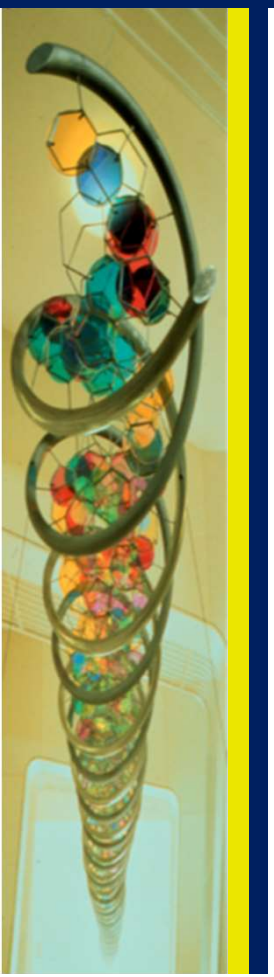
A view from California regarding methane



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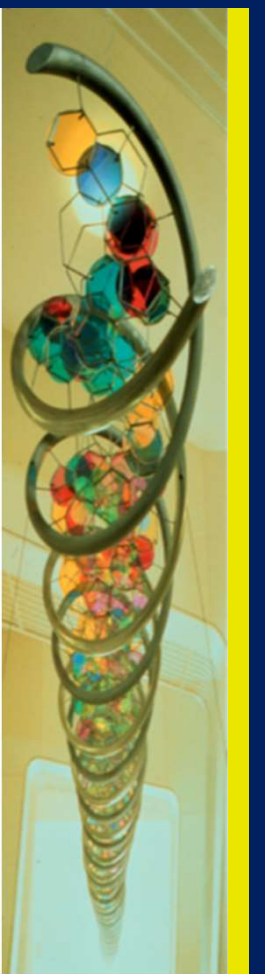
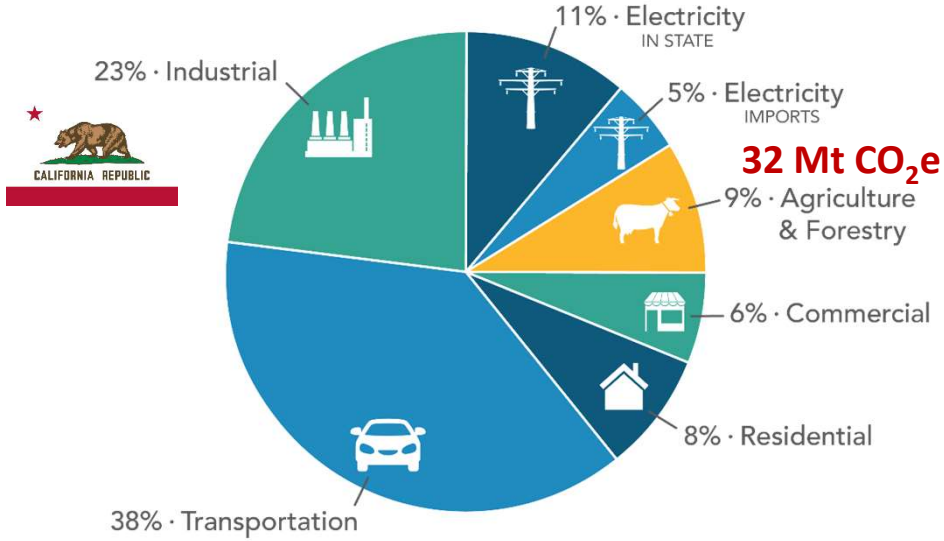
Some California Statistics

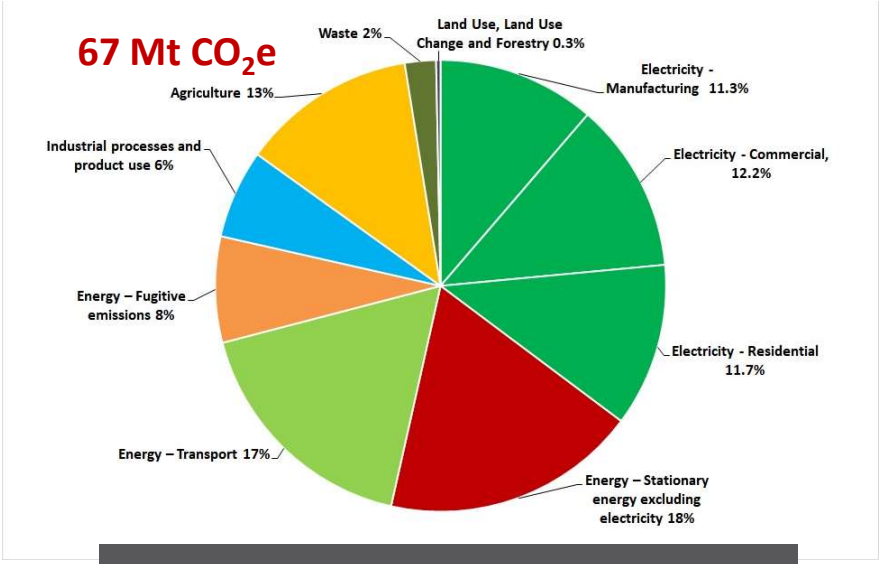


- Population: 38.9 million (12% US) (26,439,111)
- CA 2020 GHG emissions: 369.2 MMT CO_{2eq}



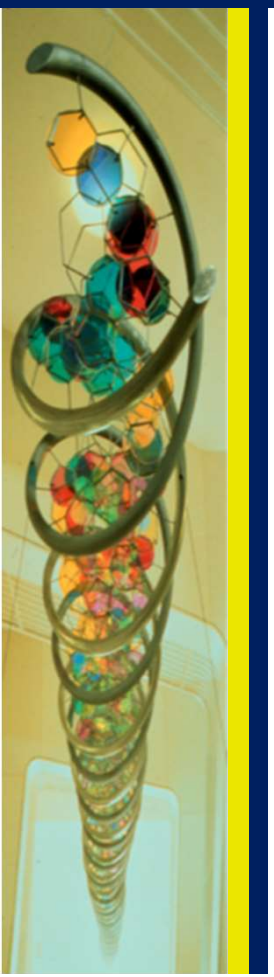
369.2 MMT CO_2e
2020 TOTAL CA EMISSIONS

6.6% US



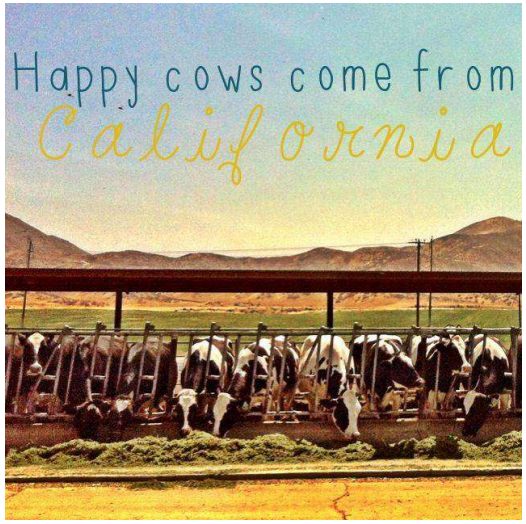
472.6 MMT CO_2e
2020 TOTAL AUSTRALIAN EMMISIONS

Some California Agriculture Statistics



2022 California's farms and ranches received $55.9 billion in cash receipts for their output
~ 11% of US ag cash receipts (Iowa is 2nd at 40.5 billion).

- Dairy Products, Milk — $7.57 billion
- Grapes — $5.23 billion
- Almonds — $5.03 billion
- Cattle and Calves — $3.11 billion
- Strawberries — $3.02 billion
- Pistachios — $2.91 billion
- Lettuce — $2.03 billion
- Tomatoes — $1.18 billion
- Walnuts — $1.02 billion
- Rice — $1.00 billion



- California ranks first out of the fifty states in dairy production.
- The state has about 1,300 dairy farms and 1.727 million dairy cows
- The state produces nearly 20 percent of all U.S milk
- There are approximately 670,000 beef cattle on about 11,000 ranches in California
- Nationally, California ranks fourth in total cattle numbers behind Texas, Nebraska, and Kansas

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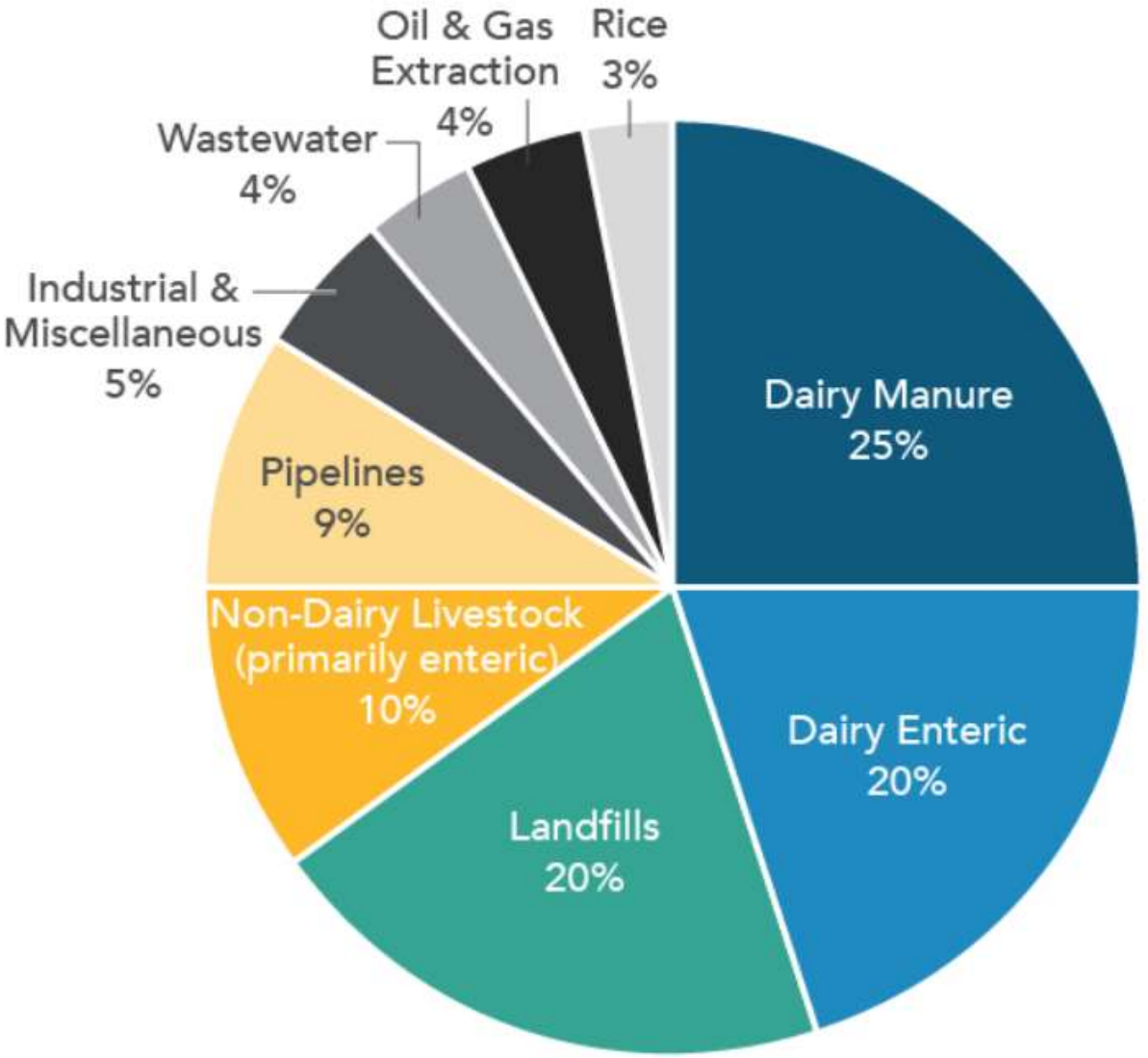
Dairies contribute 44% of California's annual CH_4 emissions



In 2016, California's Legislature passed Senate Bill 138 that requires the California Air Resources Board to approve and implement strategies to reduce methane (CH4) **emissions from the dairy and livestock sector by 40% below 2013 levels by 2030.**

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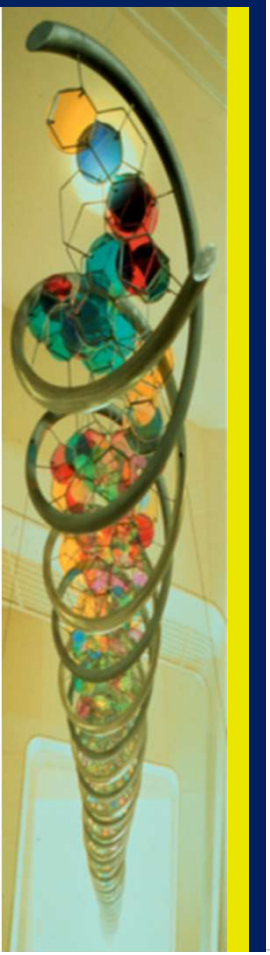


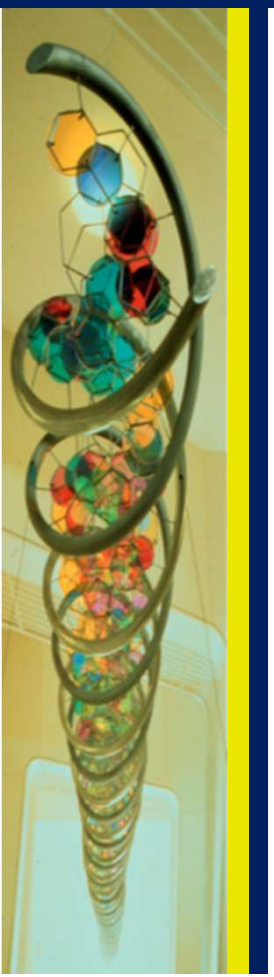
The new California gold rush into anaerobic digesters

Each cow on a farm with a digester can generate $2,827 a year in air pollution and biofuel credits for methane that would otherwise go into the atmosphere.

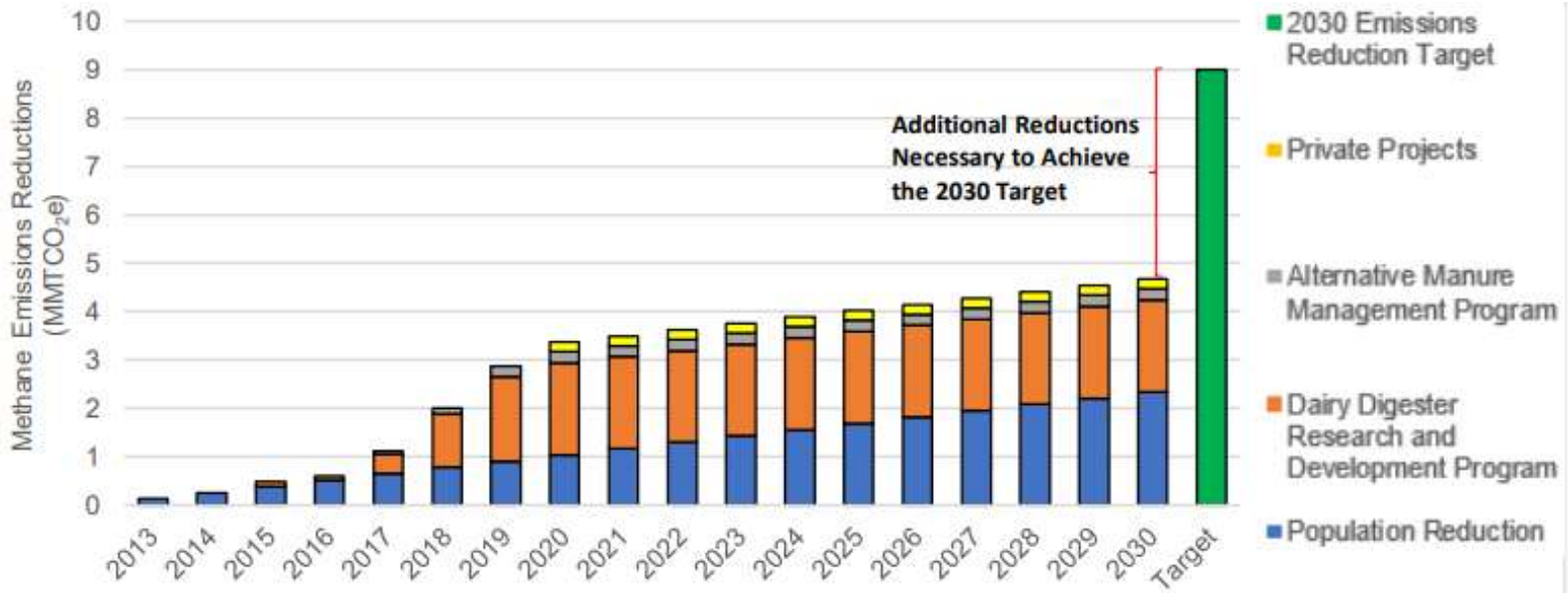
By **Chuck Abbott** | Published on February 4, 2022

Each cow on a farm with a digester can generate $2,82/cow a year in air pollution & biofuel credits for methane that would otherwise go into the atmosphere. The credits, available through California's Low Carbon Fuel Standard (LCFS) and the federal Renewable Fuel Standard, are worth half as much as the milk produced by the dairy cows.

Some California Animal Methane Statistics



- Dairy is on track to achieve 40% decrease in methane (relative to 2013 levels) by 2030
- 57% of CH4 emissions from the dairy sector are manure management, 43% enteric fermentation
- California has allocated more than $350 million to build 117 manure digesters
- To reach target is will need to install 200 more
- Produce biogas which can be sold $13-23/MMBtu vs. $3/MMBtu for natural gas



Future Direction – Microbial Genomics

Can CRISPR Cut Methane Emissions From Cow Guts?

TED Audacious Project Funds $70-Million UC Collaboration for Health, Climate

by Clémentine Sicard | April 17, 2023

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THE AUDACIOUS PROJECT

An initiative of TED

ABOUT NEWS GRANTEES APPLY IMPACT

Project Progress

In Progress

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INNOVATIVE GENOMICS INSTITUTE | 2023

ENGINEERING MICROBIOMES WITH CRISPR TO IMPROVE OUR CLIMATE AND HEALTH

Disruptions in microbiome function can cause significant damage — in the health of our bodies and the function of our planet. The Innovative Genomics Institute is creating affordable and accessible solutions by pioneering a whole new field of inquiry: precision microbiome editing.

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Future Direction – Feed Additives?

PLOS ONE

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RESEARCH ARTICLE

Red seaweed *(Asparagopsis taxiformis)* supplementation reduces enteric methane by over 80 percent in beef steers

Breanna M. Roque[1☯¤*], Marielena Venegas[1‡], Robert D. Kinley[2‡], Rocky de Nys[3‡], Toni L. Duarte[1‡], Xiang Yang[1‡], Ermias Kebreab[1☯]

1 Department of Animal Science, University of California, Davis, California, United States of America, **2** Commonwealth Scientific and Industrial Research Organisation, Agriculture and Food, Townsville, Queensland, Australia, **3** College of Science and Engineering, James Cook University, Townsville, Queensland, Australia

☯ These authors contributed equally to this work.
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Check for updates

Cattle producers waiting on FDA for feed additive products that could reshape industry world

Bipartisan FEED bill may fast-track approvals that could reduce methane emissions and increase profitability.

Jennifer M. Latzke
June 22, 2023

3 Min Read

FEED ADDITIVE: There are several feed additive products under research and on the market that could reduce ruminant animal methane emissions, while increasing livestock producers' profitability. A proposed bipartisan bill, Innovative Feed Enhancement and Economic Development (FEED) Act of 2023, could change how long they have to wait for FDA approval. RICHARD HAMILTON SMITH/GETTY IMAGES

"Currently, FDA pushes these feed additive products through one of two approval process. Either they go through the process for animal drugs — which is an eight- to 10-yearlong process — or its feed ingredients process, which is about two years."

June 23, 2023

Editor's Choice

The FDA policy matrix for feed additives – drug or food?

Article	Intended Use	Legal Status	Regulate As
Animal Feed or Food	Disease prevention or therapy excluding prevention of specific nutritional deficiencies	Drug - 201(g) Food - 201(f)	**Drug**
	Production claims	Drug - 201(g) Food - 201(f)	**Drug**
	Structure or function (g)(1)(C), excluding production claims	Drug - 201(g) Food - 201(f)	Food
Nutritional Ingredient	Disease therapy including treatment of nutritional deficiencies; disease prevention excluding specific substance nutritional deficiencies	Drug - 201(g) Food - 201(f) (1)&(3) - 201(s)	**Drug**
	Production claims, see footnote 3 for examples	Drug - 201(g) Food - 201(f)	**Drug**
	Prevention of nutritional deficiencies - (g)(1)(b) excluding diagnosis, cure mitigation, treatment	Drug - 201(g) Food - 201(f)	Food
	Structure or function - excluding production claim	Drug - 201(g) Food - 201(f)	Food
Non-nutritive Ingredient	Disease prevention or therapy	Drug - 201(g) Food - 201(f)	**Drug**
	Structure or function	Drug - 201(g) Food - 201(f)	**Drug**
	No disease prevention or therapy or structure/claims	201(s) substance Food - 201(f)	Food

Van Eenennaaam. 2023. GEN Biotechnology.Feb 2023.36-42.http://doi.org/10.1089/genbio.2023.0003

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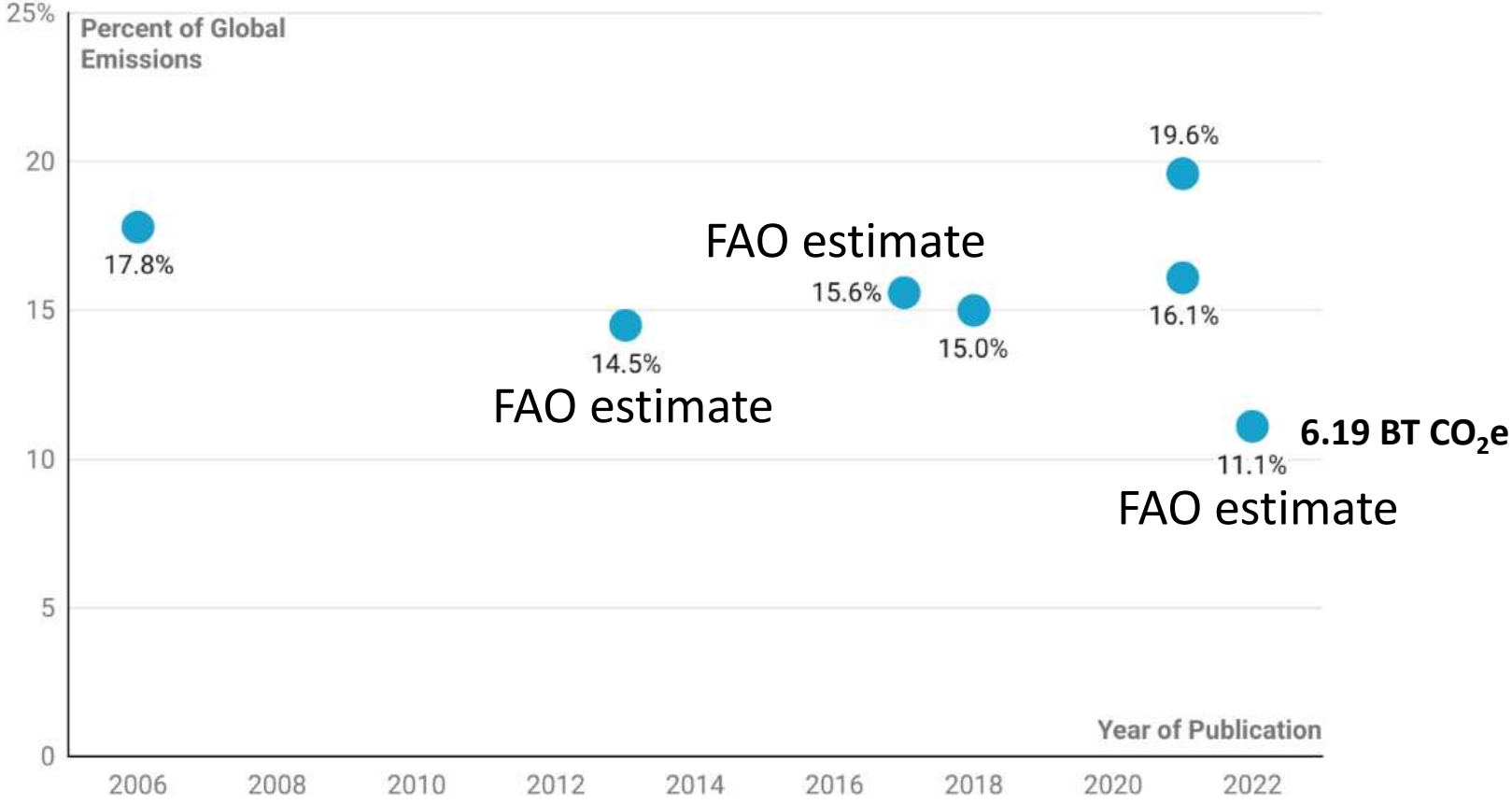
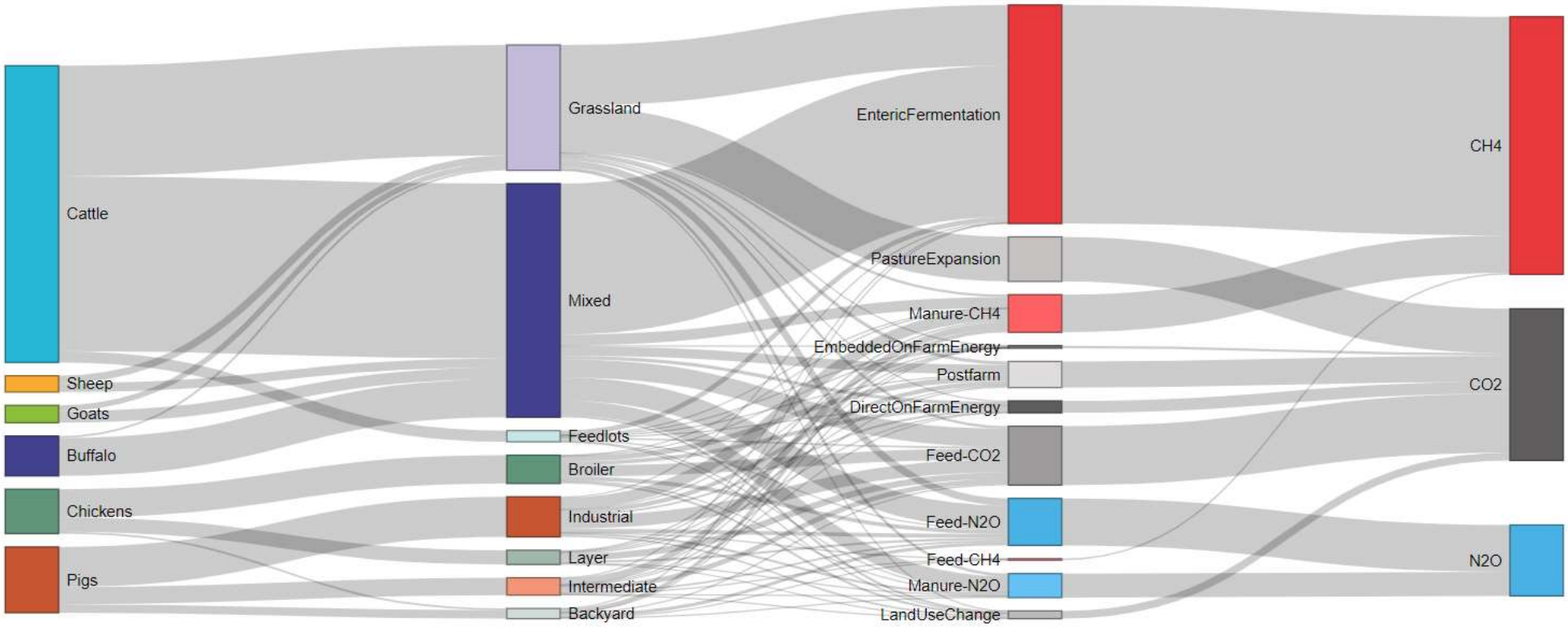
The Food and Agriculture Organization of the United Nations has released a new, global estimate that livestock produce 11.1% of global greenhouse gas emissions. Peer-reviewed studies have put the figure higher, at up to 19.6% of emissions.



https://thebreakthrough.org/issues/food-agriculture-environment/livestock-dont-contribute-14-5-of-global-greenhouse-gas-emissions

Chart: The Breakthrough Institute • Created with Datawrapper

Total emissions (6.19 BT CO2e) – the lion's share is ruminants raised on grassland and mixed systems



https://foodandagricultureorganization.shinyapps.io/GLEAMV3_Public/

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How to Cut the Carbon Footprint of Ruminants

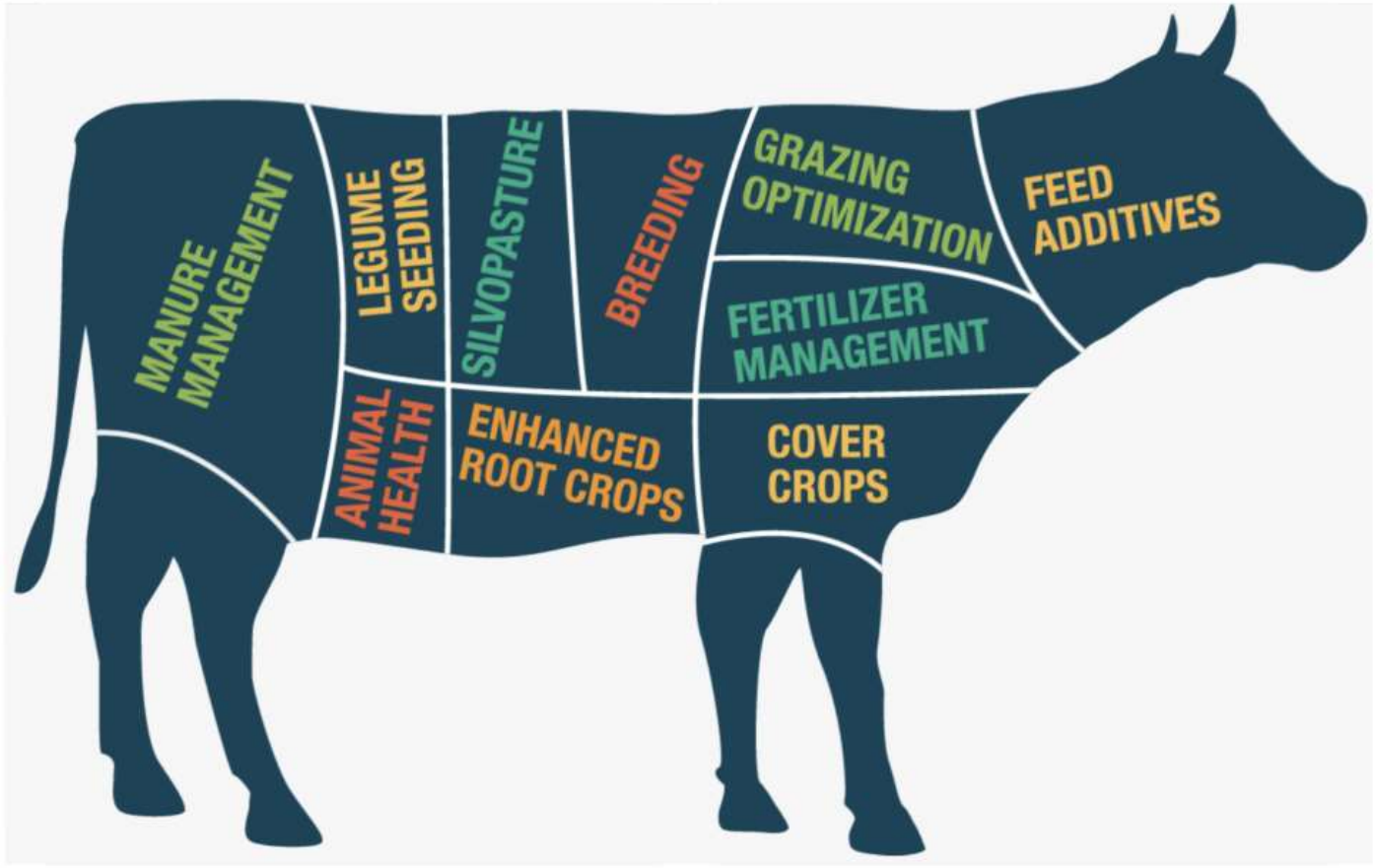

Image: The Breakthrough Institute

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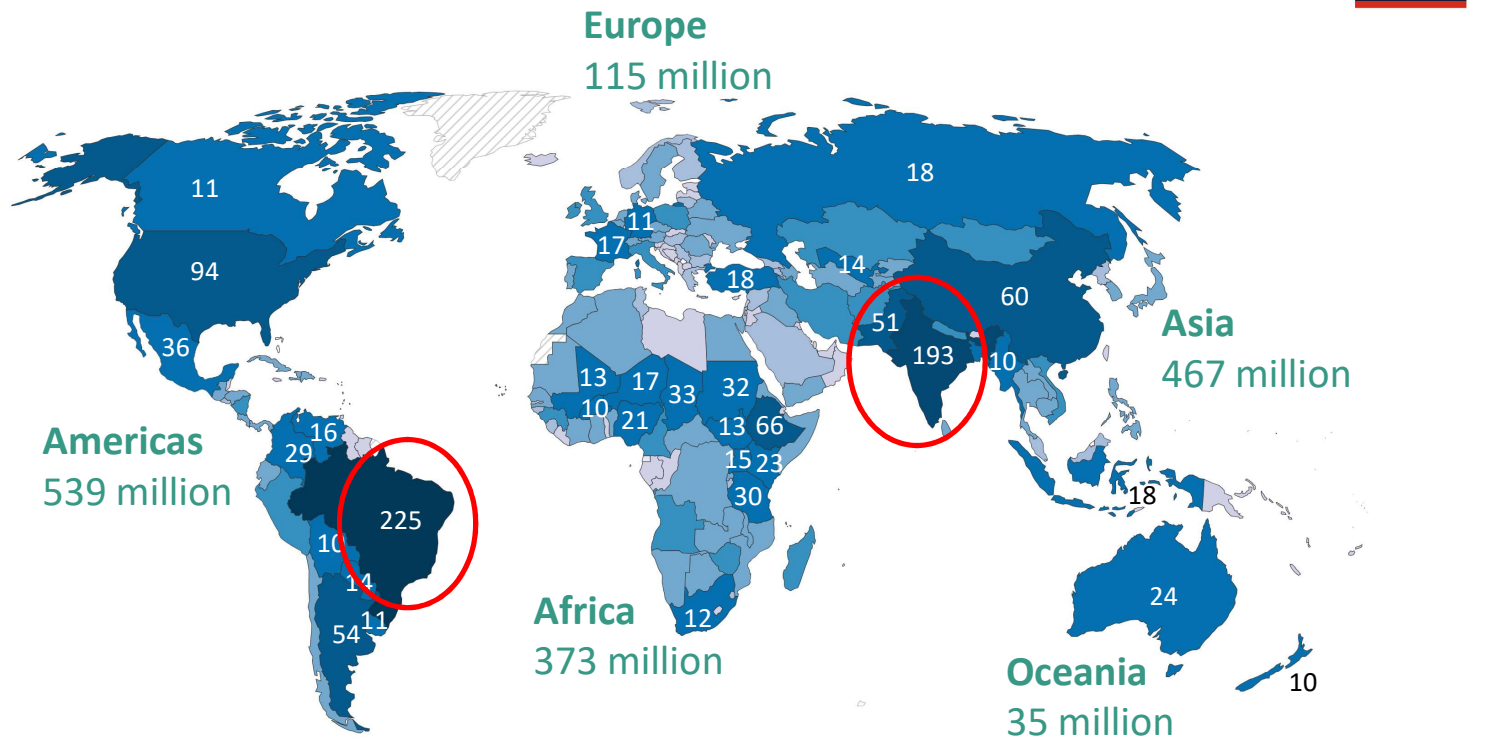
Number of cattle, 2021

(1,529,296,000)

Our World in Data

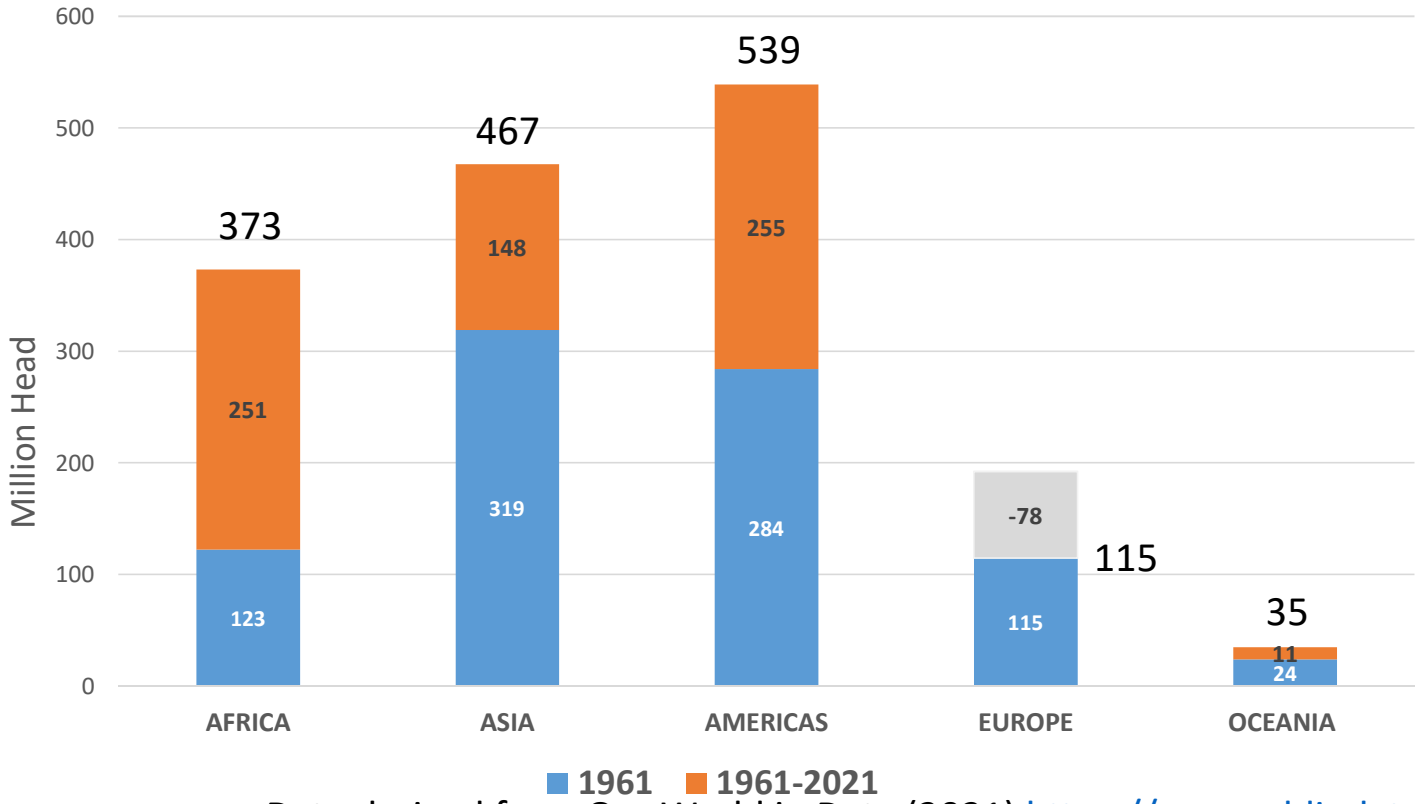


Individual countries with more than 10 million cattle show the number of cattle

Data derived from Our World in Data (2021) https://ourworldindata.org/grapher/cattle-livestock-count-heads

Source: Food and Agriculture Organization of the United Nations

Cattle numbers by FAO region 1961-2021



Growth of Cattle Populations 1961-2021 in:

- High income countries 0%
- Upper-middle income 63% (+203 M)
- Lower-middle income 70% (+201 M)
- Low income countries 251% (+177 M)

[Least developed countries 190% (+226M)]

Countries with the most growth 1961-2021

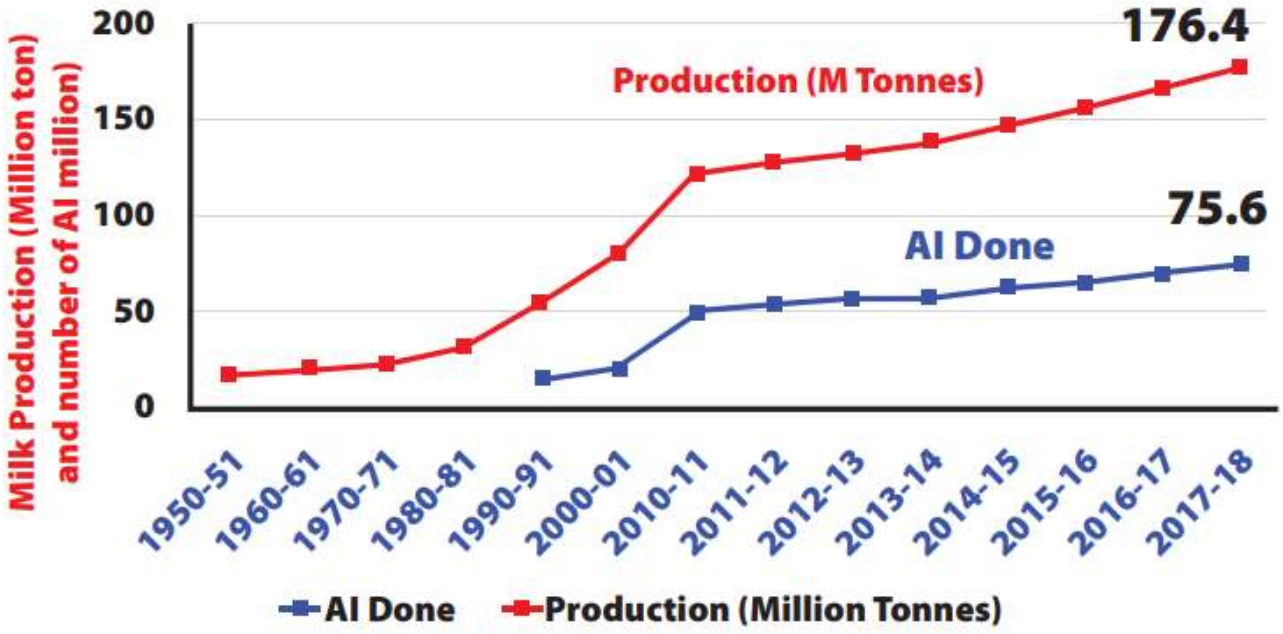
1.	Brazil	300%	(+169 M)
2.	Pakistan	263%	(+37 M)
3.	Ethiopia	125%	(+36 M)
4.	Sudan + South Sudan	491%	(+34 M)
5.	Chad	706%	(+29 M)
6.	Tanzania	281%	(+23 M)
7.	Mexico	118%	(+19.5 M)
8.	India	10%	(+17.5 M)
9.	Kenya	217%	(+16 M)
10.	Nigeria	251%	(+15 M)

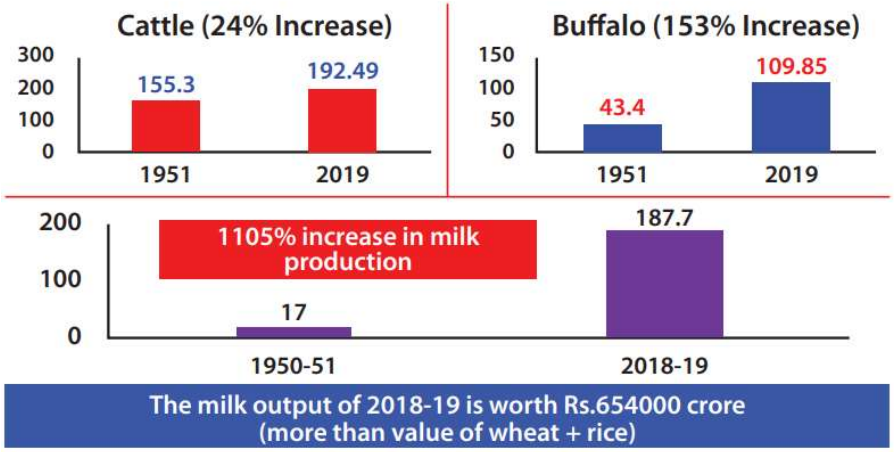
Data derived from Our World in Data (2021) https://ourworldindata.org/grapher/cattle-livestock-count-heads

Source: Food and Agriculture Organization of the United Nations

The impact of relatively simple biotechnology (Artificial Insemination) on the efficiency of Indian milk production

INDIA is the largest dairy producing nation in the world





India 22% of global milk production

NAAS 2020. Livestock Improvement through Artificial Insemination, Policy Paper No. 96, National Academy of Agricultural Sciences, New Delhi

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What opportunities are there to improve livestock production efficiencies in LMIC?

- Low- and Middle-income Countries (LMIC) are home to 76% of the global cattle herd and contribute the 75% of global ruminant greenhouse gas emission emissions
- Chang (2021) estimated that improving livestock production efficiencies in the 10 countries with the largest emission reduction potential (**Madagascar, Morocco, Niger, South Africa, Tanzania**), Asia (**China, India, Iran, Turkey**) and South America (**Brazil**) could contribute 60%–65% of the global reduction in livestock emissions by 2050 (compared to a baseline where emissions intensities are held constant in the future). Chang J, Peng S, Yin Y, Ciais P, Havlik P, Herrero M. 2021. The key role of production efficiency changes in livestock methane emission mitigation. AGU Advances. 2: e2021000391.
- Rathod (2017) wrote regarding India "researchers and **extension experts** need to make farmers more aware about the benefits of AI in the dairy sector. Further, the scientists have to analyze the problems faced by farmers and find suitable solutions for higher diffusion and adoption of AI at field conditions." Rathod et al. 2017. "Adoption status of artificial insemination in Indian dairy sector". Journal of Applied Animal Research, 45: 442-446.
- At the global scale are resources better spent further decreasing methane emissions in the relatively efficient systems of high income countries? Or improving conditions in the growing and relatively inefficient cattle herds in low income and developing countries?