

LCA of greenhouse gas mitigation measures of farms

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Introduction

To reduce the impact of farms on climate, one of the most important agricultural producer and distributor associations in Switzerland (IP-SUISSE) launched a point system that was developed together with Agroscope. For this point system, we identified and assessed greenhouse gas mitigation measures regarding their effect on global warming potential (GWP) of farms. Since 2021, it is mandatory for the approximately 10,000 IP-SUISSE farmers to implement mitigation measures, which they can freely choose from a catalogue, and with which they have to achieve an individually set mitigation goal. This article presents the list of identified greenhouse gas mitigation measures and their assessment results. Apart from the mitigation measures, the other necessary components of the point system and its design is described in detail in the LCA foods 2022 contribution by Bystricky et al..

Approach and methodology

Potential measures to reduce GWP on farms were identified in expert workshops according to their expected GWP reduction potential, reliability and feasibility. The measures selected for assessment were simulated on 4 model farms with different production focus: arable crops, milk, pigs and extensive cattle husbandry. For each model farm and measure, a full LCA was calculated using the SALCA methodology (Swiss Agricultural Life Cycle Assessment) in order to identify synergies and tradeoffs between GWP reduction and other environmental impacts.

Results with the measure applied were then compared to the results without the measure at farm level. When a measure had unfavorable effects on other impact categories, this was documented and the measure only recommended with caveats.

In order to transform the calculated GWP mitigations into the point system and thus onto the real farms, the GWP mitigations were set into relation with the quantities in which the measures were implemented on each model farm. The goal was to define the necessary amount per measure that relates to a mitigation of 1'000 kg CO₂eq. When those amounts differed between the 4 model farms, the mean value of all 4 farms was used. This average mitigation per amount of measure was then used in the point system. Farmers fill out the point system with the measures they apply on their farm and the corresponding amounts. The system then calculates how many points a farm achieves based on that information, one point equaling 1'000 kg CO₂eq mitigated.

Results and Discussion

The selected climate protection measures are categorized in the groups: energy consumption and heating, animal housing, crop production, and recycling. Table 1 shows the measures selected for the point system's catalogue. They enable a reduction of farm GWP, their feasibility was rated positive, and trade-offs with other environmental impacts were small. Mitigation measures in the category energy as well as technical measures in general have a low to medium reduction potential with relatively low uncertainties. Furthermore, there are only few tradeoffs and they show various synergies with other environmental impacts, in particular the use of non-renewable energy resources (Furrer et al., 2021; Alig et al., 2015).

Mitigation measures in the categories animal housing and plant production vary more in their results. For animal housing, covering of liquid manure stores show a particularly high reduction potential. Increasing the number of lactations of cows, too, allows a good reduction and shows synergies with many other environmental impacts. Conversely, the reduction potential of feeding of extruded linseed comes at the cost of various trade-offs originating from linseed cultivation. In the category crop production, the mitigation measures agroforestry and, to a lesser extent, application of biochar show high GWP reduction potentials, but there are still notable uncertainties, such as the extent to which the variability in practical implementation matches the conditions and assumptions in the assessment.

Table 1: measures in the point system climate protection with their reduction potential in points per amount. One point equals 1'000 kg CO₂eq mitigated.

measure	point value
Purchase of green electricity	1pt. / 7'470 kWh
Photovoltaic production	1pt. / 7'470 kWh
Frequency converter in the milking system	1pt. / 350'000 kg milk
Heat recovery from milk cooling	1pt. / 130'000 kg milk
Heat recovery from animal housing (poultry/pigs)	1pt. / 3120 kWh
Wood heating (chips)	1pt. / 3.6 bulk cubic meter
Solar panel heating	1pt. / 6.3 m ² panel area
Reducing fuel consumption through no-till seeding	1pt. / 10 ha
Reducing fuel consumption through ECOdrive	1pt. / 9.6 ha
Increasing the number of lactations of cows	1pt. / 1.8 cows*lactation
Linseed as feed for dairy cows	1pt. / 2'236 kg fed
Phase feeding in pig fattening	1pt. / 9.4 pigs fed
Covering of liquid manure stores	1pt. / 23 m ³ store capacity
Spreading of liquid manure with trailed hoses	1pt. / 770 m ³ spread
Recycling of silage films	1pt. / 300 kg recycled film
Replacement of mineral fertilizers through biogas digestate	1pt. / 28.5 t spread
Regular replacement of mower blades	1pt. / 350 ha mowed
Agroforestry (tree density: 50 trees/ha)	1pt. / 0.18 ha
Application of biochar on fields	1pt. / 810 kg biochar applied

Conclusion and outlook

All measures included in the catalogue for the point system have a positive effect on GWP. However, the amount of greenhouse gas emissions saved varies widely. Some measures with high GWP savings come with higher uncertainties or too many trade-offs with other impacts, or they would require more work or financial input from the farmers. Measures with low GHG savings, e.g. in the category energy consumption, are more robust. If implemented widely, they can still contribute substantially to a significant reduction of greenhouse gases. In the next two years, we will monitor the adoption rate of each measure on the IP-SUISSE farms and assess their impact at the level of the whole association.

References:

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