Emission of climate gasses from lamb production- 9 Danish case studies

Internorden

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PRODUKTION AF DANSK LAM
- produktionstal og klimapåvirkning
Case studier fra 9 bedrifter

TROELS KRISTENSEN OG KIRSTINE FLINTHOLM JØRGENSEN

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AARHUS
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Challenges

Consumer: Low carbon footprint is a part of shopping preferences

Society (the government): 70% reduction af CO_2-emission in 2050 (1990-level)

The figure **21,4 kg CO_2 eqivalents** per kg lamb meat – is circulation in the media

(Based on Wales data)

Method:

2020: Data collection from 10 herds (12 months)

2021: LCA was calculated using the average herd production data from 9 herds by Aarhus Unversity.

The LCA calculations were based on the principles of Product Environment Footprint (EC 2017) and specifically on the production of red meat (EC 2019). Direct Land-use change is not included.

Carbon footprint (CF) per kg produced carcass weight
Life-cycle-assessment from ”craddle to Farmgate”

Contributions to the emissions

- **PURCHASED:** Production and transport to the farm eg. fertilizer, feed and energy
- **THE FARM:** Cultivation and animals digestion, storage and use of manure

Carbon Cycle

- **Carbon dioxide CO_2**
  - **Fossil energi**
- **Methane (CH_3)**
  - **From digestion and manure storage**

Nitrogen Cycle

- **Nitrous oxide (N_20) og ammonium (NH_3)**
  - Decomposing of N in manure storage and in the soil

CO_2 equivalents

1 kg CO_2 = 1 CO_2 eq.
1 kg metan = 25 CO_2 eq.
1 kg lattergas = 298 CO_2 eq.
(100-årig time frame)

Climate footprint per:

- mothersheep
- kg carcass weight
- Kg wool
- Kg skin

+/- carbon balance in the soil

Registrations
Production year: 2020

- Breed og mature weight
- Animal in and out (birth, purchase, death/slaughter/sold)

Input

- Feed, self-supply + purchased
- Grazing area and stocking rate
- Fertilizer, fuel, electricity

Output

- Number of animals (lambing, weaned, slaughter, sold alive
- Kg weaned + carcass, price
- Wool, kg and use, price
- Skin, no. and price

Farms

Herd	1	2	3	4	5	6	7	8	9
No. of mother sheep*	10-100	10-100	10-100	10-100	100-400	100-400	100-400	>400	>400
Type	Organic		Hobby	Hobby 8 months lambing interval	outdoor lambing	Nature preserv. Organic	All year lambin outdoor lambing	Nature preserv. Outdoor lambing	Nature preserv. Outdoor lambing
Turnover besides the meat	Skin wool breeding	Skin wool breeding	breeding	breeding		Skin wool	wool	wool breeding	wool
Main grazing areas [1)]	Arable	Arable	Arable	Afther-math and nature	After-math and nature	Nature and after-math	Nature and after-math	Nature and after-math	After-math and nature

”Aftermath”= grazing grass seed fields, last cut grass (dairy herds) and cover crops

Farm data

Herd	1	2	3	4	5	6	7	8	9
Kg, mature	65	65	75	75	67	82	70	80	65
Lambing pr corr. adult sheep (årsfår)	1,03	1,10	1,04	1,19	0,96	0,56	1,05	0,97	0,69
Lamb born alive per corr. adult sheep	2,05	1,92	1,98	2,32	1,55	1,15	1,56	1,58	0,92
Lambs born alive pr sheep lambing	1,98	1,74	1,90	2,79	1,62	2,04	1,48	1,64	1,33

Farm data

Herd	1	2	3	4	5	6	7	8	9
% replacement [1)]	16,3	32,9	50	18,5	31	9,8	11,2	29,5	22,7
% death lambs at lambing	2,2	10,7	0	5,1	9,7	9,8	7,0	2,8	3,6
Age at 1. lambing, months	12	12	12	18	12	24	12	12	24

Other production data:

Daily gain until weaning: 214-301 g/day

Daily gain after weaning to slaugther: 93–256 g/day

Age at weaning: 61–158 days

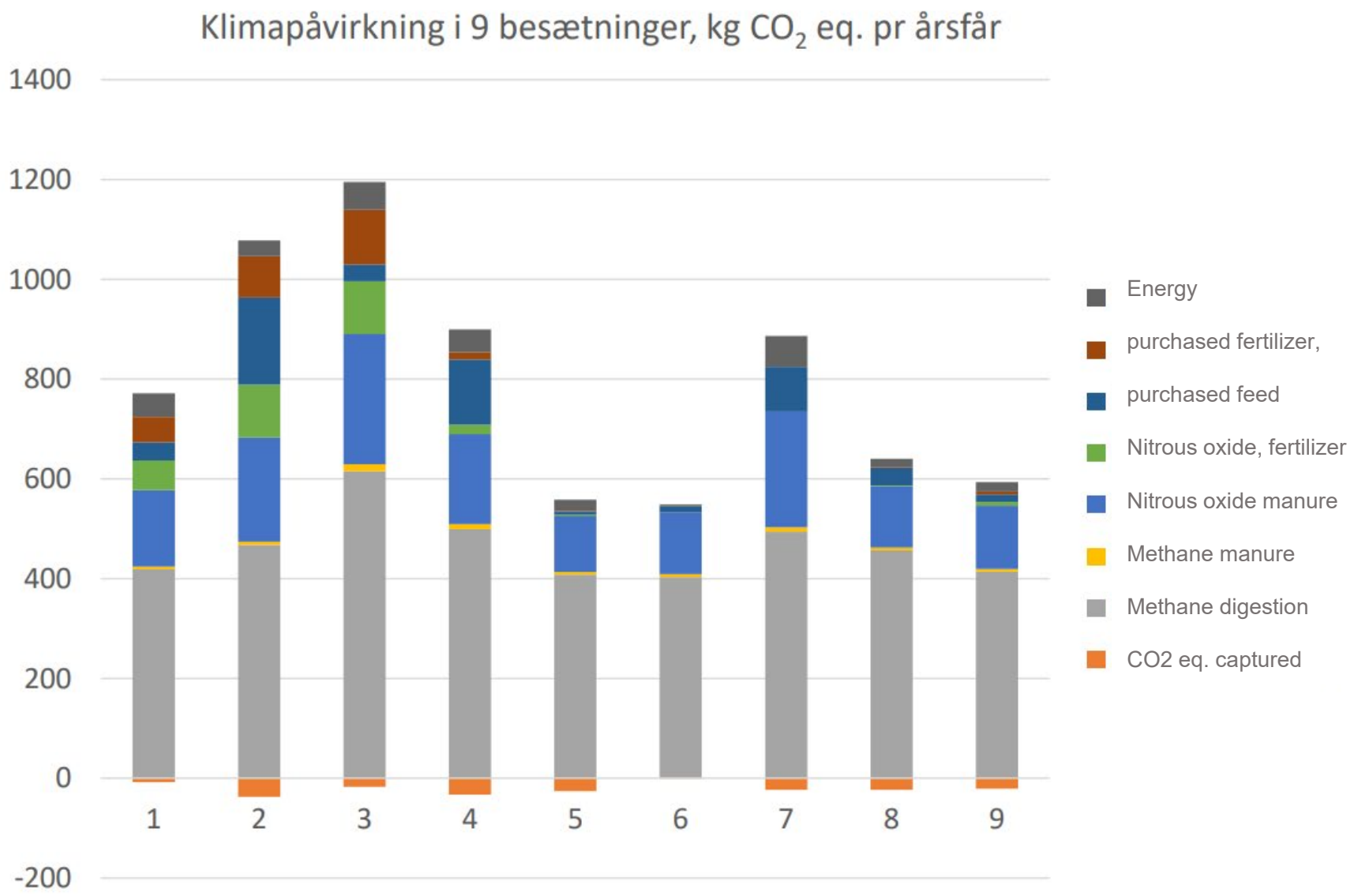
Age at slaughter: 145-405 days

Weight at slaughter: 39-57 kg

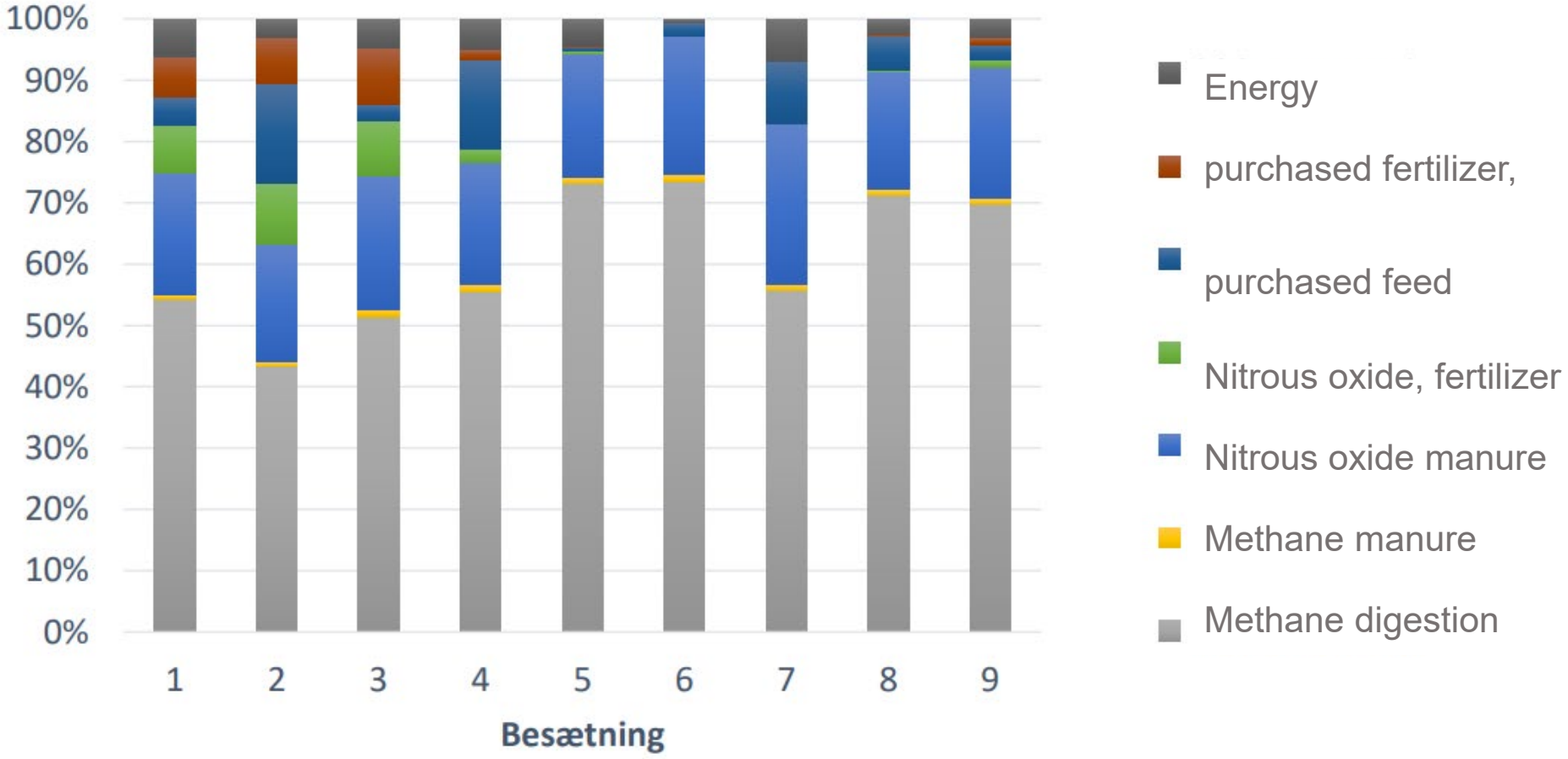
Feed Unit (FU) per sheep (årsfår): 640-1040

FU, grazing: 36-99 % af FE

FU per kg gain: 8,5-17


Klimapåvirkning i 9 besætninger, kg CO_2 eq. pr årsfår
1400
1200
1000
800
600
400
200
0
-200
1
2
3
4
5
6
7
8
9
Energy
purchased fertilizer,
purchased feed
Nitrous oxide, fertilizer
Nitrous oxide manure
Methane manure
Methane digestion
CO2 eq. captured

Fordeling af klimapåvirkning i 9 besætninger, % per årsfår



Carbon footprint

Herd	1	2	3	4	5	6	7	8	9
No allocation									
kg CO_2 eq. per kg Carcass Weigth (CW) (lamb and sheep)	22,5	22,2	20,8	19,8	18,3	17,0	26,7	16,2	28,7

Carbon footprint

Herd	1	2	3	4	5	6	7	8	9
No allocation									
kg CO_2 eq. per kg Carcass Weight (CW) (lamb and sheep)	22,5	22,2	20,8	19,8	18,3	17,0	26,7	16,2	28,7
Economic allocation									
Lamb meat, kg CO_2 eq. per kg CW	16,9	19,6	23,6	20,7	21,9	18,6	27,7	19,6	32,5
Sheep meat, kg CO_2 eq. per kg CW	11,5	12,6	15,5	4,7	8,9	5,9	7,4	6,1	13,0
Skin, kg CO_2 eq. per unit	108	151				146			
Wool, kg CO_2 eq. per kg	6,3	8,5				8,3	1,4	1,0	6,8

Carbon footprint

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Skin, kg CO_2 eq. per unit	108	151				146			
Wool, kg CO_2 eq. per kg	6,3	8,5				8,3	1,4	1,0	6,8
Other effects, pr kg lam CW									
Soil C, kg CO_2	2,9	3,3	5,5	3,0	4,8	3,4	4,9	3,7	4,9

Carbon balance in the soil

1) Without carbon balance in the soil
2) With carbon balance –arable land
3) With carbon balance arable lands plus assuming a carbon capture in the areas with seed grass and permanent pastures

Klimaaftryk pr kg lammekød beregnet ud fra tre forskellige modeller. 1) uden kulstofbalancer i jorden 2) med kulstofbalance i jorden fra gødning og sædskifte (indlejring af C kun på græs fra sædskifteareraler), 3) Med kulstofbalancer som 2 men hvor der også antages at være en kulstofindlejring, når fårene afgræsser vedvarende arealer og frøgræsarealer

Besætning		1	2	3	4	5	6	7	8	9
Model		Lammekød, kg CO_2 eq. pr kg slagtevægt								
1	Traditionel uden kulstof-balancer	16,9	19,6	23,6	20,7	21,9	18,6	27,7	19,6	32,5
2	Traditionel med jord C fra gødning og sædskifte	14,0	16,3	18,1	17,6	17,1	15,3	22,5	15,9	27,2
3	Model 2 med jord C fra vedv. arealer & frøgræs	13,0	16,3	18,1	16,9	14,2	11,9	21,9	13,8	23,5

When nature conservation is a value…

Allocating the emisions on the different products will ”lower” emission from the meat. Would it be more fair to put a value of eg. a 1000 danish kr (134 €) on nature preservation?? ….but it won’t change the emissions for the sheep.

1) Without carbon balances
2) With nature preservation given an economic value

Eksempel. Værdisætning af naturpleje og betydning for klimaaftrykket pr kg lams slagtevægt, når klimaaftrykket fordeles ud fra produkternes økonomiske værdi. Naturpleje er værdisat til 1000 kr. pr årsfår

Besætning		1	2	3	4	5	6	7	8	9
Model		Lammekød, kg CO2 eq. pr kg slagtevægt								
1	Traditionel uden kulstofbalancer	16,9	19,6	23,6	20,7	21,9	18,6	27,7	19,6	32,5
2	Med naturpleje værdisat	16,8	19,6	23,6	18,1	21,9	13,7	26,7	15,8	25,1

Emissions from lamb meat compared to other meat types

	Kg CO_2 eq per kg
Lamb meat	
- With skin & wool	17-20
- Intensive	19-24
- Extensive – nature preserv.	20-32
Beef *(Mogensen et al., 2015)*	
- Dairy Cattle	10-12
- Intensive suckler cows	26
- Extensive suckler cows	33
Porc *(Andersen et al., 2021)*	3,1

What explains the differences in the emission per kg lamb meat??

Overall – the production system, but within the system emission (CF) is reduced by:

- High feed efficiency (kg lam pr FE)
- High N utilisation
- High amount of grass and especially grazing (% of feed intake)
- High lamb production (kg lam pr sheep; årsfår)

- Bought in feed with low CF (e.g. by products)

- High economic values of other products than the meat
  (effects the allocation but not the emission!)

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…and thanks for the attention!