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A European Public-Private Partnership

EAAP European Federation of Animal Science

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Breeding towards efficiency in Finnish dairy and beef cattle improves environmental performance

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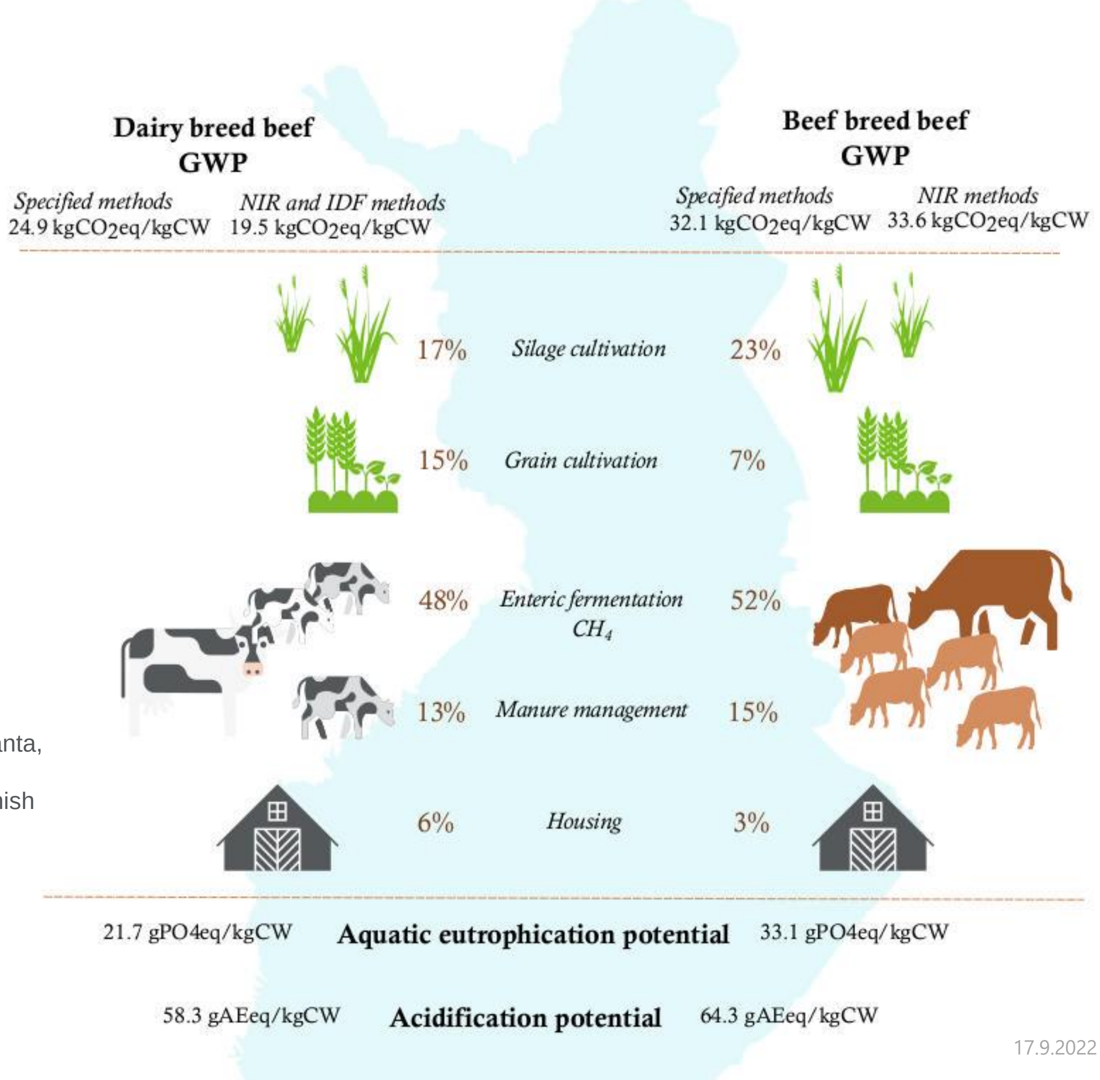
Environmental Life Cycle Assessment of Finnish beef
(Hietala et al. 2021)

Beef produced in Finland is appr. 80% dairy breed beef and 20% beef breed beef.

Overall GWP of Finnish beef was **21.9 kgCO2-eq./kg CW, with NIR and IDF methods**

Hietala, S., Heusala, H., Katajajuuri, J. M., Järvenranta, K., Virkajärvi, P., Huuskonen, A., & Nousiainen, J. (2021). Environmental life cycle assessment of Finnish beef–cradle-to-farm gate analysis of dairy and beef breed beef production. Agricultural Systems, 194, 103250.



A++COW - Breeding Dairy Cattle for Resource Efficiency and Environmental Sustainability

Genetic improvement of Finnish dairy cattle

- Based on predicting genomic breeding values for about **80 different traits** and combining of these traits into a total merit index (**Nordic total merit, NTM**)
- A++ COW project is developing the **first genomic predictions for feed efficiency traits** in Finnish and Nordic dairy cattle.

- **Maintenance Cost**
- **Metabolic Efficiency**
- **Metabolic Resilience**

A++COW - Breeding Dairy Cattle for Resource Efficiency and Environmental Sustainability

First hypothetical estimate for the impact of genetic improvement of dairy cows, a literature based scenario:

- Current genetic improvement rate was assumed to continue (based on development history)
    - With genomic selection, yearly increase in ECM was estimated to continue at a rate of 0.54 kg
    - Scenarios to 2035 and 2050
- Simplified estimation was conducted for dairy cows only
    - Production volumes for dairy and dairy cow beef were kept constant
    - *Not yet a full life cycle of dairy and meat production*

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For the current production level:

- 256 000 dairy cows are needed
    - 80% of the energy demand is associated with milk production , 20% with meat production.
    - producing 1 kg of milk required 8.2 MJ and producing 1 kg of meat 203 MJ metabolizable energy

Based on recent Life Cycle Assessment conducted at Luke (Hietala, et al., 2021)

- Carbon footprint for 1 kg raw milk was 1.47 kg CO_2-eq and for 1 kg dairy cow meat 15.7 kg CO_2-eq.
- On estimate a total of 3.81 million tons CO_2-eq is generated from the production, which served as the basis for the GHG emission reduction estimate.

A++COW - Breeding Dairy Cattle for Resource Efficiency and Environmental Sustainability

In the scenario cows were selected based on the NTM index, which included also the feed efficiency traits.

As a result, **reduction of feed requirement** due to genetic improvement

- By 2035, was estimated to be 7.6%
- By 2050, estimated to be 13.7%
- **Mainly due to dilution effect**, *as the share of energy allocated to milk production increases and to maintenance and replacement decreases*

At the same time there will be **less cows needed** to produce the same amount of milk,

- 210 000 and 173 000 dairy cows in 2035 and 2050, respectively.

Resulting **predicted yearly reductions of GHG emissions** of

- 289 000 tons by the year 2035 and 521 000 tons by the year 2050 –
- **-13% of the current level**

Beef cattle efficiency is improved in Beefgeno project - *Improving self-sufficiency and efficiency of Finnish beef production through genomic selection*

Hereford		slaughter age, d	slaughter weight, kg	daily gain, kg/d	birth weight, kg
Bull	average	602	380	0.602	43.0
Bull	q25 (worst performing)	614	333	0.516	39.8
Bull	q75 (best performing)	591	422	0.685	45.6
Heifer	average	532	244	429	39.2
Heifer	q25 (worst performing)	543	223	383	36.8
Heifer	q75 (best performing)	526	266	474	41.8

Charolais		slaughter age, d	slaughter weight, kg	daily gain, kg/d	birth weight, kg
Bull	average	587	433	706	47.1
Bull	q25 (worst performing)	601	382	606	43.7
Bull	q75 (best performing)	578	483	802	49.9
Heifer	average	512	271	495	43.3
Heifer	q25 (worst performing)	528	251	443	41.5
Heifer	q75 (best performing)	501	291	546	45.3

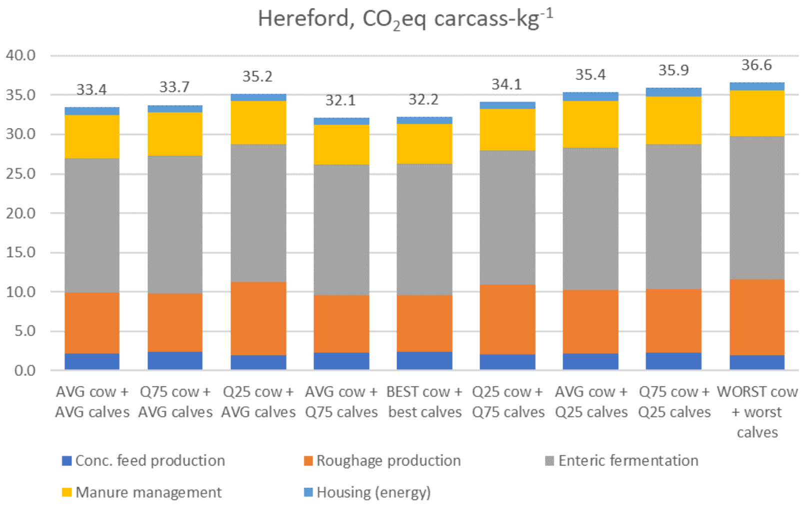
Input variables for suckler cows

	Age at 1st calving	Calvings, n	Slaughter age	Slaughter weight, AVG
	AVG			
HER	821	4.2	2474	336
CHA	842	4.3	2436	378
	Q75, Best 25%			
HER	717	8.0	3777	336
CHA	717	8.1	3763	378
	Q25, Worst 25%			
HER	1031	1.4	1432	336
CHA	1074	1.4	1397	378

- Carcass weight as average for Hereford and Charolais cows, from slaughterhouse data
- Average cow and better/poorly performing quartiles were determined based on number of calvings
- Other variables based on subgroup averages (number of calvings per lifetime as decisive variable for each group)

GWP beef from Hereford suckler cow+calf system

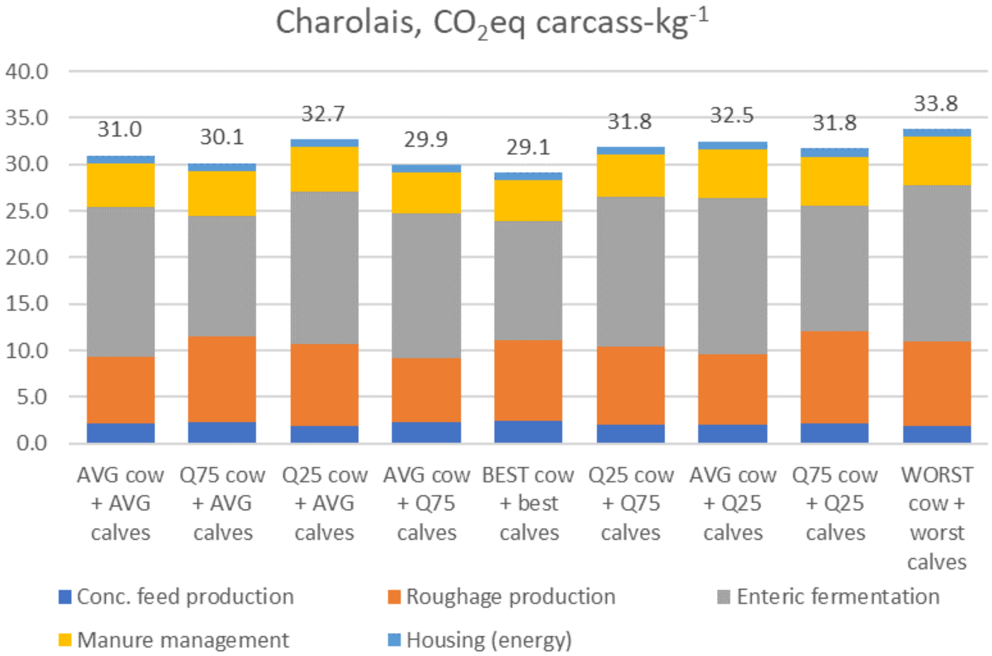
- Results from different combinations of suckler cows and offspring:
  - Average (AVG) calves, Q75 calves, Q25 calves
  - Combined with average (AVG), Q75 cows, Q25 cows



Hereford:
Best performing combination **AVG cow + Q75 calves**
Q25+Q25 performed worst

Max differences:
–12% in GWP between worst performing and best performing

GWP beef from Charolais suckler cow+calf system



Charolais:

Best performing combination **Q75+Q75,** Q25+Q25 performed worst

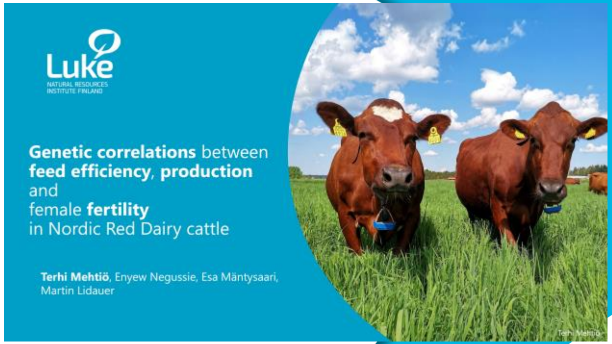
Max differences:

–14% in GWP between worst performing and best performing

Conclusions

- Based on the assessed genetic improvement alternatives, it was estimated that genetic progress based on current Finnish dairy cattle breeding system yields to a 13% reduction of GHG emissions from dairy production until 2050.
- According to LCA results of genetic improvement in beef production, Finnish Hereford production had 12% reduction potential between worst performing and best performing quartiles. Similarly, Finnish Charolais had 14% reduction potential.

Breeding for feed and resource utilization efficiency is an effective way of reducing the environmental impact (carbon foot print of) cattle production.



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Thank you!