Climate-neutral dairy farming in Latvia:

Opportunities and challenges for dairy farmers

November 30 2021

What does ‘Net Zero’ mean for Agriculture?

Balance between all GHG emissions and removals in the *annual* cycle of agricultural production systems

Emissions of GHG to the atmosphere.

- Livestock Enteric Fermentation and Manure (CH_4 & N_2O)
- N Fertiliser (N_2O)
- Energy, Fuel (CO_2)

Sequestration of CO_2 from the atmosphere.

- Soil
- Woody biomass
  - Trees
  - Hedges

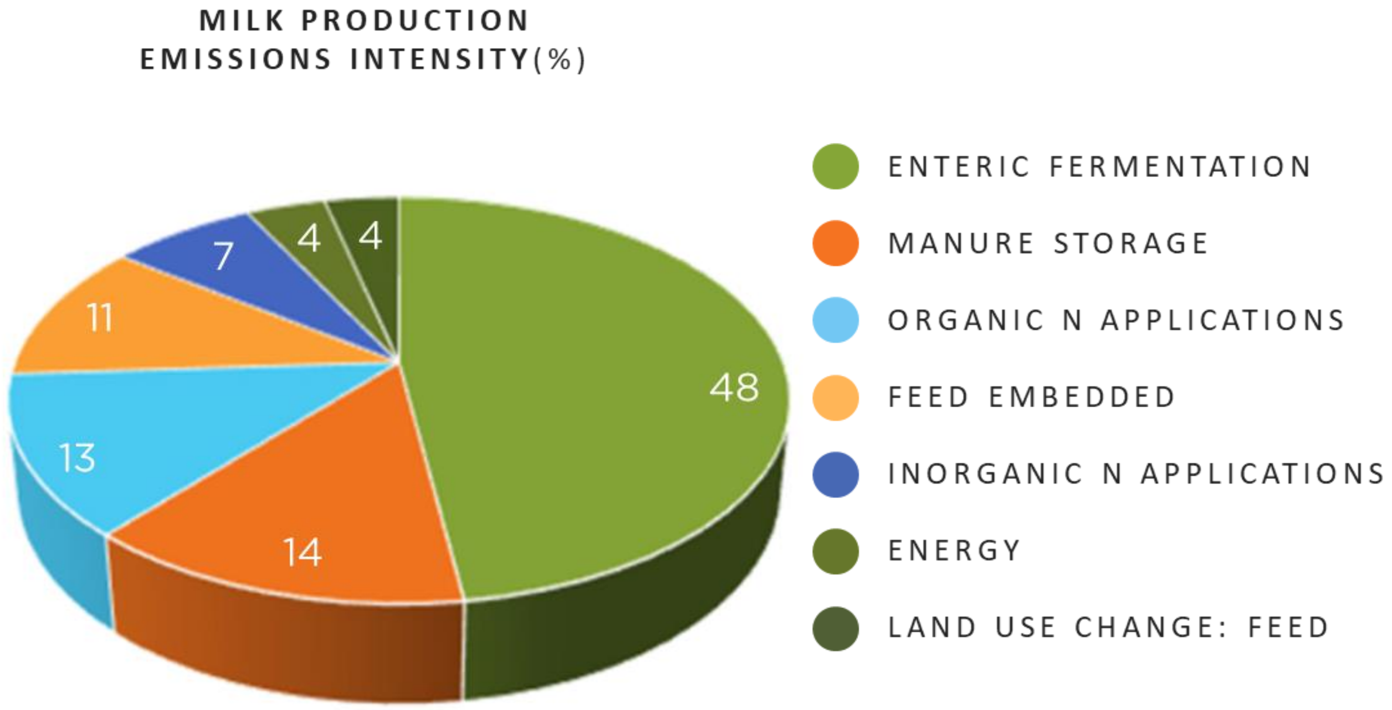
GHG Emissions

Net Zero

GHG Removals

Milk production emissions by source

- Enteric fermentation (CH4) 48%
- Embedded CO2e in feed 11%
- Inorganic N in fertilizer 7%
- LUC from feed materials 4%

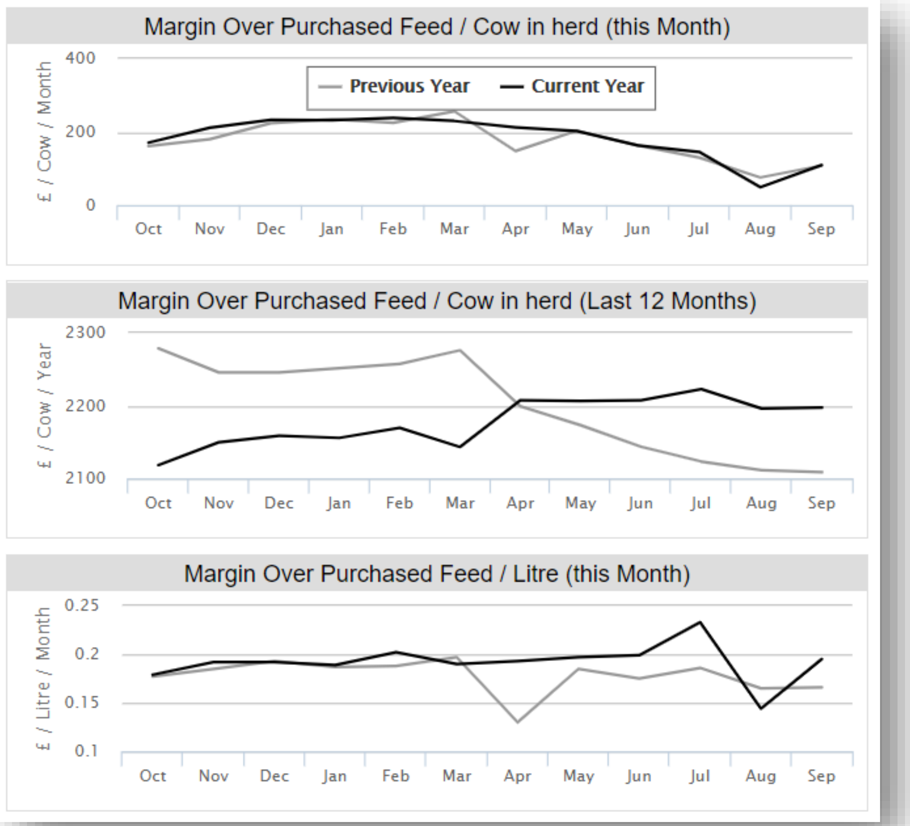


MAP OF AG

Parallels between nutritional efficiency from an economic and GHG perspective

Most KPIs are strongly related to:

- How much expensive (concentrate) feed you have to feed to achieve a desired output
    - Forage quality
    - Feeding system
- How much milk/calves you get in a set time period
    - Reproductive performance
    - Age at first calving
    - Non saleable milk



CO_2e/litre is very similar:

- Higher production dilutes the enteric and feed CO_2e
- More cows means more maintenance related CH_4
- Concentrate has a higher CO_2e/kg DM than forage

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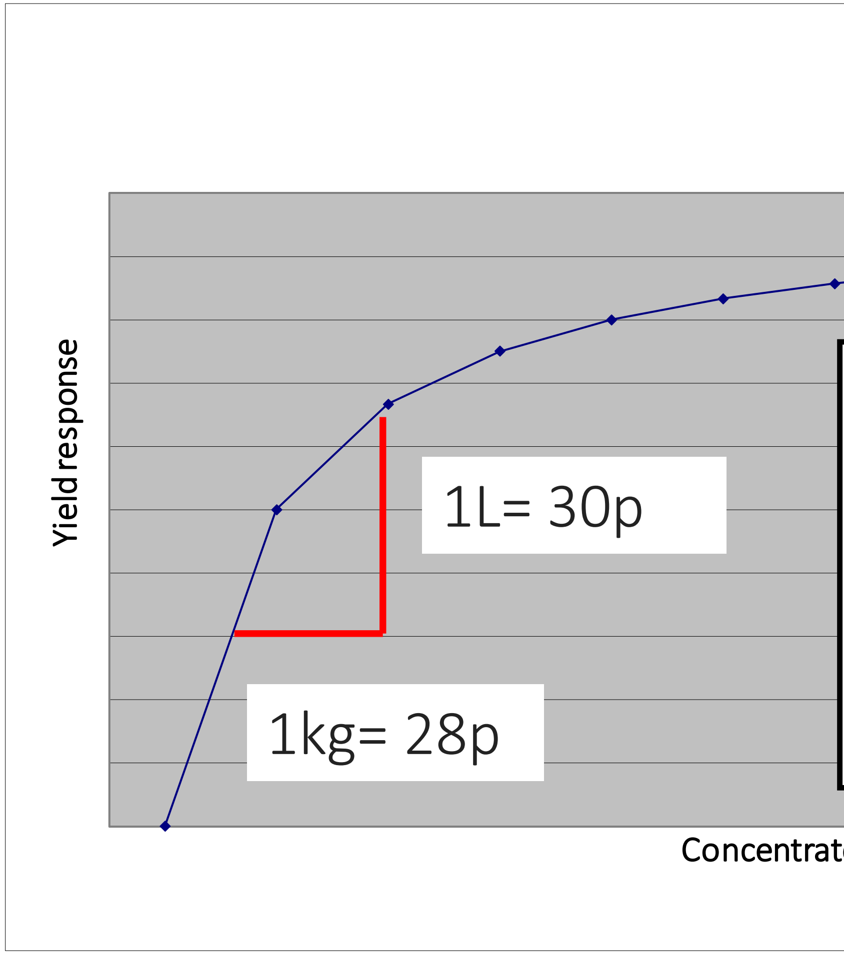
Concentrate usage: 'Marginal' litres



At what point does increasing concentrates become unprofitable?

At what point do we still get a dilution effect on GHG intensity?

Age at First Calving

- 100 cow herd with 24% replacement and 36% replacement rate
- These animals will produce 8kg CO2e/day.
- Assume 30L/cow/day (3000L/herd/day) and baseline CO2e/L of 1kg.

	24% replacement rate				36% replacement rate			
AaFC (months)	Extra animals	Extra kg CO2/day	Extra CO2/l (kg CO2/l)	% increase	Extra animals	Extra kg CO2/day	Extra CO2/l (kg CO2/l)	% increase
24	0	0	0	**0.00%**	0	0	0	**0.00%**
25	2	16	0.005	**0.53%**	3	24	0.008	**0.80%**
26	4	32	0.011	**1.07%**	6	48	0.016	**1.60%**
27	6	48	0.016	**1.60%**	9	72	0.024	**2.40%**
28	8	64	0.021	**2.13%**	12	96	0.032	**3.20%**
29	10	80	0.027	**2.67%**	15	120	0.04	**4.00%**
30	12	96	0.032	**3.20%**	18	144	0.048	**4.80%**

Examining enteric and feed related CO_2e

Yield	30
DMI	22
Feed rate	0.28
Conc DM kg	7.31
Forage intake (kg DM)	14.69
Enteric UKNIR (kgCO2/day)	10.57
Feed CO2 (kg)	9.07
Feed plus enteric (kg)	19.64
Feed plus enteric (kg) per litre	**0.65**
Forage CO2e/kg DM	**120.00**
Concentrate CO2e/kg DM	**1000.00**

Cow yielding 30L
How much she is eating
Concentrate feed rate- kg FW/litre produced
Concentrate quantity
Forage quantity= DMI- concentrate
Enteric emissions
=25*((15.185*DMI)+88.6002)/1000

CO_2e coming in with the feed from forage and concentrate:

- Forage- driven by N use
- Concentrate- also includes processing and potential effects of Land Use Change

MAP OF AG

Good versus average forage quality

Cows	Yield	DMI	Feed rate	Conc DM kg	Forage intake (kg DM)
22	45	28	0.27	10.57	17.43
22	35	26	0.21	6.46	19.54
22	25	22	0.13	2.74	19.26
22	15	20	0.00	0.00	20.00
Average	**30.0**	**24.0**	**0.19**	**4.94**	**19.06**
Total milk	**2640**				
Total DMI	**2112**				
5	**Transition**	13		2.3	10.7
7	**Far off**	13		0	13

Feed to yield: M+18 plus 0.45kg/L

Total daily CO2/L (KG) **0.66**

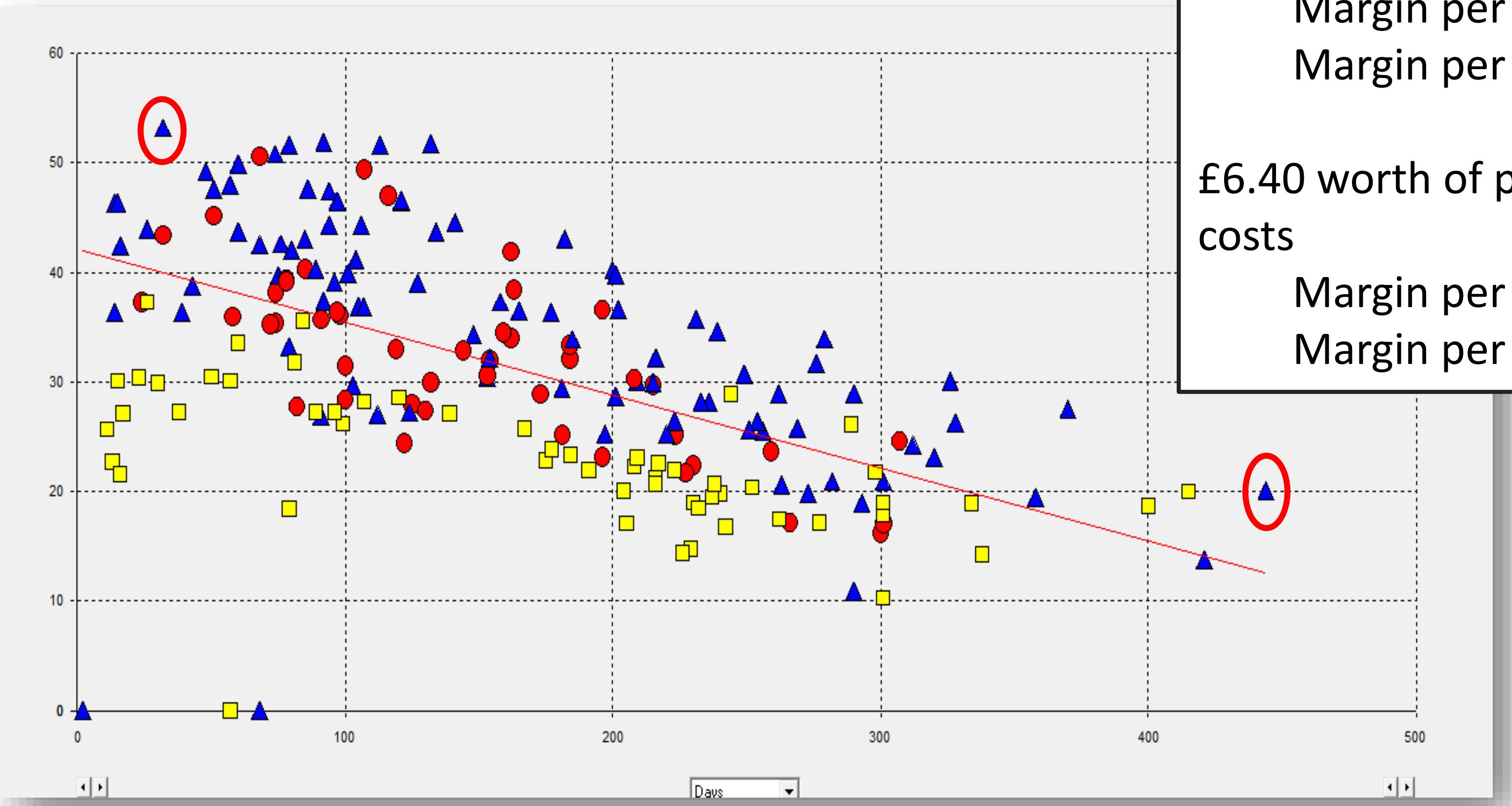
Cows	Yield	DMI	Feed rate	Conc DM kg	Forage intake (kg DM)
22	45	28	0.35	13.70	14.30
22	35	26	0.32	9.74	16.26
22	25	22	0.27	5.87	16.13
22	15	20	0.15	1.96	18.04
Average	**30.0**	**24.0**	**0.30**	**7.82**	**16.18**
Total milk	**2640**				
Total DMI	**2112**				
5	**Transition**	13		2.3	10.7
7	**Far off**	13		0	13

Feed to yield: M+10 plus 0.45kg/L

Total daily CO2/L (KG) **0.75**

Both scenarios are strictly feeding to yield
Using grass silage @120g CO2e/kg DM and a concentrate @1000g CO2e/kg DM

Fertility and feed efficiency



TMR including forages £6.00 (24kg DMI)

£16 milk income, £6.00 feed costs

Margin per cow per day =£10.00

Margin per litre= 19p

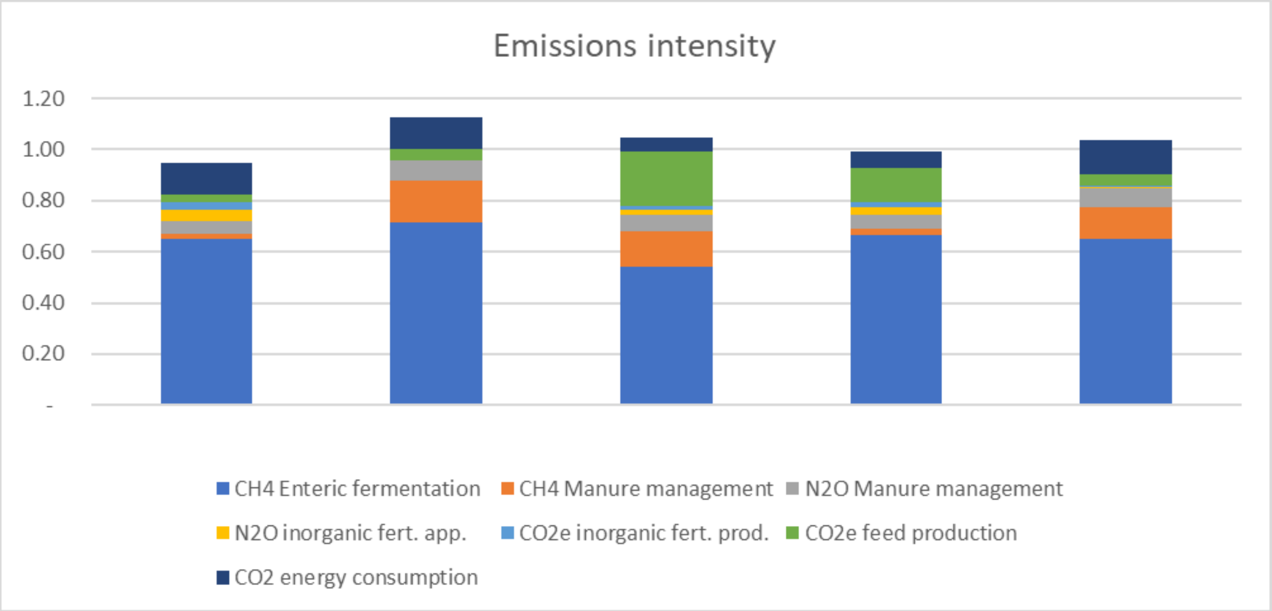
£6.40 worth of production, £4.00 feed costs

Margin per cow per day=£2.40

Margin per litre =12p

CO_2e/Litre: 0.89 vs 0.50 due to low yield but relatively high concentrate usage rate

GHG emissions from 5 Latvian farms



Information required:

- Land
- Animal numbers- milk recording data
- Livestock feed
- N usage as fertilizer
- Manure management
- Fuel and electricity

The graphs show the emissions profile from each farm based on the Map of Ag model. The emissions intensity, shown in the chart and table provides the range in emissions intensity for each farm in the pilot group. The range is 0.89 - 1.05 Kg CO_2e per Kg Milk.

Summary

- Enteric emissions (methane) and embedded CO2 in concentrate feed account for a large proportion of total emissions.
- Improving enteric and feed related emissions will improve financial performance too.
- Improving forage quality and decreasing waste can decrease feed related emissions significantly.
- Having less ‘redundant’ cows will decrease emissions- Age at First Calving and improved fertility will decrease emissions