



Disaggregating the livestock sector in the GTAP database

Carlos Gonzalez Fischer, on behalf of:

Maksym Chepeliev, Alla Golub, Thiago Simonato, Dominique van der Mensbrugghe, Peiyu Cao, Carlos Gonzalez Fischer, Mario Herrero and Daniel Mason-D'Croz

June 6th 2024



**FOOD SYSTEMS &
GLOBAL CHANGE**

Cornell
CALS
College of Agriculture
and Life Sciences
Global Development



Acknowledgements

*This work is supported by USDA NIFA-AFRI. (Project No. 2023-67023-40099)
“Meeting 21st Century Objectives in Livestock Sectors: Challenges and Opportunities”*

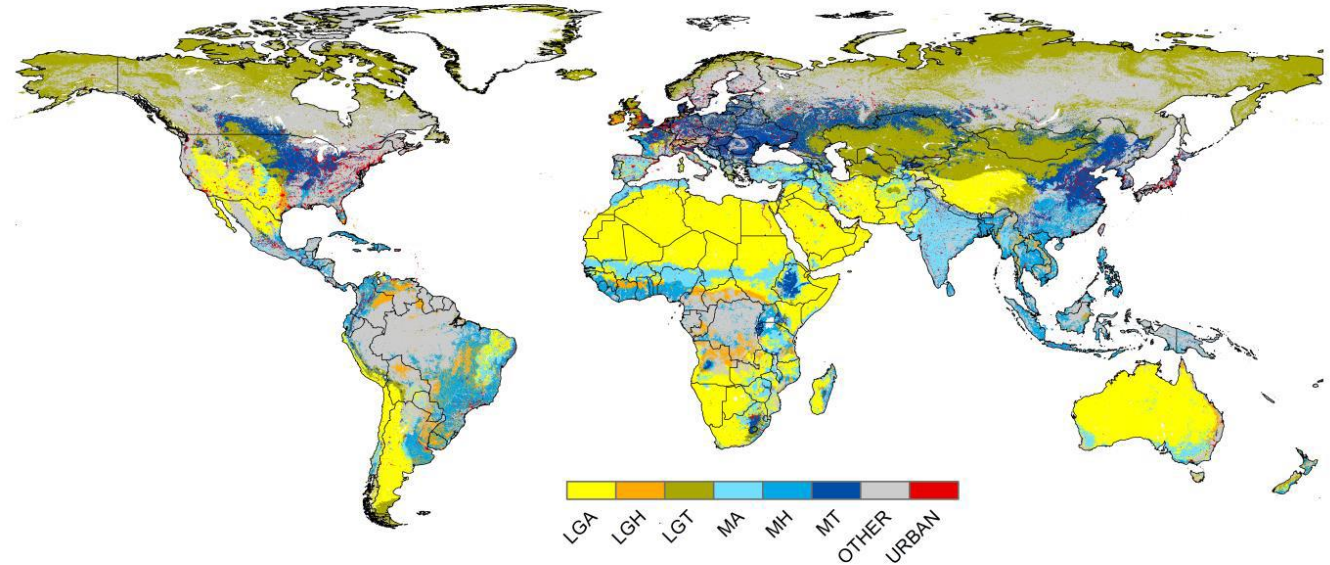
Livestock relevance



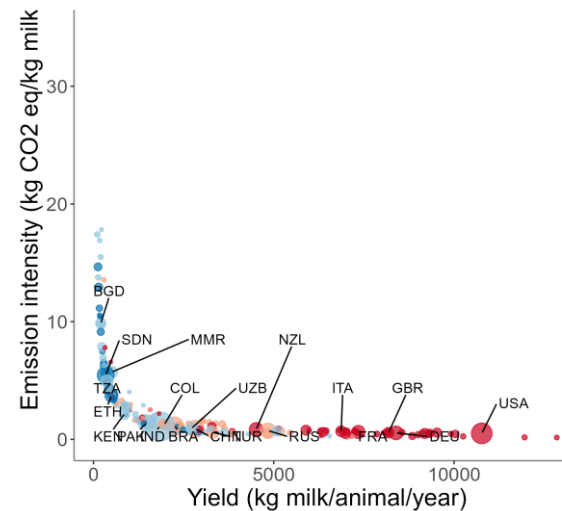
- Food provision
 - 16% kcal / 35% protein
- Economics
 - 40% ag GDP
 - 1.3 billion livelihoods
- Resource use
 - 80% ag land
 - 36% of calories produced by crops
- Impacts (GHG+)
 - 12-20% of emissions
 - Major driver of habitat loss and degradation
- Opportunities:
 - Circularity potential

Livestock heterogeneity

- Species
- Production systems
 - Use of resources (cost structure)
 - Products
 - Efficiencies



Source: Herrero et al 2013



Source: Gonzalez Fischer and Herrero, in press

Livestock sectors in the GTAP database

- Coarse classification
- No production systems
- No good representation of feed
- Limitations:
 - Representing the impact of livestock policies
 - Modeling mitigation efforts
 - Changes in consumption patterns

Original GTAP sector	Description
gro	Other grains
osd	Oil seeds
ctl	Cattle
rmk	Raw milk
oap	Other animal products

Livestock data

- Spatially explicit (5 arc min) dataset of biomass use, feed efficiencies and GHG emissions from livestock
- By species:
 - Dairy cattle
 - Beef cattle
 - Dairy sheep and goats
 - Meat sheep and goats
 - Poultry
 - Swine
- By production system
 - 8 for ruminants
 - 2 for monogastrics
- Reference year 2000, updated to 2006.
- Being updated.

Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems

Mario Herrero^{a,b,1}, Petr Havlik^{b,c}, Hugo Valin^c, An Notenbaert^b, Mariana C. Rufino^b, Philip K. Thornton^d, Michael Blümmel^b, Franz Weiss^c, Delia Grace^b, and Michael Obersteiner^c

^aCommonwealth Scientific and Industrial Research Organization, St Lucia, QLD 4067, Australia; ^bInternational Livestock Research Institute, 00100 Nairobi, Kenya; ^cInternational Institute for Applied Systems Analysis, Laxenburg, Austria; and ^dCGLAR Research Programme on Climate Change, Agriculture and Food Security, International Livestock Research Institute, 00100 Nairobi, Kenya

Edited by William C. Clark, Harvard University, Cambridge, MA, and approved October 15, 2013 (received for review April 30, 2013)

We present a unique, biologically consistent, spatially disaggregated global livestock dataset containing information on biomass use, production, feed efficiency, excretion, and greenhouse gas emissions for 28 regions, 8 livestock production systems, 4 animal species (cattle, small ruminants, pigs, and poultry), and 3 livestock products (milk, meat, and eggs). The dataset contains over 50 new global maps containing high-resolution information for understanding the multiple roles (biophysical, economic, social) that livestock can play in different parts of the world. Highlights: (i) feed efficiency as a key driver of production, and greenhouse gas emission intensities; (ii) differences between production systems and animal species; and (iii) the impact of livestock on global resource use and the environment.

such as biomass use, GHG emissions, and water footprints, they have required methodological simplifications to achieve global coverage. Such analyses fail to do justice to the considerable heterogeneity that exists in livestock production systems, management practices, resource-use efficiencies, and mitigation potentials. Detailed, disaggregated global livestock data are essential for informing policy analyses of the choices facing humanity in feeding

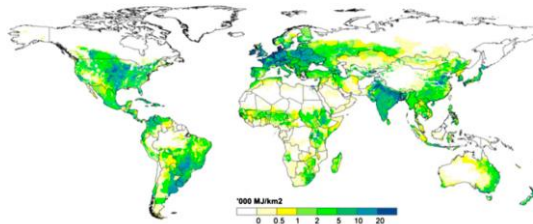
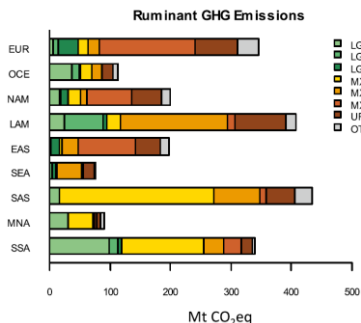


Fig. 3. Map of global ME intake by ruminants (thousands of megajoules per square kilometer).

New sectoral splits

- From 5 to 31 sectors
- Bringing in:
 - Production systems
 - 3 for ruminants
 - 2 for monogastrics
 - Products
 - Ruminants: milk, meat
 - Poultry: eggs, meat

No.	New sector	Description	Original GTAP sector	Description
1	cor	Corn	gro	Other grains
2	sor	Sorghum		
3	bar	Barley		
4	xgr	Other cereal grains		
5	soy	Soy	osd	Oil seeds
6	xsd	Other oil seeds		
7	bcg	Beef cattle, Grazing	ctl	Cattle
8	bcm	Beef cattle, Mixed		
9	bci	Beef cattle, Industrial		
10	org	Other ruminants, Grazing		
11	orm	Other ruminants, Mixed		
12	ori	Other ruminants, Industrial		
13	dcg	Dairy cows producing meat, Grazing		
14	dcm	Dairy cows producing meat, Mixed		
15	dci	Dairy cows producing meat, Industrial		
16	dmg	Other dairy producing meat, Grazing		
17	dmm	Other dairy producing meat, Mixed		
18	dmi	Other dairy producing meat, Industrial		
19	cdg	Dairy cows producing milk, Grazing	rmk	Raw milk
20	cdm	Dairy cows producing milk, Mixed		
21	cdi	Dairy cows producing milk, Industrial		
22	odg	Other dairy producing milk, Grazing		
23	odm	Other dairy producing milk, Mixed		
24	odi	Other dairy producing milk, Industrial		
25	pgi	Pigs, Industrial	oap	Other animal products
26	pgb	Pigs, Backyard		
27	pei	Poultry (eggs), Industrial		
28	peb	Poultry (eggs), Backyard		
29	pmi	Poultry (meat), Industrial		
30	pmb	Poultry (meat), Backyard		
31	xap	Rest of animal products		

New multiproduct activities

- Aggregating sectors that make use of the same resources and produce different outputs

No.	New sector	Description of sector	New activity	Description of activity
13	dcg	Dairy cows producing meat, Grazing	mcg	<u>M</u> ulti-product dairy <u>c</u> ows, <u>G</u> razing
19	cdg	Dairy cows producing milk, Grazing		
14	dcm	Dairy cows producing meat, Mixed	mcm	<u>M</u> ulti-product dairy <u>c</u> ows, <u>M</u> ixed
20	cdm	Dairy cows producing milk, Mixed		
15	dci	Dairy cows producing meat, Industrial	mci	<u>M</u> ulti-product dairy <u>c</u> ows, <u>I</u> ndustrial
21	cdi	Dairy cows producing milk, Industrial		
16	dmg	Other dairy producing meat, Grazing	mog	<u>M</u> ulti-product <u>o</u> ther dairy, <u>G</u> razing
22	odg	Other dairy producing milk, Grazing		
17	dmm	Other dairy producing meat, Mixed	mom	<u>M</u> ulti-product <u>o</u> ther dairy, <u>M</u> ixed
23	odm	Other dairy producing milk, Mixed		
18	dmi	Other dairy producing meat, Industrial	moi	<u>M</u> ulti-product <u>o</u> ther dairy, <u>I</u> ndustrial
24	odi	Other dairy producing milk, Industrial		
27	pei	Poultry (eggs), Industrial	mpi	<u>M</u> ulti-product <u>p</u> oultry, <u>I</u> ndustrial
29	pmi	Poultry (meat), Industrial		
28	peb	Poultry (eggs), Backyard	mpb	<u>M</u> ulti-product <u>p</u> oultry, <u>B</u> ackyard
30	pmb	Poultry (meat), Backyard		
13	dcg	Dairy cows producing meat, Grazing	mcg	<u>M</u> ulti-product dairy <u>c</u> ows, <u>G</u> razing
19	cdg	Dairy cows producing milk, Grazing		

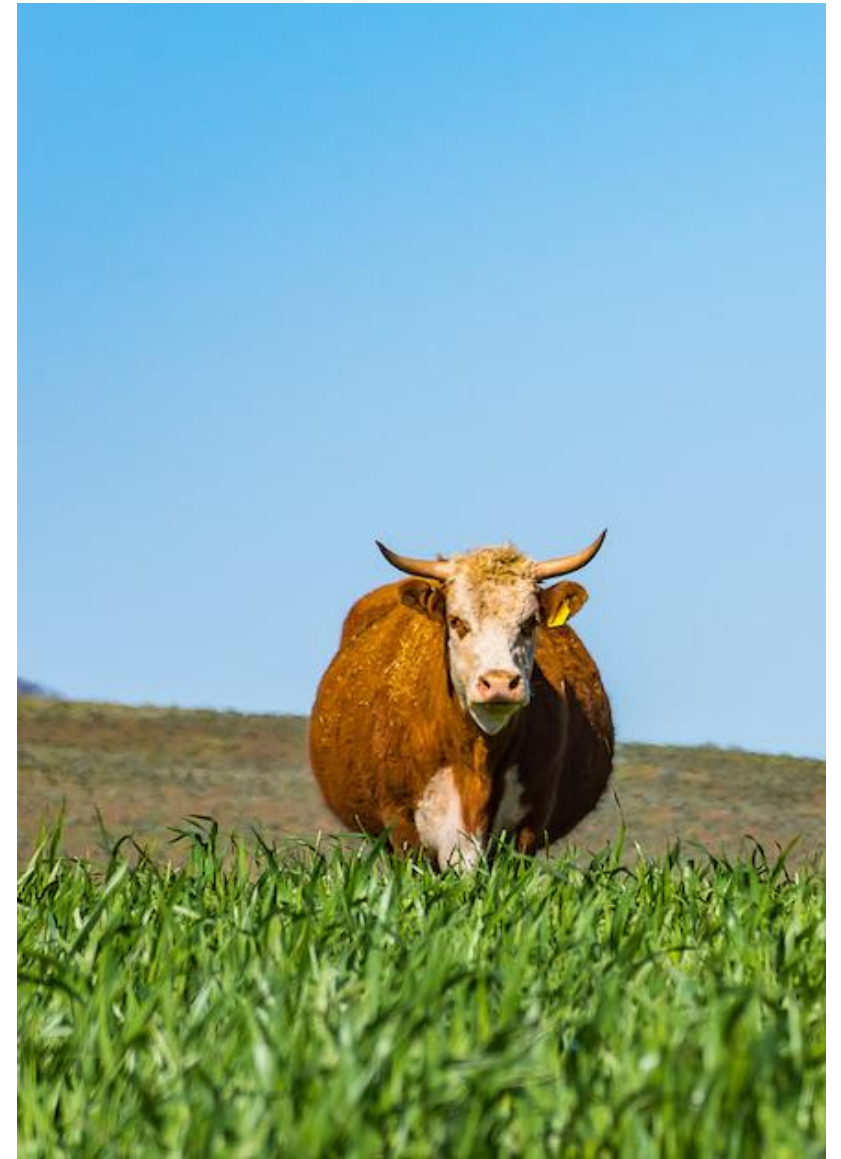
Ongoing work:

- Full feed accounting: grazing, by products, waste
- Characterize capital and labor costs in different systems
- Calculating shares and disaggregating sectors



The new dataset would allow to evaluate:

- Climate mitigation policies.
- Policies and measures toward promoting healthier diets.
- Changing demand patterns and policies focused on promoting meat substitutes.
- Measures promoting circularity in the livestock sector.



Thank You

foodsystems@cornell.edu



@GlobalFoodTeam

cals.cornell.edu/food-systems-global-change

**FOOD SYSTEMS &
GLOBAL CHANGE**

Cornell
CALS

College of Agriculture
and Life Sciences

Global Development

