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GHG Emissions
And Dairy Farming in the Future

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Climate Changes the (Dairy) World

The political landscape

1992 / '97 Earth Summits:

Rio de Janeiro: Climate on the agenda!
Kyoto: 6-8% reduction goal (2012 vs 1990)

2015 Paris: First global + goal setting summit

All countries agreed on
<2°C (1.5°C) in temperature rise

2021 Significant in efforts on CO_2 reduction

EU (Green Deal); **USA** (Climate Summit)
UN Climate Change Conference Glasgow

Dairy and GHG emissions

2006 **FAO** Report "Livestock's Long Shadow"
18% of total CO_2eq emissions from livestock

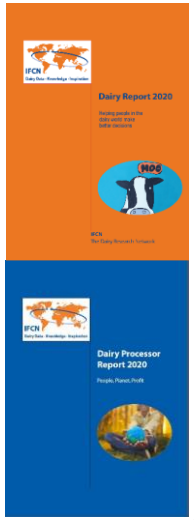
2010 **FAO** Report "GHG Emissions Dairy sector"
2.7% of total CO_2eq emissions from dairy

IFCN research on dairy and carbon emissions

2008 2% of world emissions by milk production
1st Dairy LCA model, 40 countries benchmarked
3 PHD theses on carbon and water footprint

2018 Annual benchmark for farms in over 50 countries

2020 1st IFCN Top 20 dairy processors benchmark
50% declared carbon neutrality by 2050
https://ifcndairy.org/dairy-processor-report/



Definitions and Wordings

GHG - Greenhouse gases[1]: Gases causing global warming like CO_2, CH_4, N_2O, etc.

CO_2eq - Carbon dioxide equivalent [1]: Method to convert different GHG emissions into one unit.

Carbon neutrality: Achieved when CO_2 emissions are balanced globally by CO_2 removals.

Net-Zero emissions: Achieved when emissions of all GHG are balanced by GHG removals.

Climate neutrality: Achieved when a sector does not impact temperature rise on earth.

Country classification following UNSTATS (simplified)

Developed countries: Mainly Europe, North America, Oceania, Japan, Israel, etc.
Emerging countries (developing countries): Mainly Africa, Latin America, Near & Middle East, Asia, etc.

Sources: Overall slide adapted from C. Emond (IDF, 2021) 1. IPCC, 2007.

Dairy & GHG Emissions – Big Picture

Status quo

2.2% Milk production on global GHG emissions[1,2]

75% Emissions in emerging dairy countries [1]

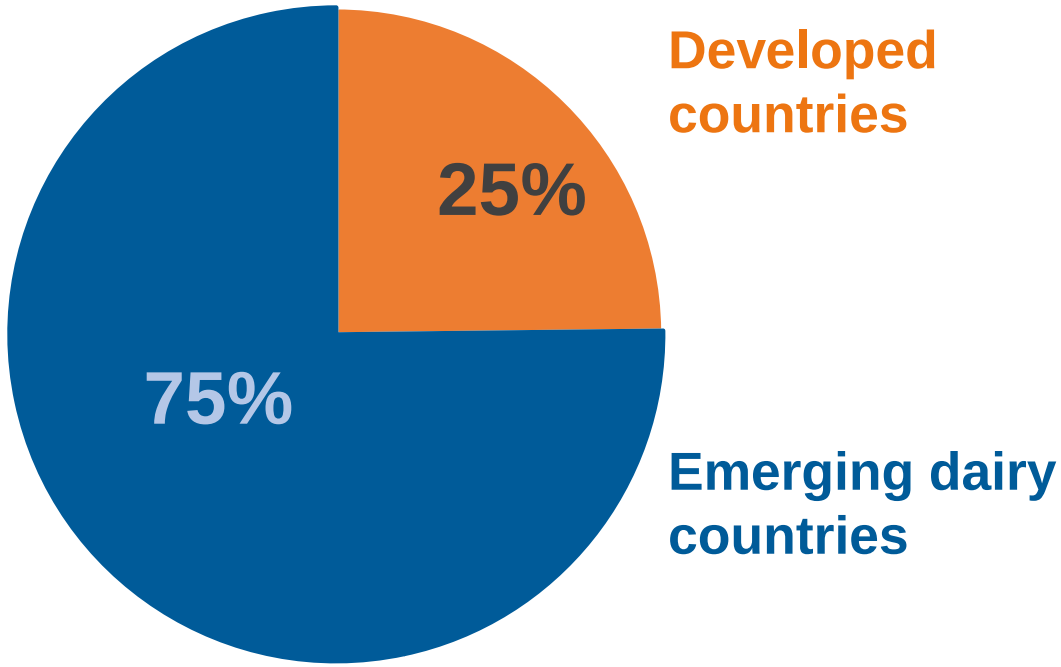
IFCN Baseline 2020 – 2050 [2]

+50% Milk production and demand

-28% GHG emissions / kg milk

+ 8% total emissions; stable from 2030

Dairy GHG emission by segments [2]



Sources: 1. FAO,2010; 2. IFCN database, LCA model and estimation 2021.

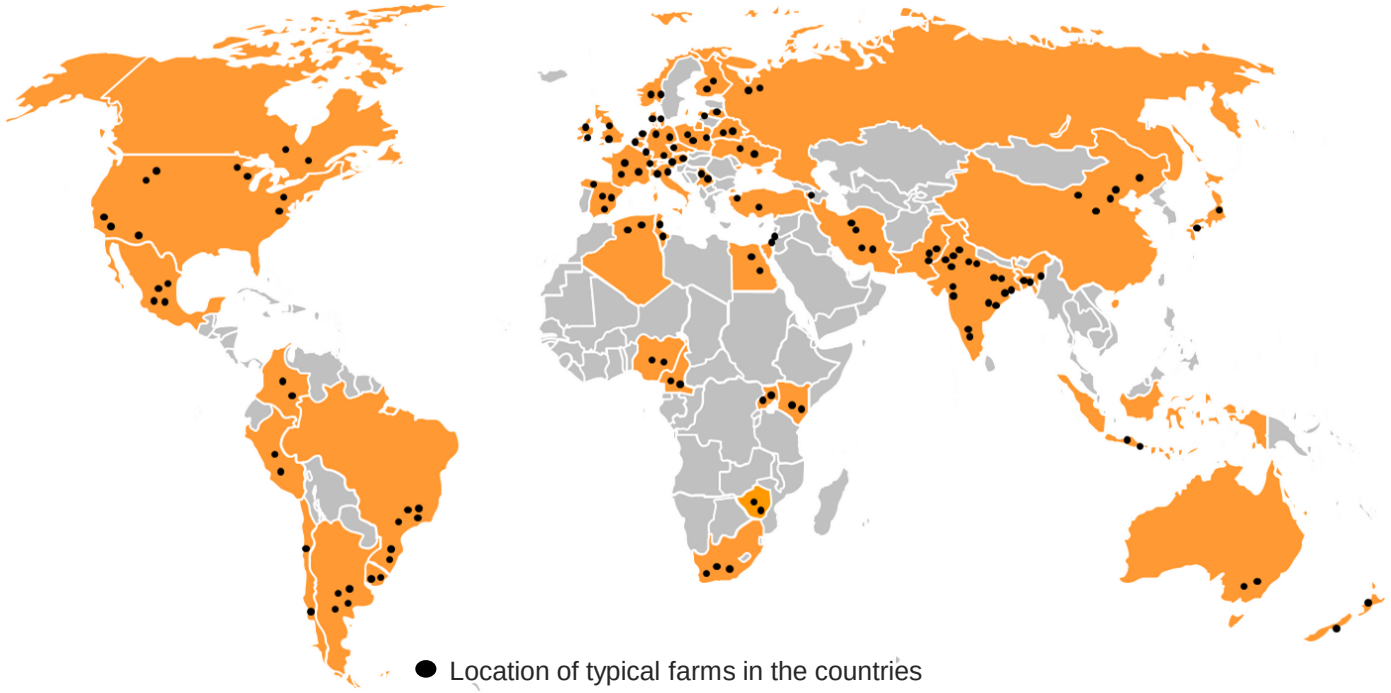
IFCN Dairy Farm Database

Why: Estimation of dairy competitiveness and sustainability

What: Collected since 2000 to compare countries internationally

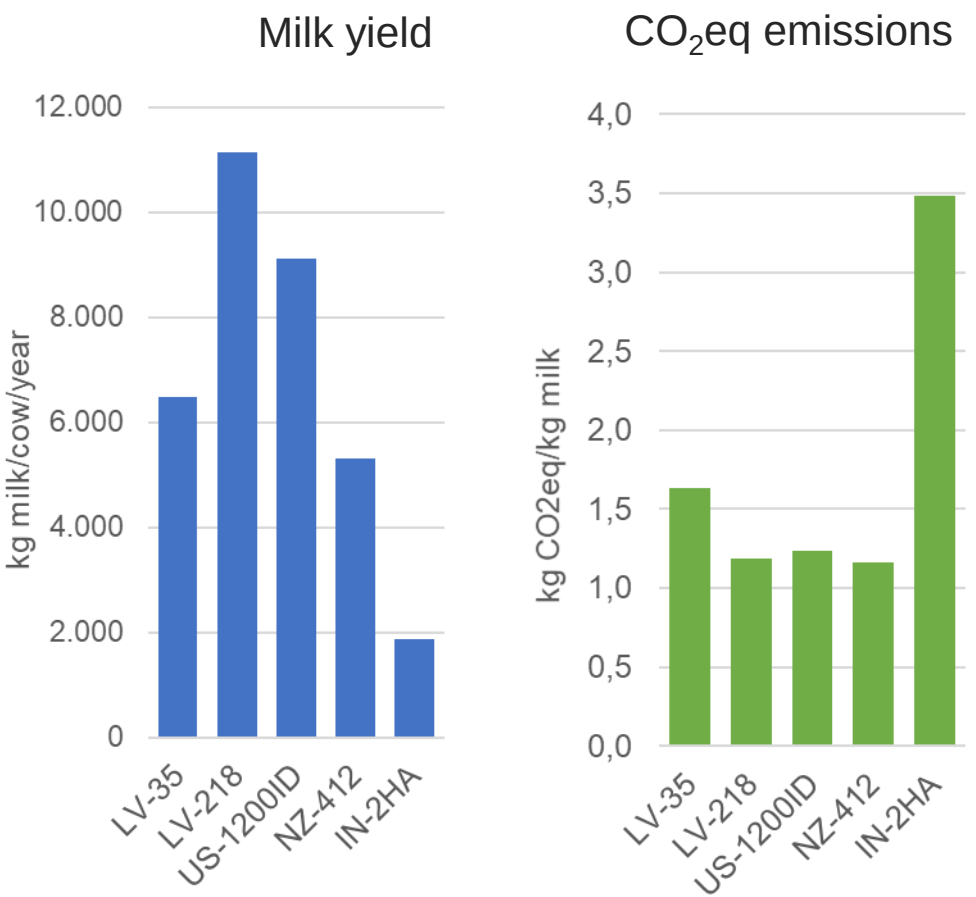
How: Typical farm concept + model TIPICAL + validation

Typical farm types in 52 countries / 90% of world milk production



● Location of typical farms in the countries

Results of 5 dairy farming systems



Example US-1200ID: farm with 1200 cows in USA, Idaho

IFCN Methodology on Dairy GHG

Aim
Simple methodology based on farm data to calculate CO_2eq emissions for every country in the world for the past and future

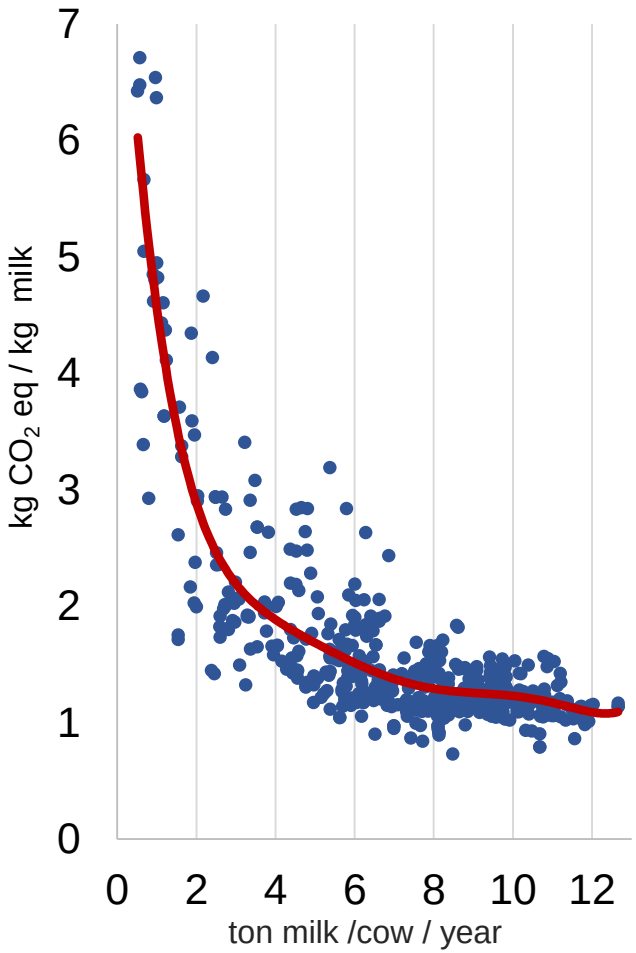
Approach
Regression function between milk yield and CO_2eq emissions

Estimation of the regression function
- Data: IFCN comparable data from dairy farming systems in 52 countries (90% of world milk production)
- Model: partial life cycle assessment until farm gate to estimate CO_2eq/kg milk

Quality of the regression function: $R^2 = 0.77$

Limitations
- Very low or high milk yield; Different production systems might be a challenge
- Not considering carbon action on farm and its impact. Over estimations.

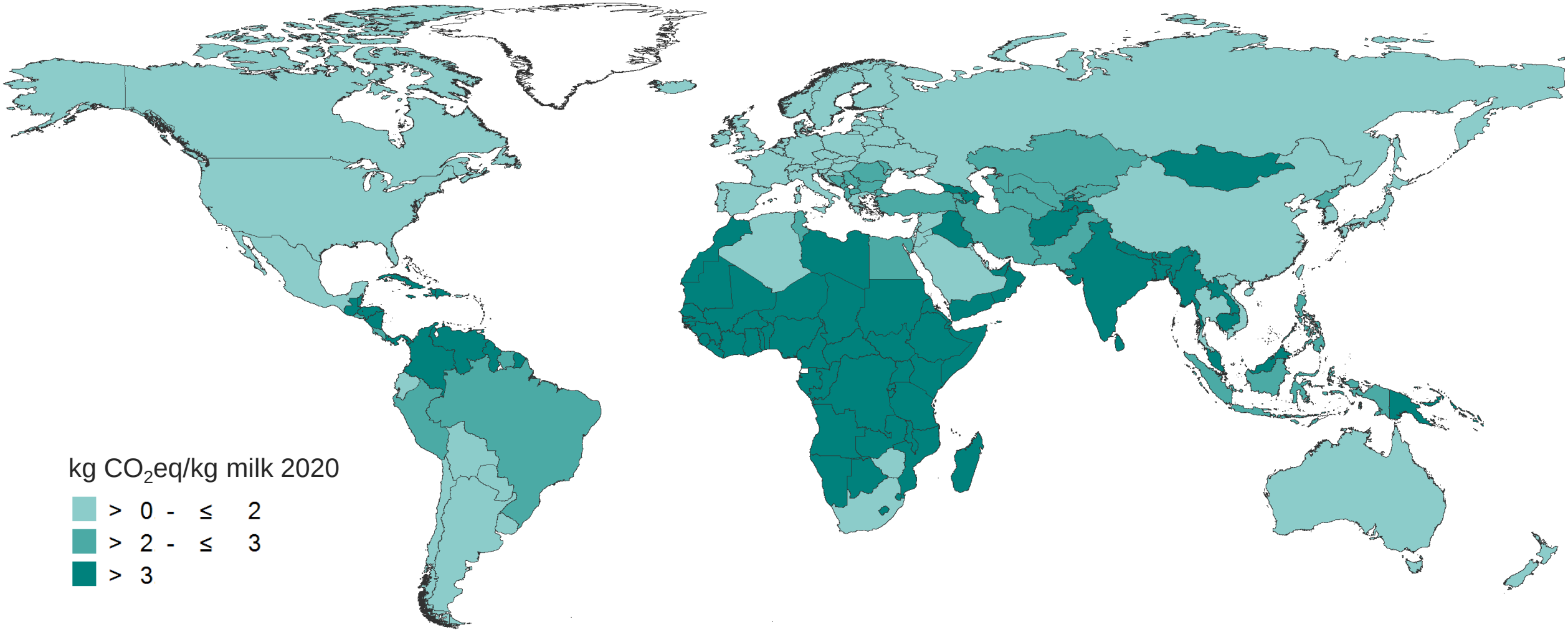
Relation: milk yield – CO_2eq emissions



Source: IFCN 2020; GHG estimation based on IFCN regression function between milk yield and CO_2eq emissions on typical farms.

GHG Emissions per kg Milk

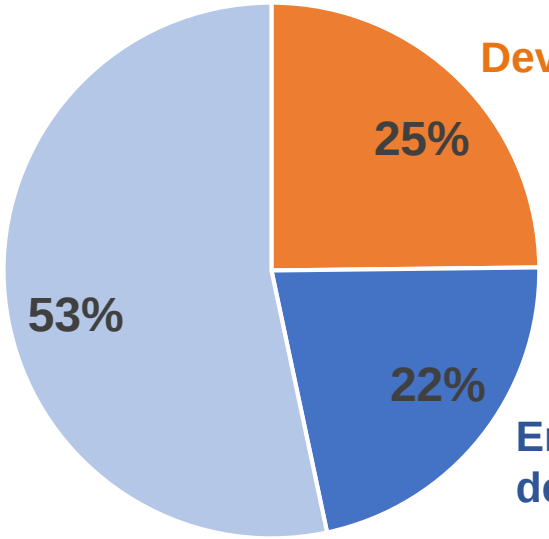
High emissions per kg milk are in countries with low milk yields



Sources: IFCN 2020; GHG estimation based on IFCN regression function between milk yield and CO_2eq emissions on typical farms.

Dairy GHG Emissions Today

Breakdown of dairy emissions [1]



Developed countries

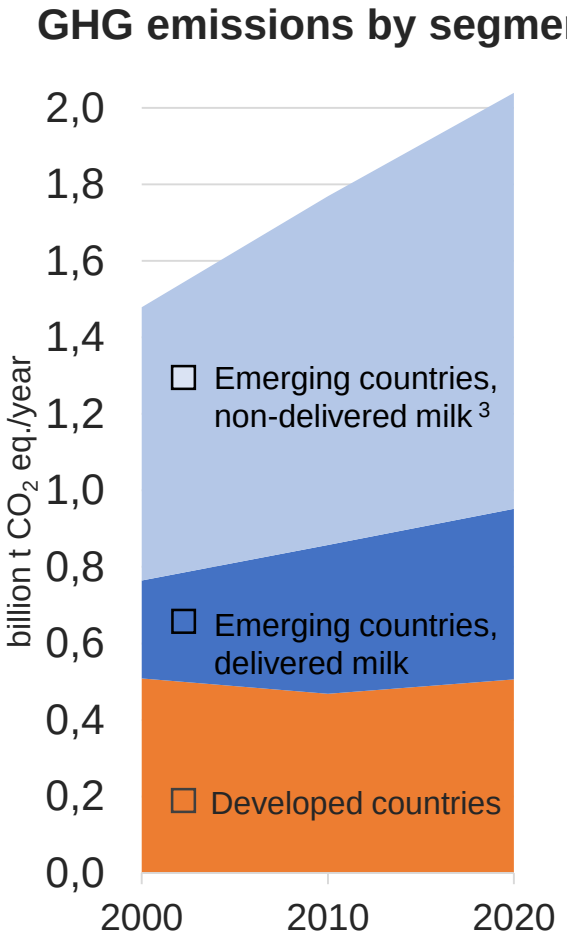
Emerging countries, delivered milk

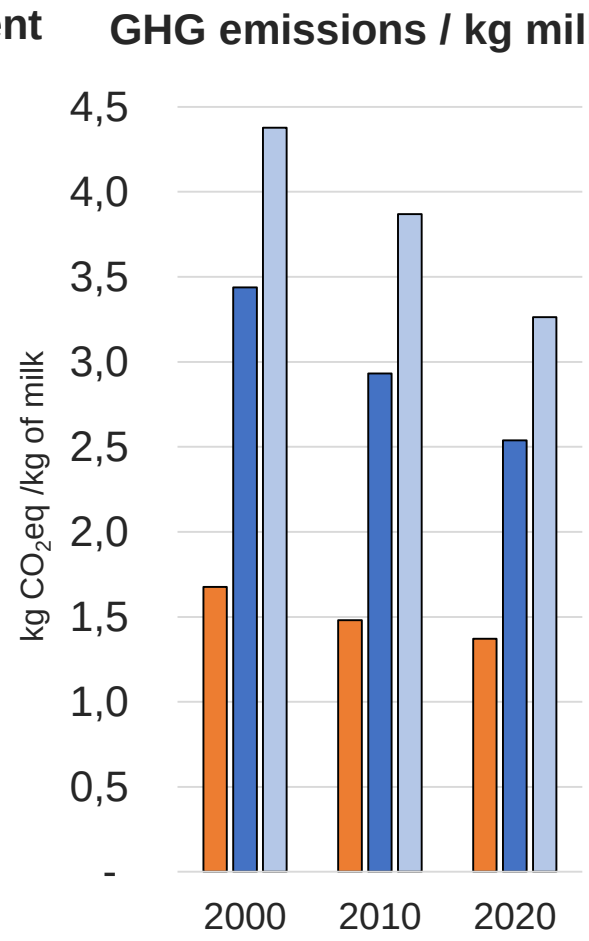
Emerging countries, milk non-delivered, milk consumed on the farms or sold informally

Developed countries [1]	**Emerging countries (all)**
6 million farms with	**115** million farms with
Ø 34 cows / farm and	2-4 cows / farm and
7.4 t milk yield / cow	1-2 t milk yield / cow
= 1.4 kg CO_2eq/kg milk	**>3 kg** CO_2eq/kg milk

Method: IFCN GHG estimation for dairy IFCN dairy data base all countries; GHG estimation based on IFCN regression function between milk yield and CO_2eq emissions on typical farms.
Definitions: Milk delivered: Milk delivered from farm gate to dairy processors. Milk non-delivered: Milk on household farm use or sold informally in the market.
1. Average farm size excl. countries with an average farm size < 2. For Russia considered only farms delivering milk; Average farm size for US, CA, EU, UK, CH, NO, AU, NZ, JP = 37.

Dairy GHG Emissions 2000-2020





World:

+62% milk production,
-15% CO_2eq/kg milk,
Total GHG emissions **+38%**

Emerging countries

+114% more milk
-26% CO_2eq emission/kg milk
Total GHG emissions **+58%**
=> 100% of global dairy GHG emission growth

Developed countries

+ 22% more milk produced
-18% CO_2eq emission/kg milk
Total GHG emissions = **stable**

Method: IFCN GHG estimation for dairy IFCN dairy data base all countries; GHG estimation based on IFCN regression function between milk yield and CO_2eq emissions on typical farms.
Definitions: Milk delivered: Milk delivered from farm gate to dairy processors. Milk non-delivered: Milk on household farm use or sold informally in the market.

Method - IFCN Dairy Outlook 2050

The tool for better strategy building in dairy

What: Solid database 1996- 2020 + baseline 2020 – 2050

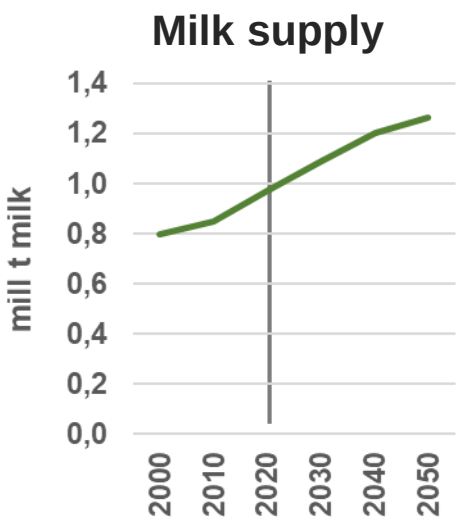
How: Done by IFCN annually since 2013

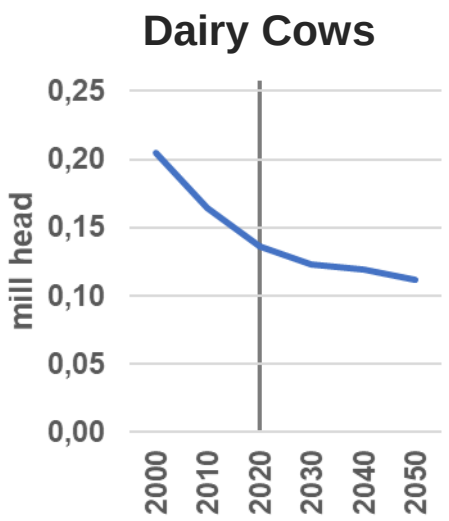
So what?: Comparable data => Insights => Better decisions

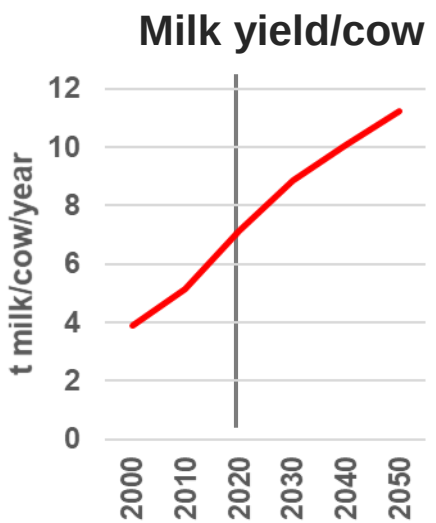
12 variables covered per country in the world

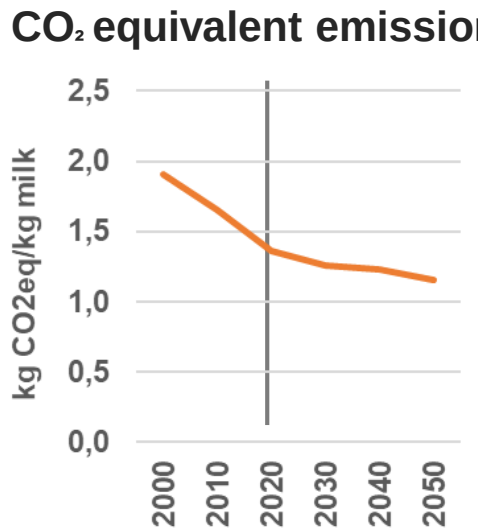
- Milk supply and demand and self-sufficiency
- Various milk supply and demand drivers
- New: CO_2 equivalent emissions per kg milk

Example Long-term Dairy Outlook Latvia 2000 - 2050



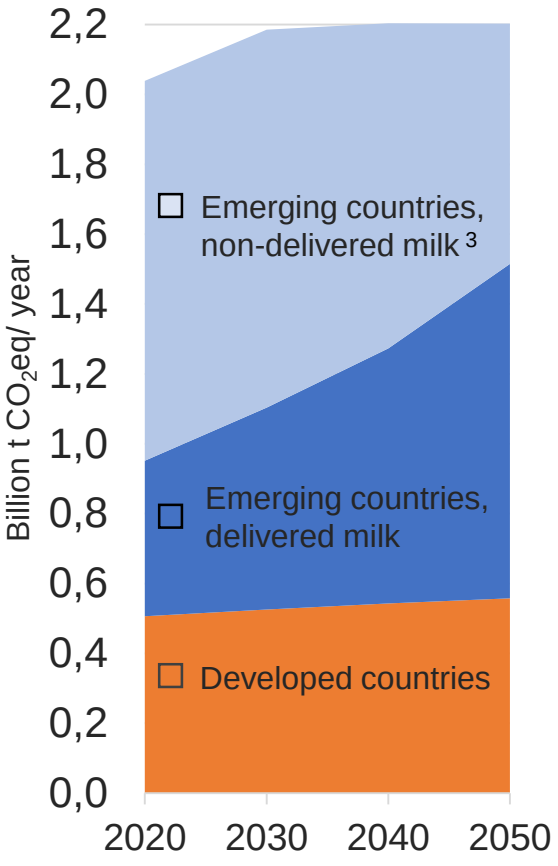




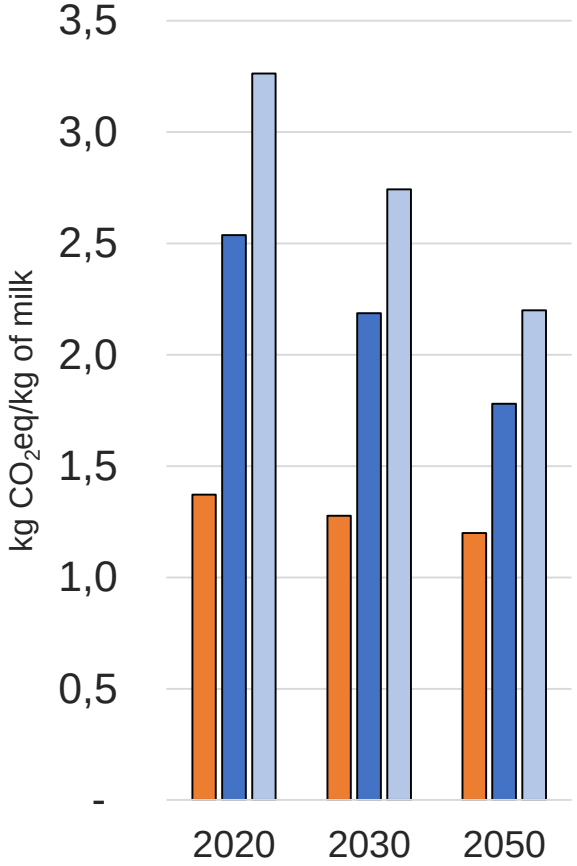


Dairy GHG emissions 2020 - 2050

GHG emissions by segment



GHG emissions / kg milk



World:

+50% milk production and demand,
-28% CO_2eq/kg milk,
+8% CO_2eq emissions

Emerging countries

+67% more milk produced
-36% CO_2eq emission/kg milk
Total GHG emissions **+7%**

Developed countries

+26% more milk produced
-13% CO_2eq emission/kg milk
Total GHG emissions slightly growing

Method: IFCN GHG estimation for dairy IFCN dairy data base all countries; GHG estimation based on IFCN regression function between milk yield and CO_2eq emissions on typical farms.
Definitions: Milk delivered: Milk delivered from farm gate to dairy processors. Milk non-delivered: Milk on household farm use or sold informally in the market.

Reducing GHG Emissions in Dairy?

Milk Production Becoming Net Zero?

Benefits of Net Zero Dairy in 2050

Overall: The dairy sector earned its licence to operate and will be part of feeding 10 billion people on earth

Millions of dairy farmers, their employees, their family members and rural areas benefit socially & economically

Dairy Processors can win in a growing market on more milk consumed (+50%) and more milk collected (+100%)

Farm input companies can win as catalysts for transformation in dairy farming systems and management

Options of GHG Reduction in Dairy

		GHG reduction[1]
1. Reductions	•Normal rate of increased efficiency	**28%**
	•Methane reduction by feed additives or methane inhibitors	**5 – 10%**
	•Farm management improvements	**20%[2]**
2. Removals	•Soil carbon sequestration	**5 – 10%**
	•Planting trees on the farm	**1 – 5 %**
3. Avoidance	•Avoid Land Use Change	**?**
	•Recycle and reuse of agro-industrial waste	**?**
1.4. Offset strategies	•Renewable energies (biogas, solar, wind)	**10 – 15%**
	1.Carbon offsetting (buy credits)	**?**
1.5. New technologies & 2. farming systems		**?**

Sources: Five options: Adapted from H. Montgomery; 1 IFCN estimation based on various sources. 2 IFCN Estimate

Economics of Reducing GHG Emissions

Economics on different GHG reduction options*

Positive: Improving GHG emissions & farm profits
Neutral: Improving GHG emissions & profit neutral
Negative: GHG emissions create significant costs

GHG emissions levels and reductions

Easy: From **4** to **1.4** kg CO_2eq/kg milk
Moderate From **1.4** to **0.7** kg CO_2eq/kg milk
Difficult From **0.7** to **0** kg CO_2eq/kg milk

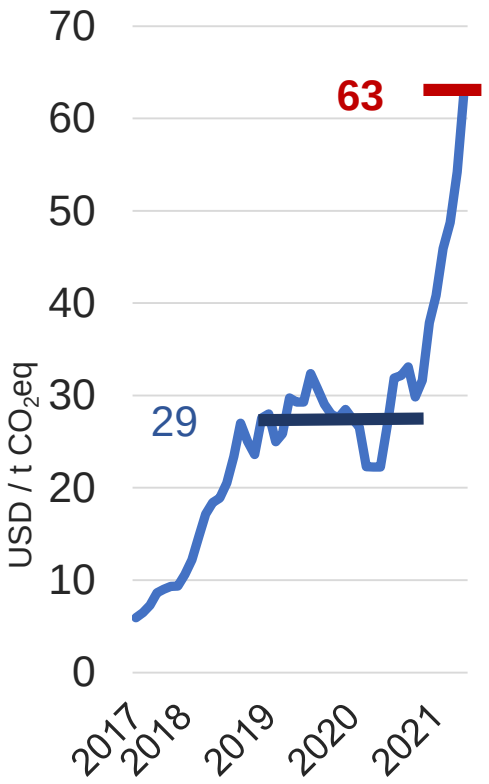
Wrapping up: GHG reduction in dairy by 2050

- **30%** GHG/kg milk with normal technical progress realistic
- **35%** GHG/kg milk possible but can create costs
- **35%** by new technologies to be developed or to offset it

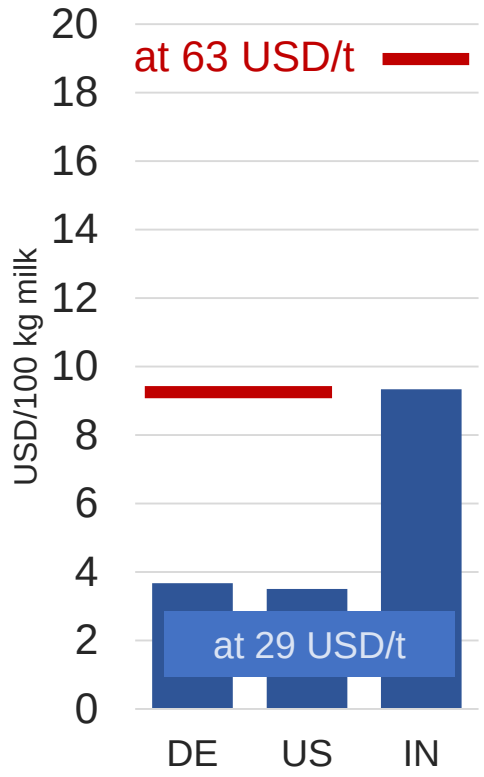
*Sales of “carbon credits” excluded

Carbon Price & its Impact on Dairy

Carbon price EU-ETS [1]



Carbon cost /100 kg milk



Average carbon price 2019-2020
Maximum carbon price 2021
Historical carbon price

Cost at carbon price 63 USD/t - developed & emerging countries
Cost at carbon price 29 USD/t – DE, US, IN

1. CO_2 Price reached new heights in 2021

2. Potential impact for farmers/processors [3]

Negative: Possible tax or costs to buy carbon credits

Positive: By reducing emissions & selling carbon credits

3. Impact can be 10 – 50% of current milk prices

Developed countries: 4 – 9 USD/100 kg milk

Emerging countries: 9 – 19 USD/100 kg milk

Can reach 300 – 600 USD/ cow

Sources: 1. Carbon Emissions Futures Historical Data from Investing.com, Fusion Media Ltd., 2021; Historical exchange rate: IFCN data. 2. IFCN estimation for Germany, USA, India (blue bars), developed countries and emerging countries (red lines), considering average levels of kg CO_2eq/ kg milk. 3. Depends on political decisions to incl. or excl. agriculture, reliable CO_2eq measurement methods; Functional carbon market.

Dairy & GHG Wrap-up

Net zero dairy creates benefits to billions of people

Understand dairy farming systems is key to make it

Economic impact of CO_2 price can become strong

GHG reductions for dairy classified in buckets
- 30% easy via normal technical progress
- 35% doable with effort, can create additional costs
- 35% with new technologies and new farming systems

Questions to be answered:
Who is responsible?
Who takes the lead making it happen?
Who will pay for it?

IFCN
Dairy Data · Knowledge · Inspiration

Thank you for your attention!

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