# Management matters:

# Testing a mitigation strategy for greenhouse gas emissions on intensively managed grassland

**Kathrin Fuchs**[1], Lutz Merbold[1], Nina Buchmann[1]
[1]**Department of Environmental Systems , ETH Zurich**

## 1 Motivation

- Nitrous oxide ($N_2O$) is a potent greenhouse gas
- 11% of the global emissions occur due to agriculture
- Management practices e.g. N inputs (synthetic/organic fertilizer) – besides climate variables – are the most important drivers of $N_2O$ fluxes
- Biological Nitrogen Fixation (BNF) can replace anthropogenic N inputs ➔ potential reduction in $N_2O$ emissions

## 2 Main Objectives

- to quantify the net GHG exchange of an intensively managed grassland in Switzerland in a field experiment
- to assess the consequences of an alternative management practice on GHG exchange
- to asses side effects on yields and yield quality (C/N ratio)

## 3 Material and Methods

- Experiment-control study at the ETH research station Chamau in the lowlands of Switzerland (Chamau, Kanton Zug)
- Eddy covariance (EC) flux measurements of $CO_2$/$CH_4$/$N_2O$/$H_2O$, meteorological, soil and vegetation measurements (Fig.1.)
- Management information




**Fig. 1.** Experimental setup at the SwissFluxnet site Chamau (CH-CHA) for the years 2015/2016: The grassland system under experimental management is managed to bind large N inputs by biological nitrogen fixation (BNF) by over-sowing of clover. In contrast, the system under conventional management is characterized by N amendments in form of organic fertilizer (300 kg N / ha) and small amounts by BNF (approx. 50 kg N / ha).

## 4 First Results

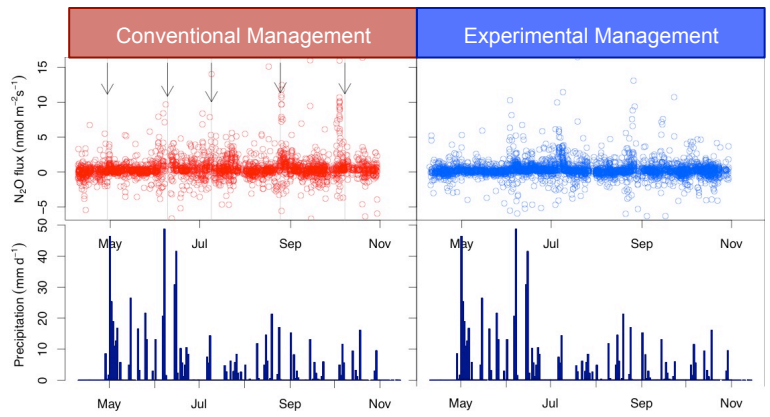


**Fig. 2**. Nitrous oxide fluxes and precipitation at SwissFluxnet site Chamau (CH-CHA) in 2015

We measured enlarged **$N_2O$ fluxes** following organic fertilizer application in the control site and unchanged $N_2O$ emissions in the treatment site for the experimental treatments. We observe peaks in $N_2O$ emissions also on the non-fertilized parcel, which can be attributed to rain events. Net annual fluxes are about 60% lower at the experimental parcel compared to the control parcel.

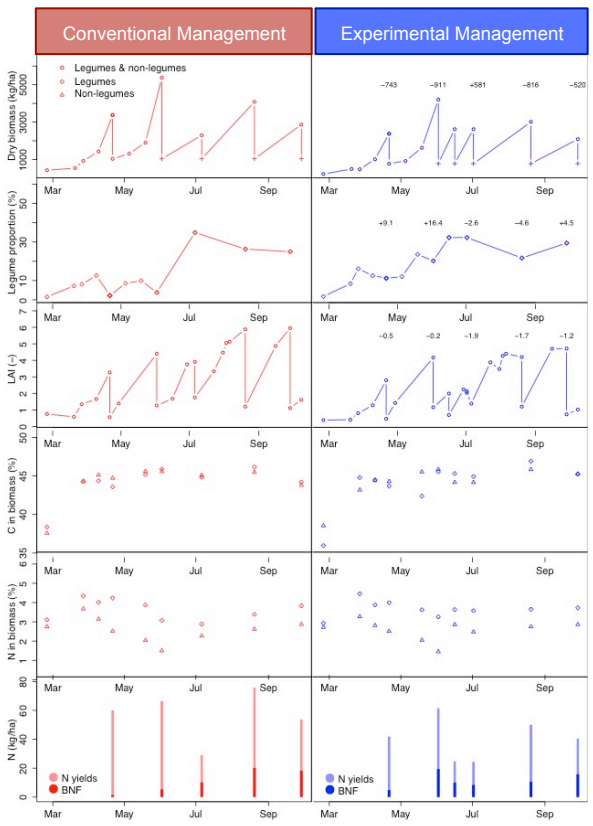


**Fig. 3.** : (A) Harvested and grazed biomass of the control (left) and experiment parcel (right). Circles represent the total biomass, crosses are displaying the remaining biomass after harvest, which was measured once at 21.04.2015 and assumed to be approximately equal at further harvests. (B) Clover proportion in dry biomass; (C) LAI; (D) C concentrations and (E) N concentrations of biomass where diamonds represent the legumes, triangles represent non-legumes; (F) Histogram of total N yields (semitransparent) with total amount of N derived from the atmosphere (saturated).

**Annual yields** were 19% lower at the experimental parcel compared to the control parcel. N exported from both parcels accumulated to 285 kg $ha^{-1}$ $yr^{-1}$ for the control and 244 kg $ha^{-1}$ $yr^{-1}$ for the experimental parcel. From this N, 55.6 kg $ha^{-1}$ $yr^{-1}$ at the control parcel and 69.2 kg $ha^{-1}$ $yr^{-1}$ at the experimental parcel were bound by **BNF**.

## 5 Conclusions

Significantly lower nitrous oxide fluxes at the experimental management compared to the control parcel indicate that nitrous oxide emissions can be effectively reduced at very low costs with a clover-based management. Longer-term effects on the N budget and implications of the experimental management on animal feed need further evaluation.

**Partners**

Soil as a Resource
National Research Programme NRP 68

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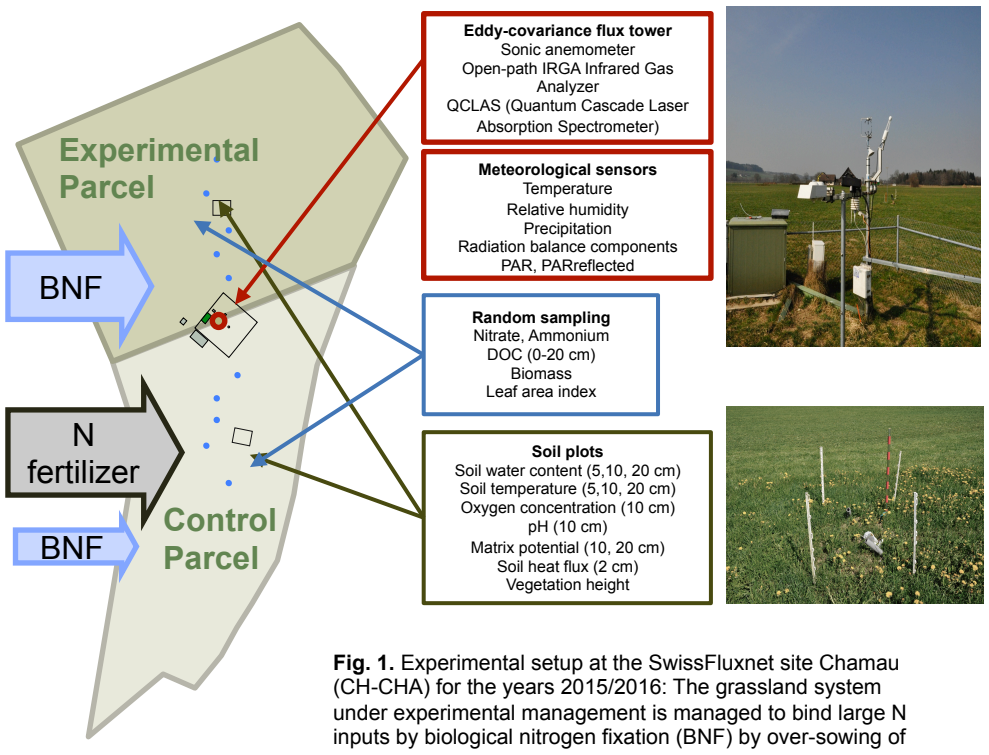


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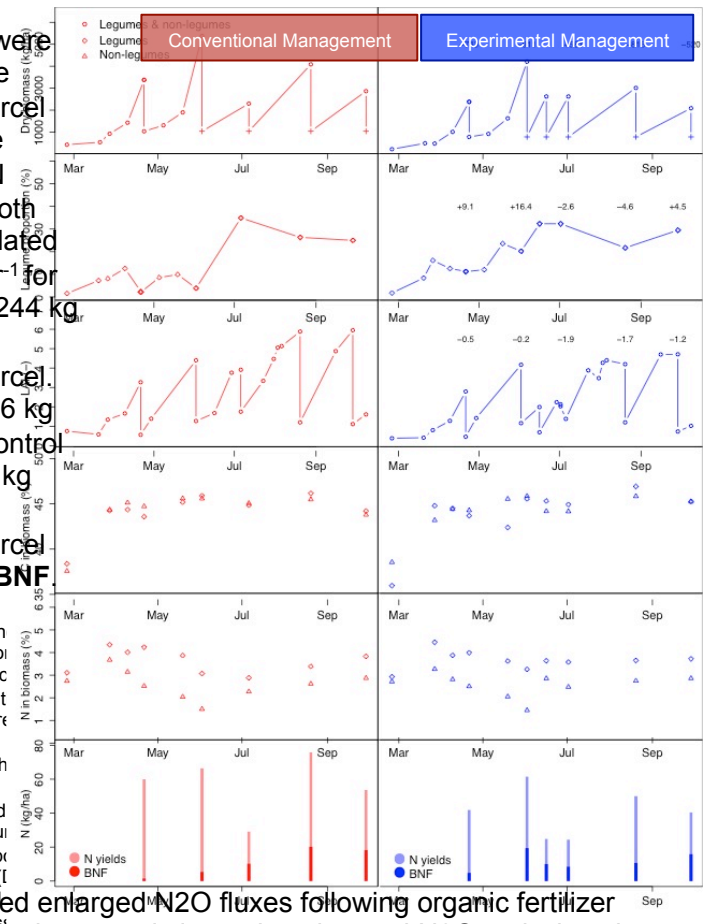


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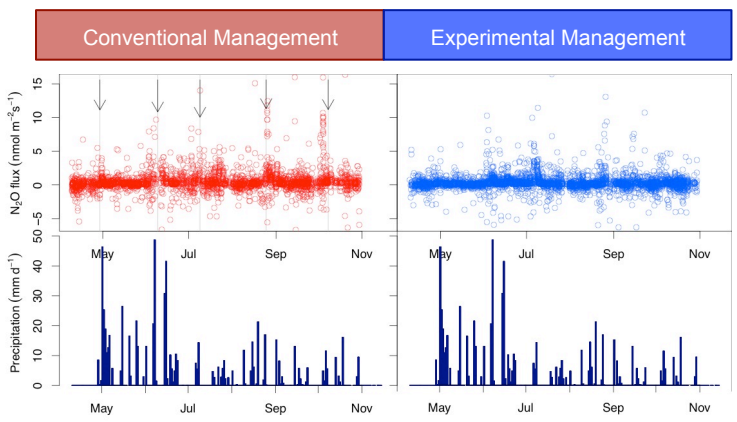


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