

The dairy sector in the face of climate change: a summary of the CAP'2ER analyses in the Upper Rhine region

Dairy farming systems are as diverse as the regions in which they are practised. Whether mountain pasture farms, mixed systems combining grass and maize, or farms with a stronger focus on maize production – the technical decisions made influence both the farms' production output and their environmental footprint. Against the backdrop of climate change, it is essential to gain a better understanding of the factors that determine the greenhouse gas emissions and carbon sequestration capacities of these various systems. This series of factsheets, produced as part of the ResKuh project, presents the findings observed across several representative dairy farming systems. Using a set of common indicators, they highlight the characteristics, specific features and key influencing factors that contribute to their carbon footprint. An invitation to gain a better understanding of the diversity of livestock farming models and their contribution to current climate policy challenges.

There are five overviews of the results for the various farming systems:

**LOWLAND
GRASS-MAIZE**

LOWLAND GRASS

MOUNTAIN

LOWLAND MAIZE

BY COUNTRY



Interreg



Cofinancé par
l'Union Européenne
Kofinanziert von
der Europäischen Union

Rhin Supérieur | Oberhein



Further ResKuh fact sheets on greenhouse gas emissions or other aspects of the project can be found on our website:

[https://agroecologie-rhin.eu/en/reskuh-en/downloads/!](https://agroecologie-rhin.eu/en/reskuh-en/downloads/)

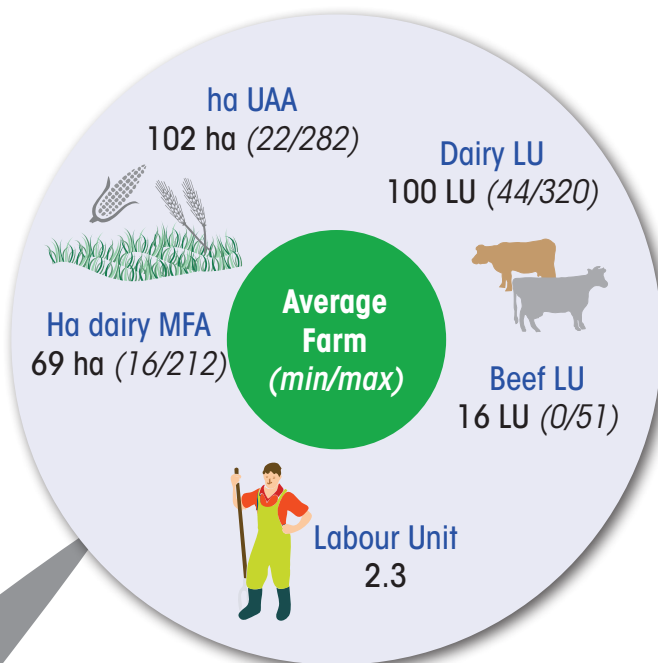
ResKuh Project: key findings by country

Lowland Grass-Maize System

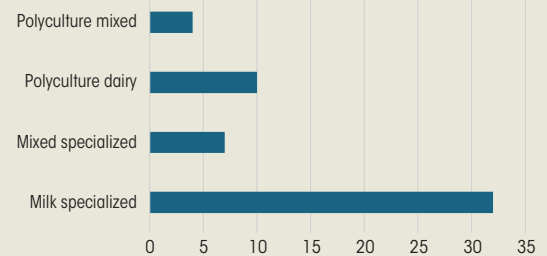
Years 2023-2026



Farm

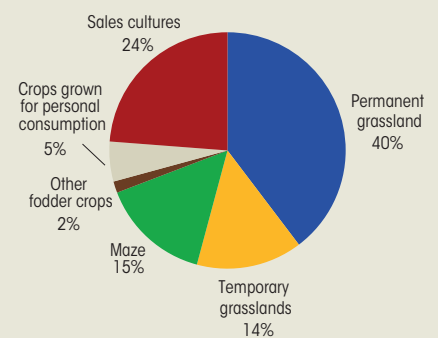


Classification* of farms



* mixed crop if MFA/UAA < 0.7 and mixed dairy meat if Beef LU > 8.

Crop allocation



THE ENVIRONMENTAL IMPACT OF AN AVERAGE FARM

I feed*
29
people./ha UAA



Source : Perfalim, CEREOPA

* based on the animal protein content of agricultural.

I emit as GHGs*
3 627
kg eq. CO₂/ha UAA



*GHG = GreenHouse Gas.

I store*
537
kg eq. CO₂/ha UAA



* thanks to the grasslands and hedges.

I consume
28
MJ/ha UAA



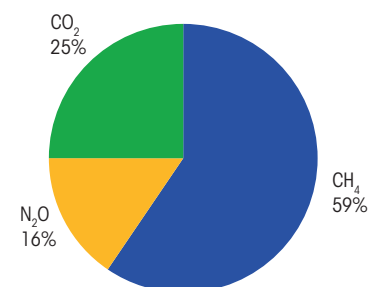
I maintain
0.62
eq. ha of biodiversity/ha UAA



Nitrogen
balance surplus
106 kg N/ha UAA



Breakdown of GHG emissions at farm level





	RESKUH average	Swiss average	French average	German average
Number of farms	53	22	23	8
Share of maize in forage area (ha maize/ha dairy forage area)	22%	19%	24%	23%
Number of dairy cows	71	62	77	76
Dairy forage area (ha)	59	47	68	66
Environmental results				
Average GHG emissions	1.02	0.93	1.08	1.10
Average carbon storage	0.55	0.52	0.55	0.65
Average net carbon footprint	0.16	0.16	0.16	0.13
Gross emissions (kg CO ₂ eq/l milk)	0.07	0.06	0.08	0.07
<i>of which enteric fermentation</i>	0.07	0.06	0.08	0.08
<i>of which manure management</i>	0.12	0.08	0.16	0.10
<i>of which nitrogen fertilization</i>	0.02	0.01	0.02	0.02
<i>of which fuel and electricity</i>	0.04	0.04	0.03	0.05
<i>of which feed</i>	0.09	0.06	0.11	0.10
<i>of which fertilizers</i>	0.02	0.01	0.02	0.02
<i>of which livestock purchases</i>	0.04	0.04	0.03	0.04
Carbon sequestration (kg CO ₂ eq/l milk)	0.09	0.06	0.11	0.10
Technical criteria				
Herd management				
Milk/cow (l)	8 778	8 930	8 689	8 618
Corrected milk production (l/ha dairy forage area)	11 725	13 374	10 404	10 987
Heifer LU/cow (%)	38%	25%	48%	46%
Age at first calving (month)	29	28	29	28
Replacement rate (%)	31%	29%	35%	23%
Herd feeding				
Concentrates per cow (g/l)	208	131	278	219
Heifer concentrates (kg/heifer LU)	572	539	678	361
N excreted (kg N/LU)	113	107	113	128
Protein self-sufficiency (%)	64%	71%	54%	72%
Land management				
Mineral nitrogen (kg N/ha dairy UAA)	46	27	64	46
Organic nitrogen pressure (kg N/ha dairy UAA)	131	144	113	142
Grass yield (t DM/ha)	7.8	8.7	6.0	10.3
Carbon storage criteria				
Hedgerow (ml/ha dairy UAA)	6	4	6	12
% permanent grassland / dairy UAA	53%	43%	57%	68%
Manure management				
Grazing days	74	95	64	44
Energy				
Fuel (l/ha dairy UAA)	239	240	234	250
Electricity (kWh/1000 L)	72	87	65	52

My situation



*10% of farms with the lowest gross GHG emissions (upper decile) or highest gross emissions (lower decile).



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Contact Tool: CAP2ER@idele.fr

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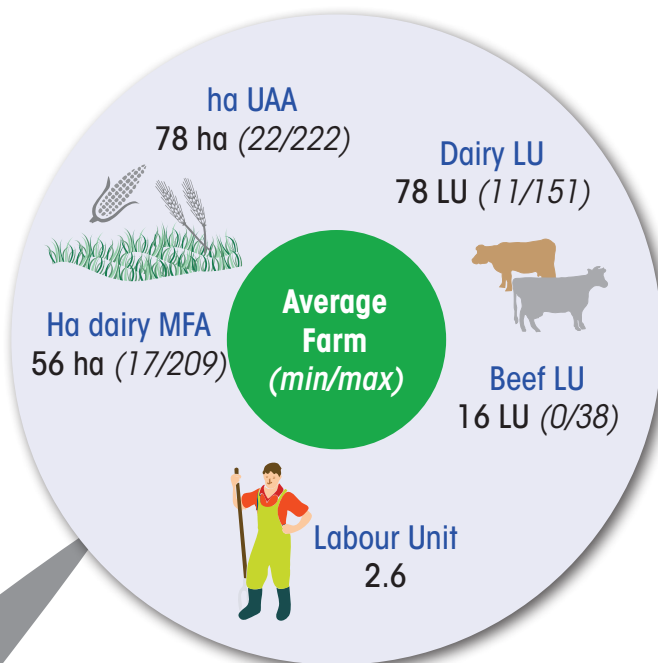
ResKuh Project: Key Results

Lowland Grass System

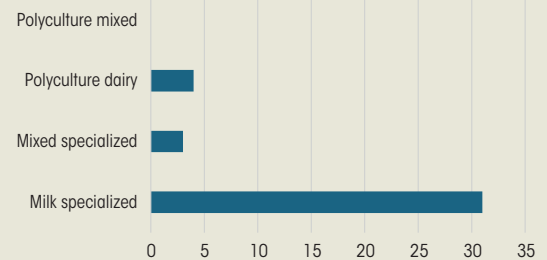
Years 2023-2026



Farm

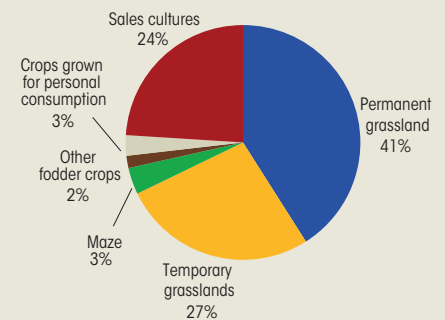


Classification* of farms



* mixed crop if MFA/UAA < 0.7 and mixed dairy meat if Beef LU > 8.

Crop allocation



THE ENVIRONMENTAL IMPACT OF AN AVERAGE FARM

I feed*
26
people./ha UAA



Source : Perfalim, CEREOPA

* based on the animal protein content of agricultural.

I emit as GHGs*
3 369
kg eq. CO₂/ha UAA



*GHG = GreenHouse Gas.

I store*
576
kg eq.CO₂/ha UAA



* thanks to the grasslands and hedges.

I consume
18
MJ/ha UAA



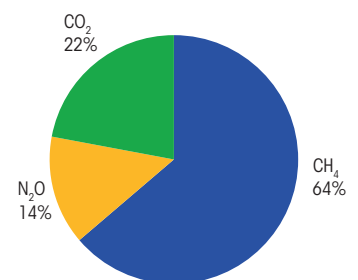
I maintain
4.10
eq. ha of biodiversity/ha UAA



Nitrogen
balance surplus
104 kg N/ha UAA



Breakdown of GHG emissions at farm level





Average GHG emissions:
1.00 kg eq.CO₂/l milk



Average carbon storage:
0.11 kg eq.CO₂/l milk



Average net carbon footprint:
0.90 kg eq.CO₂/l milk

	Upper decile*	Average	Lowest decile*
Share of maize in forage area (ha maize/ha dairy forage area)	7%	5%	4%
Number of dairy cows	64	57	57
Dairy forage area (ha)	51	45	45
Environmental results			
Gross emissions (kg CO ₂ eq/l milk)	0.78	1.00	1.27
of which enteric fermentation	0.49	0.56	0.66
of which manure management	0.16	0.18	0.16
of which nitrogen fertilization	0.04	0.05	0.08
of which fuel and electricity	0.06	0.07	0.11
of which feed	0.02	0.10	0.20
of which fertilizers	0.00	0.01	0.02
of which livestock purchases	0.01	0.03	0.04
Carbon sequestration (kg CO ₂ eq/l milk)	0.10	0.11	0.17
Technical criteria			
Herd management			
Milk/cow (l)	7 969	7 602	6 141
Corrected milk production (l/ha dairy forage area)	10 064	10 254	9 059
Heifer LU/cow (%)	33%	31%	22%
Age at first calving (month)	28	29	29
Replacement rate (%)	29%	32%	28%
Herd feeding			
Concentrates per cow (g/l)	141	160	222
Heifer concentrates (kg/heifer LU)	112	558	716
N excreted (kg N/LU)	95	102	98
Protein self-sufficiency (%)	91%	74%	58%
Land management			
Mineral nitrogen (kg N/ha dairy UAA)	10	20	28
Organic nitrogen pressure (kg N/ha dairy UAA)	156	131	120
Grass yield (t DM/ha)	8.2	8.3	6.9
Carbon storage criteria			
Hedgerow (ml/ha dairy UAA)	9.5	6	0.2
% permanent grassland / dairy UAA	56%	55%	65%
Manure management			
Grazing days	146	89	52
Energy			
Fuel (l/ha dairy UAA)	191	248	285
Electricity (kWh/1000 L)	105	94	124

My situation



*10% of farms with the lowest gross GHG emissions (upper decile) or highest gross emissions (lower decile).



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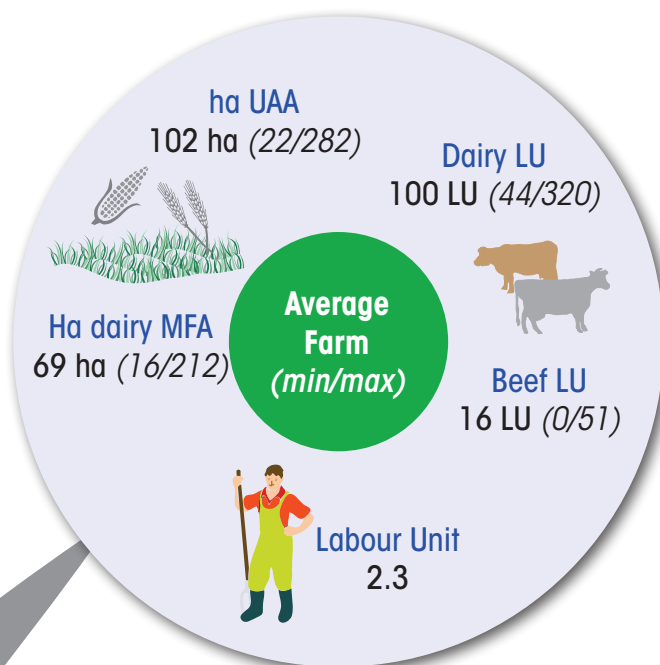
ResKuh Project: Key Results

Lowland Grass-Maize System

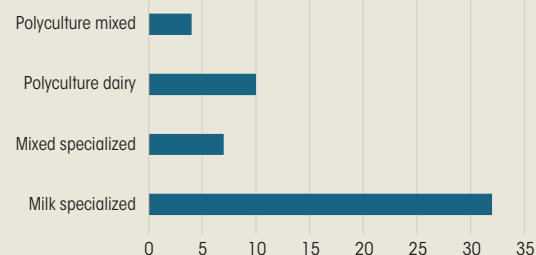
Years 2023-2026



Farm

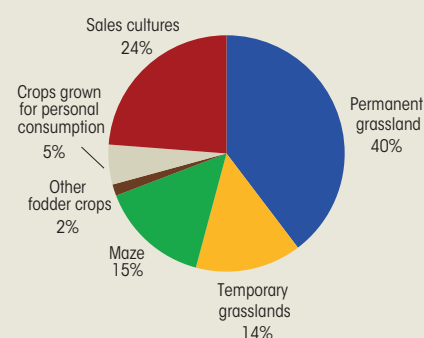


Classification* of farms



* mixed crop if MFA/UAA < 0.7 and mixed dairy meat if Beef LU > 8.

Crop allocation



THE ENVIRONMENTAL IMPACT OF AN AVERAGE FARM

I feed*
29
people./ha UAA



Source : Perfalim, CEREOPA

* based on the animal protein content of agricultural.

I emit as GHGs*
3 627
kg eq. CO₂/ha UAA



*GHG = GreenHouse Gas.

I store*
537
kg eq. CO₂/ha UAA



* thanks to the grasslands and hedges.

I consume
28
MJ/ha UAA



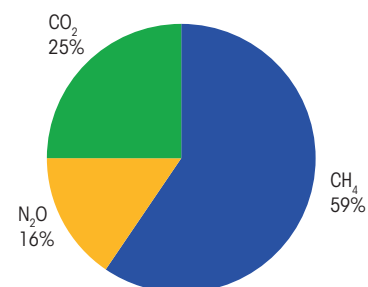
I maintain
0.62
eq. ha of biodiversity/ha UAA



Nitrogen
balance surplus
106 kg N/ha UAA



Breakdown of GHG emissions at farm level





Average GHG
emissions:
1.02 kg eq.CO₂/l milk



Average carbon
storage:
0.09 kg eq.CO₂/l milk



Average net carbon
footprint:
0.93 kg eq.CO₂/l milk

	Upper decile*	Average	Lowest decile*
Share of maize in forage area (ha maize/ha dairy forage area)	23%	22%	25%
Number of dairy cows	58	71	67
Dairy forage area (ha)	46	59	52
Environmental results			
Gross emissions (kg CO ₂ eq/l milk)	0.82	1.02	1.38
<i>of which enteric fermentation</i>	0.47	0.55	0.72
<i>of which manure management</i>	0.13	0.16	0.20
<i>of which nitrogen fertilization</i>	0.05	0.07	0.11
<i>of which fuel and electricity</i>	0.05	0.07	0.09
<i>of which feed</i>	0.09	0.12	0.16
<i>of which fertilizers</i>	0.01	0.02	0.03
<i>of which livestock purchases</i>	0.02	0.04	0.08
Carbon sequestration (kg CO ₂ eq/l milk)	0.07	0.09	0.14
Technical criteria			
Herd management			
Milk/cow (l)	9 532	8 778	6 807
Corrected milk production (l/ha dairy forage area)	13 306	11 725	9 084
Heifer LU/cow (%)	26%	38%	50%
Age at first calving (month)	26	29	29
Replacement rate (%)	34%	31%	32%
Herd feeding			
Concentrates per cow (g/l)	163	208	295
Heifer concentrates (kg/heifer LU)	327	572	1 001
N excreted (kg N/LU)	110	113	118
Protein self-sufficiency (%)	66%	64%	63%
Land management			
Mineral nitrogen (kg N/ha dairy UAA)	34	46	61
Organic nitrogen pressure (kg N/ha dairy UAA)	138	131	164
Grass yield (t DM/ha)	8.4	7.8	7.7
Carbon storage criteria			
Hedgerow (ml/ha dairy UAA)	5.0	6	10.0
% permanent grassland / dairy UAA	44%	53%	64%
Manure management			
Grazing days	104	74	74
Energy			
Fuel (l/ha dairy UAA)	226	239	240
Electricity (kWh/1000 L)	76	72	72

My situation

*10% of farms with the lowest gross GHG emissions (upper decile) or highest gross emissions (lower decile).



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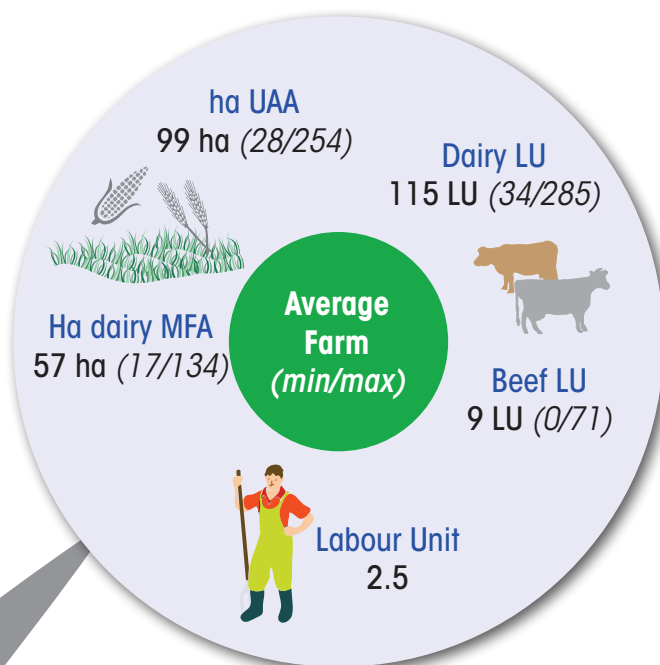
ResKuh Project: Key Results

Lowland maize system

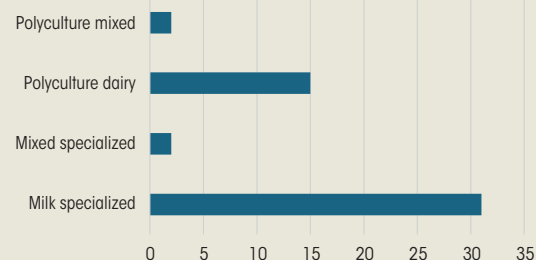
Years 2023-2026



Farm

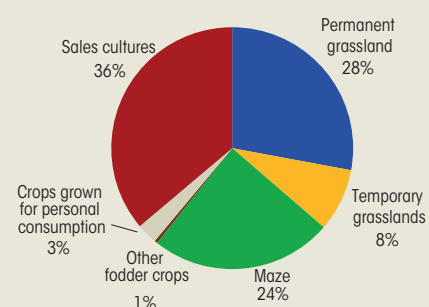


Classification* of farms



* mixed crop if MFA/UAA < 0.7 and mixed dairy meat if Beef LU > 8.

Crop allocation



THE ENVIRONMENTAL IMPACT OF AN AVERAGE FARM

I feed*
34
people./ha UAA



Source : Perfalim, CEREOPA

* based on the animal protein content of agricultural.

I emit as GHGs*
1 658
kg eq. CO₂/ha UAA



*GHG = GreenHouse Gas.

I store*
204
kg eq.CO₂/ha UAA



* thanks to the grasslands and hedges.

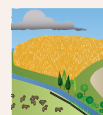
I consume
51
MJ/ha UAA



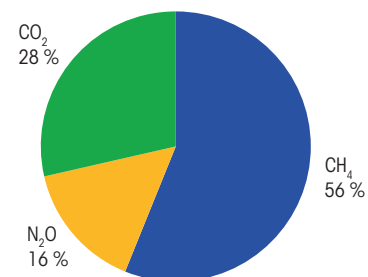
I maintain
0.70
eq. ha of biodiversity/ha UAA



Nitrogen
balance surplus
128 kg N/ha UAA



Breakdown of GHG emissions at farm level





Average GHG
emissions:
1.02 kg eq.CO₂/l milk



Average carbon
storage:
0.05 kg eq.CO₂/l milk



Average net carbon
footprint:
0.97 kg eq.CO₂/l milk

	Upper decile*	Average	Lowest decile*
Share of maize in forage area (ha maize/ha dairy forage area)	40%	40%	40%
Number of dairy cows	85	82	71
Dairy forage area (ha)	47	50	46
Environmental results			
Gross emissions (kg CO ₂ eq/l milk)	0.80	1.02	1.44
<i>of which enteric fermentation</i>	0.47	0.52	0.68
<i>of which manure management</i>	0.11	0.14	0.15
<i>of which nitrogen fertilization</i>	0.04	0.07	0.10
<i>of which fuel and electricity</i>	0.04	0.06	0.08
<i>of which feed</i>	0.12	0.16	0.21
<i>of which fertilizers</i>	0.01	0.02	0.03
<i>of which livestock purchases</i>	0.00	0.05	0.20
Carbon sequestration (kg CO ₂ eq/l milk)	0.04	0.05	0.07
Technical criteria			
Herd management			
Milk/cow (l)	10 482	9 375	7 697
Corrected milk production (l/ha dairy forage area)	18 643	15 986	11 894
Heifer LU/cow (%)	36%	39%	42%
Age at first calving (month)	27	28	28
Replacement rate (%)	34%	33%	34%
Herd feeding			
Concentrates per cow (g/l)	181	229	243
Heifer concentrates (kg/heifer LU)	633	590	837
N excreted (kg N/LU)	107	118	118
Protein self-sufficiency (%)	57%	51%	50%
Land management			
Mineral nitrogen (kg N/ha dairy UAA)	59	82	117
Organic nitrogen pressure (kg N/ha dairy UAA)	135	129	110
Grass yield (t DM/ha)	8.7	8.2	5.1
Carbon storage criteria			
Hedgerow (ml/ha dairy UAA)	2.4	4	5.6
% permanent grassland / dairy UAA	45%	45%	44%
Manure management			
Grazing days	18	20	55
Energy			
Fuel (l/ha dairy UAA)	225	309	273
Electricity (kWh/1000 L)	51	66	70

My situation

*10% of farms with the lowest gross GHG emissions (upper decile) or highest gross emissions (lower decile).



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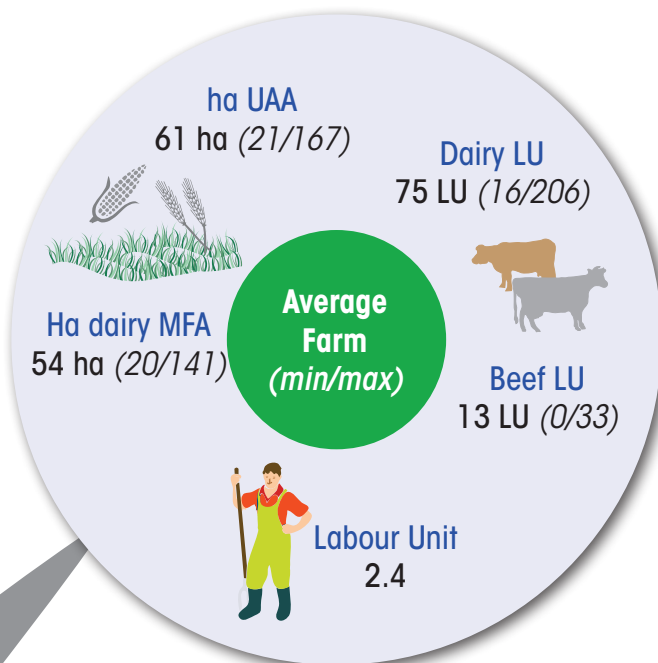
ResKuh Project: Key Results

Mountain system

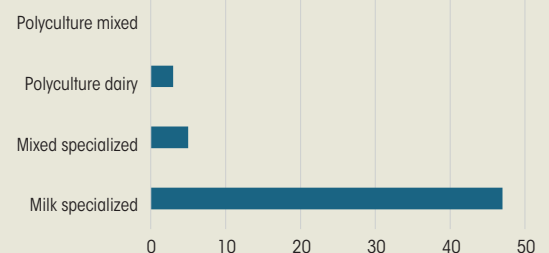
Years 2023-2026



Farm

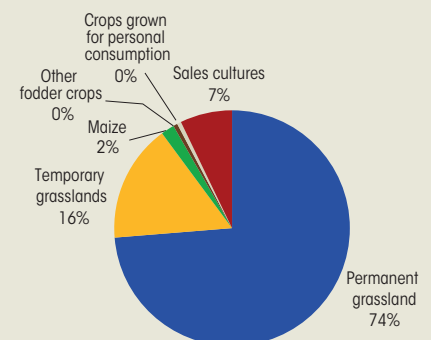


Classification* of farms



* mixed crop if MFA/UAA < 0.7 and mixed dairy meat if Beef LU > 8.

Crop allocation



THE ENVIRONMENTAL IMPACT OF AN AVERAGE FARM

I feed*
26
people./ha UAA



Source : Perfalim, CEREOPA

* based on the animal protein content of agricultural.

I emit as GHGs*
1 101
kg eq. CO₂/ha UAA



*GHG = GreenHouse Gas.

I store*
1 582
kg eq. CO₂/ha UAA



* thanks to the grasslands and hedges.

I consume
16
MJ/ha UAA



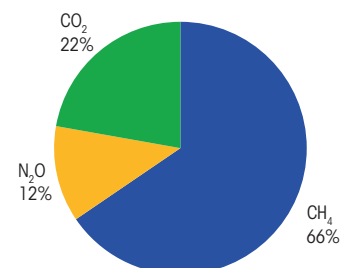
I maintain
15.18
eq. ha of biodiversity/ha UAA



Nitrogen
balance surplus
66 kg N/ha UAA



Breakdown of GHG emissions at farm level





Average GHG
emissions:
1,06 kg eq.CO₂/l milk



Average carbon
storage:
0,26 kg eq.CO₂/l milk



Average net carbon
footprint:
0,80 kg eq.CO₂/l milk

	Upper decile*	Average	Lowest decile*
Share of maize in forage area (ha maize/ha dairy forage area)	1%	2%	3%
Number of dairy cows	61	52	46
Dairy forage area (ha)	45	51	39
Environmental results			
Gross emissions (kg CO ₂ eq/l milk)	0.78	1.06	1.72
<i>of which enteric fermentation</i>	0.49	0.59	0.81
<i>of which manure management</i>	0.12	0.17	0.21
<i>of which nitrogen fertilization</i>	0.05	0.05	0.06
<i>of which fuel and electricity</i>	0.05	0.07	0.11
<i>of which feed</i>	0.07	0.10	0.17
<i>of which fertilizers</i>	0.00	0.00	0.01
<i>of which livestock purchases</i>	0.01	0.08	0.36
Carbon sequestration (kg CO ₂ eq/l milk)	0.22	0.26	0.35
Technical criteria			
Herd management			
Milk/cow (l)	7 770	7 164	5 841
Corrected milk production (l/ha dairy forage area)	10 445	8 142	8 374
Heifer LU/cow (%)	25%	36%	41%
Age at first calving (month)	26	30	31
Replacement rate (%)	26%	31%	36%
Herd feeding			
Concentrates per cow (g/l)	74	132	165
Heifer concentrates (kg/heifer LU)	463	398	389
N excreted (kg N/LU)	97	104	106
Protein self-sufficiency (%)	81%	76%	76%
Land management			
Mineral nitrogen (kg N/ha dairy UAA)	14	11	17
Organic nitrogen pressure (kg N/ha dairy UAA)	164	141	155
Grass yield (t DM/ha)	7.1	7.0	7.5
Carbon storage criteria			
Hedgerow (ml/ha dairy UAA)	25.3	8	16.0
% permanent grassland / dairy UAA	88%	78%	65%
Manure management			
Grazing days	154	140	155
Energy			
Fuel (l/ha dairy UAA)	172	196	335
Electricity (kWh/1000 L)	99	126	213

My situation



*10% of farms with the lowest gross GHG emissions (upper decile) or highest gross emissions (lower decile).



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