Science-fiction or science-fact? Research for sustainable livestock agri-food systems

TropAg 2022 Keynote presentation
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I acknowledge the Traditional Owners and their custodianship of the lands on which we meet today and pay my respect to their Ancestors and their descendants.

Key messages

Multiple and contrasting metrics are used for some key livestock-related development parameters—nutrition, climate change, environment

Demand for food, especially livestock-derived food, is likely to sky-rocket, but that food will have to be produced using the same resource base while mitigating potential harms

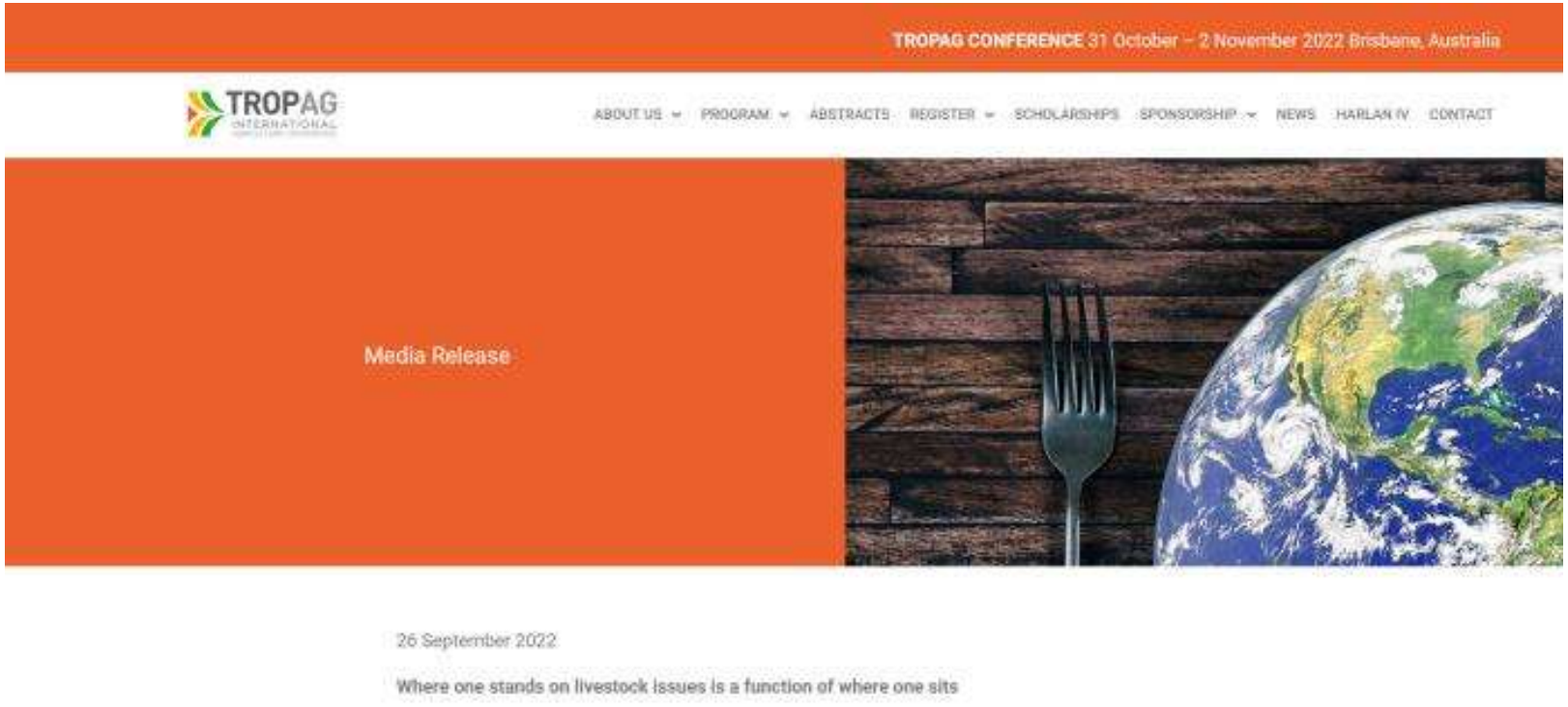
Metrics about livestock can be confusing

Science must help clarify the evidence and facts to inform decision-making

Science solutions are needed to address challenges and transform livestock agri-food systems

Where one stands on livestock issues is a function of where one sits

Let’s not allow our different perspectives to detract from the immense task at hand that we all agree with—ensuring sustainable healthy diets—for everyone



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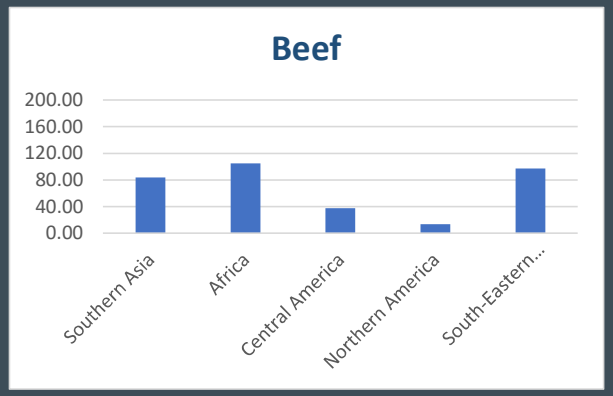
Demand for food will keep growing

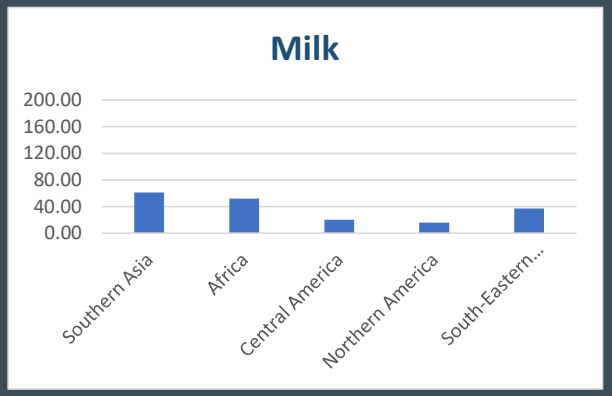
Especially in LMICs

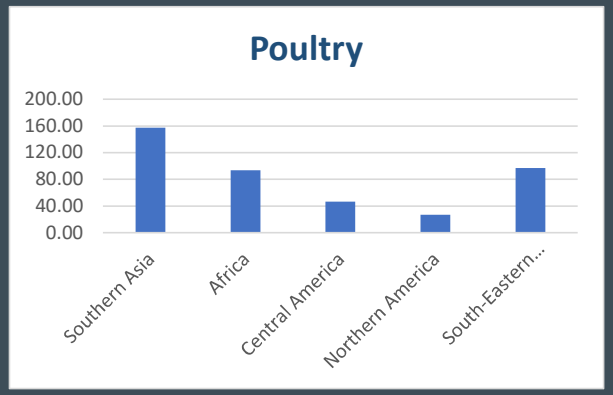
- Demand for milk, meat, eggs is increasing fastest in LMICs driven by population, rising incomes and urbanization
- Not based on significant over-consumption in LMICs (attention: 'double burden')
- 70% of livestock-derived foods consumed in LMICs are
  - **Produced on small-scale farms**
  - **Sourced in informal markets**

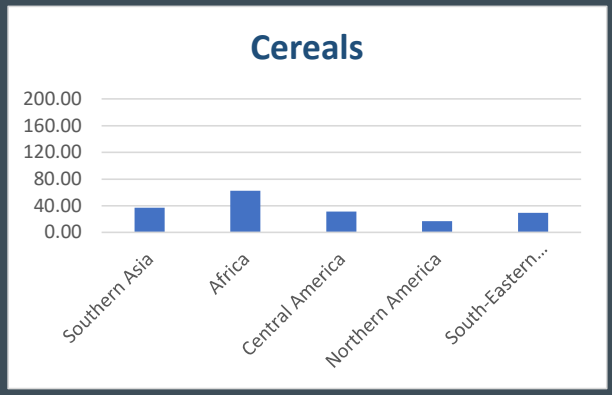
Percentage changes in demand 2010 to 2030

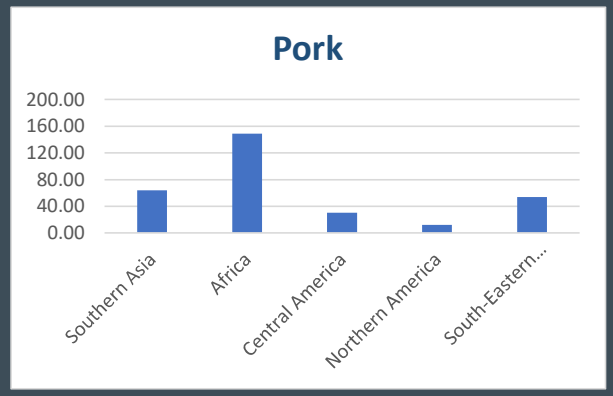
Projections based on IMPACT model, Dolapo Enahoro (ILRI)

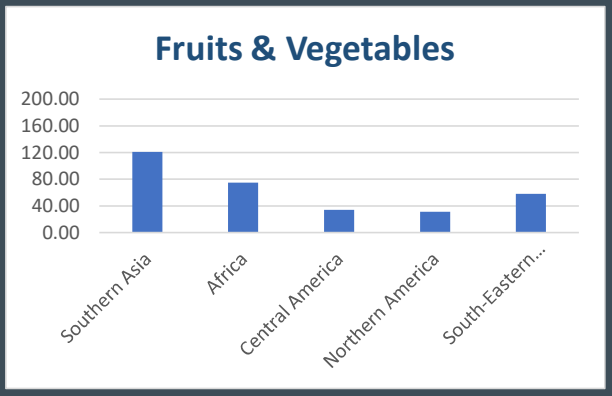













Livestock & Nutrition

NUTRITION: Contrasting livestock metrics can cause CONFUSION


THE LANCET

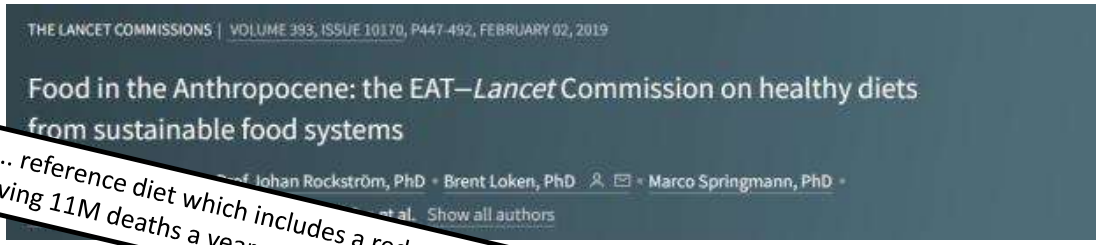
Volume 399, Issue 10332, 2–8 April 2022, Pages e23–e26

Correspondence

36-fold higher estimate of deaths attrib…
red meat intake in GBD 2019: …

Alice V Stanton a b, Frédéric Leroy c, Chri…

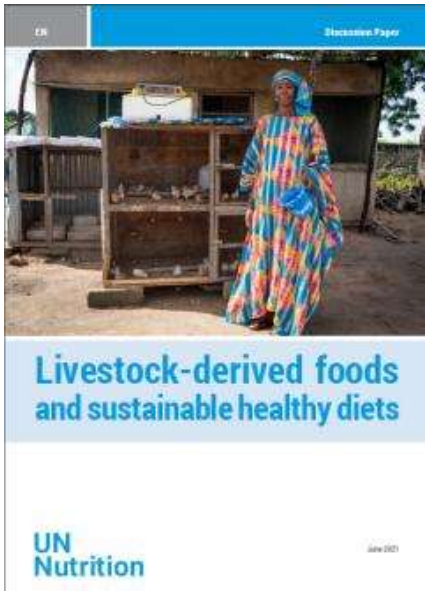
Ongoing debate: 2019 Global Burden of Disease estimates for deaths attributed to red meat in 2019 were 36 times higher than in 2017 ..... metrics and evidence are being questioned.....


THE LANCET COMMISSIONS | VOLUME 393, ISSUE 10170, P447-492, FEBRUARY 02, 2019

Food in the Anthropocene: the EAT–*Lancet* Commission on healthy diets from sustainable food systems

…f. Johan Rockström, PhD • Brent Loken, PhD • Marco Springmann, PhD • …et al. Show all authors

….. reference diet which includes a reduction in red meat consumption could contribute to saving 11M deaths a year .....



….. because of their high nutritional value, livestock-derived foods are essential to the diets of infants and young children, especially in low-resource settings. For other groups, such as those that eat high amounts of livestock-derived foods, consumption should be reduced to improve health and lessen environmental impacts.

……to achieve sustainable healthy diets for all, any consideration of livestock-derived foods must take into account evidence-based, integrated solutions that incorporate diversity and equity. …….

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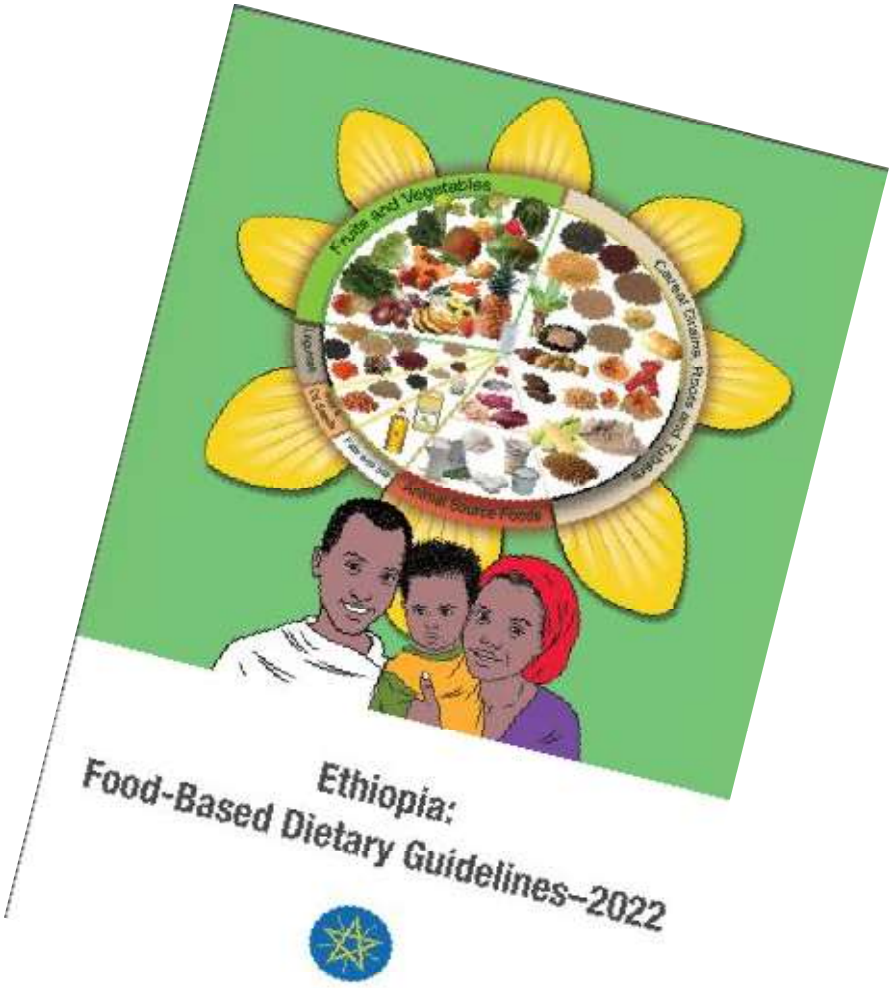
NUTRITION: Science evidence helps inform decision-making

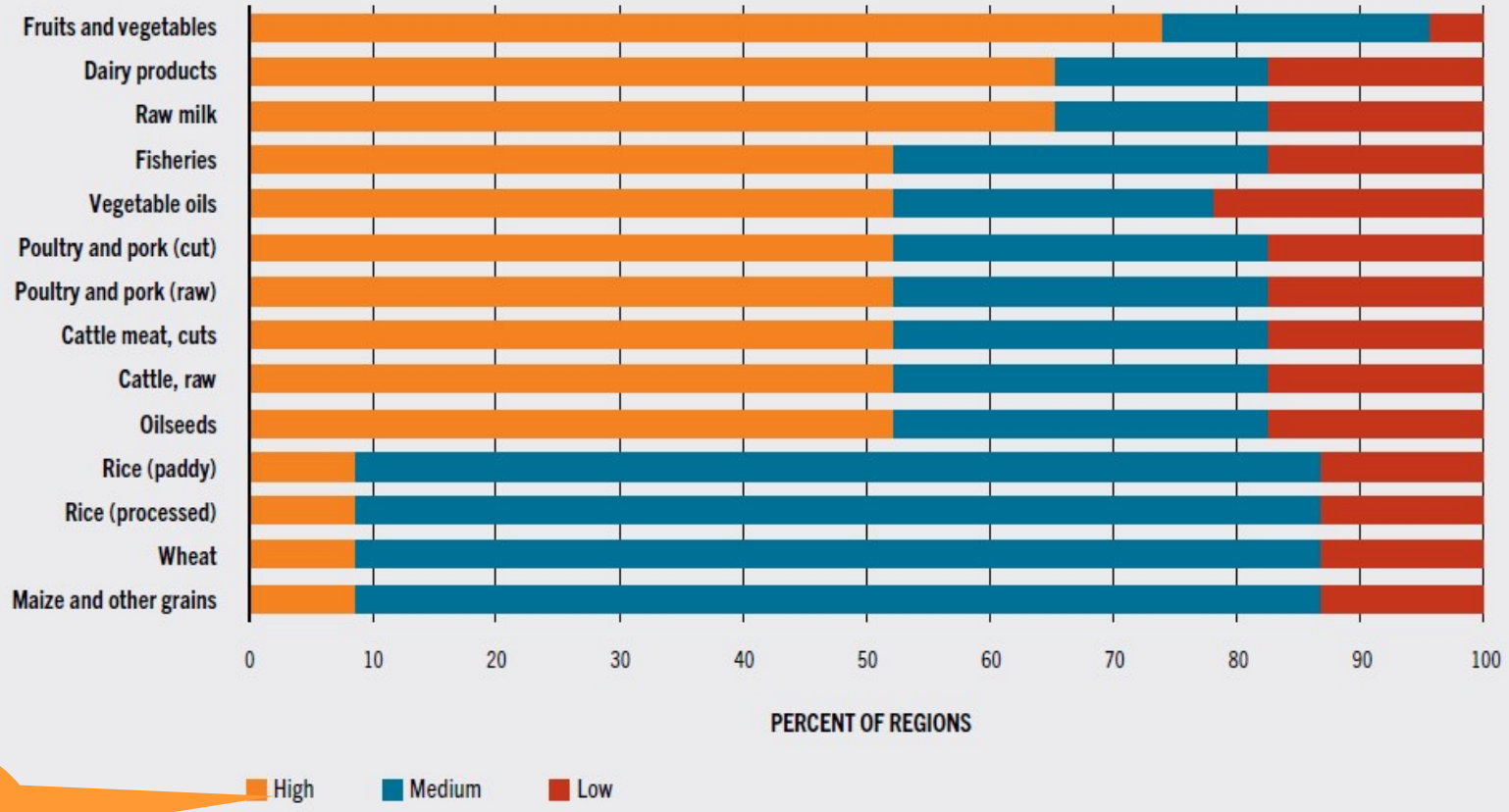
Science can inform national nutrition guidelines on the roles animal-source foods can and should play in providing healthy, balanced and nutritious diets



More—not less—animal-source foods are needed in more than half of the world's regions today to achieve a 'least cost healthy diet'

Current consumption levels of "high-priority" foods are on average less than 80 percent of the recommended level to adhere to a least cost healthy diet

FIGURE A CLASSIFICATION OF FOOD GROUPS BASED ON PER CAPITA CONSUMPTION RELATIVE TO REGIONAL DIETARY GUIDELINES



SOURCE: Glauber, J. & Laborde, D. (forthcoming). *Repurposing food and agricultural policies to deliver affordable healthy diets, sustainably and inclusively: what is at stake?* Background paper for *The State of Food Security and Nutrition in the World 2022*. FAO Agricultural Development Economics Working Paper 22-05. Rome, FAO.

FAO, IFAD, UNICEF, WFP and WHO. 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable*. Rome, FAO. https://doi.org/10.4060/cc0639en

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NUTRITION: Livestock research solutions address GLOBAL CHALLENGES

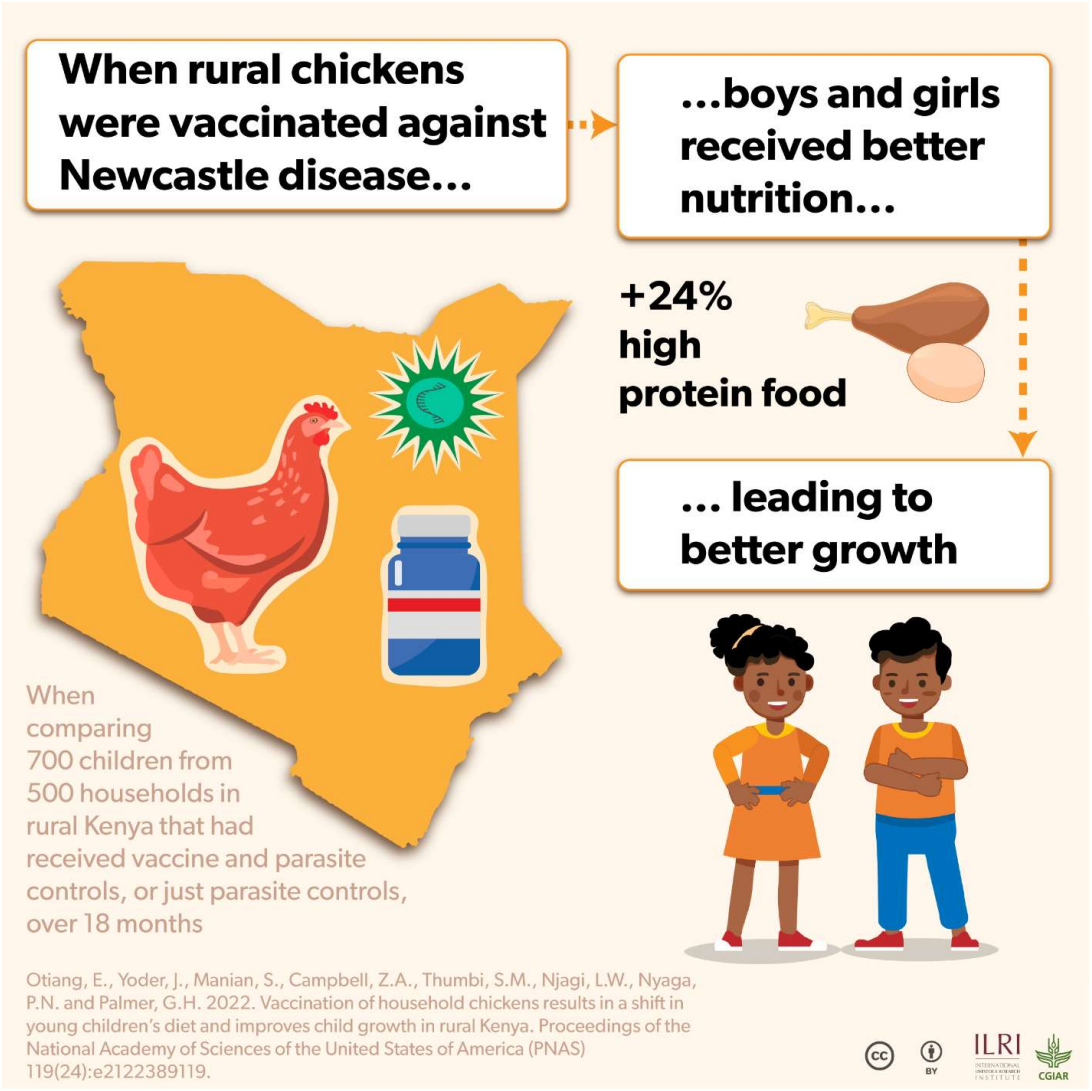
- Provide technical and policy solutions to improve access, availability and affordability of animal-source foods for those who need them most
- ‘De-risk’ the traditional (informal) food markets of lower income countries to ensure that meat, milk, eggs and other fresh foods are safe from food-borne diseases

NUTRITION: Livestock research addresses child stunting

Vaccinating rural poultry flocks against Newcastle disease and supporting animal health technicians to deliver the vaccines:

- enhances poultry productivity
- enhances household well-being
- significantly reduces stunting of both girls and boys

Otiang, E. et al., 2022: https://doi.org/10.1073/pnas.2122389119



Livestock & Climate

CLIMATE: Contrasting livestock metrics can cause CONFUSION

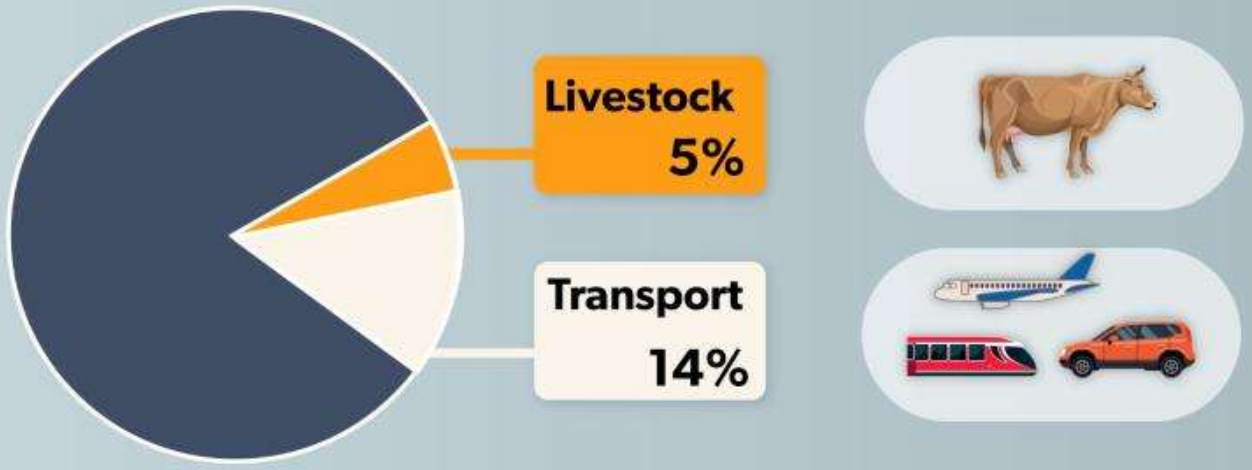
? Different boundaries used for live cycle assessments result in different results for of greenhouse gas emissions

? There are different ways to measure methane emissions (e.g. **GWP100** or **GWP*** for measuring the global warming potential)

? Different reports focus on different functional units (e.g. the amount of **food** or **protein** or **nutrients** produced in relation to greenhouse gas emissions)

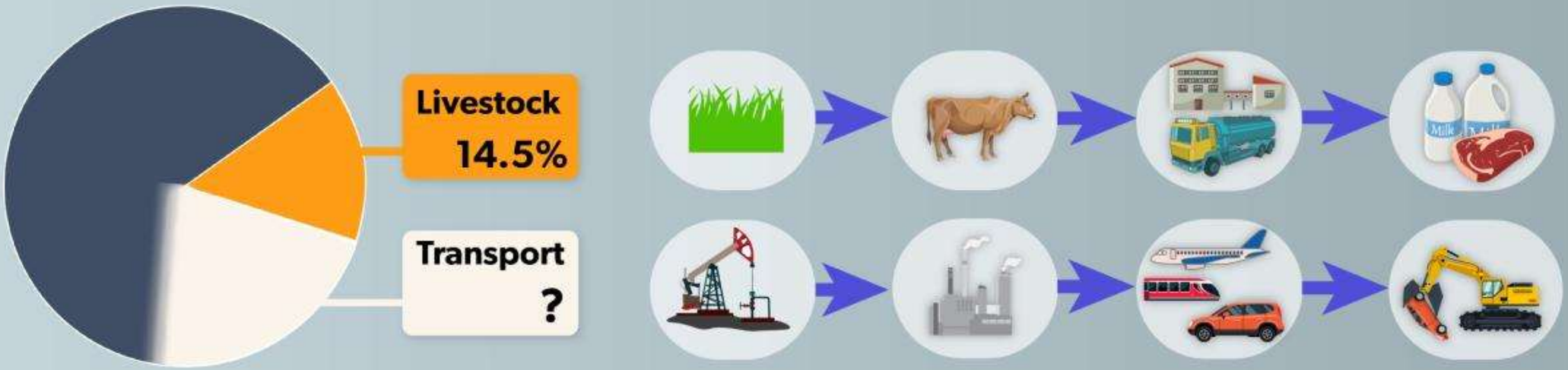
? Considerable variation in reports of livestock impacts on **carbon sequestration**

Direct emissions (IPCC sectorial approach)

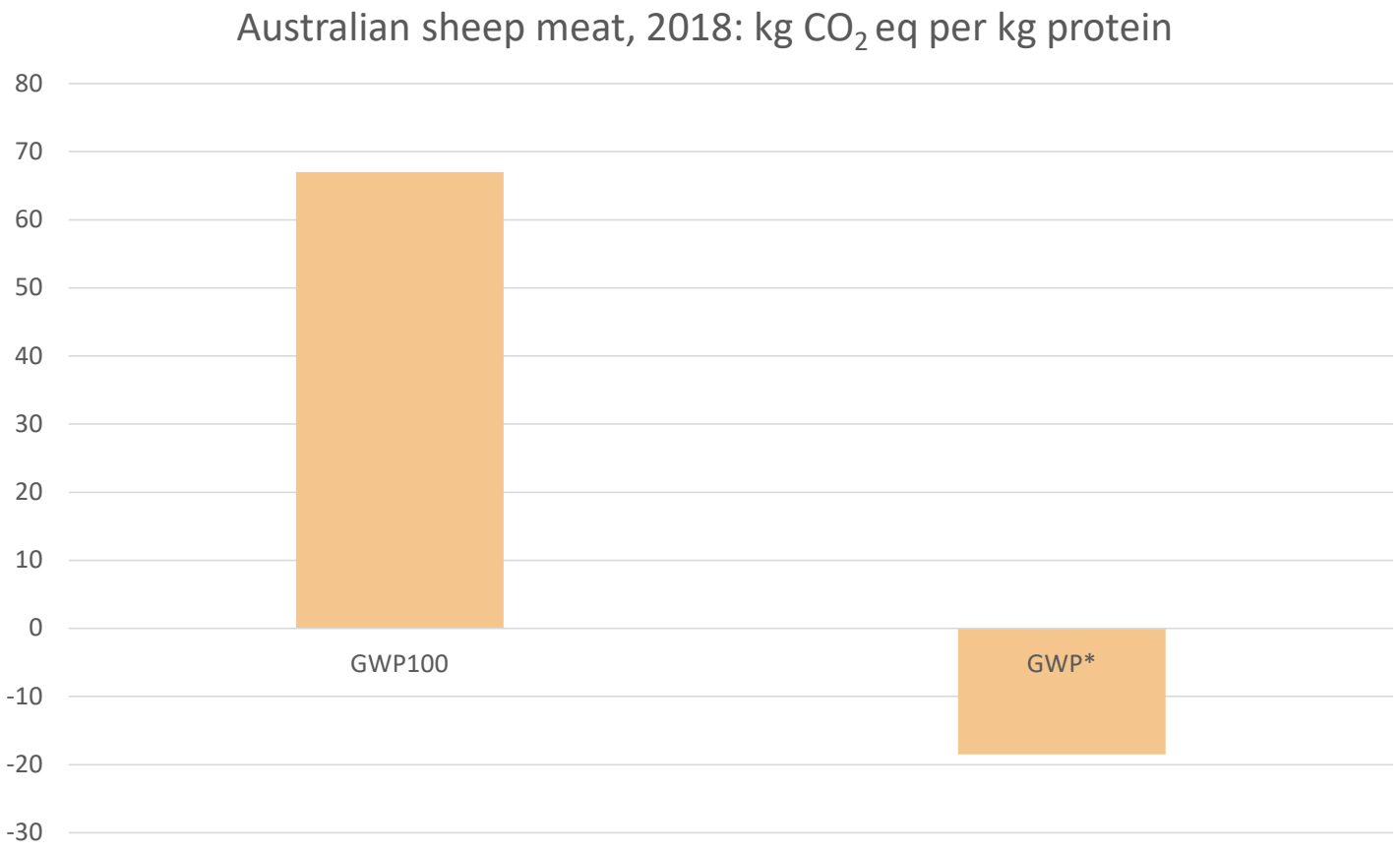


Results differ when assessing ‘direct’ vs ‘life cycle’ GHG emissions

Life cycle emissions

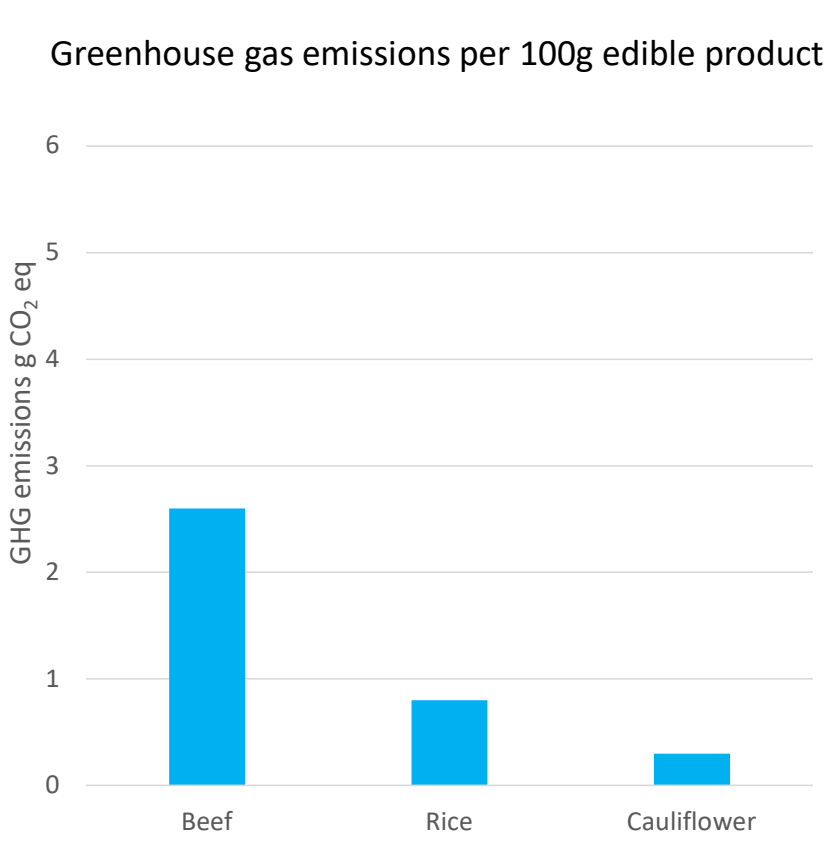


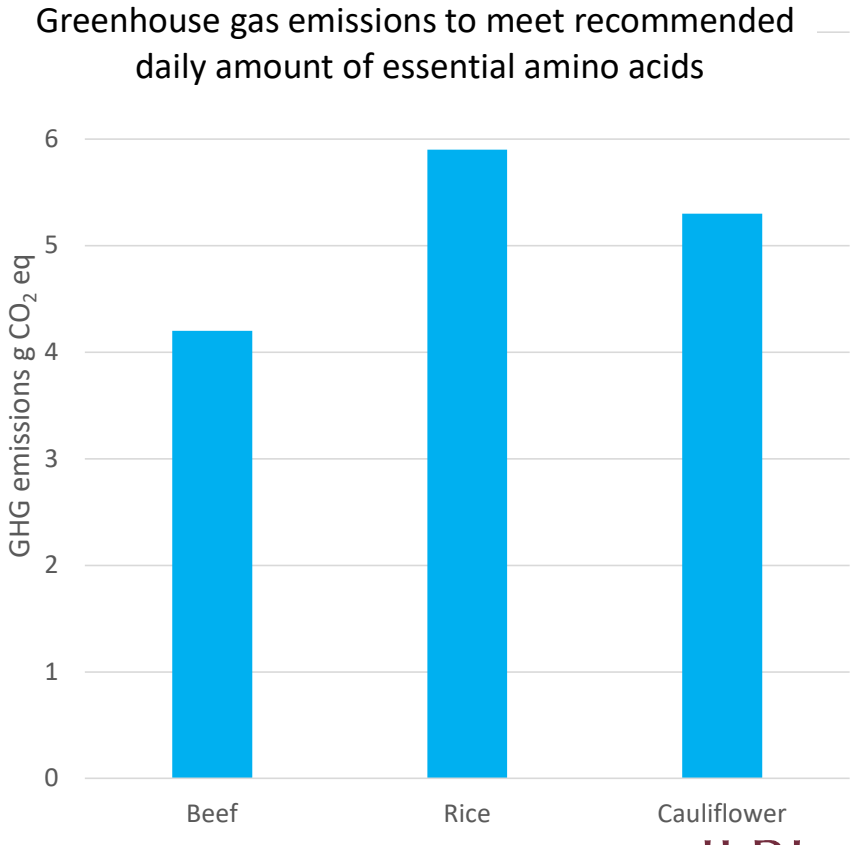
Using GWP100 or GWP* to measure methane gives very different results



Ridoutt, B., 2021. Short communication: climate impact of Australian livestock production assessed using the GWP* climate metric. Livestock Science 246,. https://doi.org/10.1016/j.livsci.2021.104459 104459

Measuring greenhouse gas emissions according to functional unit





Tessari, P. et al. Essential amino acids: master regulators of nutrition and environmental footprint? *Sci. Rep.* 6, 26074; doi: 10.1038/srep26074 (2016).

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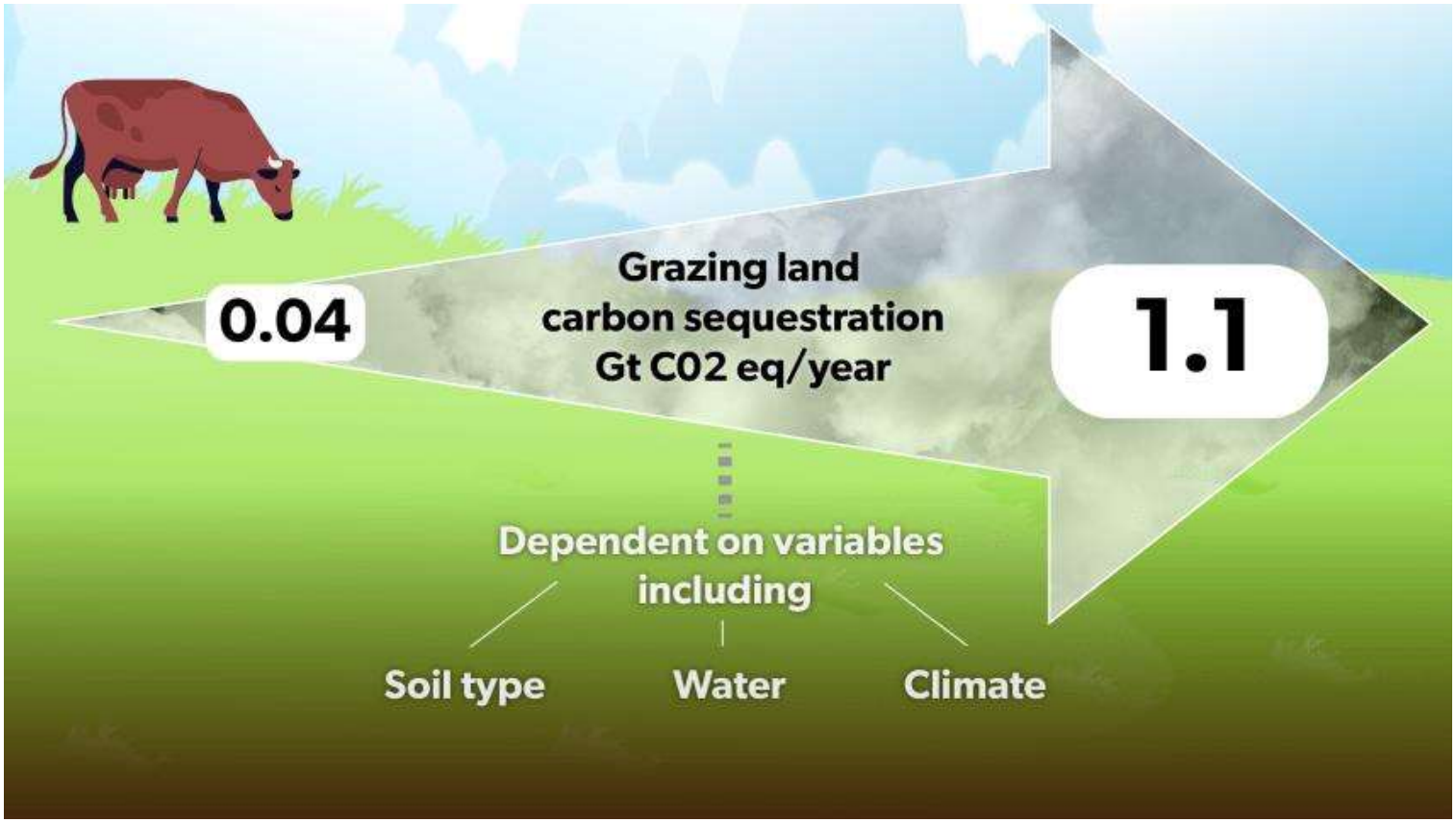
Multiple factors impact on carbon sequestration in grazing lands



Henderson, B.B. et al. 2015. Greenhouse gas mitigation potential of the world's grazing lands: Modeling soil carbon and nitrogen fluxes of mitigation practices. *Agriculture, Ecosystems & Environment* 207, 91–100. https://doi.org/10.1016/j.agee.2015.03.029

CLIMATE: Science evidence helps inform decision-making

Global efforts, e.g.:

- Global Research Alliance on Agricultural Greenhouse Gases (**GRA**)
- Livestock Environmental Assessment and Performance (**LEAP**)

Regional and local initiatives, e.g.:
Research by ILRI's **Mazingira Centre** conducts the first reliable assessments of African and Kenyan livestock-generated greenhouse gas emissions

Emission Factors based on experiments conducted at Mazingira informed the IPCC database

https://cgspace.cgiar.org/handle/10568/122005?show=full
https://www.ilri.org/news/recent-progress-and-future-priorities-greenhouse-gas-emissions-livestock-africa

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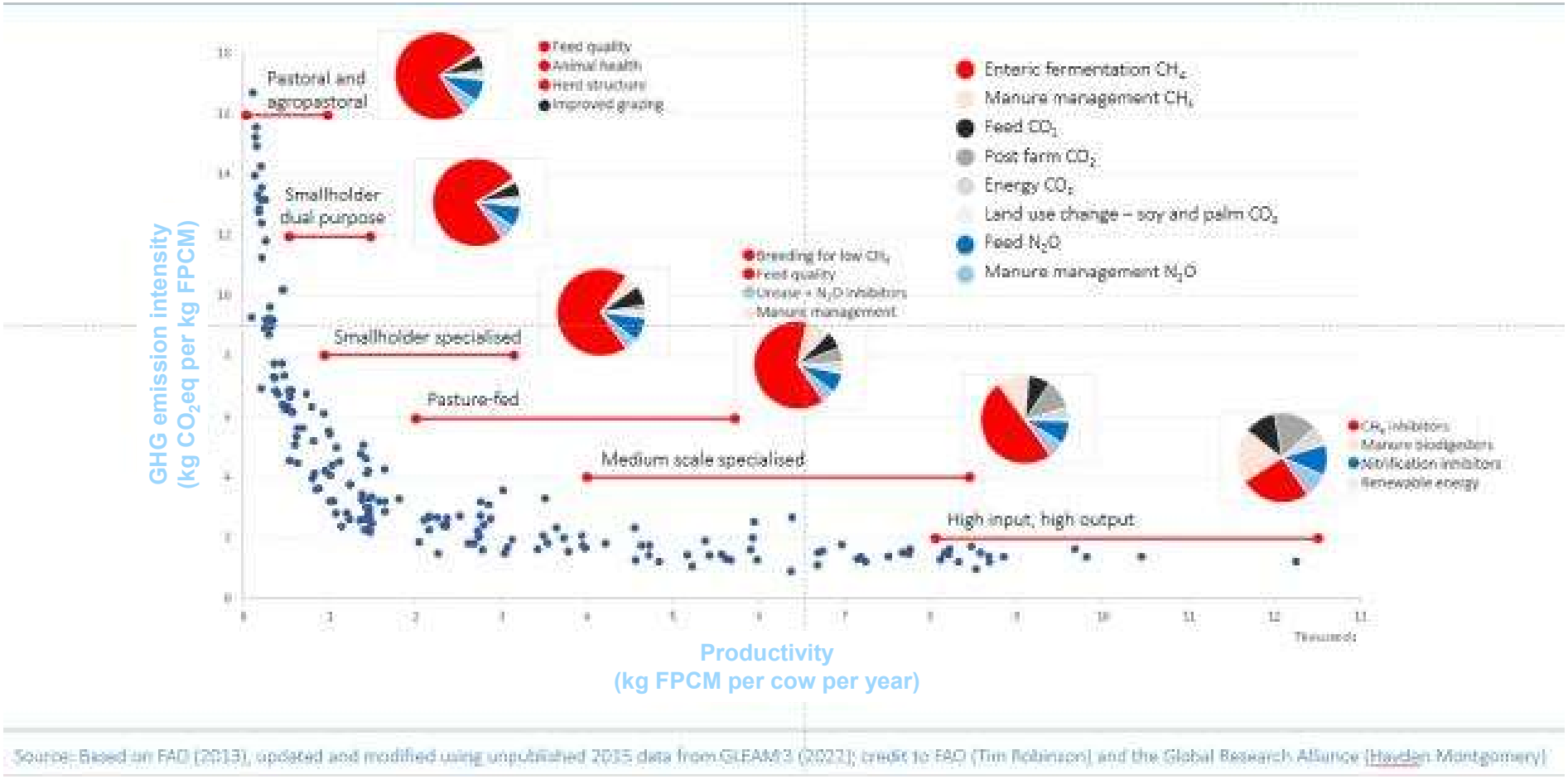
GHGs from different livestock systems need different solutions

Dairy system characterization and emissions



Source: Based on FAO (2013), updated and modified using unpublished 2015 data from GLEAM 3 (2022); credit to FAO (Tim Robinson) and the Global Research Alliance (Hayden Montgomery)

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CLIMATE: Livestock research solutions address GLOBAL CHALLENGES

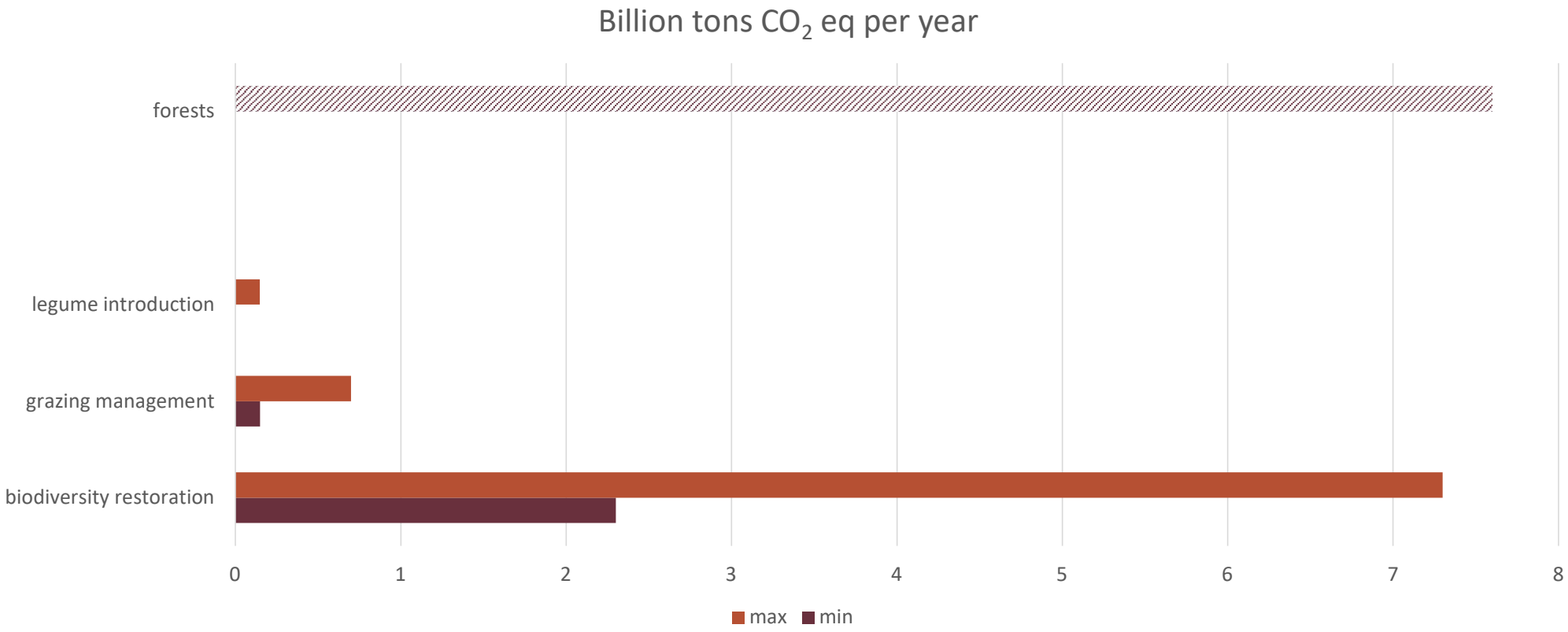
- Improve livestock production efficiencies via
  - Health
  - Genetics
  - Feeds
- Identify genetic opportunities to breed low-methane livestock
- Identify genetic opportunities to breed heat-tolerant livestock
- Explore feed additives that reduce livestock methane emissions
- Manage manure for lower GHG emissions
- Determine the impacts of livestock diseases on GHG emissions

CLIMATE: Livestock research addresses the genetics of heat tolerance

- Milk yields decline when cows are under heat stress, and heat stress is rising under climate change
- Evidence of genetic variations among bulls makes possible improved breeding programs that select 'climate-tolerant' animals that maintain good milk yields under heat stress while reducing their greenhouse gas intensity

Ekine-Dzivenu C. et al., 2020 https://doi.org/10.1016/j.livsci.2020.104314

CLIMATE: Livestock research addresses carbon sequestration in rangelands



Yongfei Bai & M Francesca Cotrufo. 2022. Grassland soil carbon sequestration: Current understanding, challenges, and solutions *Science* 377, 603–608
Nancy L Harris et al. 2021. Global maps of twenty-first century forest carbon fluxes. *Nature Climate Change* volume 11, pages 234–240

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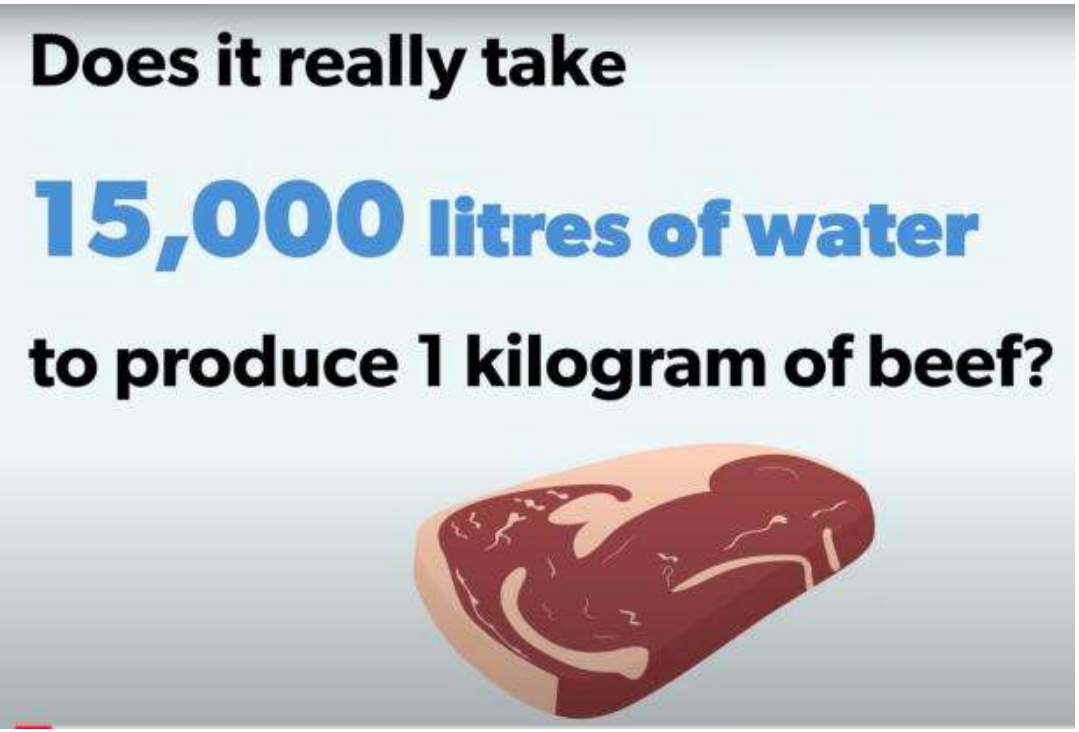
Livestock & Environment

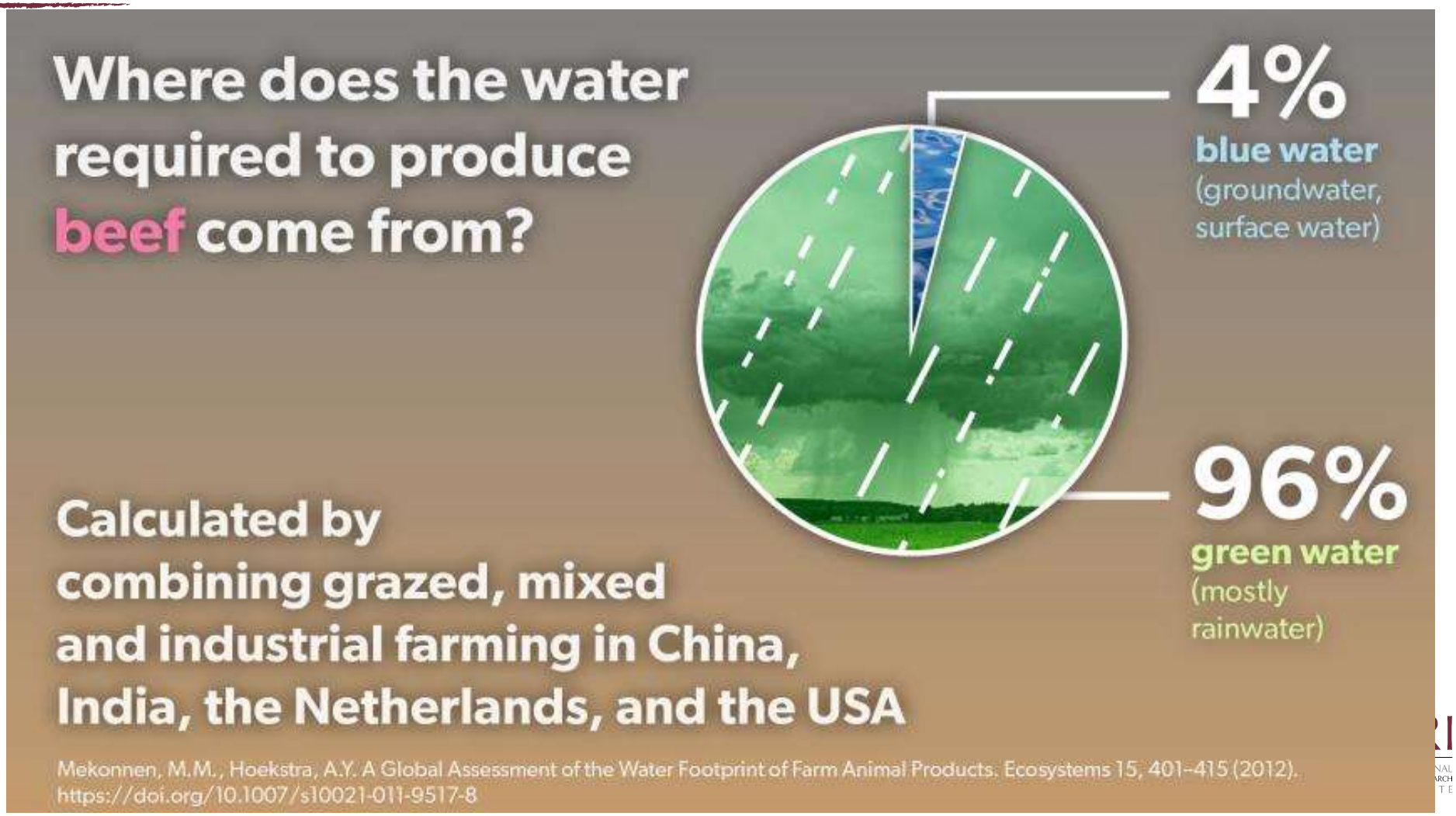
WATER: Contrasting livestock metrics can cause CONFUSION



This global average is mixing:

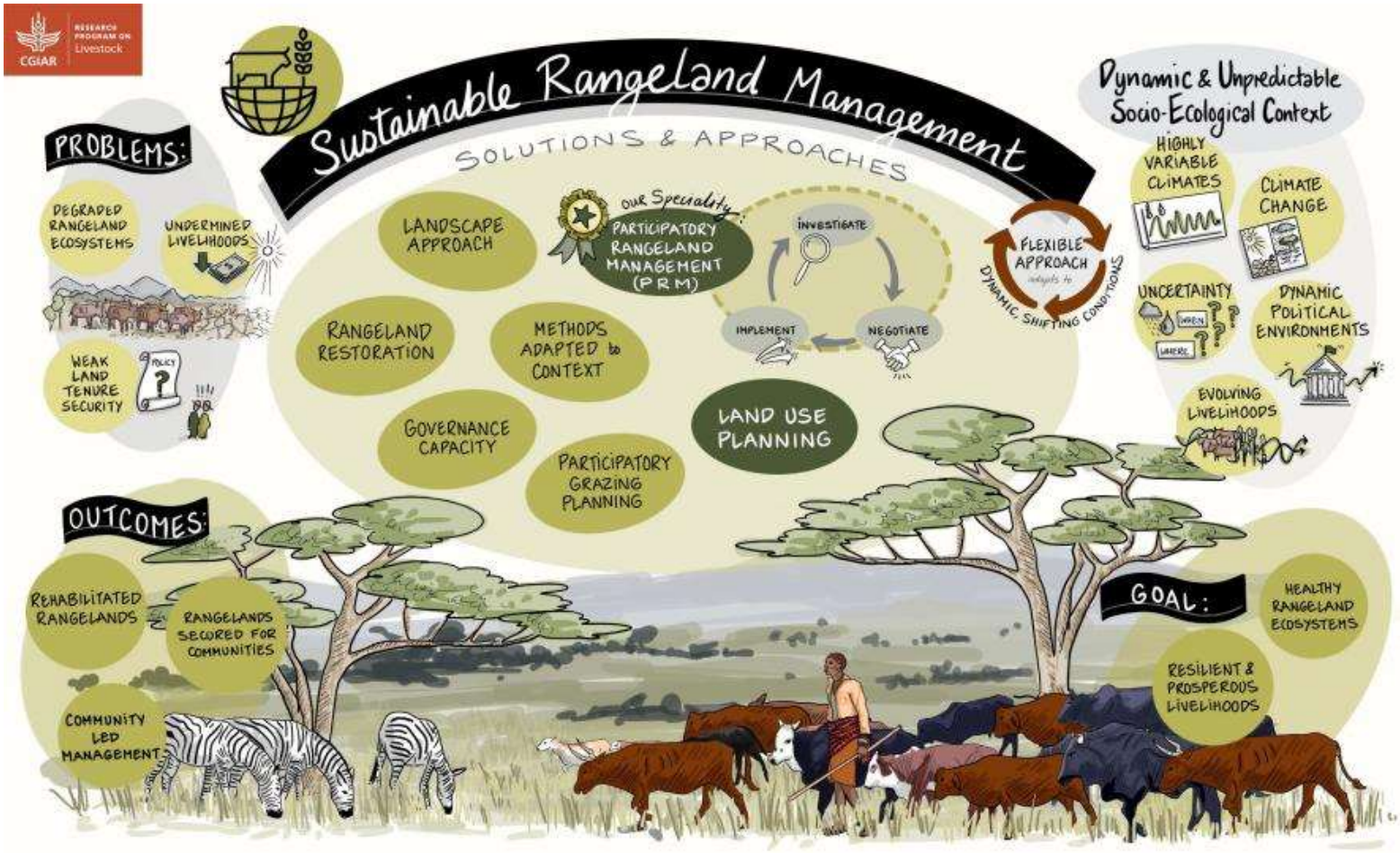
- *Green* water (rainfall) with *blue* water (surface water)
- Intensive production (*feedlots*) with extensive production (*pastoralist*) livestock systems
- Whole *lifecycles* with component *parts*

WATER: science evidence helps inform decision-making



WATER: Livestock research addresses GLOBAL CHALLENGES

- Improving water-use efficiency in smallholder livestock systems
- Recycling water
- Improving rangeland vegetation management

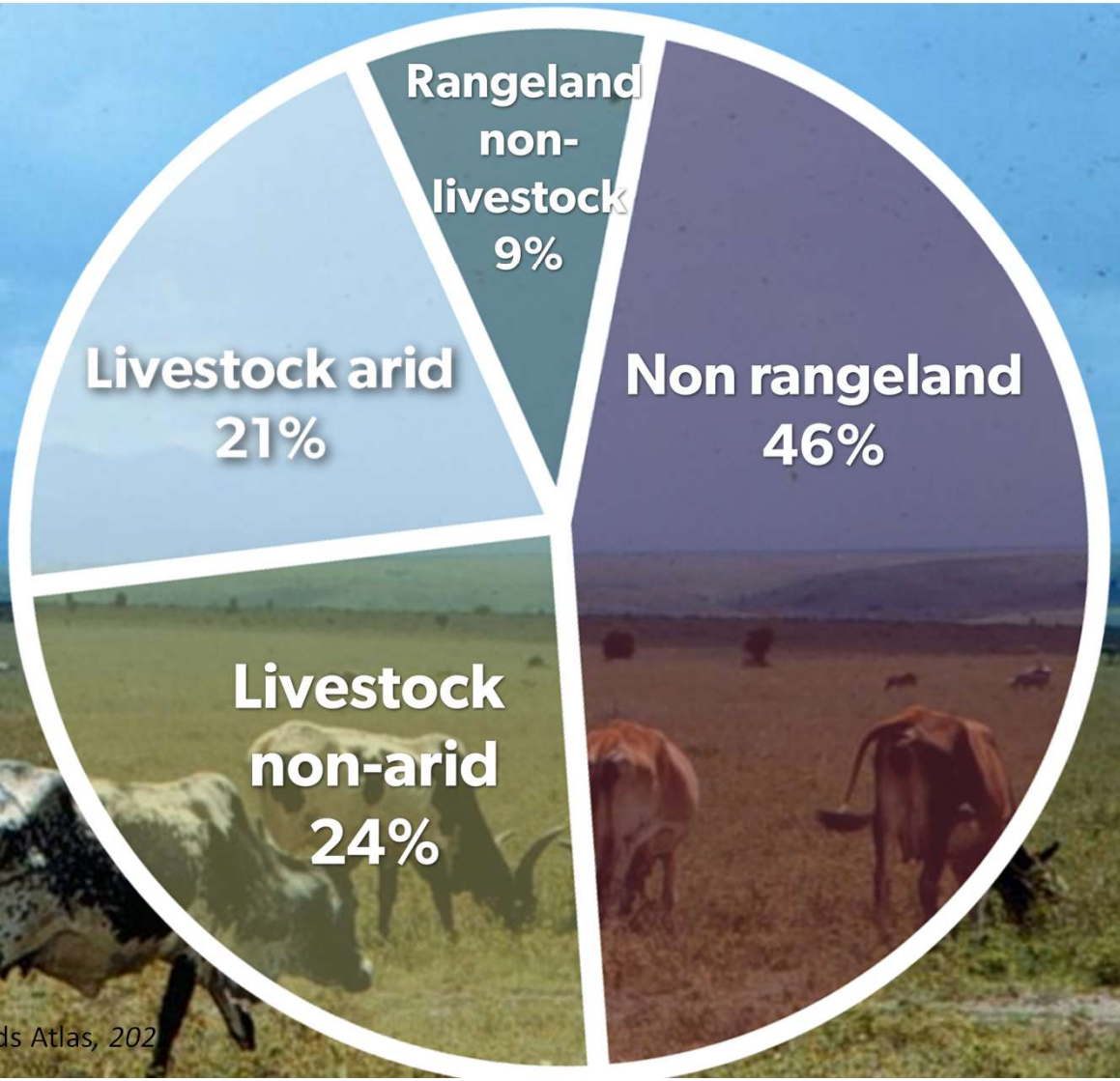


LAND: Contrasting livestock metrics can cause CONFUSION

? Livestock use over half the world's land

Total terrestrial surface 148 million sq km

21% livestock only
24% livestock supports crop production

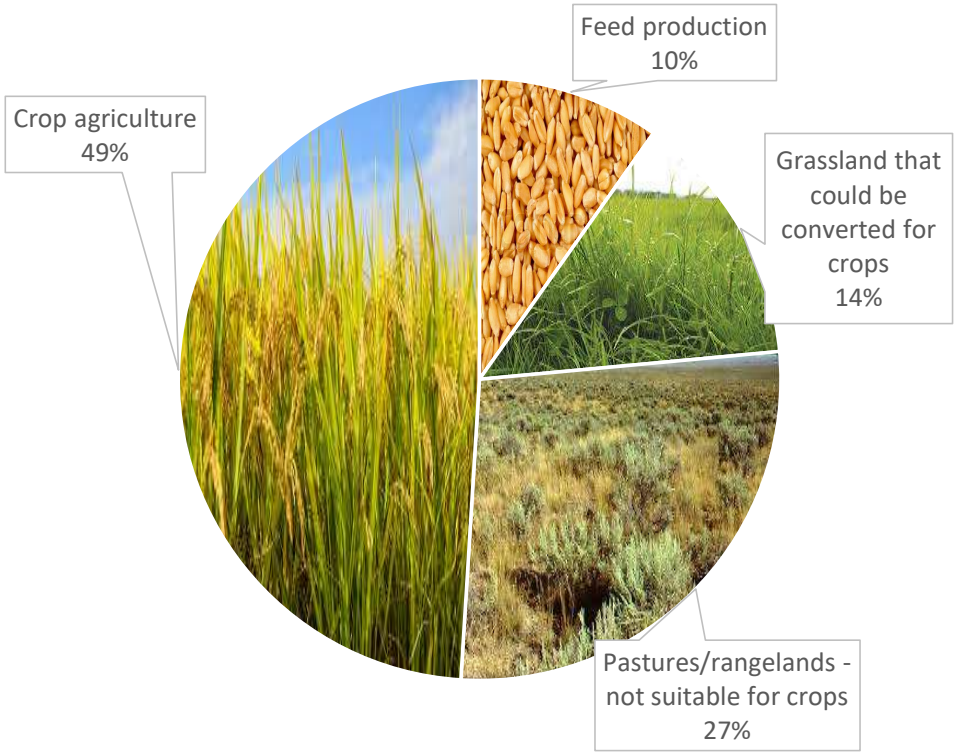


Source: Rangelands Atlas, *202*

LAND: Livestock research addresses GLOBAL CHALLENGES

6 billion tonnes dry feed

5 billion ha global agricultural area



Anne Mottet, Cees de Haan, Alessandra Falcucci, Giuseppe Tempio, Carolyn Opio, Pierre Gerber. 2017. Livestock: On our plates or eating at our table? A new analysis of the feed/ food debate. http://dx.doi.org/10.1016/j.gfs.2017.01.001

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LAND: Livestock research addresses rangeland management

Participatory rangeland management and participatory grazing planning with local communities is helping to rehabilitate rangeland ecosystems, to secure land tenure and to increase the resilience of pastoralist communities

Waweru, T. et al. 2021. Independent impact assessment report: Participatory Rangeland Management (PRM) in Kenya and Tanzania. Nairobi, Kenya: African Research and Economic Development Consultants Limited.

LAND: Livestock research addresses feed challenges

The straw and stover by-products of crop production make up more than half of livestock feed resources in lower income countries

Research on cereal, legume and tuber crops shows that genetic variation in their livestock feed traits can be exploited to increase livestock productivity by 15–25% with little to no trade-offs in grain yields

Superior ‘dual-purpose’ (feed as well as food) crops are now being bred to make their residues more nourishing for cattle, goats and sheep

Blümmel, M et al. 2020. Recent advances in dual-purpose rice and wheat research: A synthesis. *Field Crops Research*, 253, 107823 https://hdl.handle.net/10568/108077

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Key messages

Multiple and contrasting metrics are used for some key livestock-related development parameters—nutrition, climate change, environment

Demand for food, especially livestock-derived food, is likely to sky-rocket, but that food will have to be produced using the same resource base while mitigating potential harms

Let's not allow our different perspectives to detract from the immense task at hand that we all agree with… sustainable healthy diets, ….for every citizen….

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The International Livestock Research Institute (ILRI) is a non-profit institution helping people in low- and middle-income countries to improve their lives, livelihoods and lands through the animals that remain the backbone of small-scale agriculture and enterprise across the developing world. ILRI belongs to CGIAR, a global research-for-development partnership working for a food-secure future. ILRI's funders, through the CGIAR Trust Fund, and its many partners make ILRI's work possible and its mission a reality. Australian animal scientist and Nobel Laureate Peter Doherty serves as ILRI's patron.

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