

Large variation in emission intensities from dual-purpose sheep production system

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30.08.2023

Norwegian natural resources

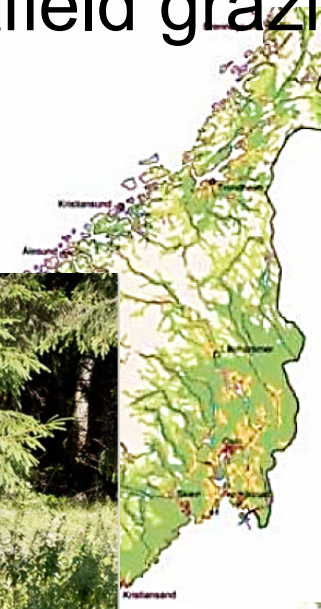
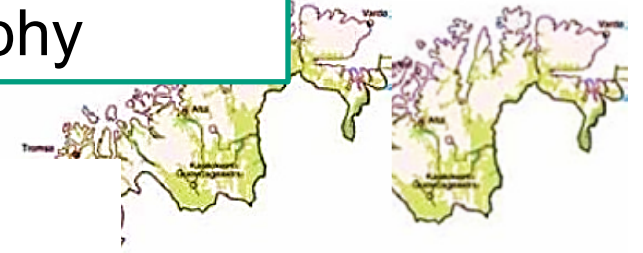
Limitations:
- climate
- topography

- 3% arable land
 - 1/3 cereals
 - 2/3 grass



- In addition: 50% of area suitable for outfield grazing

→ use of ruminants



- Mountains
- Birch forest
- Pine forest
- Agricultural areas
- Urban areas

Statens kartverk

Norwegian sheep production



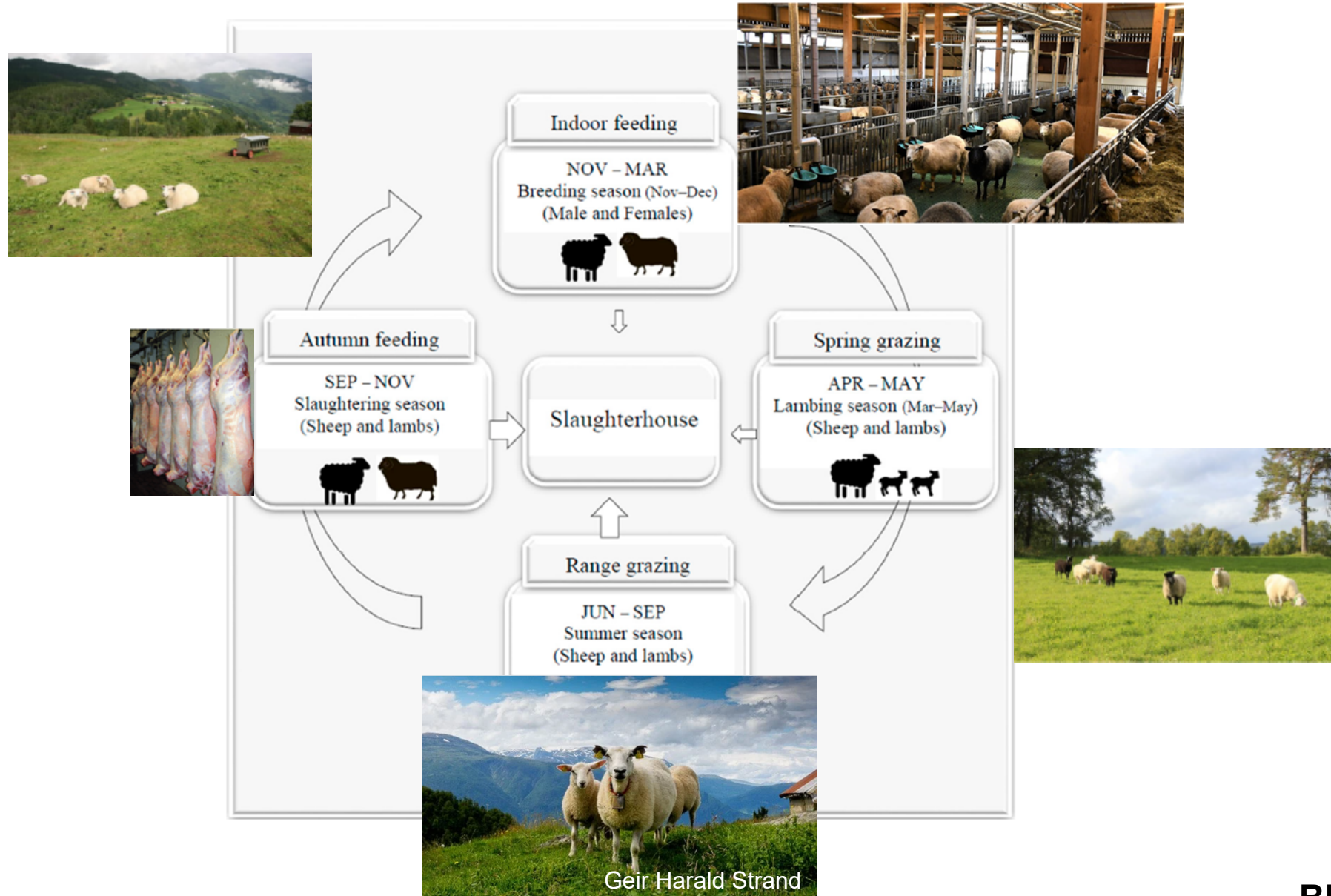
- Population size:
 - 1 million winterfed ewes
 - 1.3 million lambs slaughtered
- One dominant breed:
 - Norwegian White Sheep: 70%



Grete Ringdal

Bhatti et al., 2019;

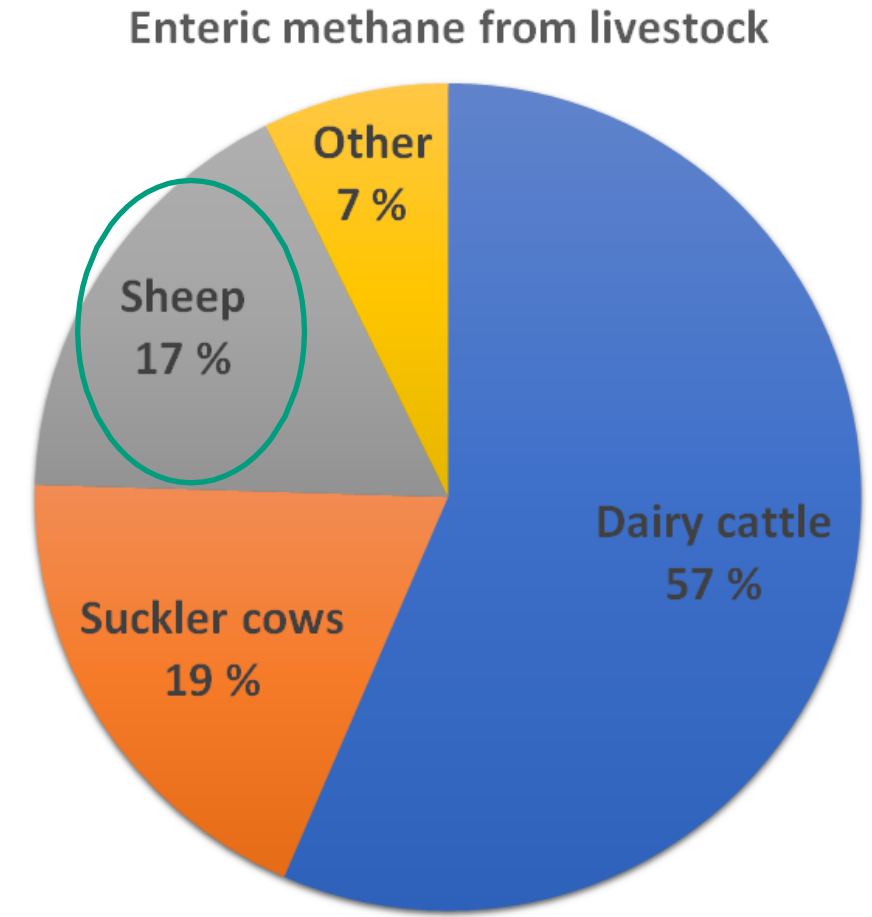
Norwegian sheep production system



Greenhouse gas emissions



- Greenhouse gas emissions (GHG) from agriculture (ruminants) is focused in the public debate
- Agriculture: 9.4% of total GHGs
- Enteric methane is the most important emission source
 - ~50% of GHG from agriculture
- Need mitigation options





Edited by Simon Eggleston, Leandro Buendia,
Kyoko Miwa, Todd Ngara and Kiyoto Tanabe



IPCC National Greenhouse Gas Inventories Programme



M-1255|2018

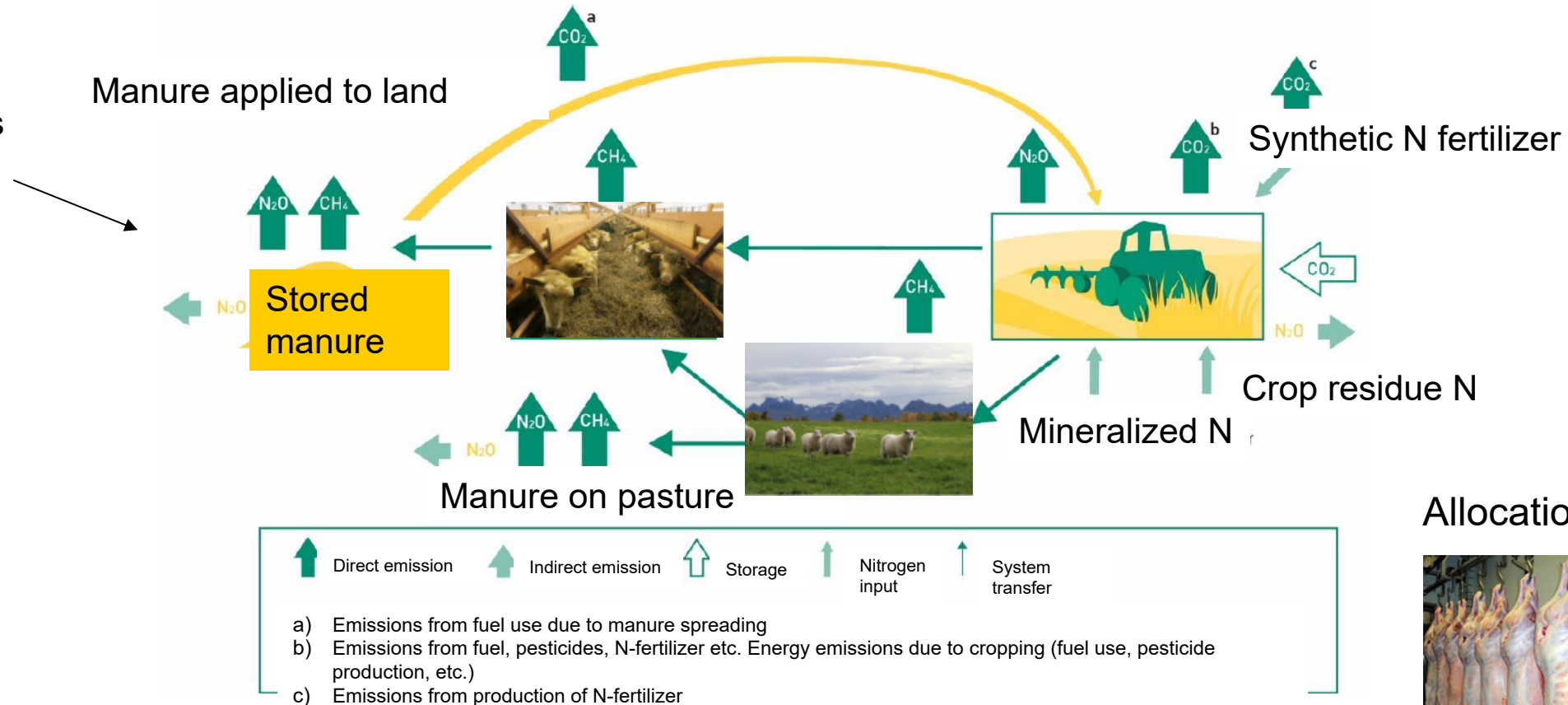
M-1590|2019

Swedish arable land ranges 5–10% and its topsoil contains about 300 Mg C. The mineral soil seems to be the main store of C in the soil. The Swedish arable land has been cultivated for more than 200 years. In this study, we have devised a conceptual model (JCM05) for estimating annual agricultural crop production, soil dynamics and atmospheric fluxes to calculate annual C input to the soil together with crop yield and soil C model (JCM05), collected using long-term field data. In Sweden, annual total emissions are reported for different crops, for each of eight agricultural regions. Present topsoil carbon content and regional distribution of soil types have recently been mapped. We use daily weather station data for each region together with crop type, fielded data on crop yield and soil type to calculate an annual soil carbon balance for each crop/region combination. We use 14 soil types and 5 crop types, which given 70 parameters used for each year and region, each representing a fraction of the region's area. For each year, region, crop type and soil type, JCM05 calculates the change in young and old soil carbon per hectare, and sums up the changes in, e.g., annual C input to the soil, annual C output from the soil, annual C input to the atmosphere and annual C output from the atmosphere.

HolosNorSheep



N-fertilizer
Diesel fuel
Electricity
Pesticides
Preservatives



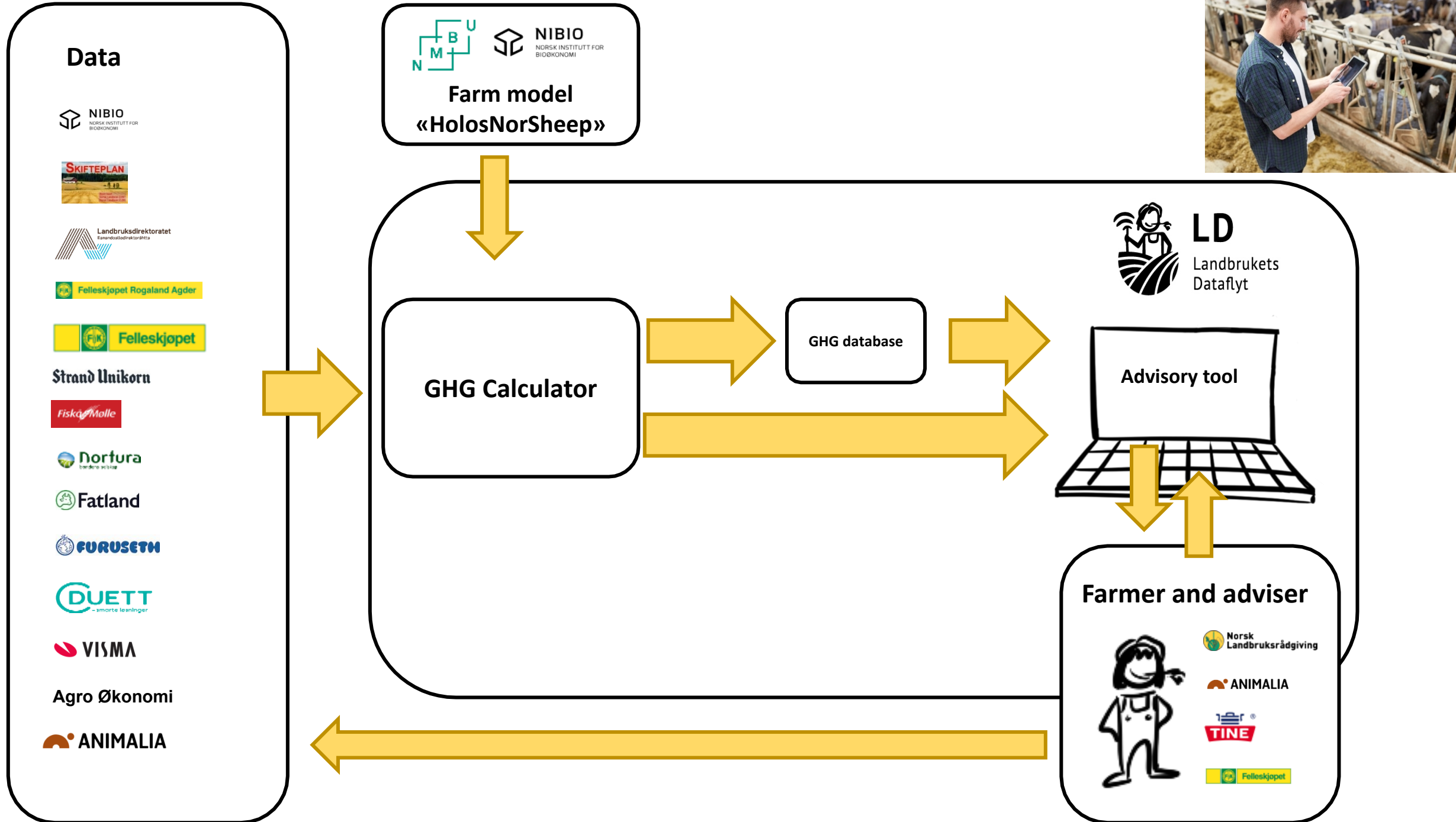
Allocation of GHGs:



Soil carbon balance set to zero

Input data HolosNorSheep





Pilot study

- 38 farms distributed across Norway with varying climate, natural resource base, feeding and management practices
- Data from 2019 to 2021 (n=68)
- Average:
 - herd size: 83 ewes (± 49)
 - ley area: 24 hectares (± 17)



Animal performances

	Average (std)	Min	Max
Ewes			
Live weight, kg	78 (± 6.5)	56	81
Number of weaned lambs	2 (0.3)	1.4	3.0
Lambs			
Autumn weight, kg	45 (± 4.8)	33	54
Carcass weight, kg	20.6 (± 2.4)	15	27
Growth rate birth-autumn, gram	310 (± 40)	230	400
Autumn fattening, no. of days	20 (± 12)	4	78

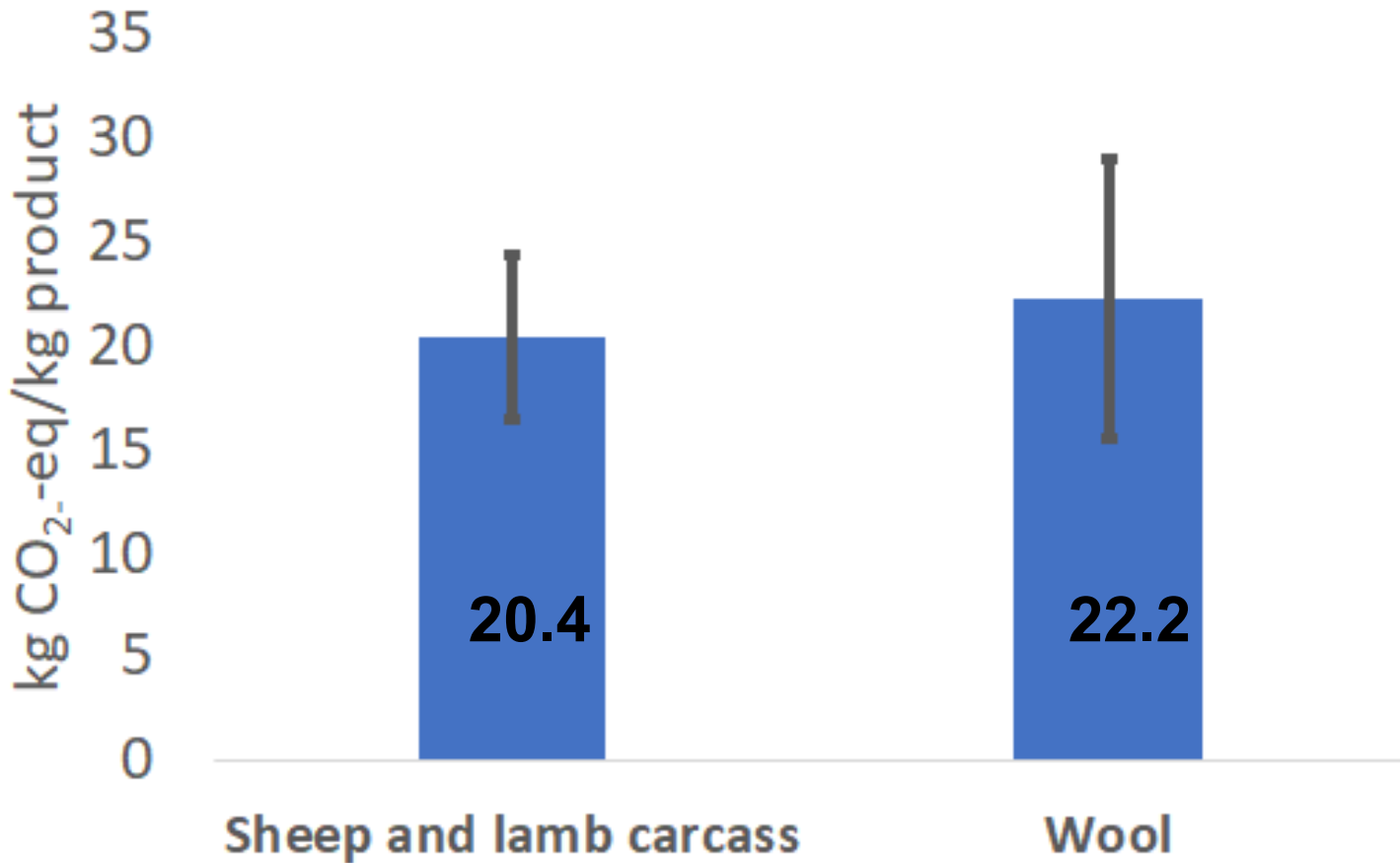
Input factors

Input factor	Average (std)	Min	Max
Electricity, kwh	13,207 ($\pm 16,623$)	0	95,532
Concentrates, kg/kg carcass	2.2 (± 1.7)	0	7.8
Fuels, liters	-	0	349

Preliminary results

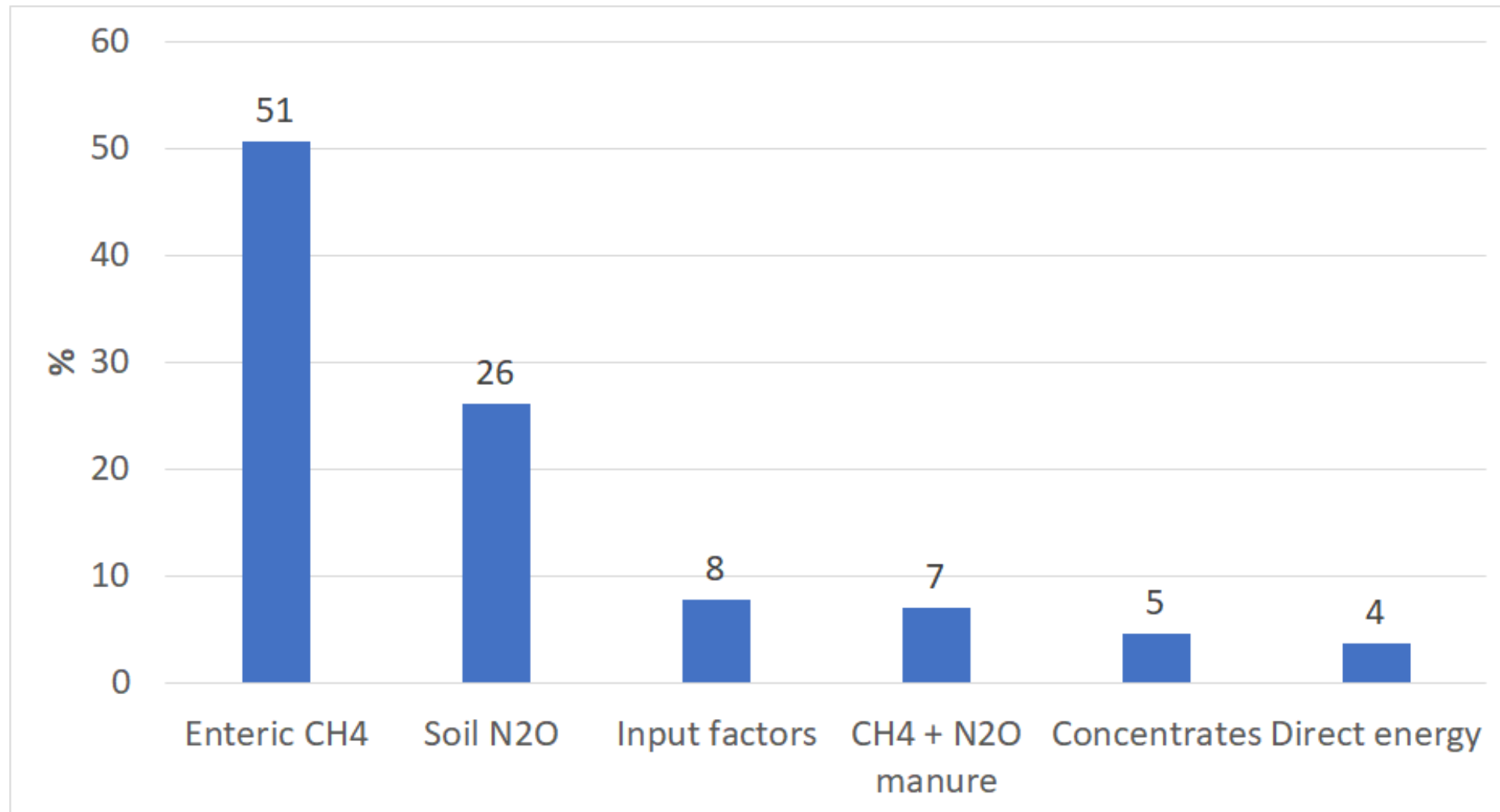


Emission intensities



	Min	Max
Carcass	11.3	30.4
Wool	10.7	51.0

Emission sources



Summary



- The GHG calculator is available to all sheep farmers in Norway
 - need to share data from many sources
- Pilot study:
 - large variation in animal performances and use of input factors
 - large variations in emission intensities (11-30 kg CO₂-eq/kg carcass)
 - potential to reduce emission intensities from Norwegian dual-purpose sheep production

Thank you for your attention!