

How measures for greenhouse gas mitigation in agriculture are implemented strongly determines cost-effectiveness

Zhengzheng Hao, Daniel Bretscher, Sonja G. Keel

Climate and Agriculture Group, Agroscope, 8046 Zürich, Switzerland; (zhengzheng.hao@agroscope.admin.ch)

Background

- Switzerland targets a 40% reduction in agricultural greenhouse gas (GHG) emissions by 2050 (compared to 1990)
- Progress has stagnated in recent years, calling for more efficient measures
- The Marginal Abatement Cost Curve (MACC) is a widely used approach to identify cost-effective measures, but rarely addresses uncertainties related to how measures are implemented.

Objectives

- Identify agri-climate mitigation measures and define up to three ways of implementation
- Assess costs and mitigation potentials for each measure and scenario at the national level
- Group results based on mitigation costs and create three MACCs (reference, low-cost, and high-cost)

GHG	Measures
CH ₄ ↓	1. Biogas Plants
	2. Higher Lactation Number
	3. Feed Additive (Bovaer®)
N ₂ O ↓	4. Nitrification Inhibitor (ENTEC® 26)
	5. Slurry Covers
	6. More Grain Legumes
	7. Slurry Spreading (trailing hose/shoes)
	8. Nitrogen-Optimized Fertilization
CO ₂ ↓	9. Nitrogen-Optimized Feeding
	10. Rewetting Organic Soils
CO ₂ uptake	11. Biochar
	12. Agroforestry

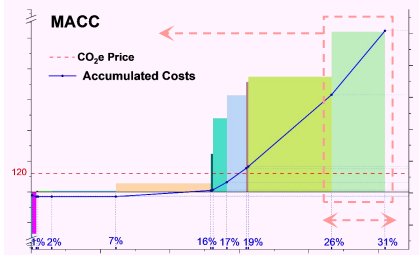
An example of Implementation scenarios (S)

S1: Area expansion based on maximum agronomic potential (conventional farming)

S2: Area expansion based on maximum market demand (organic farming)

S3: Area expansion based on site-adapted land-use (organic farming)

A brief overview of the MACC

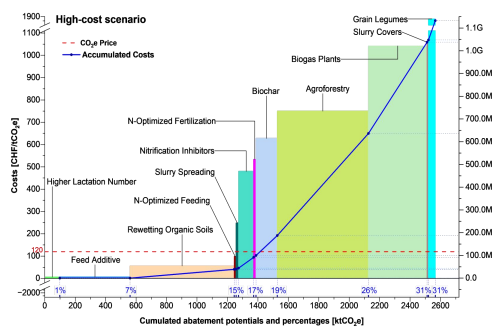
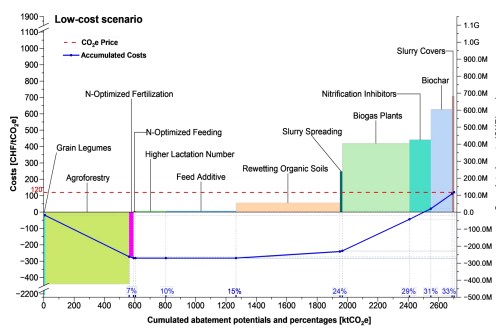
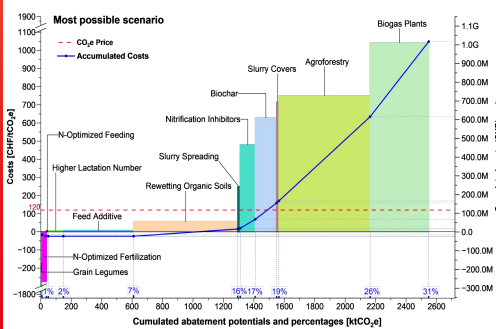


Colored Bars: Measures ranked from lowest to highest cost (Width = potential, Height = cost)

Left Y-axis: CO₂e cost per measure; below red line = cost-effective measures

X-axis: Incremental mitigation potentials (in absolute values and in % relative to 1990 level)

Blue Line: Accumulated costs (measure uptake from left to right) shown on the right Y-axis



Results

	Results from MACCs	Reference scenario	Low-cost scenario	High-cost scenario
All 12 measures	Emission reduction (kt CO ₂ e/year)*	2,548 (31%)	2,701 (33%)	2,566 (31%)
	Cost (Mio CHF/year)	1017	118	1133
	Number	6	7	4
Cost-effective measures	Emission reduction (kt CO ₂ e/year)*	1,294 (16%)	1,950 (24%)	1,257 (15%)
	Cost (Mio CHF/year)	16	-231	40

Conclusions

- Assumptions on measure implementation introduce substantial uncertainty in MACCs → transparency is essential for policymakers
- Agri-climate target (40%) is achievable with the 12 measures (31–33% reduction in addition to past reduction of about 15%; 118–1,133 Mio CHF/year)
- Cost-neutral and cost-negative measures indicate non-economic cost barriers to uptake

* Reduction potentials are given in CO₂ equivalents for the national scale assuming current conditions. Reduction percentages are calculated based on 1990 agricultural emissions, according to measure uptake in ascending order of cost.