

Reducing nitrate leaching for a more sustainable crop production

Background

- **Nitrogen (N)** input is essential for crop production (Fig. 1)
- At the same time: **nitrate leaching threatens** both the environment and human health
- In Switzerland: ca. 380,000 ha > 25 mg nitrate / L in groundwater (quality criteria for drinking water) ^[1]
- **Organic fertilizers** (animal manure, recycling fertilizers etc.), especially important for organic farming, might entail considerably increased leaching risks

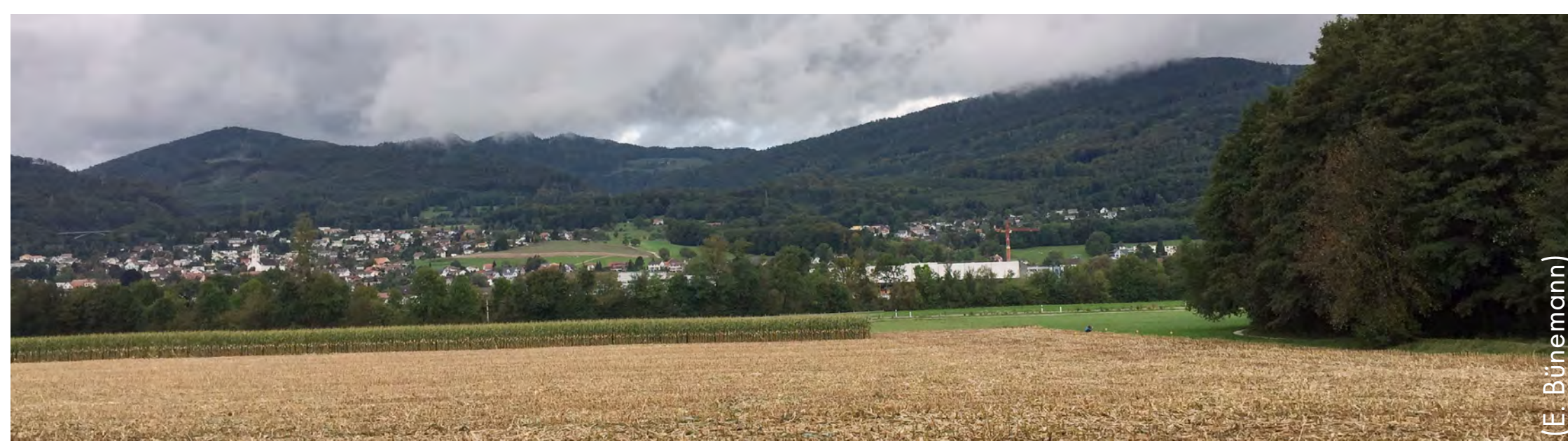


Fig. 4: Field site in the region Gäu-Olten, Switzerland

Research questions

- Which are the **sources of nitrate** in agricultural drainage water?
- How much nitrogen is lost from animal manure by **leaching**?
- Can composting improve **nitrogen use efficiency** of animal manure and reduce leaching risk?

Material and Methods

- ¹⁵N-labelled animal manure will be produced by feeding a cattle with ¹⁵N-labelled ryegrass hay (*L. multiflorum*) over several days (Fig. 2 & 3)
- Additionally, **natural ¹⁸O/¹⁵N isotope signature** will be used to investigate sources of nitrate in agricultural drainage water

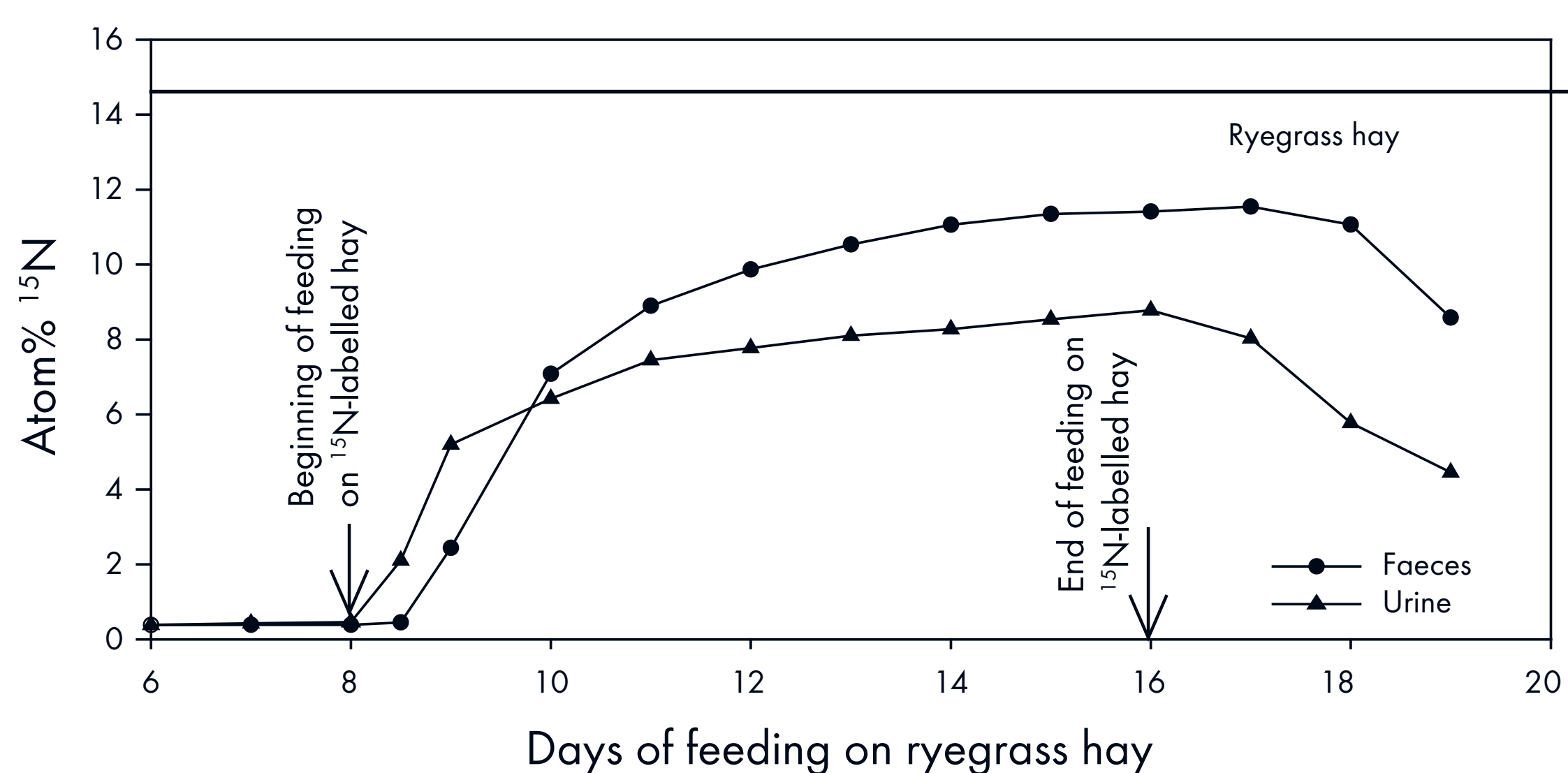


Fig. 2: Development of ¹⁵N-labelling in manure over time [2]

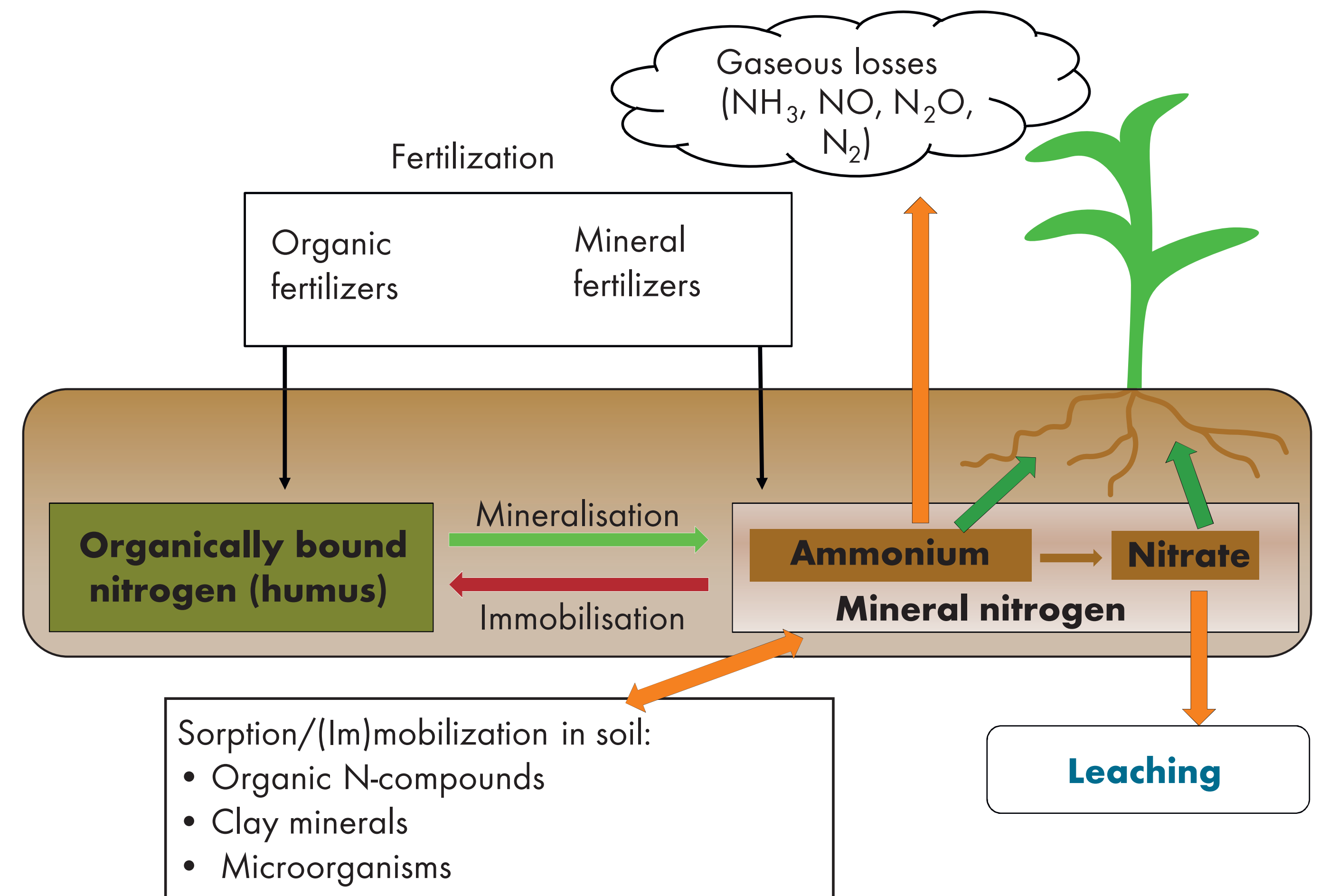


Fig. 1: Nitrogen flows in soil (adapted: incona Foliensammlung, <http://www.oeffizientduengen.de> (21.07.2017))

Expected outcome

- Field data on N use efficiency, leaching losses, and residual effect of fertilizers over several years
- Better understanding of processes behind formation of stable soil organic N pools
- Identification of measures for reducing nitrate leaching from animal manure

Experimental approach

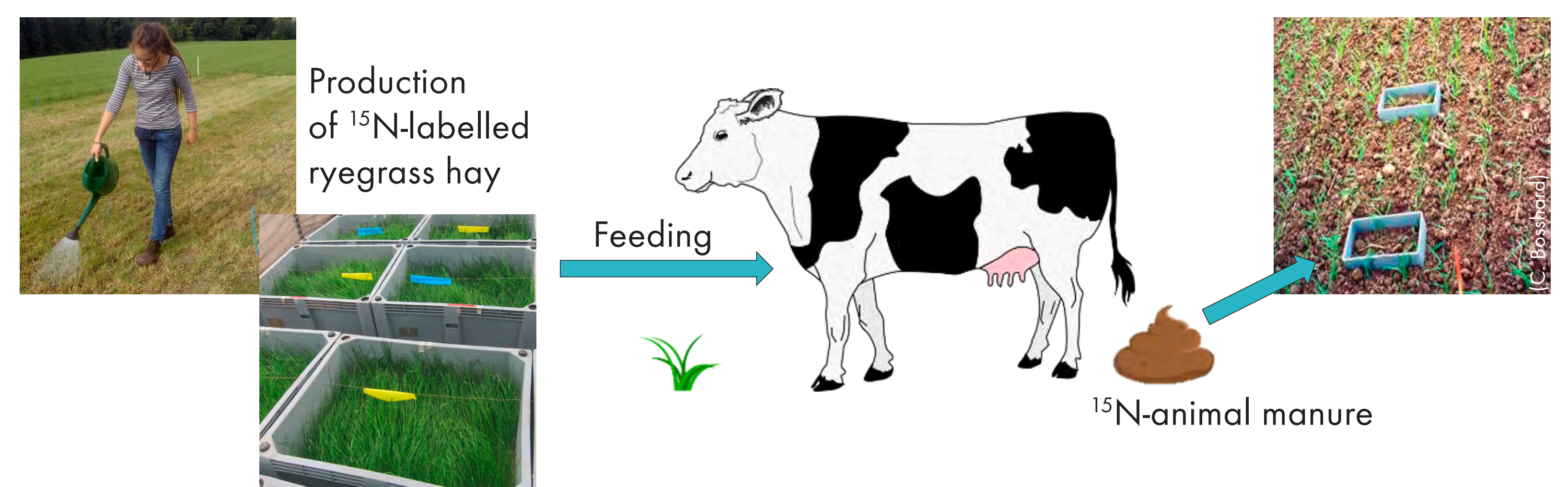


Fig. 3: Schematic illustration of experimental approach

- In a microplot study (Fig. 3), ¹⁵N-labelled cattle manure will be applied to two different field sites in the region Gäu-Olten, Switzerland (Fig. 4)
- By repeatedly analyzing plant, soil and drainage water over 2.5 years, we want to track the **fate of fertilizer N in the field** and establish a full **N-balance** (gaseous losses will be calculated)
- Comparison with 0N-control, ¹⁵N-mineral fertilizer, and composted ¹⁵N-cattle manure will reveal differences in fertilizer use efficiencies
- We expect that **composting** of animal manure will increase the residual effect of the N on the subsequent crop, thus, reduce nitrate leaching

References

- [1] Prasuhn, V., Kupferschmid, P., Spiess, E., Hürdler, J. 2016. Szenario-Berechnungen für das Projekt zur Verminderung diffuser Nährstoffeinträge in die Gewässer der Schweiz mit MODIFFUS. Bundesamt für Umwelt BAFU.
- [2] Bosshard, C., Oberson, A., Leinweber, P., Jandl, G., Knicker, H., Wettstein, H.R., Kreuzer, M., Frossard, E. 2011. Characterization of fecal nitrogen forms produced by a sheep fed with N-15 labeled ryegrass. Nutrient Cycling in Agroecosystems, 90(3), 355-368.

Partners

