SOLID | Sustainable Organic and Low Input Dairying

Sustainable Organic and Low Input Dairying
(SOLID)
European Project n° 266367

The environmental footprint of organic and low-input dairying

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SEVENTH FRAMEWORK PROGRAMME

Environmental impact of dairy products Why care?

- Meat and dairy products are estimated to be responsible for around 20% of the total environmental impact originating from all human consumption in EU
- Of this, milk is estimated to be responsible for 1/3
  - The dairy sector emit 190 mill t of CO_2 eq.
  - Responsible for around 40% of total eutrophication pressure from meat and milk
- Non-quota sectors (agriculture) are anticipated to be included in achieving the reduction goals for greenhouse gas emissions
  - By 2050 agriculture will represent 1/3 of EU-emissions (pressure for further reductions)
  - Increased capacity to preserve and sequester carbon may be a tool
- EU Biodiversity strategy 2020 ask for
  - Halting the loss of biodiversity and the degradation of ecosystem services while stepping up the EU contribution to averting global biodiversity loss

Increased focus on quantifying and documenting the environmental performance

- Allow decision makers in business and among consumers to consider the environment impact of the particular products they use
  - The life cycle methodology
- First, business and NGO driven initiatives like Round Table for Sustainable Consumption
  - Setting methods and rules for quantification
- Now, Commission driven initiative – the Product Environmental footprint (PEF)
  - Setting guidelines about dimensions to be considered and methods to estimate these, also for foods including dairy products
  - Aim to set the authoritative way to declare the environmental performance in EU

From PEF – screening report – dairy products

- Biodiversity is a key environmental issue for the dairy sector, which is only partly addressed through current LCA methodologies

- Carbon sequestration in sustainable managed grazing dairy systems should be considered where relevant

In this project we have made effort to operationalize these aspect to be included in the assessment

Which environmental impacts of milk?

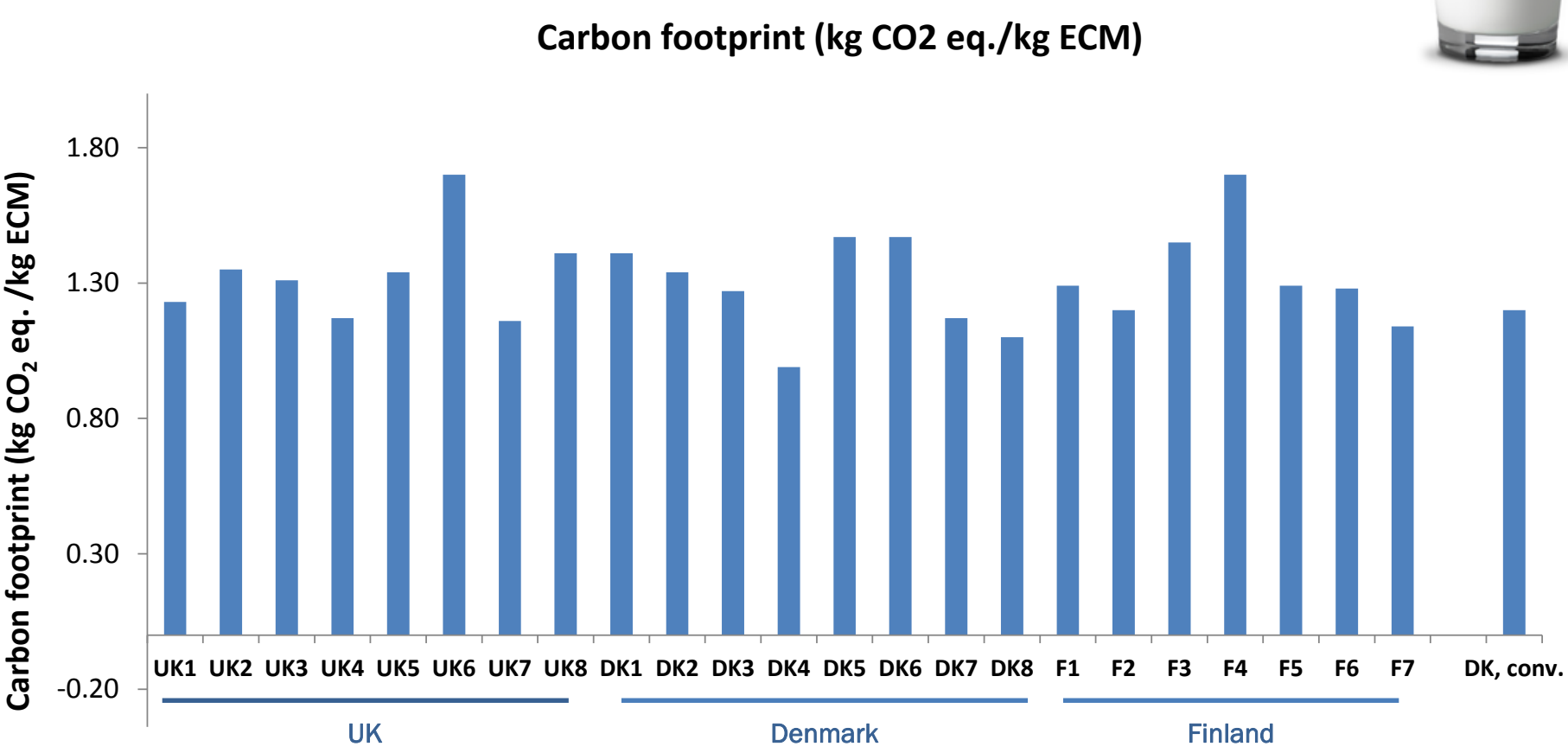
Global warming

Nutrient enrichment

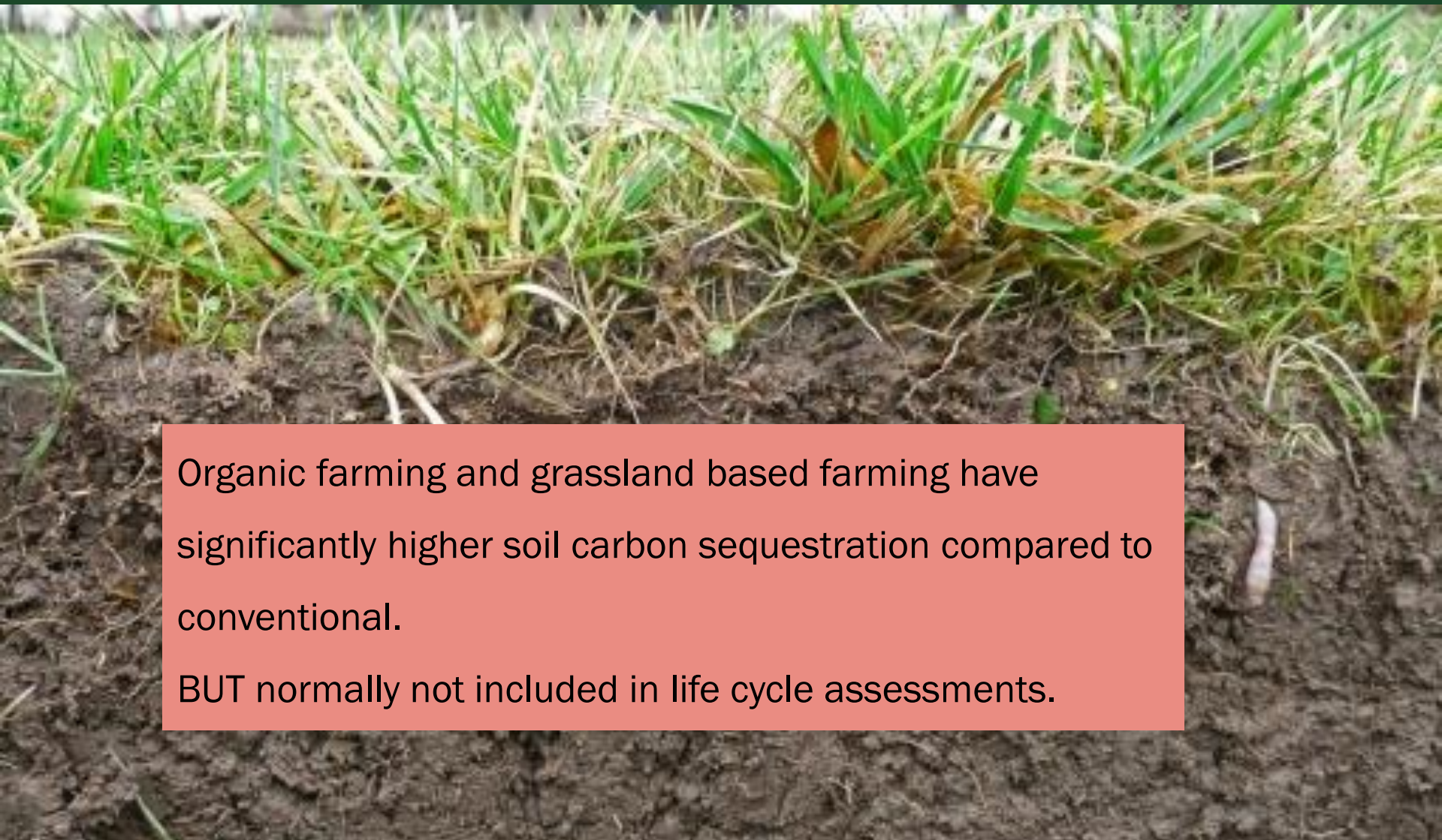
Carbon sequestration / soil fertility

Biodiversity

Carbon footprint of milk from 23 farms



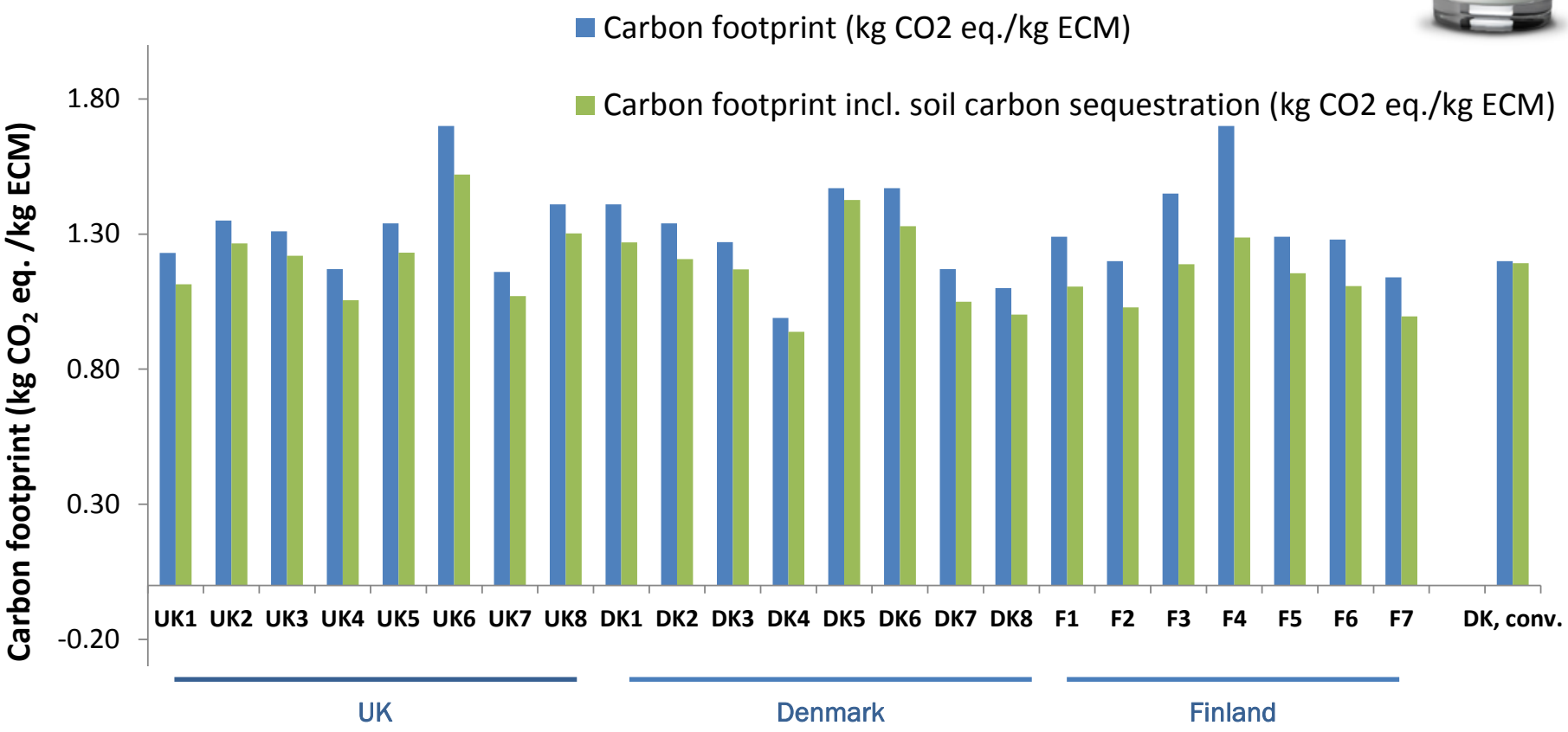
Soil carbon sequestration – should be included!



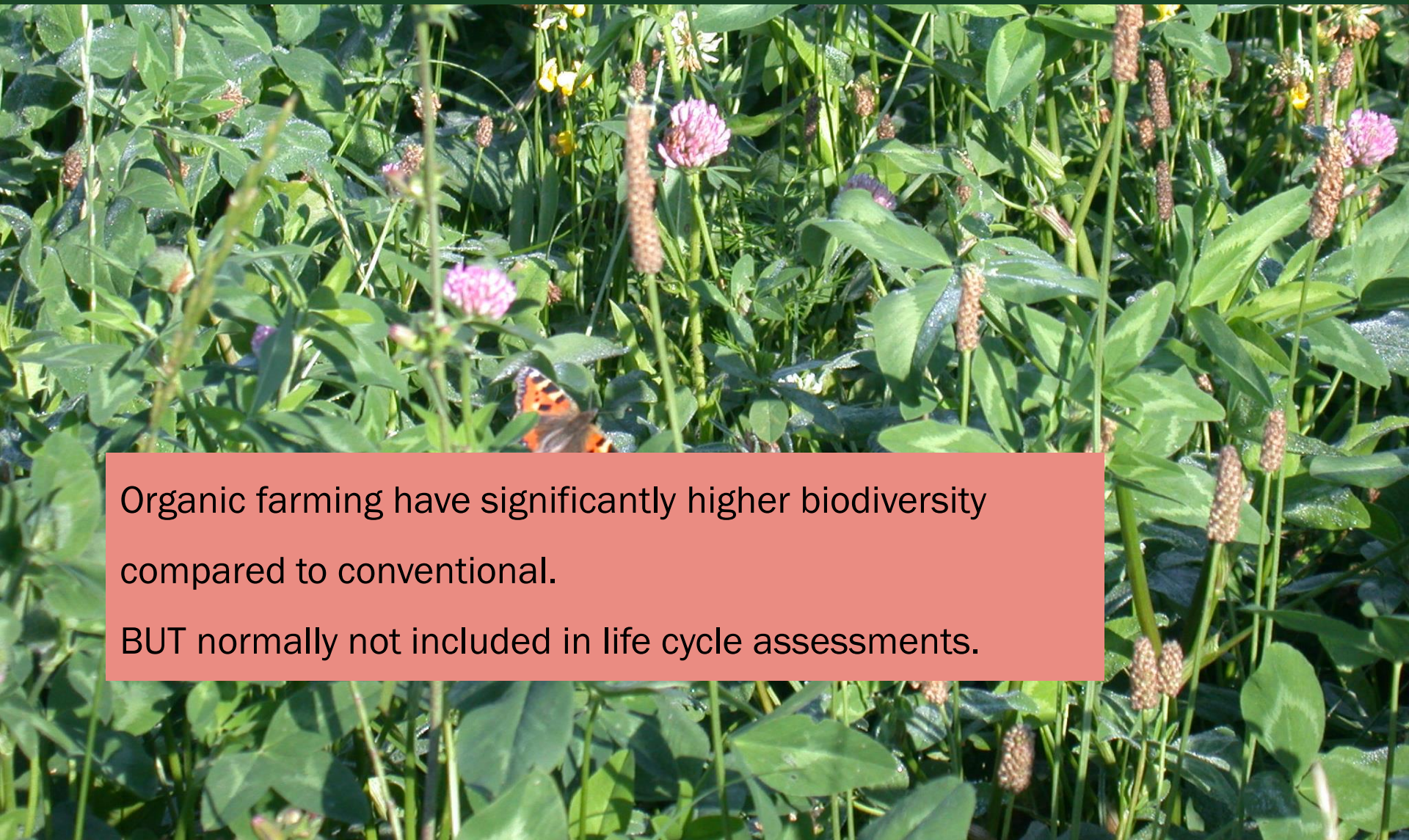
Organic farming and grassland based farming have significantly higher soil carbon sequestration compared to conventional.

BUT normally not included in life cycle assessments.

Carbon footprint of milk from 23 farms - including soil carbon sequestration



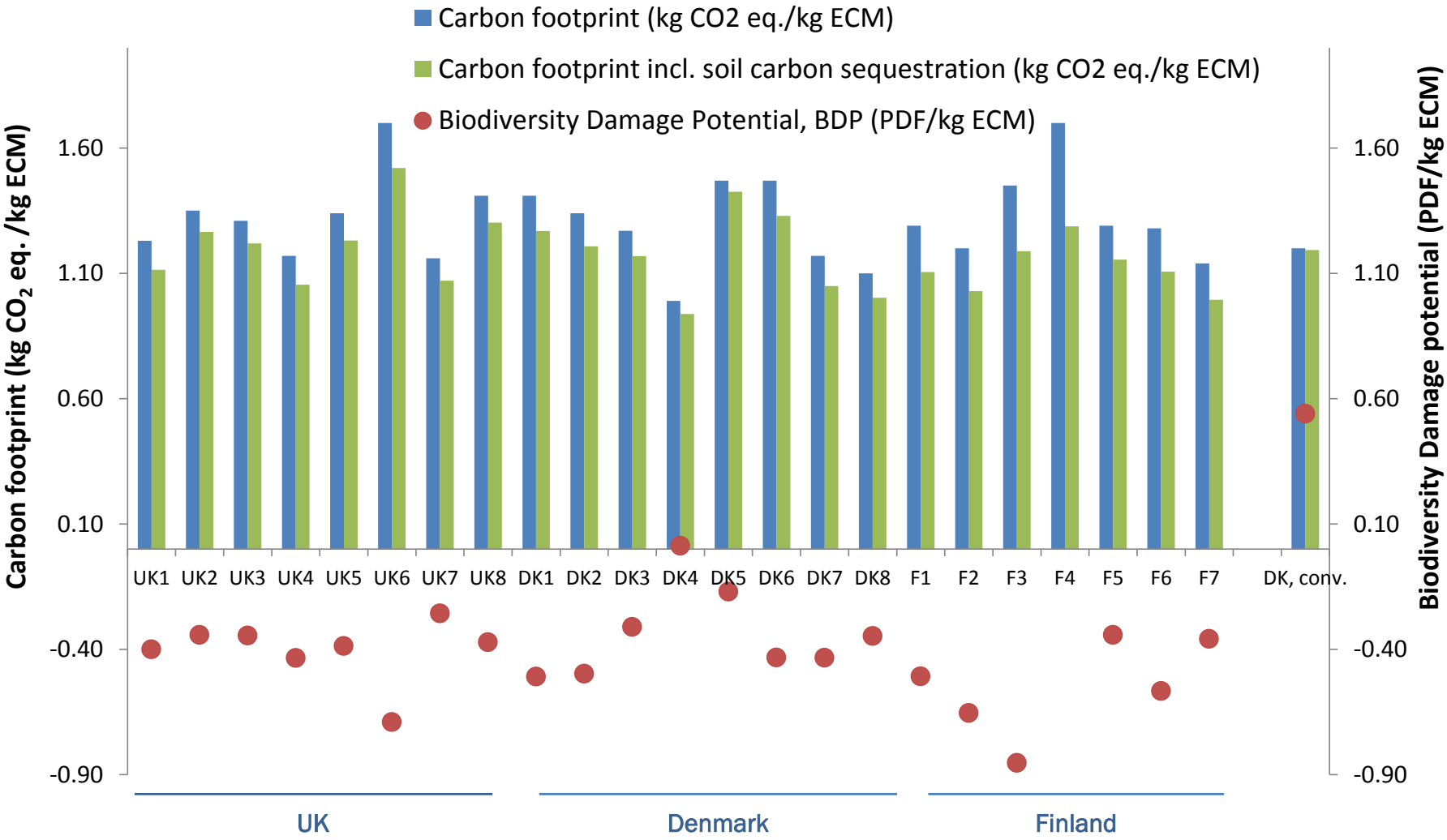
Biodiversity should also be included!



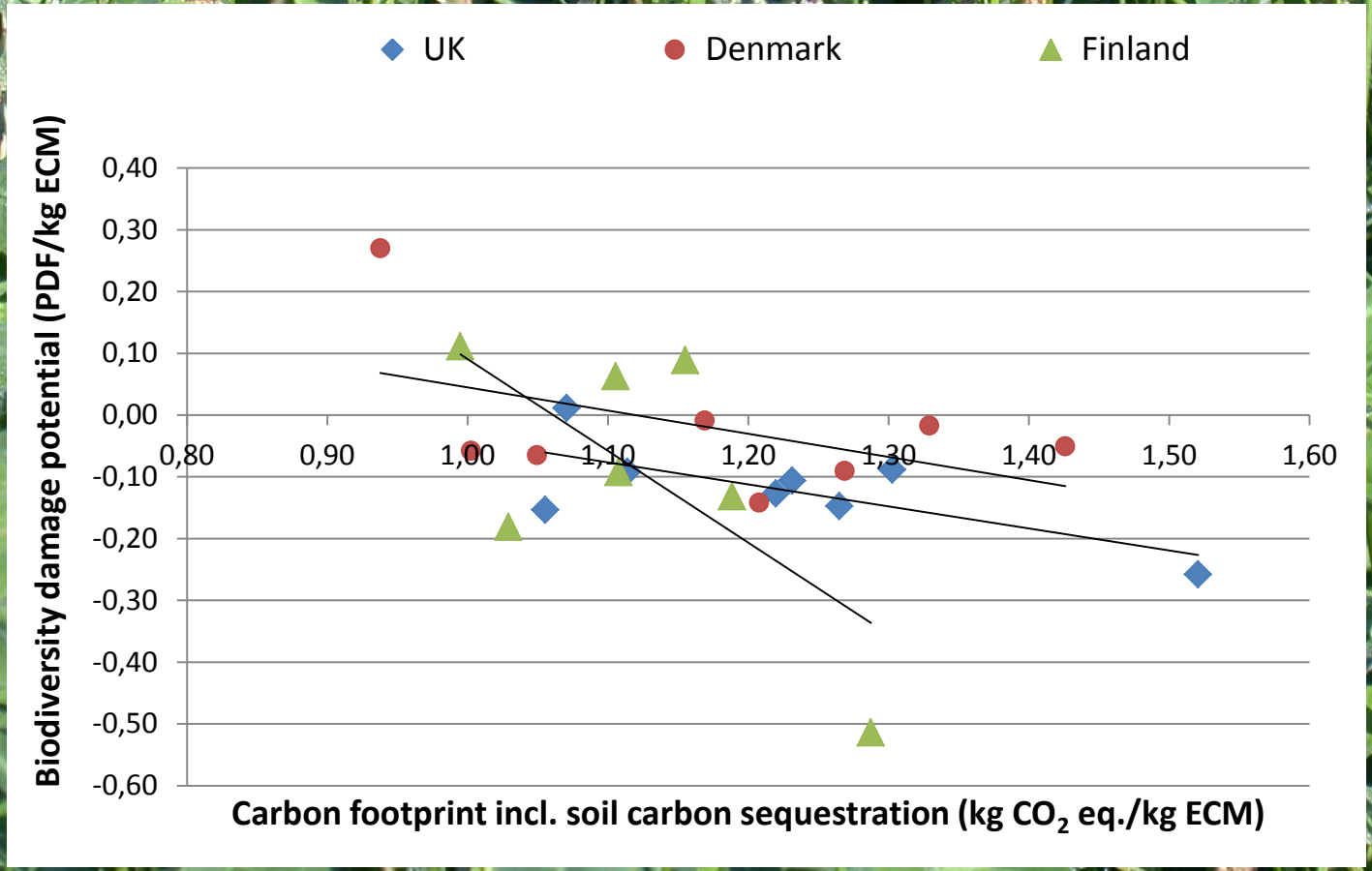
Organic farming have significantly higher biodiversity compared to conventional.

BUT normally not included in life cycle assessments.

Biodiversity impacts of milk from 23 farms



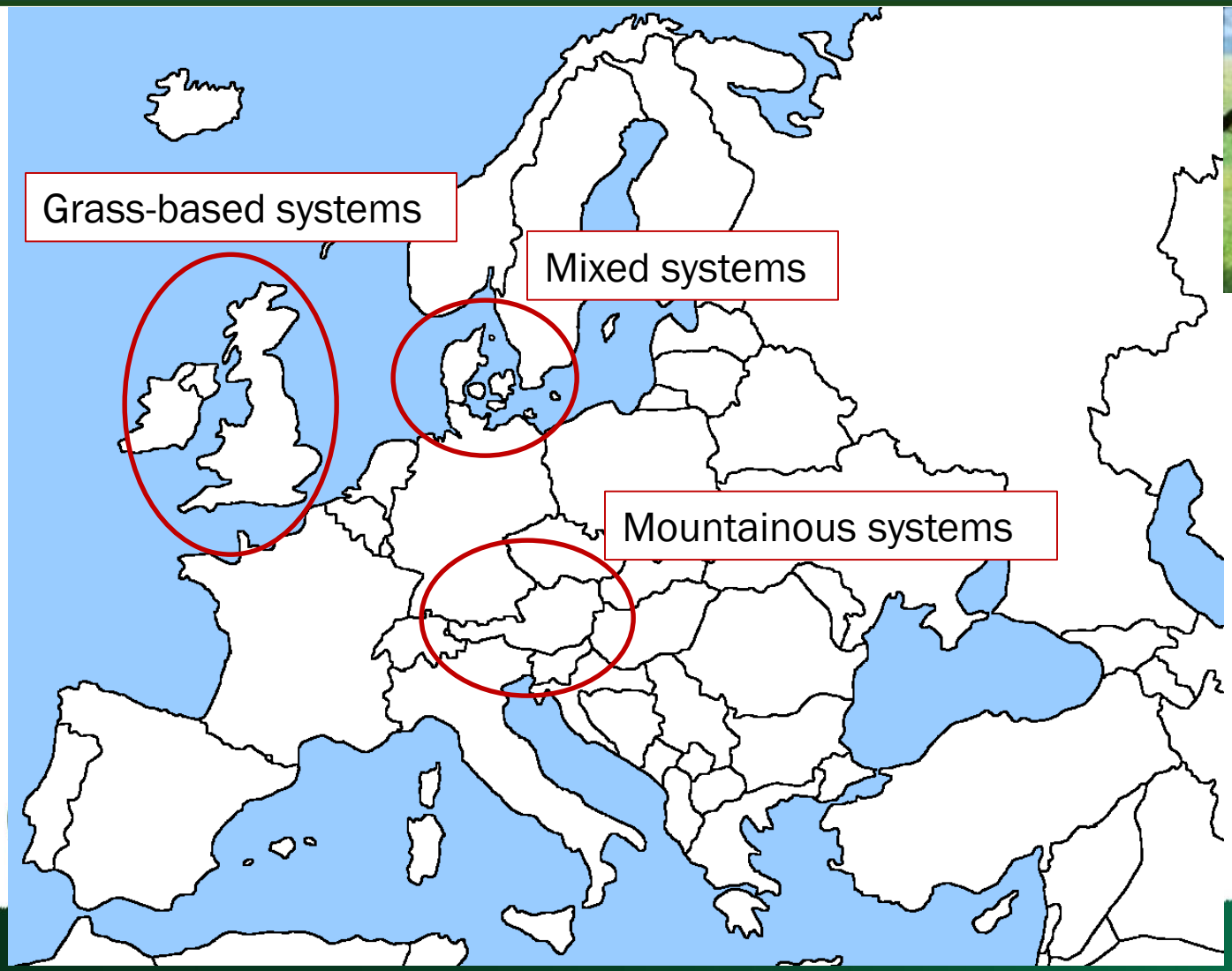
Biodiversity vs. carbon footprint



Impact categories covered (PEF)

Environmental impact category
 Global warming potential (kg CO_2 eq./kg ECM)
Acidification (mol H^+ eq. /kg ECM)
 Marine eutrophication (g N eq. /kg ECM)
Terrestrial eutrophication (mol N eq./kg ECM)
 Fresh water ecotoxicity (CTUe/kg ECM)
 Potential biodiversity damage (PDF/kg ECM)
 Land use (m^2/kg ECM)
Minerals, fossil and renewable energy (g Sb eq./kg ECM)

Overall environmental assessment of organic and conventional dairy production



Making a Life Cycle Assessment of milk

Emissions to air (N_2O, NH_3 etc.)

INPUTS

- Imported feed
- Fertilizer
- Manure
- Diesel
- Electricity
- ect.

HERD

FIELD

OUTPUTS

Milk and meat

Emissions to soil and water (NO_3^- etc.)

Conventional dairy production in DK

Emissions to air (N_2O, NH_3 etc.)

INPUTS

345 t DM imported conc.
8727 kg N-fertiliser
pesticides
15,091 l diesel
134,980 kWh electricity

HERD

168 cows
153 young stock

Outdoor, cows:
0 days/year

DMI:
23% imported concent.
10% own cereals

31% maize silage

30% grass silage
6% grazing

FIELD

150 ha in total:

34 ha cereals (23%)
49 ha maize (33%)

28 ha grass (19%)
28 ha grass clover (19%)

8 ha other crops (5%)
3 ha small biotopes (2%)

OUTPUTS

168 x 9,599 kg ECM/cow (milk)
71 cull cows
108 calves

Emissions to soil and water (NO_3^- etc.)

Key characteristics of dairy systems

	Mixed (DK)		Grass-based (UK)		Mountainous (AT)		
	Conv.	Org.	Conv.	Org.	Conv.	Low.	Org.
No. of cows	168	168	118	127	12	13	10
Milk production (kg ECM/cow)	9599	8708	7411	6193	6230	5120	5500
Outdoor, cows (days/year)	0	150	172	224	20	180	80
Farm area (ha)	150	208	129	153	12	16	13
% Cereals/grain legumes	28	35	11	8	23	-	16
% Maize	33	5	9	-	16	-	-
% Pasture	37	58	80	92	62	100	85
Mineral N fertilizer (kg N/ha)	58		134		49	5	
Imported feed (kg DM/ha)	2437	1321	1422	695	535	470	258

Environmental Impact of milk

DK

Global warming
(kg CO2 eq/ kg ECM)

1.06
1.00

Land use (m²/ kg ECM)

1.5
1.0

Eutrophication
(mol N eq./ kg ECM)

0.07
0.06

0.03
-0.07

0.002

0.004

0.9

0.49

ORGANIC
CONVENTIONAL

Resource use
(g Sb eq./ kg ECM)

Fresh water ecotoxicity
(CTUe/ kg ECM)

Potential biodiversity damage
(PDF/ kg ECM)

Environmental impact of organic and conventional milk, per kg milk

Impact category	Mixed (DK)		Grass (UK)		Mountainous (AT)		
	Conv.	Org.	Conv.	Org.	Conv.	Low.	Org.
Global warming, kg CO_2 eq.	1.06	1.00	0.87	0.75	0.97	0.98	0.92
Acidification, mol H^+ eq .	0.016	0.013	0.012	0.011	0.020	0.017	0.018
Marine Eutrop., g N eq.	7.8	5.9	9.3	5.9	8.3	15.3	9.6
Terrestrial Eutro.,mol N eq.	0.07	0.06	0.05	0.05	0.09	0.08	0.08
FW ecotox., CTUe	0.9	0.03	0.8	0.02	0.7	0.2	0.01
Biodiversity Damage, PDF	0.5	- 0.1	0.5	- 0.5	0.4	- 0.4	- 0.5
Land Use, m^2	1.0	1.5	1.7	1.9	1.4	2.1	2.0
Mineral and energy, Sb eq.	0.004	0.002	0.002	0.001	0.0006	0.0002	0.0006

Main messages

- Carbon footprint of organic milk is reduced when soil carbon sequestration is included in the assessment
- Carbon footprint decreases within creasing milk yield per cow, but to a lesser extent when soil carbon is included in the assessment
- It is possible to include biodiversity in the life cycle assessment of milk through an indicator of biodiversity damage.
- Generally milk from organic farms does not imply biodiversity damage contrary to milk from conventional systems
- Inverse relationship between carbon footprint and biodiversity damage
- Ecotoxicity impacts are significantly lower in organic dairy systems – and should thus be included in the overall environmental assessment

Conclusion

- Within all types of dairy production there are improvement options in relation to environmental impact
- Organic dairy system perform generally better in terms of biodiversity, ecotoxicity and marine water eutrophication, while global warming impacts are close to conventional
- Land use are higher per kg milk in low input and organic dairy systems and thus indirect land use impact are probably higher which will increase the global warming impact if included in the assessment
- Low input systems with lower milk yield per cow can perform as good as or better than high input systems in terms of global warming

This work was done in a collaboration with

- Aberystwyth University (Peter Dennis)
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- ORC (Susanne Padel, Laurence Smith)
- BOKU (Werner Zollitsch, Stefan Hörtenhuber)
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Carbon footprint of organic and conventional milk

Global warming