

Pathways to Dairy Net Zero Webinar: Research Work Program

September 28, 2023



**PATHWAYS
TO DAIRY
NET ZERO.**

AGENDA

- 01 Welcome & Agenda Overview**
Kevin Burkum, Chief Communications Officer, Global Dairy Platform
- 02 P2DNZ Updates**
Donald Moore, Executive Director, Global Dairy Platform
- 03 Intro to GRA and P2DNZ Research**
Professor Richard Dewhurst, Global Research Alliance on Agricultural Greenhouse Gases and Head of the Dairy Research Centre at Scotland's Rural College
- 04 Barriers and Incentives for the Uptake of GHG Mitigation Technologies**
Professor Andrew Barnes, Professor of Rural Resource Economics, Scotland's Rural College
- 05 Dairy Demand Projections**
Dominik Wisser, Livestock Policy Officer, FAO
- 06 Modeling the Global Warming Effect of Dairy**
Professor Richard Dewhurst
- 07 Next Steps**
Professor Richard Dewhurst
- 08 Questions and Answers**

Industry Statement for Antitrust Compliance

There shall be no discussion or activities for the purpose of arriving at any understanding or agreement regarding price, the terms or conditions of sale, distribution, volume of production, territories, or customers.

There shall be no discussion or activity for the purpose of preventing any person or persons from gaining access to any market or customer for goods or services, nor any agreement or understanding to refrain from purchasing or using any material, equipment, services, or supplies.

There shall be no discussion or activity that may be construed as forestalling or limiting research and development.

We, of course, expect your full compliance with these guidelines, both while in attendance at this Global Dairy Platform, Inc. meeting and at all times and in all matters relating to Global Dairy Platform, Inc.

PATHWAYS TO DAIRY NET ZERO: ACCELERATING ACTION, ACHIEVING RESULTS

September 28, 2023



**PATHWAYS
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NET ZERO.**

Getting to “Zero”

Changing **existing practices** through **known levers**

~40%
reduction

Scaling existing
and emerging
technologies

~35%
reduction

Long term,
fundamental
and **applied**
research

~25%
reduction

Initial P2DNZ Strategy: Promote value & accelerate progress of initiatives in developed dairy economies – while creating a model to deliver reductions in emerging dairy economies

20% of GHG Emission come from developed dairy countries

- Many have already got plans in place, most are members of the DSF
- Start by telling the dairy story based upon these countries
- Seek opportunities to accelerate progress

However, 80% of emissions come from emerging dairy countries

- ~10 developing countries represent >30% of total dairy emissions
- This group can achieve significant intensity reductions in a relatively short time frame by implementing practice changes

Progress in developed dairy economies

4 Tracks guide regional work:

Methods /
Frameworks
/Proof points

Accelerated
Implementation
& R+D

Policy Making
and Partnerships

Pilots /
Lighthouse
Projects

Globally seek 3-4 Collaborative actions:

1. **Carbon Accounting**
Ensuring the sector is recognized for its emission reductions efforts is key to the Pathways initiative.



2. **Dairy Processing**
Taskforce to investigate latest advances in dairy processing technologies to tackle GHG emissions.



3. **Methane**
Develop science based narrative on dairy and methane emissions and actions underway

4. **Animal Nutrition (launching soon)**



Progress in emerging dairy economies

Identifying *Early Adopters* from emerging dairy economies

- ✓ Working with the Global Methane Pledge, Cornell University, FAO and GDP, we identified 10 countries to approach as “Early Adopters” of the Pathways to Dairy Net Zero initiative.
- ✓ Between them, these countries represent over 30% of the GHG emissions from dairy.
- ✓ Through the Global Methane Pledge and US Department of State, letters were sent to the first group of countries inviting them to join the program



*

* GDP is a supporter of the Global Methane Pledge

Progress in emerging dairy economies

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Potential Early Adopters

Region	Early Adopters	Status
Africa	Tanzania	Agreed
	Kenya	Agreed
	Rwanda	Agreed
	Uganda	Agreed
Americas	Uruguay	Agreed
	Costa Rica	Agreed
	Colombia	Agreed
Asia	Pakistan	Agreed
	Vietnam	Agreed
	India	In discussion
Dairy GHG %	~31%	



GREEN
CLIMATE
FUND



Investing in rural people



GLOBAL
DAIRY
PLATFORM



USAID
FROM THE AMERICAN PEOPLE

Progress in emerging dairy economies

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DEVELOPMENT BANK
OF LATIN AMERICA



GLOBAL
DAIRY
PLATFORM



Global
Methane
Hub



Pathways to Dairy Net Zero

www.PathwaysToDairyNetZero.org

Pathways to Dairy Net Zero: Research Program

Richard Dewhurst

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Pathways to Dairy Net Zero

Quarterly Webinar

28th September 2023



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Presentations

Richard Dewhurst	Introduction to the GRA and its work with Pathways to Dairy Net Zero.
Andrew Barnes	Barriers and incentives for uptake of GHG mitigation technologies.
Dominik Wisser	Dairy demand projections
Richard Dewhurst	Modelling the global warming effect of dairy
Richard Dewhurst	Next steps – leading into discussion.

Role of the Global Research Alliance

Global Research Alliance on Agricultural Greenhouse Gases (GRA) is a knowledge partner of the Pathways to Dairy Net Zero initiative.

- GRA unites 67 countries in the pursuit of low emissions agricultural production, drawing on expertise across all regions and production systems (livestock and crops).
- Livestock Research Group co-chairs taking the lead on behalf of the GRA. Work done in close collaboration with FAO – building on their GLEAM modelling and analysis of trends in demand.
- Work is consultative, but led by a core team with relevant expertise, diverse dairy systems knowledge, and spread of geographic coverage.
- GRA also coordinates mitigation research (e.g. Methane Reducing Additives Flagship)



GLOBAL RESEARCH ALLIANCE

ON AGRICULTURAL GREENHOUSE GASES



Key contact:

Dr Harry Clark - GRA Special Representative

n,

GRA at glance

GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

AT A GLANCE

67 member countries

29 partner organisations

Over **3000** scientists involved in activities of the GRA

6 GRA Flagship Projects and a further...

152 international collaborative projects supporting the GRA, and...

278 fellowships awarded to recipients from **49** countries

4 Research Groups

- Paddy Rice Research Group
- Livestock Research Group
- Croplands Research Group
- Integrative Research Group

18 Science Networks

53 technical training workshops held

80 technical guidelines, resource materials and databases produced

globalresearchalliance.org [@GRA_GHG](https://twitter.com/GRA_GHG) April 2023

Livestock Research Group

- Animal Health & GHG Emissions Intensity Network*
- Animal Selection, Genetics & Genomics Network*
- Feed & Nutrition Network*
- Manure Management Network*
- Rumen Microbial Genomics Network*

Paddy Rice Research Group

- Americas Sub-Group*
- Asia Sub-Group*
- Africa Sub-Group*

Croplands Research Group

- Agroforestry Systems Network*
- Conservation Agriculture Network*
- Integrated Crop-Livestock Systems Network*
- Landscape Management of Agricultural Systems Network*
- Nutrient Management Network*
- Peatland Management Network*

Integrative Research Group

- Farm To Regional Scale Integration Network*
- Inventories and NDC Network*
- Soil Carbon Sequestration Network*
- Circular Food Systems Network*

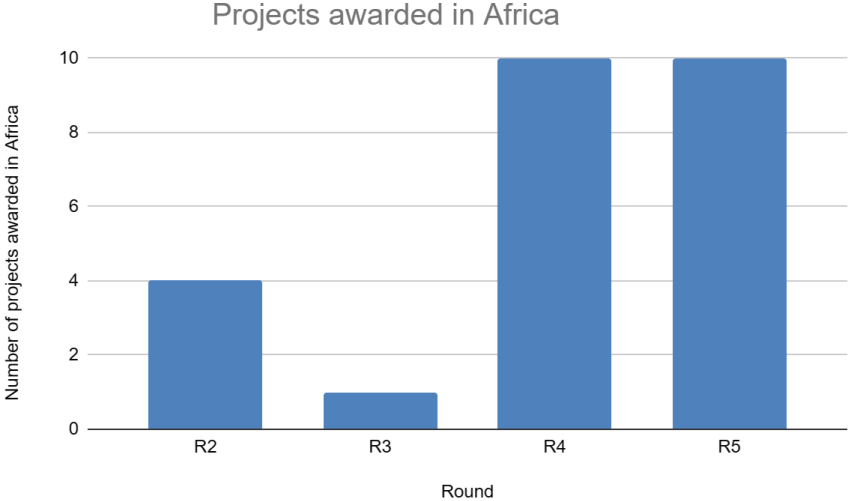
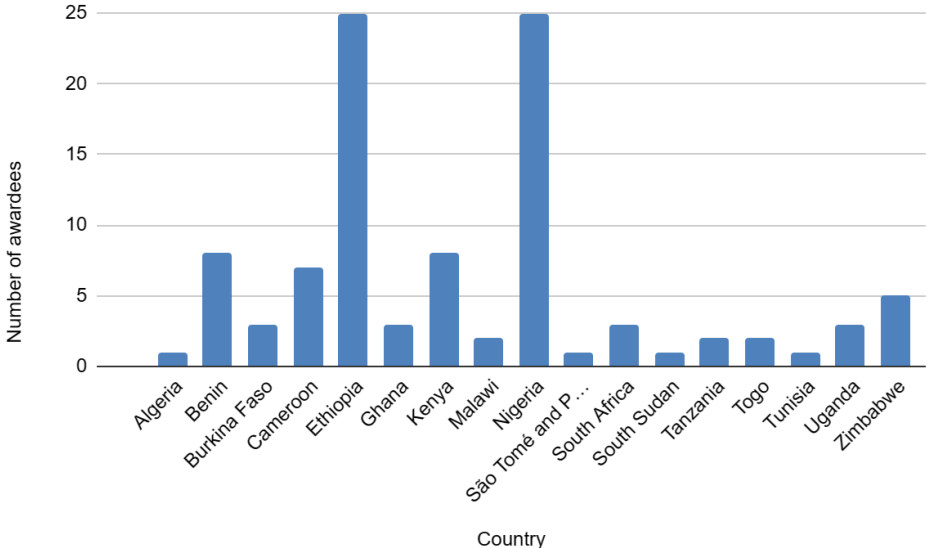
GRA Partners and Members



GRA Scholarships

CLIFF-GRADS Programme

- The Climate, Food and Farming, Global Research Alliance Development Scholarships Programme (CLIFF-GRADS) is a joint initiative of the **GRA & Mitigate+**: Research for Low Emissions Food Systems
- 176 PhD students** have received awards since 2017



GRA Scholarships

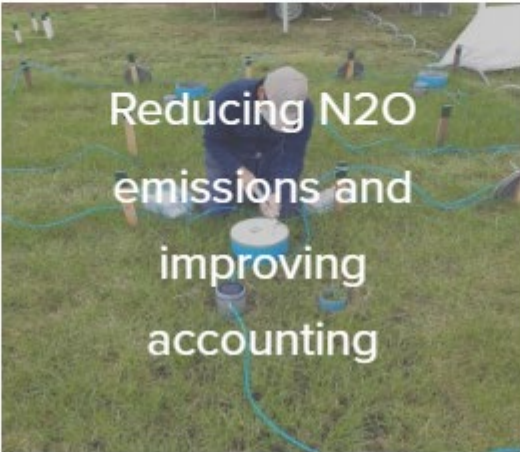
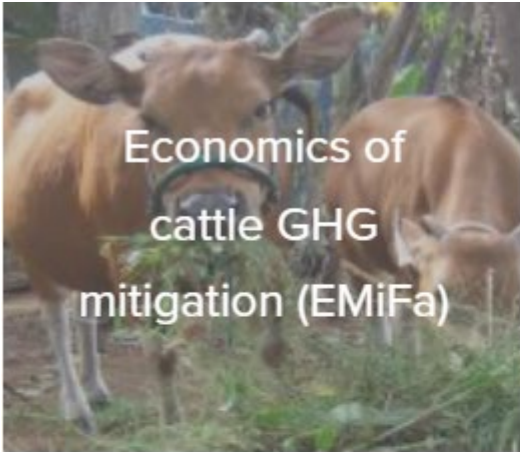
RUFORUM GRA Graduate Research Grants

Aim: to build the capability of graduate students and post-graduate scientists in Africa to conduct applied research on agricultural GHGs

- 2020: R1 supported **8 projects**, involving **22 Masters students**
- 2022: R2 will support **8 research grants including Masters students and 2 PhD research grants**
 - R2 closed on 10 April 2023 and selected projects will be announced at the end of October.
 - 57 applications received for Graduate Research Grants & 24 for Doctoral Grants
- The R2 PhD projects are part of a joint research initiative between GRA, RUFORUM and ILRI's Mazingira Centre



Current Flagship projects

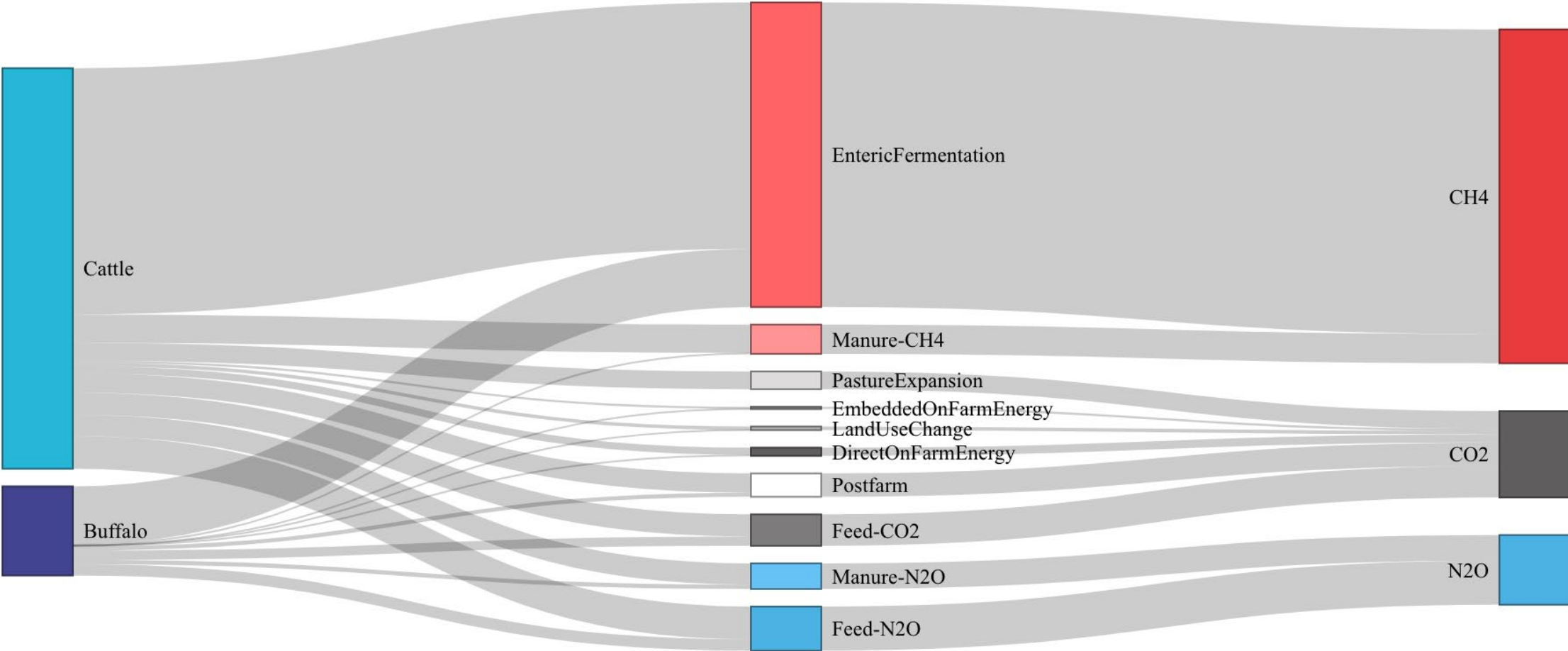


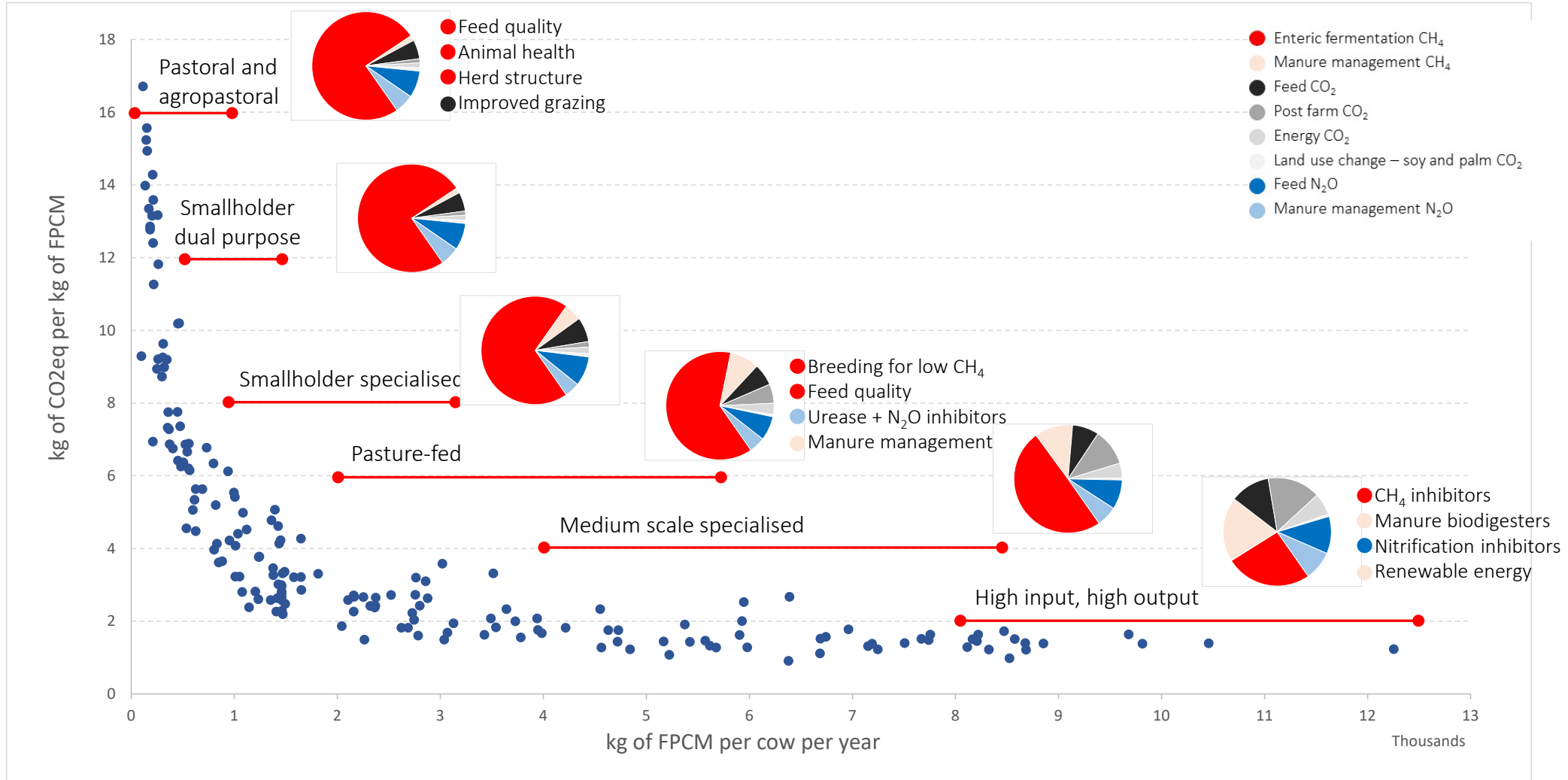
Approaches adopted

1. Classification of GHG mitigation options, grouping similar methods;
2. Dairy typologies - description of dairy systems in country case studies;
3. Evaluation of mitigation options and potential for uptake, including barriers to adoption
4. Estimating the range of potential GHG mitigation in each dairy system and scaling up to global estimates;
5. Modelling the effects on global temperature of 'business as usual' and mitigated scenarios.

Sources of dairy emissions - 2.7 GT CO₂eq. (38% of all livestock emissions)

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Categories of mitigation options

- Improving feed quantity/quality (agronomy; plant breeding; processing)
- Improving productivity per animal
- Methane inhibiting feed additives
- Breeding programme for low emitting animals
- Use of a methane vaccine
- Manure storage and treatment option
- Use of biodigesters
- Optimising the feed mix - diet formulations (e.g. Improve Energy: Nitrogen ratio)
- Use of urease and nitrification inhibitors
- Reducing over-grazing & nutrient depleting forage production (C sequestration)
- Other C sequestration methods; e.g. agro-forestry
- Reducing feed loss and waste
- Reducing fertilizer use
- Reducing fossil-fuel use on-farm
- Use of electricity from on- or off-farm renewable sources
- Improved animal health

Discussion of mitigation options

Emission source	Mitigation actions	Technical reduction potential	Availability	Observations
Enteric fermentation (CH ₄)	Improve feed quantity/quality	up to 50%	now	Increases milk production and emissions per cow, resulting in reduced milk footprint. Higher potential in low productivity systems.
Enteric fermentation (CH ₄)	Improve productivity per animal	up to 50%	now	Higher potential in low productivity systems, but it MUST be supported by improved nutrition.
Enteric fermentation (CH ₄)	Changes in management	up to 70%	now	Higher potential in low productivity systems. Potential tradeoffs with productivity.
Enteric fermentation (CH ₄)	Methane inhibiting feed additives	up to 50%	2-5 years	Diet (roughage/TMR) may affect performance. Difficult implementation outside of TMR (would depend on slow release mechanism).
Enteric fermentation (CH ₄)	Breeding programme for low emitting animals	up to 15%	5-10 years	Better in systems where few bulls produce most of the herd
Enteric fermentation (CH ₄)	CH ₄ Vaccine	N/A	30 years	Applicable to all systems. Still speculative. Working prototype still pending.
Manure and urine (CH ₄ , N ₂ O)	Manure storage, treatment, and collection of gases.	up to 80%	now	Mostly for systems with active manure management. Anaerobic digestion could offset energy emissions, as well as reducing manure emissions.
Manure and urine (CH ₄ , N ₂ O)	Improve Energy:Nitrogen ratio in diet		now	Excess nitrogen primarily in intensive pasture-based systems. Tradeoffs with productivity and other mitigation options
Manure and urine (N ₂ O)	Urease and nitrification inhibitors	up to 60%	now	High dependence on soil type and temperature. Toxicity concerns.
Feed production (CO ₂ , N ₂ O)	Reduced land area for feed production, land released for afforestation or other uses	up to 100%	now	Constrained by availability of suitable land. Afforestation could offset other emissions as well.
Feed production (CO ₂)	Reduced over-grazing& nutrient depleting forage production		now	Individual vs communal ownership of land resource Carbon sequestration could help offsetting other emissions.
Feed production (N ₂ O)	Reduce fertilizer use		now	Depends on current nutrient status and fertilizer use, local rainfall and fertilizer cost.
Energy and fuel (CO ₂)	Reduced diesel/fossil-fuel use on-farm	up to 100%	now	Depends on current feed production characteristics, and availability of alternative energy sources.
Energy and fuel (CO ₂)	Electricity from on- or off-farm renewable sources	up to 100%	now	Depends on the availability of renewable electricity.

Dairy systems

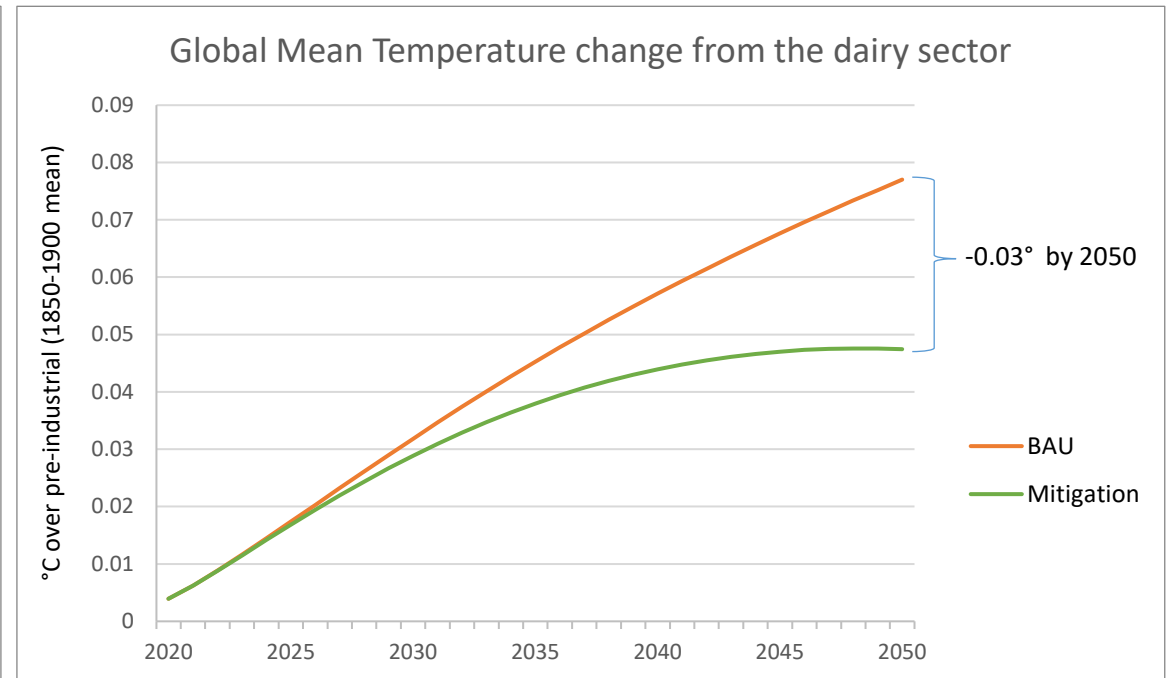
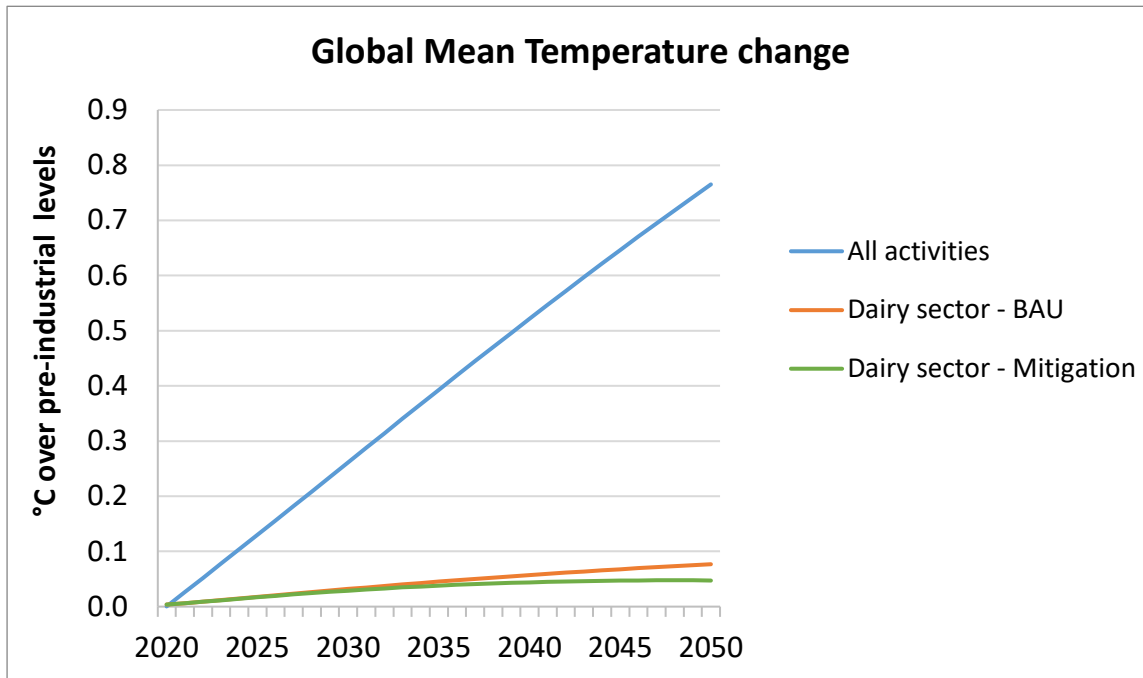
- High input, high output (fully housed)
- Medium-scale specialised (part housed; part grazing)
- Pasture-based (high pasture consumption)
- Pasture-based (high supplement consumption)
- Mixed enterprise smallholders (zero grazing)
- Mixed enterprise smallholders (some zero grazing)
- Mixed enterprise smallholders (no zero grazing)
- Livestock only smallholders
- Small and marginal (landless)
- Agro-pastoralist
- Pastoralist

Case Studies

- **Kenya:**
 - Smallholders – Extensive Semi-intensive Intensive (‘Cut and Carry’)
- **Uruguay:**
 - Higher concentrate use (grazing systems)
 - Lower concentrate use (grazing systems)
- **United Kingdom:**
 - Intensive fully housed
 - Mixed housed/grazing
 - High use of grazed grass
- **India:**
 - Marginalised, landless
 - Smallholder with cropping

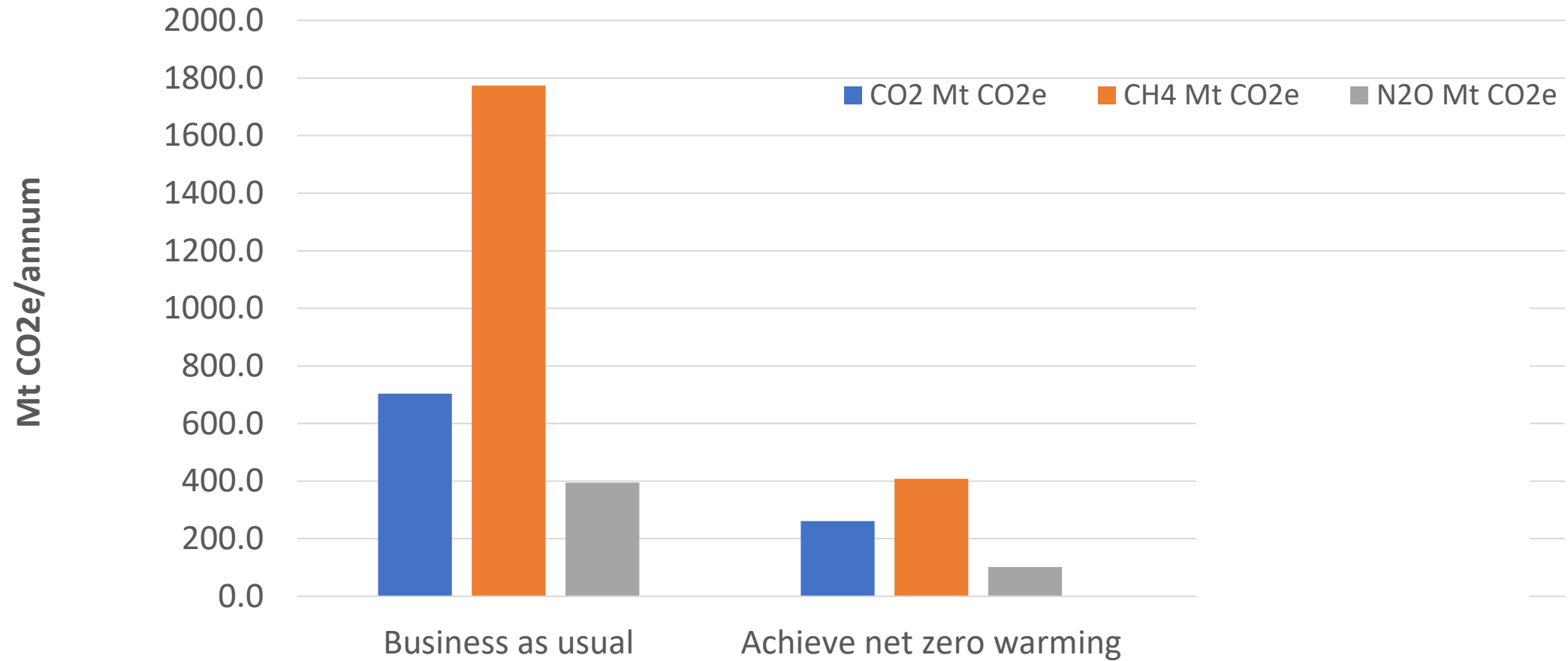
MAGIC-C: Modelling warming effects

- Addresses the issue that methane is short-lived in the atmosphere, so that methane reductions offer 'quick wins'
- Scenario to remain under 2°C warming since pre-industrial (0.8°C 2020-2050)

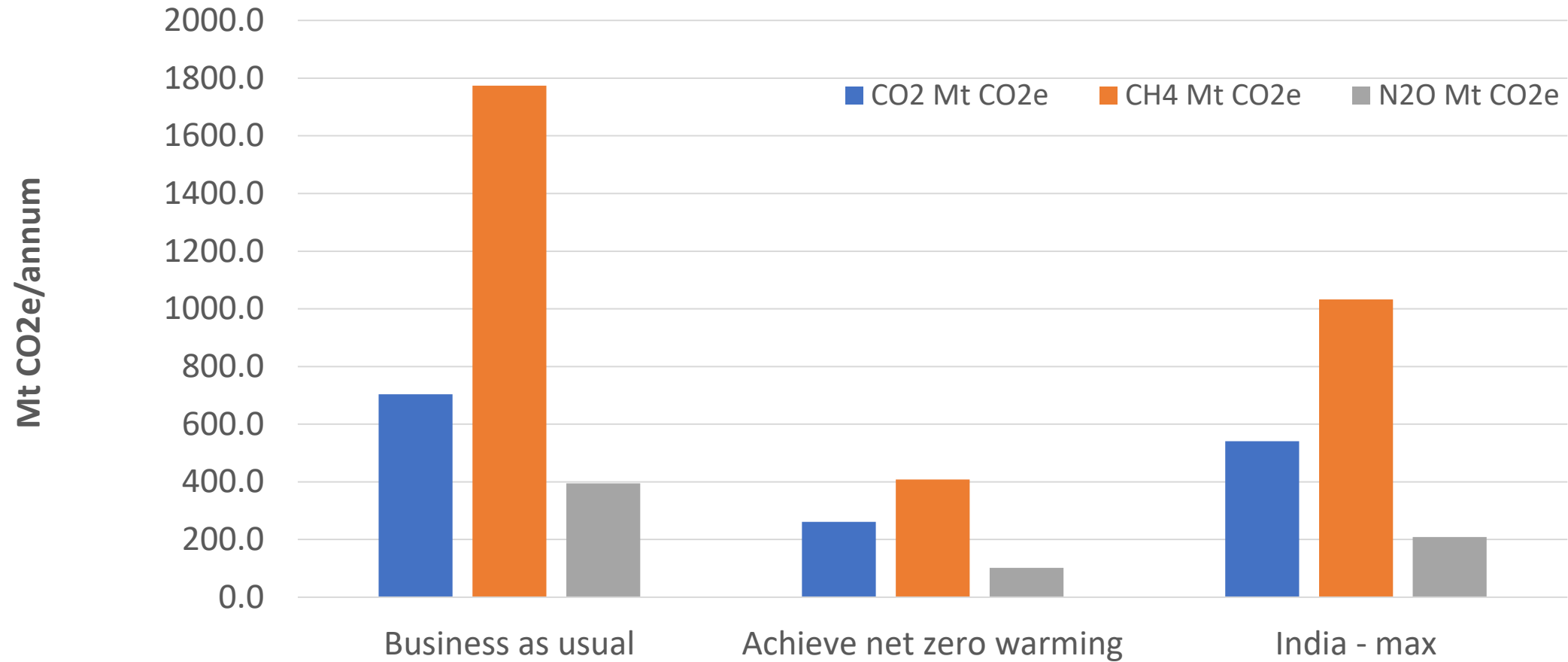


This mitigation scenario would result in avoiding 0.03°C by 2050, when compared with the BAU scenario

Mitigation required



Mitigation required



Summary

- Modelling demonstrates the level of GHG mitigation to achieve 'net zero warming' from dairy
- This is not reducing to zero emissions; but reductions are still well beyond currently identified options
- Methane reduction will be important – but currently has fewer options (though a very active research area)
- There remain large uncertainties in areas identified with large mitigation potential, such as: C sequestration, reducing food waste; energy generation
- Needs more technological advances, particularly in methane mitigation (additives, vaccine....)
- Needs more work on how to incentivise uptake of mitigations – particular opportunities to reduce emissions and improve food security in low- and middle-income countries through increasing efficiency

Next steps?

- Prioritising work on barriers to uptake, incentives for adoption, and linkage with policy – which options for which systems?
 - Both in the context of existing technologies (esp. ‘win-win’ solutions) and technologies at various stages of the R&D pipeline
- Global collaborations working on methane mitigations for the short-, medium- and long-term.
 - Building on the GRA Feed Additives Flagship that GRA supports.
 - Opportunities with the Global Methane Hub
- Better insights into C sequestration, energy systems (generation and use), food waste and co-products (circular bioeconomy)

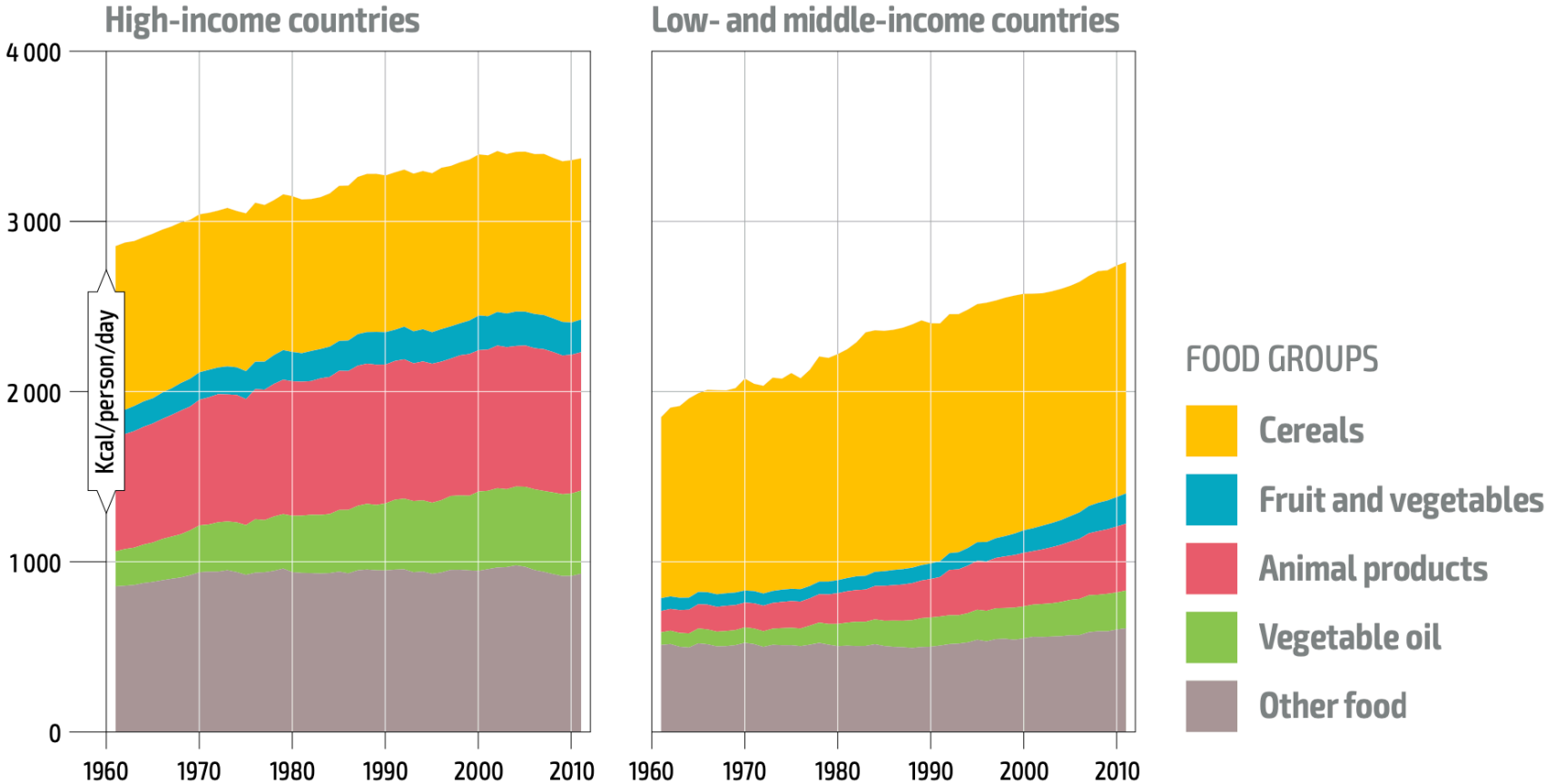
Dairy demand projections

Dominik Wisser and Giuseppe Tempio



**Food and Agriculture Organization
of the United Nations**

Diets change with income



Source: FAO Global Perspective Studies, based on FAOSTAT (various years).



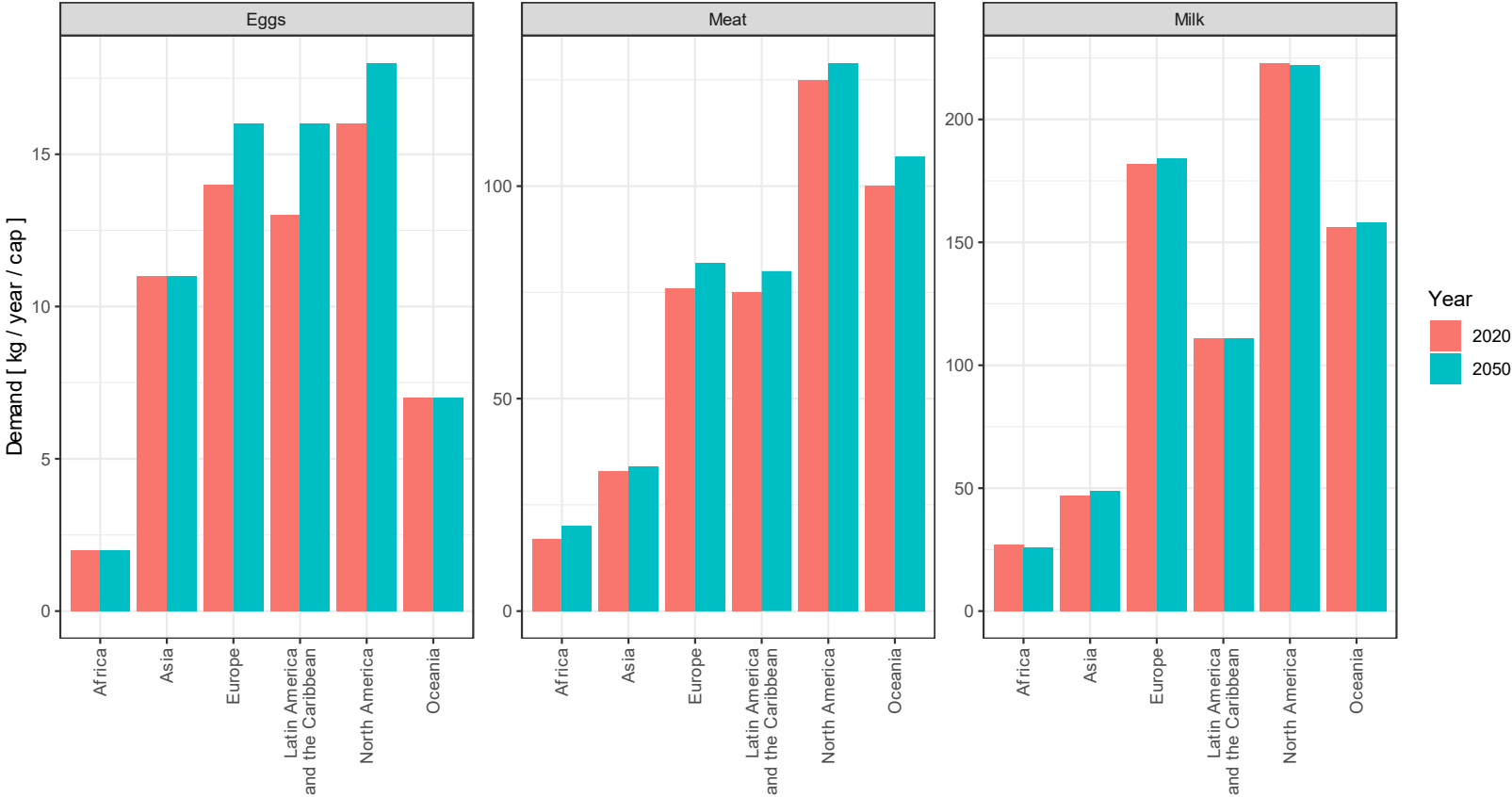
Demand = Production

Population x demand per capita = Herd x off-take + netTrade

- **Protein demand** from animal sources calculated combining data on:
 - Per capita daily protein supply
 - Human population
- **Global Perspective Studies (GPS)** dataset (FAO, 2018): 5-year steps projections, from 2020 to 2050.
- **FAOSTAT** Food Balance Sheet: historical trends from 1961 to 2020
- GPS data combined with FAOSTAT to produce a **long-term time series of animal protein demand**, from 1961 to 2050.



Projections of per capita demand for meat, milk, eggs




 Food and Agriculture Organization of the United Nations

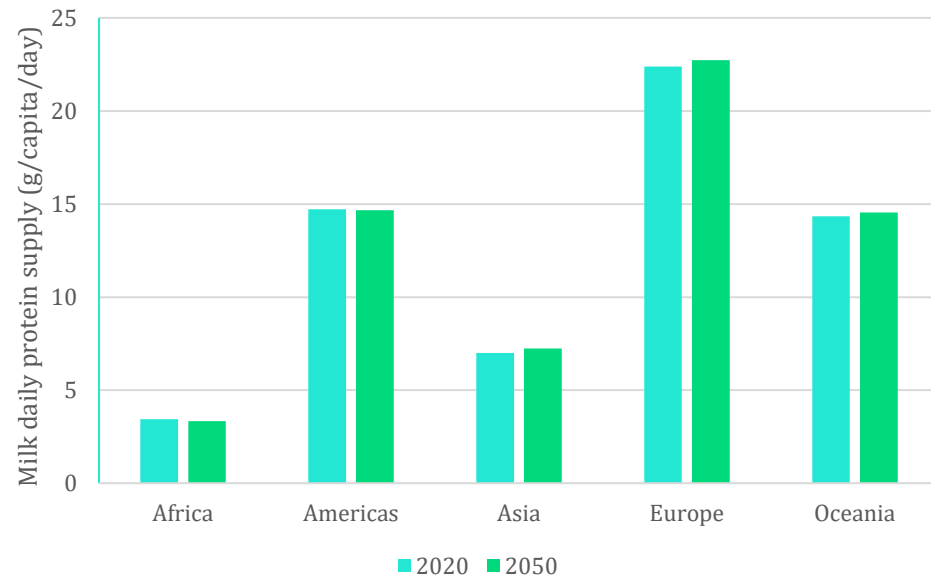
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The future of food and agriculture
 Alternative pathways to 2050

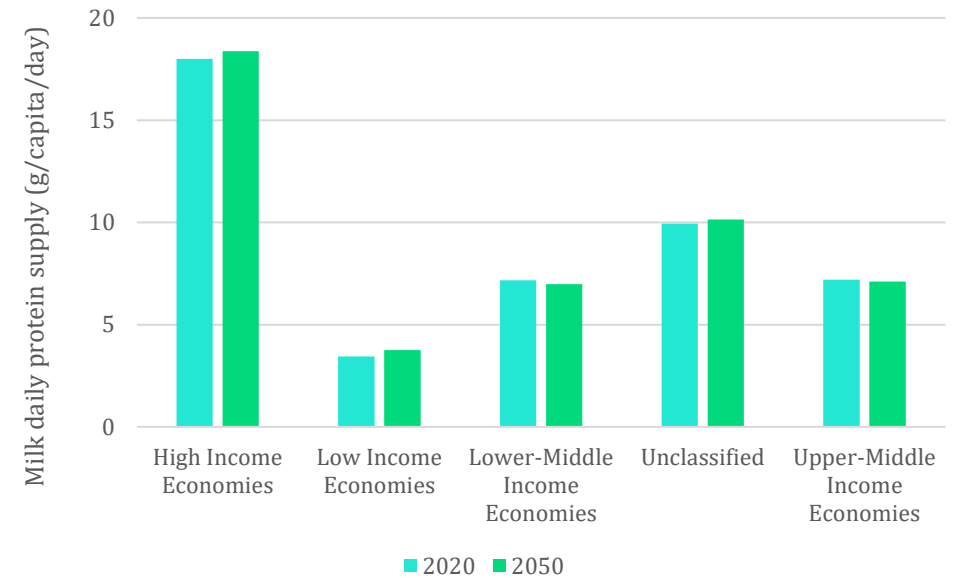


Per capita protein supply from milk – projections to 2050

Projections by continent



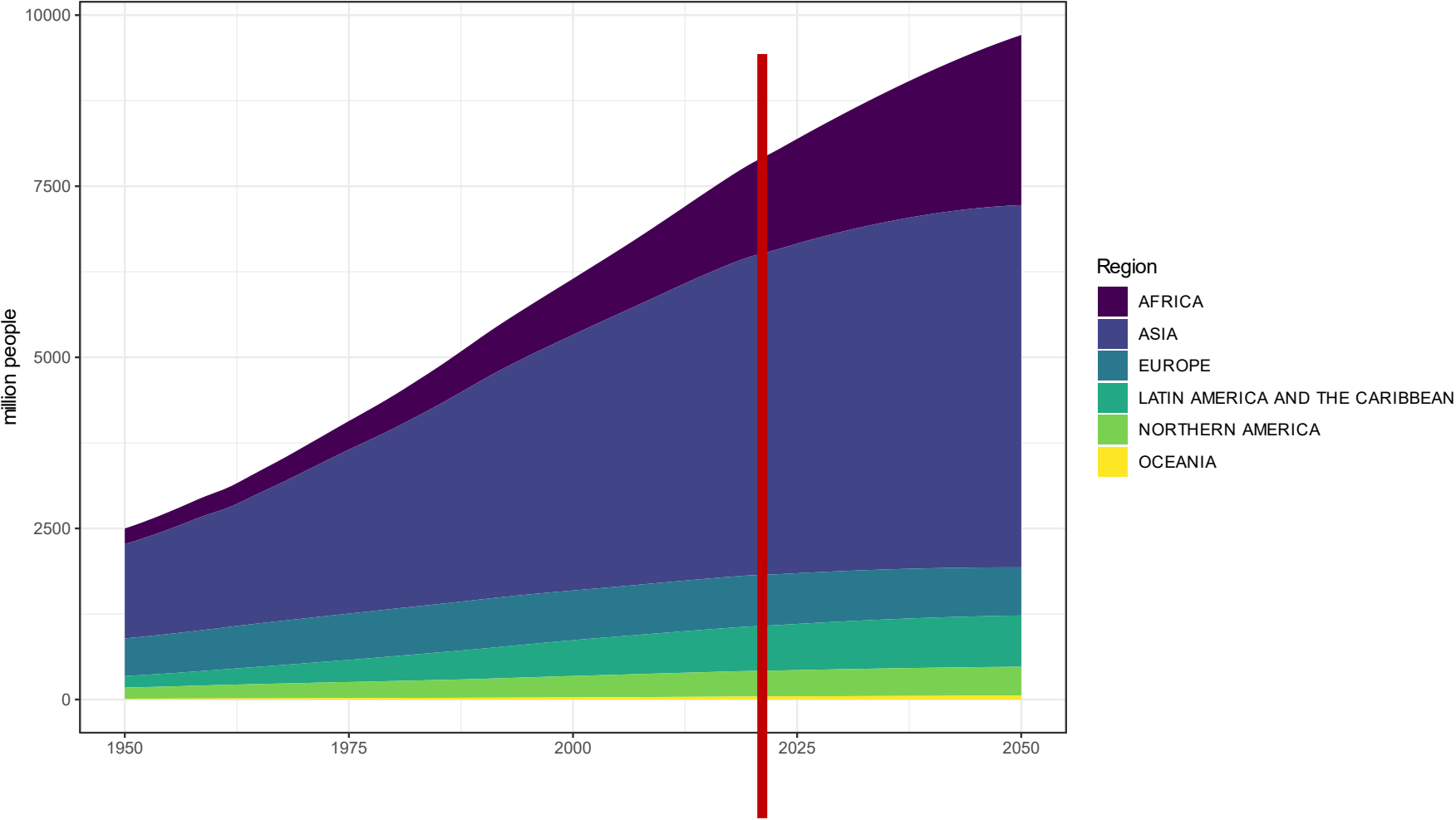
Projections by World Bank Regions



CONTINENT	g/capita/day - 2020	g/capita/day - 2050	Relative change
Africa	3.44	3.34	-3%
Americas	14.72	14.66	0%
Asia	7	7.25	4%
Europe	22.38	22.73	2%
Oceania	14.35	14.55	1%

WORLD BANK REGIONS	g/capita/day - 2020	g/capita/day - 2050	Relative change
High Income Economies	18.00	18.37	2%
Low Income Economies	3.45	3.77	9%
Lower-Middle Income Economies	7.18	6.99	-3%
Upper-Middle Income Economies	7.20	7.11	-1%

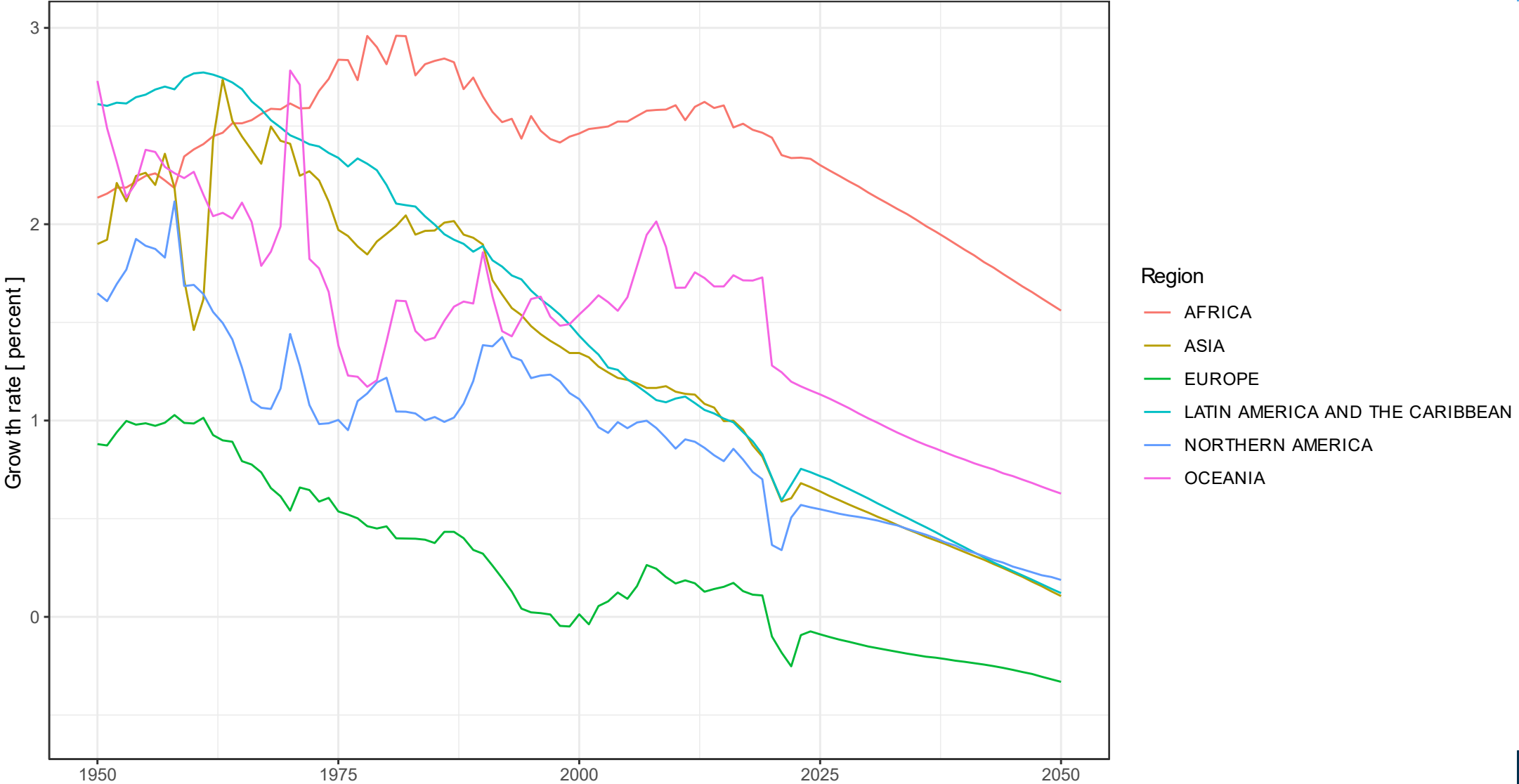
Population Growth



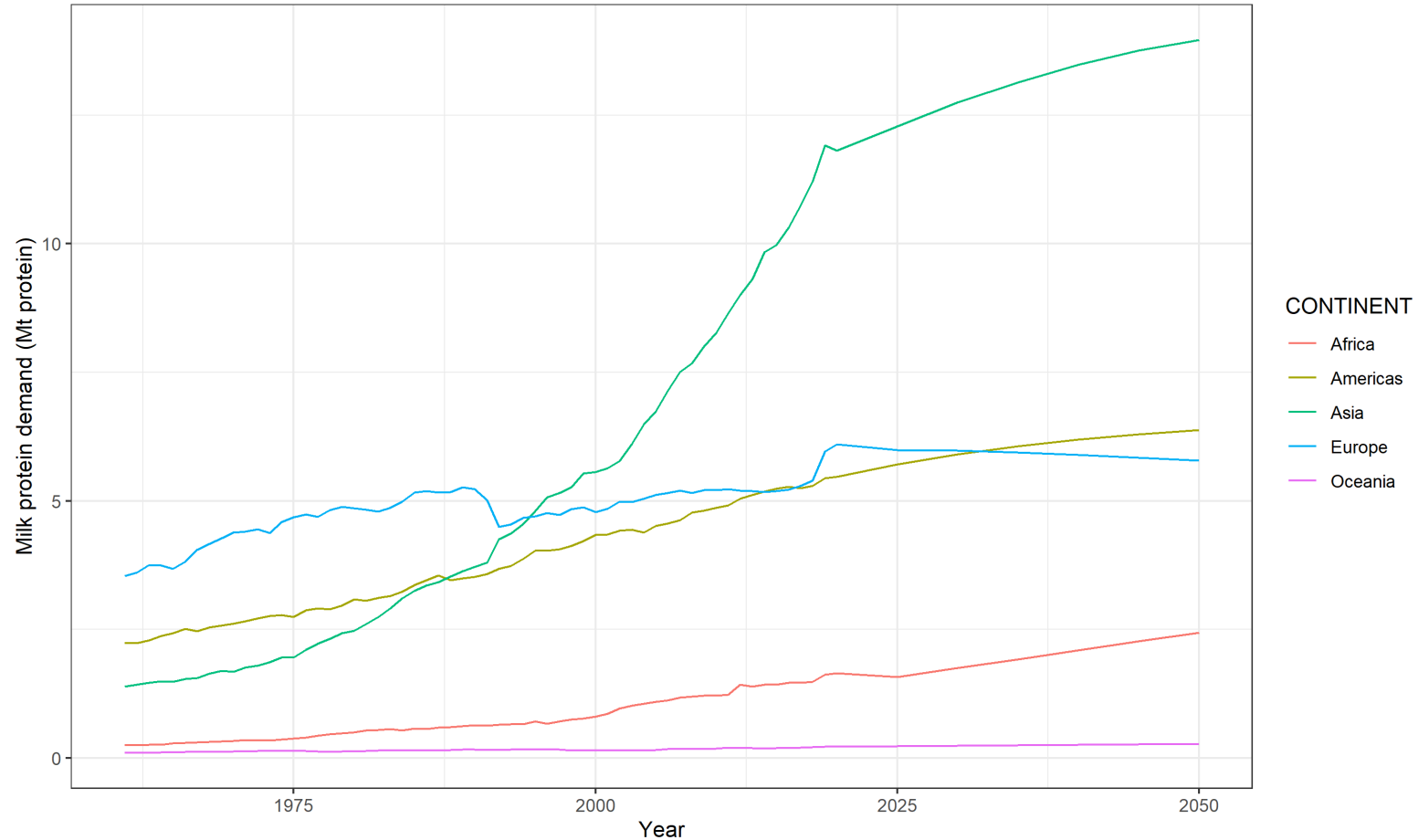
Global population:
2.52B in 1950
7.84B in 2020

UN DESA 2022- medium variant:
9.72B by 20250
Declining growth rates after 2020

Population Growth-rates



Total protein demand from milk – long-term time series



Dairy protein demand could increase by 17% by 2050 on a global scale.

Total demand of raw milk would increase from about 731 Mt in 2020 to 855 Mt in 2050.

The highest increase rate will occur in Africa (78%) and Oceania (31%).

Europe could be the only continent with a slight decrease in dairy total demand (about -3%).

Pathways to Dairy Net Zero: Barriers and Incentives for Uptake

Andrew Barnes and Dave Shearer

GDP Quarterly Webinars

28th September 2023



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Constraints to adoption

Personal and social-psychological factors

Age, gender, education, farming experience training, Awareness and Knowledge, leadership position, membership in an agricultural association



Farm and economic factors

Farm size, formal employment/off-farm income, land tenure arrangements, cost of adopting technologies, limited access to inputs



Environmental, physical & ecological factors

Impact of climate change, access to natural resources



Climate
Smart
Approaches

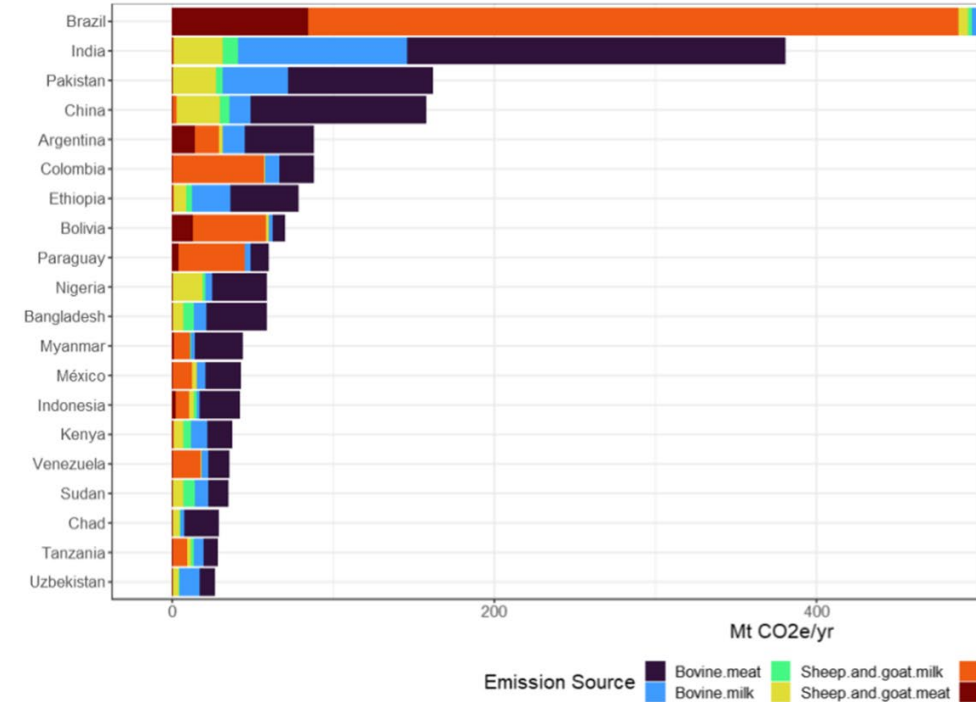
Institutional, policy and structural factors

Extension services, credit institutions, infrastructure, land tenure security



Case Study: India

- World's largest milk producer – 210MT in 2022 (22% of global supply)
- Growing fast, the fastest in the world, at 4.76% p.a over 20 years
- Growth been driven by demand, expected to increase at 10% p.a
- 85% supplied by small and marginal farmers with between 2-5 cows
- Highly diverse – over 50 cross-breed and indigenous cows used
- Milk is self-consumed (up to 24%), informally marketed (up to 23%), marketed through coops (up to 28%) with a growing market share controlled by domestic and foreign private sector firms



Applicable Technologies and Current Adoptions

- efficiency of dairy animals
 - herd health
 - breeding and animal selection
 - feeding strategies
 - ration balancing
 - pastures
 - mixed farming systems, and
 - manure and animal waste management
- Overall adoption of technologies in the Indian dairy sector is low
 - On average between 20 – 60%
 - Variable – similar technologies between 0 – 85% adoption
 - Profitability drives adoption
 - Of the current and emerging technologies to lower GHG emissions only some are suitable in India
 - The enabling environment is crucial to support adoption

Case Study Kenya

Kenya has the highest milk consumption per capita in Africa.

Inadequate infrastructure around milk collection centres, chilling facilities, and processing plants also limits the sector's development.

There are around 30 milk processors and 67 mini dairies operating within the country

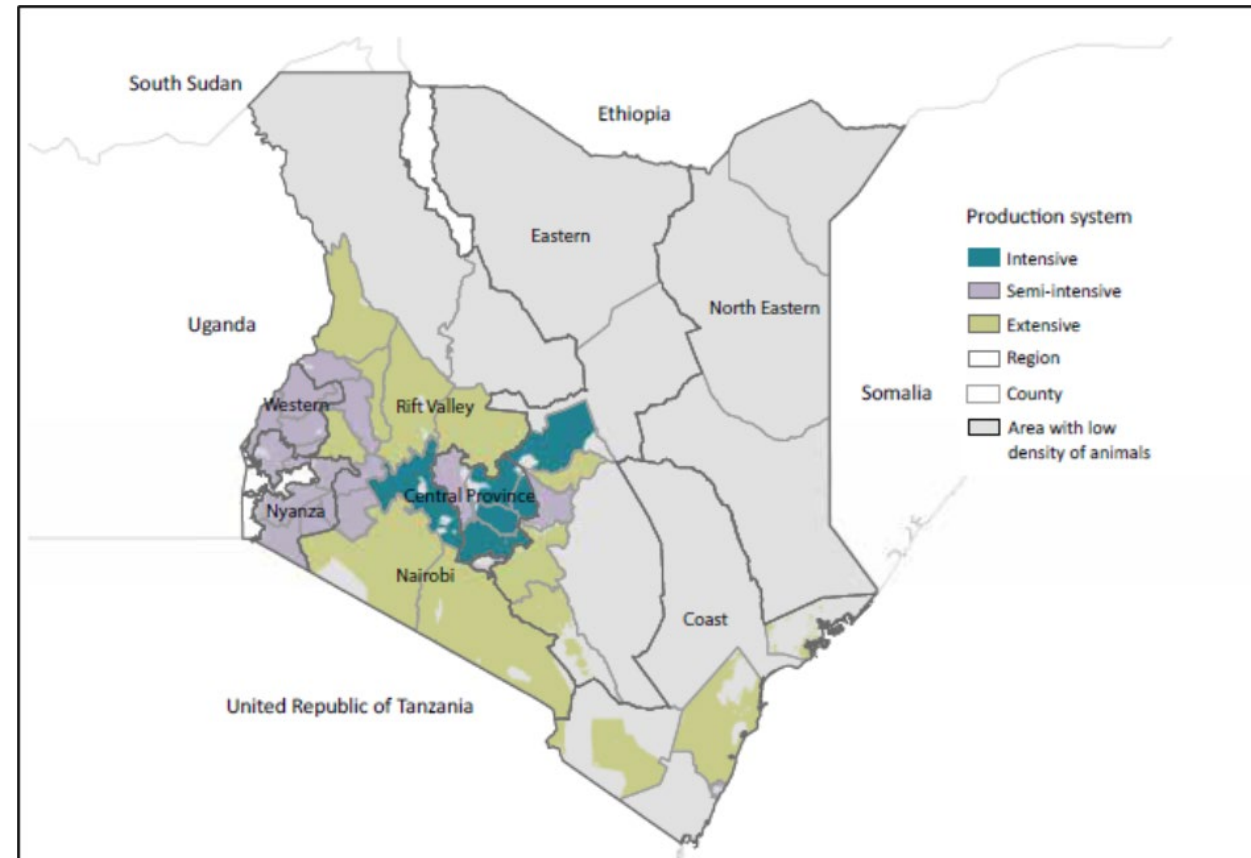
The majority of milk in Kenya is sold through informal actors

Multiple domestic policies aimed at improving productivity

Nationally Determined Contribution (NDC) for reducing GHG emissions by 30% by 2030 compared to business-as-usual

Dairy NAMA (Nationally Appropriate Mitigation Action) aims to reduce GHG emissions from the dairy sector in Kenya while increasing productivity and promoting sustainable production practices.

The programme targets smallholder dairy farmers who are responsible for most of the milk production in the country



Applicable Technologies and Current Adoptions



Adoption can range from low (0-20%) to medium (20-50%) dependant on practice

This is also dependant of system and location

Key drivers of change are the supply chain and its incentives as well as the institutional environment (access to capital, extension, support for cold chains etc)

We would expect structural change in the industry up to 2050 through intensity and specialism, e.g. supply of inputs

Potential uptake of climate smart approaches

Mitigation Category	Practice	Kenya			India	UK		
		Intensive	Semi Intensive	Extensive	Small and Marginal Producers	Housed high input	Mixed Housed/grazing	High use of grazed grass
Improve feed quantity and quality	Sustainable forage intensification	High	High	Low	High			
	Maximise nutrient intake	High	High	High	Med			
	Precision feeding				Low	High	High	N/A
	Methane inhibiting supplements				Med	High	High	Low
Land and Nutrient Management	Establish nutrient-dense pasture	High	High	High	Low			
	Integrated manure management	High	High	Low	High	High	High	Low
	Adoption of inhibitors				Med	Low	High	High
	Renewable Energy	High	High	Low	Low	High	High	Med
Herd structure/improvement	Genetic Improvement (<i>inc AI</i>)	High	Med	Low	High	High	High	High
	Uptake of Sexed Semen				High	High	High	Med
Animal disease and pest management	Animal Health Management	High	High	Med	High	High	High	Med

Summary

- Multiple technologies are suitable for Indian and Kenyan dairy systems
- Technologies must be both productivity and profit-positive to be adopted
- Adoption varies dependant on system, location and institutional structure
- More work is needed to establish demonstration around technologies and support infrastructure
- Development of viable and lucrative markets, e.g. milk contracts could provide an assured return to invest in the practices outline here.
- This requires an enabling environment to incentivise uptake of mitigations



Thank you