Regional GHG balances

In order to monitor climate resilience in livestock farming in the Upper Rhine region, greenhouse gas (GHG) balances were drawn up for various farms as part of the KlimaCO project. Among other tools, the calculation tool of the Luxembourg animal husbandry organisation CONVIS was used for this purpose.The CONVIS tool was used to evaluate 22 farms in Baden and 4 farms in the canton of Basel-Land. In Alsace, 4 farms were also evaluated, but their results are not presented here. This overview only includes farms that also practise arable farming in addition to dairy farming, in order to compare farms that are as similarly structured and representative as possible.

Key figures of the farms		Convis (L)	Baden	Kanton Basel-Land
Dairy cows	Number	90	71	31
Performance	kg ECM / cow	8.010	8.250	7.328
Arable area	ha	38,4	51,2	17,6
Permanent grassland	ha	53,2	55,0	15,0

Structure of the results: The results of the evaluation can be divided into three categories in which emissions occur. In the category of inputs/resources (1), indirect emissions from additional purchases are the main source of emissions in the farm balance sheet. In animal husbandry (2), methane is particularly relevant, which is released through rumen fermentation and barn emissions. In crop production (3), nitrous oxide emissions from soil and fertilization are produced in addition to CO_2 from fuel combustion and humus depletion. Emissions from animal husbandry, soil and fertilization are calculated according to the IPCC standard. The remaining emissions, such as those from additional purchases, are determined using emission factors from common databases. In addition to the GHG emissions, the C-binding (e.g. through renewable energies; as humus in the soil) is also determined. The net emissions (CO_2 balance) result from the difference between emissions and C-binding.

1 Resources	2 Animal husbandry	3 Plant production
Fertilizer	Rumen fermentation, barn emissions	Soil emissions
Animal feed	Slurry/manure storage	Mineral nitrogen fertilization
Electricity, fuels	Spreading of organic manure	Diesel combustion
Other resources	Pasture grazing	Crop residues, humus depletion

Legend column 1: Fertilizer, Feed, Energy, Other

Legend column 2: Rumen, Storage, Spreading, Pasture

Legend column 3: Soil, Fertilization, Diesel, Other

Results of the GHG balances

Overview

Results	Convis (n=138)	Baden (n=22)	Basel-Land (n=4)
kg ECM/AA	8262	6667	6217
t CO_2eq/ha	12,08	7,41	8,68
kg CO_2eq/kg ECM	1,29	0,97	1,48
t CC/ha	0,70	1,27	5,516
kg CC/ECM	0,07	0,17	0,65

An important parameter for assessing production and for comparing regions is, among other things, the production intensity in kg ECM/ ha AA. This makes it easier to compare the value CO2eq/ ha. The CO2 emissions can be presented both product-related and area-related. In addition, values for carbon credits (CC) are listed in this table, which indicate a value for CO2 storage. Carbon credits are also expressed in CO2eq per ha and per kg ECM. The differences in the results are mainly due to the fact that in Baden also organic farms were evaluated and in the canton of Basel-Land a project for humus build-up was implemented on the farms.

Emissions from production and transport of inputs/resources

Category inputs/resources	Convis t CO_2eq/ha	Baden t CO_2eq/ha	Basel-Land t CO_2eq/ha
Category input/resources total	4,44	2,32	2,19
Fertilizer	0,55	0,20	0,09
Feed	2,90	1,25	0,63
Energy	0,44	0,39	0,88
Other	0,56	0,48	0,61

In Baden, emissions from farm inputs are noticeably lower. On the one hand, this is due to the higher proportion of own fodder production and the high proportion of grassland in the rations and the resulting lower quantities of purchased fodder. On the other hand, the calculation also includes organic farms where there are virtually no additional purchases of feed and fertilizer.
It is also noticeable on Swiss farms that little fertilizer and feed was purchased. On the other hand, energy purchases were higher than in Baden. This is linked, among other things, to the plant cultivation measures to build up humus.

Emissions from animal husbandry and organic fertilizers

Category animal husbandry	Convis t CO_2eq/ha	Baden t CO_2eq/ha	Basel-Land t CO_2eq/ha
Category animal husbandry total	6,06	4,45	4,71
Rumen	4,39	3,33	3,45
Storage	0,86	0,59	0,60
Spreading	0,41	0,35	0,14
Pasture	0,40	0,18	0,52

For emissions from animal husbandry and organic fertilisation, the results are comparable between the regions. An exception is the emissions from pasture, here the value of the farms in Baden is lower than in the other two regions, as pasture farming was less common. In addition, some of the manure was given to biogas plants, where emissions are reduced by gas-tight manure storage.

Emissions from crop cultivation and soil

Category plant production	Convis t CO_2eq/ha	Baden t CO_2eq/ha	Basel-Land t CO_2eq/ha
Category plant productiontotal	1,57	1,01	1,78
Soil	0,46	0,30	0,29
Fertilization	0,55	0,20	0,21
Diesel	0,44	0,42	0,47
Other	0,12	0,09	0,82

The results of the farms in Baden and Basel are very close to each other – except for the item "other sources". This is probably due to the fact that two farms in Switzerland have converted parts of their grassland.
The Luxembourg comparison value for fertilization is somewhat higher than in the other two regions, which may be due to the fact that Baden also includes organic farms and the farms in the canton of Basel-Land have worked a lot via green manure for project-related reasons (humus build-up).

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Carbon Credits

Carbon credits are credited for the production of biodiesel, biogas electricity and heat as well as photovoltaic electricity; furthermore, through a positive humus balance, as well as through the conversion of arable land into grassland. The carbon credits can be deducted from the previously determined emissions to calculate the net emissions.

Carbon Credits	Convis t CO_2eq/ha	Baden t CO_2eq/ha	Basel-Land t CO_2eq/ha
Category carbon credits total	0,70	1,27	5,52
Photovoltaic	0,09	0,28	0,35
Biogas electricity	0,13	0,76	0,00
Humus build-up	0,46	0,23	5,16

Compared to the farms in Luxembourg, the farms in Baden achieve quite high values. This is mainly due to the fact that some farms in this region have PV systems and some also have biogas plants. The very high value of carbon credits on farms in the canton of Basel-Land is an effect of the project on humus build-up in arable land and shows the possibilities that can be achieved with it, at least in the medium term.

Summary

With the online version of the calculation tool used by the Luxembourg livestock organisation CONVIS, it was possible to draw up a GHG balance or calculate a CO2 balance for dairy farms across borders. The calculation is based on the international IPCC standard.

Overall, when comparing the regional results, it becomes very clear that the results are strongly influenced by the structural differences between the regions (livestock, production intensity, organic/conventional, presence of biogas plants, etc.). On the other hand, this shows that there is certainly potential for reducing CO2 emissions in agriculture. In addition in all three regions the farms were able to build up carbon credits through various measures and thus contribute to the avoidance of CO2 emissions.

In order to assess efficiency differences between the farms studied, but above all between the regions, the data collection must be expanded, i.e. extended to additional farms and conducted over several years. This would lead to more homogeneous groups of farms being able to be compared with each other. At the same time, the influence of the structure on the result of the farms would be reduced to a minimum, and the differences between the farms could then be assessed with regard to differences in management efficiency.