KLIMACO

CO_2 und methane

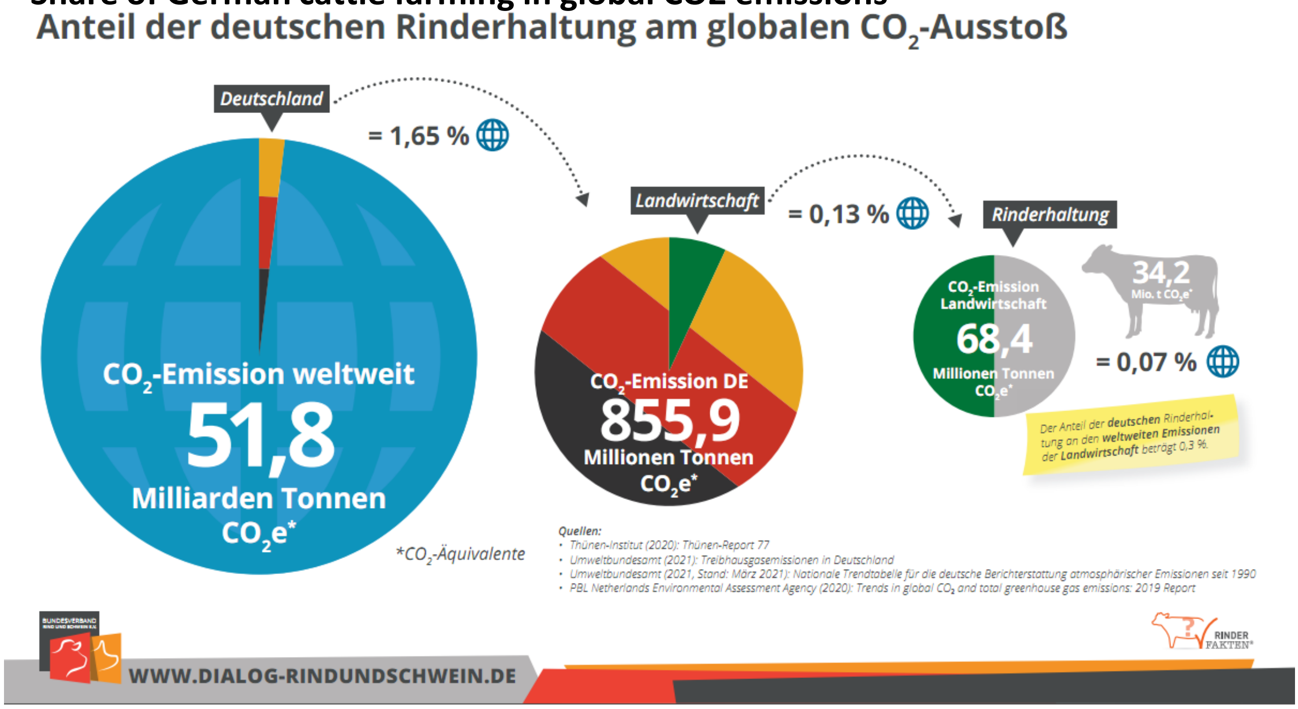
Measures to improve GHG balance

According to the German Climate Protection Act, the agricultural sector should also have reduced its greenhouse gas emissions (GHG emissions) by 30% by 2030. In order to achieve this goal, measures to reduce GHG emissions in agriculture will be required in the future. Many dairies also assume that the declaration of a carbon footprint will become a supply condition for the trade within the next few years. Therefore, the question arises where to start at farm level in order to optimize GHG balances. In this context, it is of particular interest which climate protection measures are possible in the farm context and how a change towards more climate-friendly production methods affects the farm result. In addition to the modelling of GHG emissions at farm level, the economic assessment of GHG abatement options is therefore important.

GHG sources on the farm

- In the agricultural sector, both the direct GHG emissions generated on the farm and the indirect emissions that are brought onto the farm through purchases, etc. must be taken into account.
- In contrast to all other sectors, which are almost exclusively concerned with switching from fossil to renewable energy, the challenge for agriculture is to reduce biogenic emissions - above all methane and nitrous oxide. So far, there are only few technical mitigation options beyond restricting agricultural production.
- Improved nutrient management in particular can be very effective.

Share of German cattle farming in global CO2 emissions



KLIMACO

CO_2 und methane

Measures in the field of arable and fodder farming / permanent crops

Reduce the purchase of mineral fertilizer: CO2 is released both during the production of fertilizer and during transport. Avoiding/reducing N surplus prevents leaching and saves money.

- Reduced fertilization with mineral fertilizer: carrying out nutrient balances for the optimal supply of the plants (determination of the N requirement of the plants)
- Crediting of nutrient replenishments from the soil
- Adjusted application dates
- Immediate incorporation of organic fertilizers

➢Reduction of product-related GHG emissions through higher yields

- Reduced tillage: Good yields with less energy input.
- Crop rotation; plant protection; reduction of losses during harvest, storage,....
- Fertilisation (non-efficient N fertilization has a negative effect)
- Fuel saving: Energy-saving driving (under optimal conditions in the field, GPS-controlled vehicles, tyre pressure control system.

•Further measures

- Year-round ground cover
- Cultivation of legumes
- Cultivation of diverse catch crop mixtures/ green manures
- Agroforestry
- Planting of trees/hedges

Cofinancé par l'Union européenne
Fonds européen de développement régional (FEDER)
Von der Europäischen Union kofinanziert
Europäischer Fonds für regionale Entwicklung (EFRE)

Measures in the area of animal husbandry

Increase in milk yield/high lifetime yield (reduction of emissions related to the product milk)	•Promotion of animal health (udder health, hoof care) •Feeding adapted to performance, good feed quality •Breeding
➢Cow weight	•(BCS, breed): the higher the weight, the higher the energy requirement for maintenance (But: high weight= prerequisite for high performance level).
•Reduce animal losses	•good herd management (animal health, feeding, husbandry management)
•Adapted feed rations	•Higher forage quality: Increasing the energy content of the forage allows for a reduction in the amount of forage. (forage production consumes energy and generates GHG through fertilization, crop protection, seed, processing, harvesting, storage). •Cultivation of legumes in grassland •Reduction of concentrate purchase, for example through own production
Reduce the use of concentrated feed (but still provide nutrients in line with performance)	•better basic fodder qualities (basic fodder has a better climate balance) •lower losses of concentrated feed •Higher energy content in concentrate •Do without soya (clearing of rainforests for soya cultivation in South America) or use deforestation-free so
Efficient slurry use and management	•Slurry analyses •Covering the slurry stores •Spreading the slurry using emission-reducing techniques •Greatest potential for savings by transferring the slurry to a biogas plant: the sooner the slurry enters the gas-tight storage, the better
Increase grazing	•Grazing loses GHG mitigation potential if slurry could be utilised in a gas-tight biogas plant.
Reduction of energy consumption	•Conversion to green electricity or self-production of electricity through PV/ biogas •Milk cooling with heat recovery; pre-cooling of milk •Installation of a frequency converter or a speed-controlled vacuum pump •Conversion of the barn lighting to LED lights

Cofinancé par l'Union européenne
Fonds européen de développement régional (FEDER)
Von der Europäischen Union kofinanziert
Europäischer Fonds für regionale Entwicklung (EFRE)

KLIMACO
RHIN SUPÉRIEUR OBERRHEIN

CO_2 und methane

Application examples for potential savings

- Fuel
- 1 L of agricultural diesel means: 3.25 kg CO2-eq emitted into the atmosphere. Savings through regular maintenance of the tractor, environmentally conscious driving, optimization of journeys (plot swapping, arrangement of paths, etc.) less tillage and grazing.

Measure	Investment	Potential
Avoidance of additional consumption due to engine testing (tractors in use 344 h/year on 110 ha, i.e. 3 h/ha).	140 bis 200 Euro /tractor	- 29 kg CO_2-eq/ha
Practice ecological driving and adapt mechanisation to needs, Eco-driving (median consumption of 110 L agricultural diesel/ha), install tyre pressure control system (adapt tyre pressure to subsoil - field, meadow, road).	/	- 52 kg CO_2-eq/ha
Loading with care: (Example of the influence of removing an unnecessary overload of 1 tonne at 7 km/h. Tractor in use 2.5 h/ ha/ year)		- 12 kg CO_2-eq/ha
Adjusting the power of the tractor to that required for the job: ➢ change from a 100 hp tractor to 51 hp to chop straw. ➢ change from a 110 hp tractor to 80 hp to load the mixer wagon.		-750 kg CO_2-eq/year - 3,3 kg CO_2-eq/cow
Less tillage: ➢ Change from systematic ploughing to occasional ploughing (from 100 % to 70 % of the crop rotation). ➢ Change from deep to reduced tillage (2 stubble tillages + subsoiler) to shallower reduced tillage (1 quick stubble tillage) ➢ Change from reduced tillage to no-tillage ➢ Change from ploughing to no-till (On areas with cereals and oil and protein crops)		- 16 kg CO_2-eq/ha - 31 kg CO_2-eq/ha - 42 kg CO_2-eq/ha - 81 kg CO_2-eq/ha
Pasture Grazing instead of mowing:(3 cuts of which 1 silage) against 1 ha of grazed meadow (1 clean-up cut).	Fence, paths, accesses	- 280 kg CO_2-eq/ha

*CO2-eq: Greenhouse gases do not have the same global warming potential (GWP) and are therefore converted into CO2 equivalents in order to compare them. Over a 100-year period, releasing 1 kg of CH4 into the atmosphere has the same effect on climate as releasing 28 kg of CO2, and releasing 1 kg of N2O has the same effect as releasing 265 kg of CO2 (IPCC, 2007).

Cofinancé par l'Union européenne
Fonds européen de développement régional (FEDER)
Von der Europäischen Union kofinanziert
Europäischer Fonds für regionale Entwicklung (EFRE)

Application examples for potential savings

- Feeding

- Forage autonomy makes it possible to limit the purchase of external feed and thus energy consumption and the associated GHG emissions. With the same number of livestock, this can be achieved by exchanging land (less feed) and by increasing grass productivity via nitrogen fertilization or by improving pasture management.

Measure	Investment	Potential
Per LSU: Replace 8 ares of cereals with grassland (productivity of 6 t DM/ha) to produce 500 kg DM of additional grass	/	- 284 kg CO_2-eq/LSU
Per LSU: substitute 4.5 ares of cereals with silage maize (productivity 11 t DM) for the production of 500 kg DM maize in addition	/	- 194 kg CO_2-eq/LSU
Optimization of utilization on pasture from 50 ares/ LSU in spring to 35 ares/ LSU in order to harvest an additional 500 kg DM grass/ LSU.	/	- 99 kg CO_2-eq/LSU
Replacement of MLF 18 with self-produced grain and soy meal: -100 kg MLF 18/cow +20 kg purchased soya meal +80 kg self-produced grain/cow	Arable land, ventilation systems, storage area	-38 kg CO_2-eq/cow
Optimize amount of concentrate feed:-100 kg MLF 18/ cow	/	-62 kg CO_2-eq/ cow/ year
Replace soy meal with rapeseed meal: -100 kg soy meal/cow +150 kg rapeseed meal/cow	/	-46 kg CO_2-eq
Replacing 3-4 kg maize silage/day/cow, by growing 11.4 ares of legumes/cow instead of 9.3 ares of maize silage/cow.	/	-222 kg CO_2-eq/year

Application examples for potential savings

- Milking:
- Electricity accounts for about 1/5 of direct and indirect energy costs on dairy farms.
- 85% of the electricity is used around milk production. For milking, electricity is needed to drive the vacuum pump, to heat the water for cleaning the equipment and to cool the milk in the tank.

Measure	Investment	Potential
Service the milk tank	/	=
Install a variable displacement vacuum pump	Ca. 5000 Euro	- 0,2 kg CO_2-eq/1000 L
Install a milk pre-cooler	2500 to 4500 Euro	- 0,5 kg CO_2-eq/1000 L
Install a heat recovery system	2000 to 3000 Euro	- 0,5 kg CO_2-eq/1000 L
Air-condition the milk room Set up a room temperature of 10 °C; Do not place the cooling unit in the milk room, but outside on the north side of the barn.	0 to 1500 Euro	- 0,18 kg CO_2-eq/1000 L

Application examples for potential savings

- Nitrogen fertilization:

- 1 unit of nitrogen means: 12.6 kg CO2-eq. are released into the atmosphere. The optimisation of fertilization consists primarily in optimally adapting the previous crop, fertilizers, organic matter, soil cover, cropping system and soil type to meet the actual needs of the crop.

Measure	Investment	Potential
Optimizing the utilization of mineral nitrogen by the plant: Choice of fertilizer form at an average dose of 100 N units/ha: ➢ Replace ammonium nitrate with urea ➢ Replace ammonium nitrate with a nitrogen solution	0	- 215-470 kg CO_2-eq/ha - 90 kg CO_2-eq/ha
Fertilizer application at the optimum time (when it can be best utilized by the plant) ➢ e.g. depending on the BBCH of the wheat and the amount of precipitation, dose average total of 200 N-units ➢ Burying urea by hoeing in maize at a dose of 100 uN	Working too, 5000 to 15000 Euro	- 380 bis 500 kg CO_2-eq/ha - 300 kg CO_2-eq/ha
Optimize the utilization of organic nitrogen by the plant: choose crops that best utilize the organic matter and periods when the risk of nitrate losses is lowest, or incorporate quickly to limit emissions. ➢ Feed 30 t/ha of manure: in autumn, before rapeseed sowing instead of before winter cereals/before maize, at the end of winter instead of in autumn. ➢ Application of 30 m3/ha cattle slurry: on winter cereals in spring instead of autumn/ on maize at leaf stage instead of before sowing ➢ Incorporation of 30 m3/ha of slurry: with a drag hose/ with a drag shoe (compared to a paddle nozzle) ➢ Incorporation of solid excreta (e.g. 30 t/ha fresh manure) by appropriate tillage within 12 hours, instead of after 24 hours		- 40 - 50 kg CO_2-eq/ha - 380 kg CO_2-eq/ha / -150 kg CO_2-eq/ha - 315 kg CO_2-eq/ha / - 415 kg CO_2-eq/ha - 130 kg CO_2-eq/ha

Cofinancé par l'Union européenne
Fonds européen de développement régional (FEDER)
Von der Europäischen Union kofinanziert
Europäischer Fonds für regionale Entwicklung (EFRE)

Application examples for potential savings

Measure	Investment	Potential
Integrate legumes or crops with low N requirements into the crop rotation (CR): Legumes (clover, alfalfa, peas, soybeans, lentils, chickpeas, lupins…) can supply themselves with nitrogen and make nitrogen available for the next crop in the rotation. Crops with low N requirements such as sunflowers, hemp or oats make it possible to reduce the consumption of synthetic nitrogen. ➢ CR: silage maize/ winter wheat/ barley: integrate 3 years of meadow with legumes. ➢ CR: Pea/ rape/ wheat/ sunflower/ wheat (with intercrop before summer crops) compared to a rape/ wheat/ barley system.	Possibly sunflower cutting unit	- 960 kg CO_2-eq/ha - 660 kg CO_2-eq/ha
Plant catch crops: take up nitrogen from the soil. After crushing or harvesting, part of the mobilized nitrogen can be made available again. ➢ Oats + pea as fodder crop sown at the end of July, harvested at the beginning of October.	15 €/ha when seeds are produced by the farmers themselves	- 600 kg CO_2-eq/ha
Transfer humus to support humus build-up on arable land		
Cereal cultivation in ridge culture with simultaneous cultivation of legumes as undersown crops		