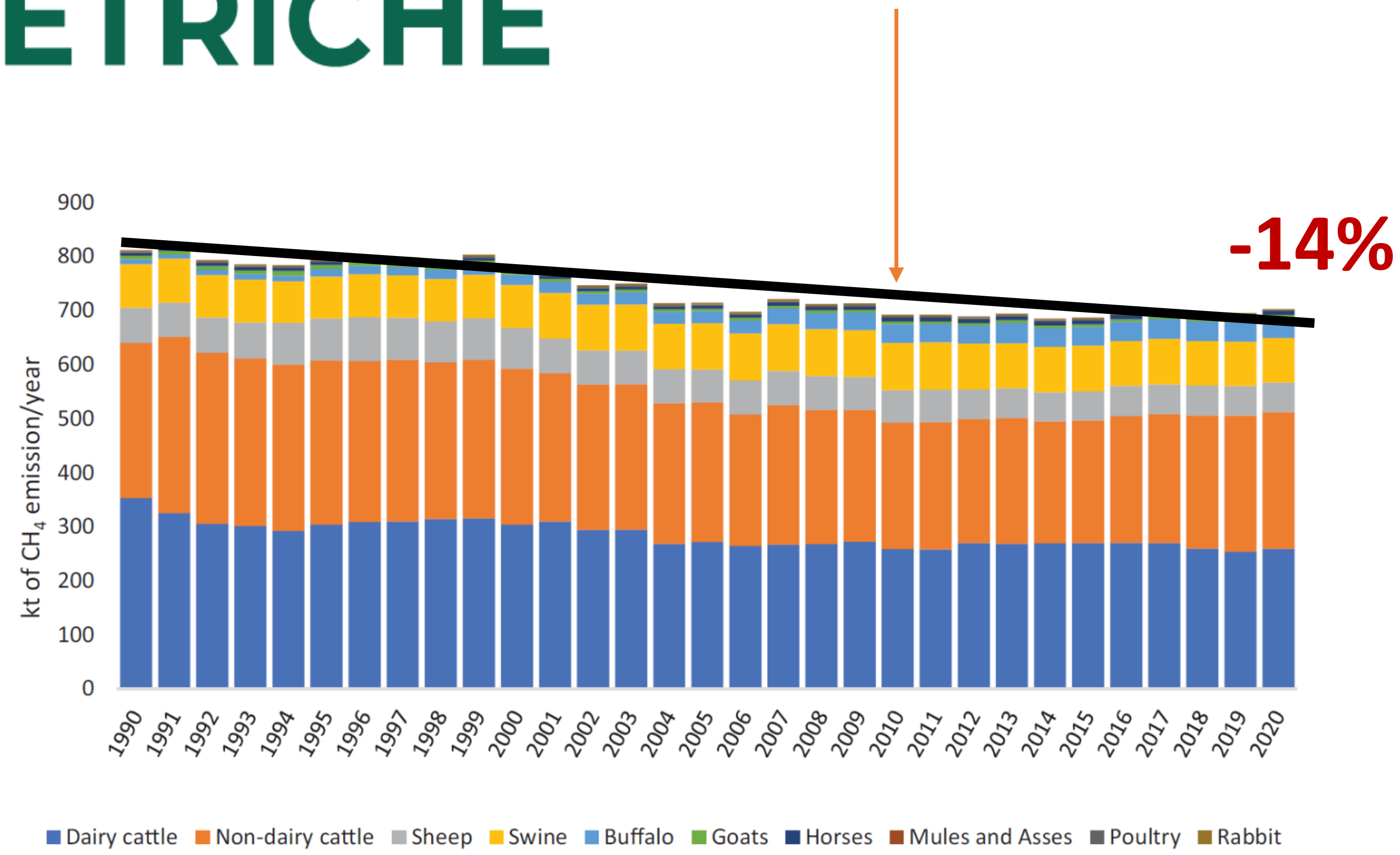
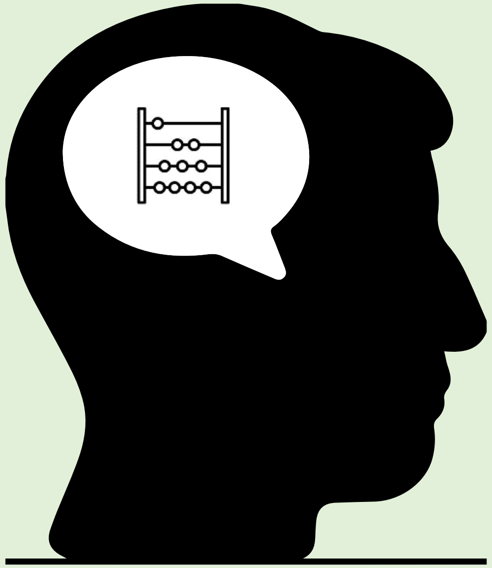


Figure 2. Livestock methane (CH_4) emissions in kilotons (kt) from 1990 to 2020 (Romano et al. 2021) from International Panel on Climate Change (IPCC)'s emission category 'enteric fermentation' and 'manure management systems' (IPCC 2019).

La sfida climatica della zootecnia Italiana

LE NUOVE METRICHE



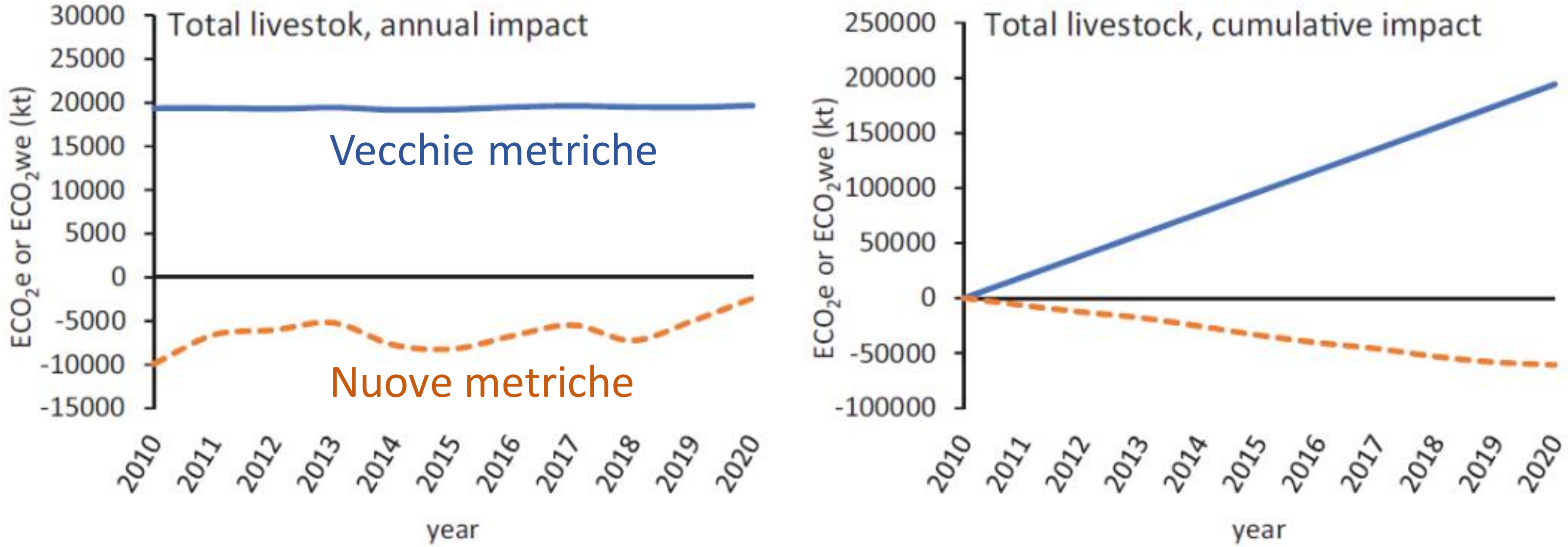


Figure 7. Total methane (CH_4) climate impact of Italian livestock (dairy cattle, non-dairy cattle, buffalo, sheep, goat, swine, horses, mule and asses, poultry, rabbits) from 2010 to 2020. Annual (left panel) and cumulative (rigth panel) methane emissions estimated as CO_2 equivalents (ECO_2e; blue solid lines) using the global warming potential (GWP), and as CO_2 warming equivalents (ECO_2*we*; orange dotted lines), calculated by global warming potential star (GWP*).

La sfida climatica della zootecnia Italiana

EMISSIONI DI METANO ENTERICO IN ITALIA METRICHE A CONFRONTO

$E_{CO_2\text{-e}} = E \times GWP_H$ **(IPCC, 1990)**

$CH_{4(CO_2e)} = CH_4 \times GWP_H$

+206.091 Mln t $C0_2e$

$GWP^*: CH_4(CO_2ew) =$ **(Cain et al., 2019)**

$E_{CO_2\text{-}ew} = GWP_H \times [r \times (\Delta E_{SLCP}/\Delta t) \times H + s \times E_{SLCP}]$

-48.759 Mln t $C0_2ew$

18,7 Mln t/anno

VS

-4,4 Mln t /anno

Compresa la CO_2e da N_2O

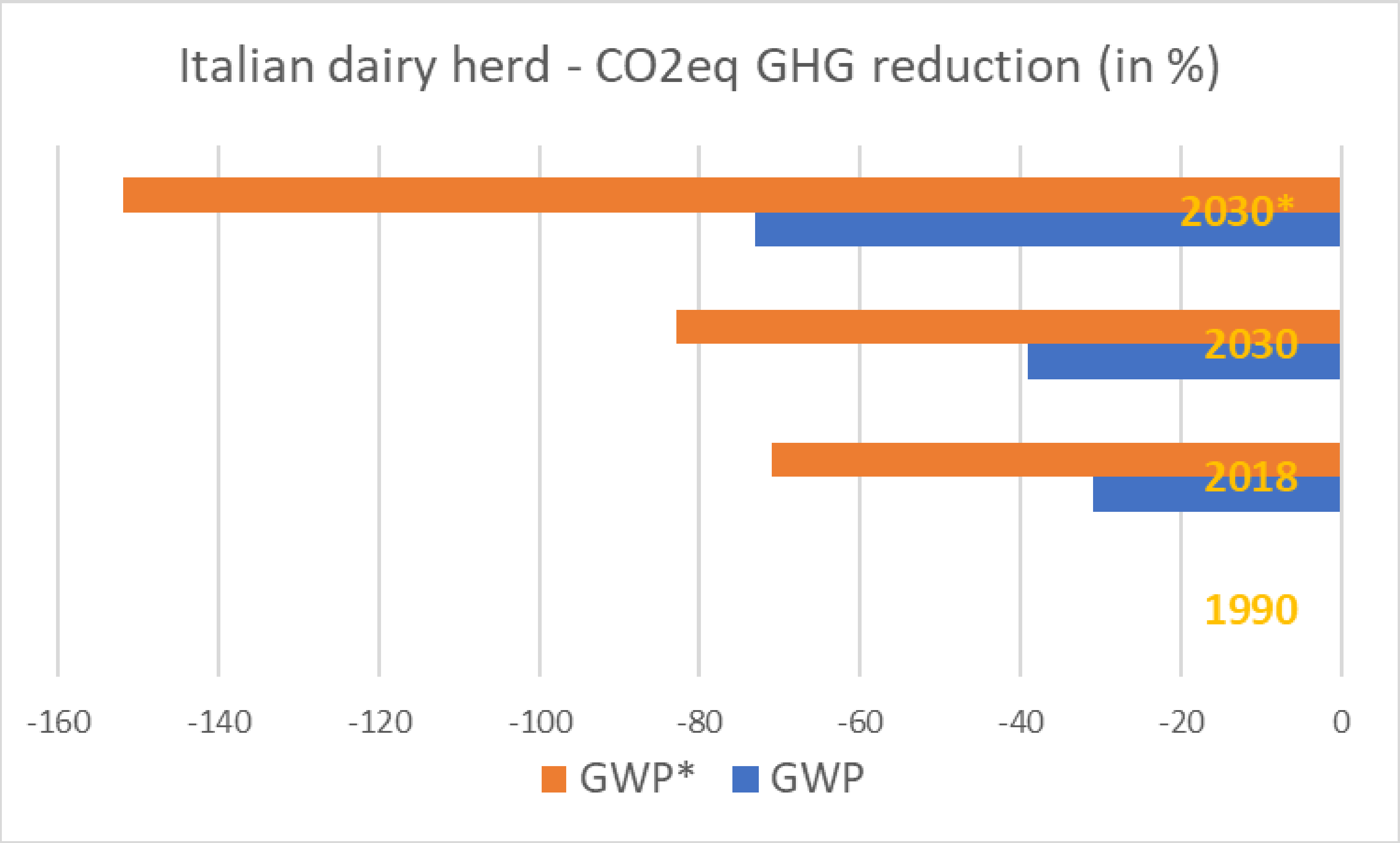
Table 4. Predicted reduction in CO_{2eq} emissions and Nitrogen and Phosphorus excretions by high yielding cows in 2030 in comparison with actual cows in 1990.

Year	Milk/y per head (kg)	Italian milk yield (t)	Concentration (g/kg of milk)	Total (t)	%	**%**
Carbon footprint						
1990	4,210	11,120,700	2,135	23,744,986	100	0
2018	7,136	12,084,030	1,346	16,269,643	69	-31
2030*	8,672	12,084,030	1,193	14,413,536	61	-39
2030**	15,307	12,084,030	0,529	6,395,865	27	-73

year	Total CO_2 e (t/year)	%	Tot. CO_2 e emitted (t/period)	CH4 (t/year)	CO_2ew other GHG (t/year)	CO_2ew other GHG (t/period)	CO_2 ew CH4 (Cain et al) (t/period)	CO_2 ew considering CH4 with GWP*	%
1990	23,744,986	0		356,175	13,772,092				0
2018	16,269,643	-31	600,219,435	244,045	9,436,393	348,127,272	-172,450,110	***175,677,162***	-71
2030*	14,413,536	-39	763,170,440	216,203	8,359,851	442,638,855	-311,786,020	***130,852,835***	-83
2030**	6,395,865	-73	602,817,020	95,938	3,709,602	349,633,872	-665,365,194	***-315,731,322***	-152

*Current phenotipic trend **20t milk production level for the high yielding dairy farm in 2019

Giuste metriche, grande differenza!



Risposte

1. Impatti climalteranti, quanto conta l’allevamento animale?

r. Relativamente poco, ma dobbiamo ridurre le emissioni in particolare di metano

2. Come riduciamo le emissioni degli allevamenti?

r. Con l’aumento della produttività

3. Gli allevamenti intensivi sono un male?

r. No, sono una via importante per ridurre le emissioni

4. Le metriche utilizzate (standard IPCC) sono corrette?

r. Per l’allevamento dei ruminanti occorrono nuove metriche che tengano conto del particolare comportamento del metano in armosfera.

The Sustainable Livestock group

Fabio Correddu

Mondina F. Lunesu

Maria Francesca Caratzu

Sara Sechi

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Grazie per l'attenzione

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