Impact of soil conservation practices on soil health, climate smartness and performance of smallholder farms in Western Kenya

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Rationale

GIZ together with partners are implementing selected soil protection and rehabilitation interventions in Western Kenya as part of the BMZ global program on *Soil Protection and Rehabilitation for Food Security*, under the German *One World – No Hunger* Initiative. The effectiveness of some of these interventions was assessed by a range of soil biological and soil health indicators. The poster shows a few of examples.

Photo: CIAT-KALRO-GIZ-Welthungerhilfe farmer's field in May 2016

Soil greenhouse gas emissions:

Nitrous oxide (N_2O) emissions from soils were measured on conventional (CT) and zero-tillage (ZT) plots planted with maize (M) or soybean (S) in CIAT's long-term trial (12 yrs. old) as well as on farmers fields. These plots or fields either received 4 t/ha farm yard manure (FYM) or not, and crop residues (R) were retained or removed. Also, a slow-release (coated) urea fertilizer was tested for its potentially mitigating impact on emissions.

- Overall, nitrous oxide emissions were small, never exceeding 50 g N_2O-N/ha/d.
- Omitting tillage (ZT) or retaining residues did not have any impact on emissions.
- Retaining residues *and* applying manure increased emissions early in the season in April on farmer fields if not tilled (ZT).
- Use of controlled release urea fertilizer resulted in higher emissions in May.

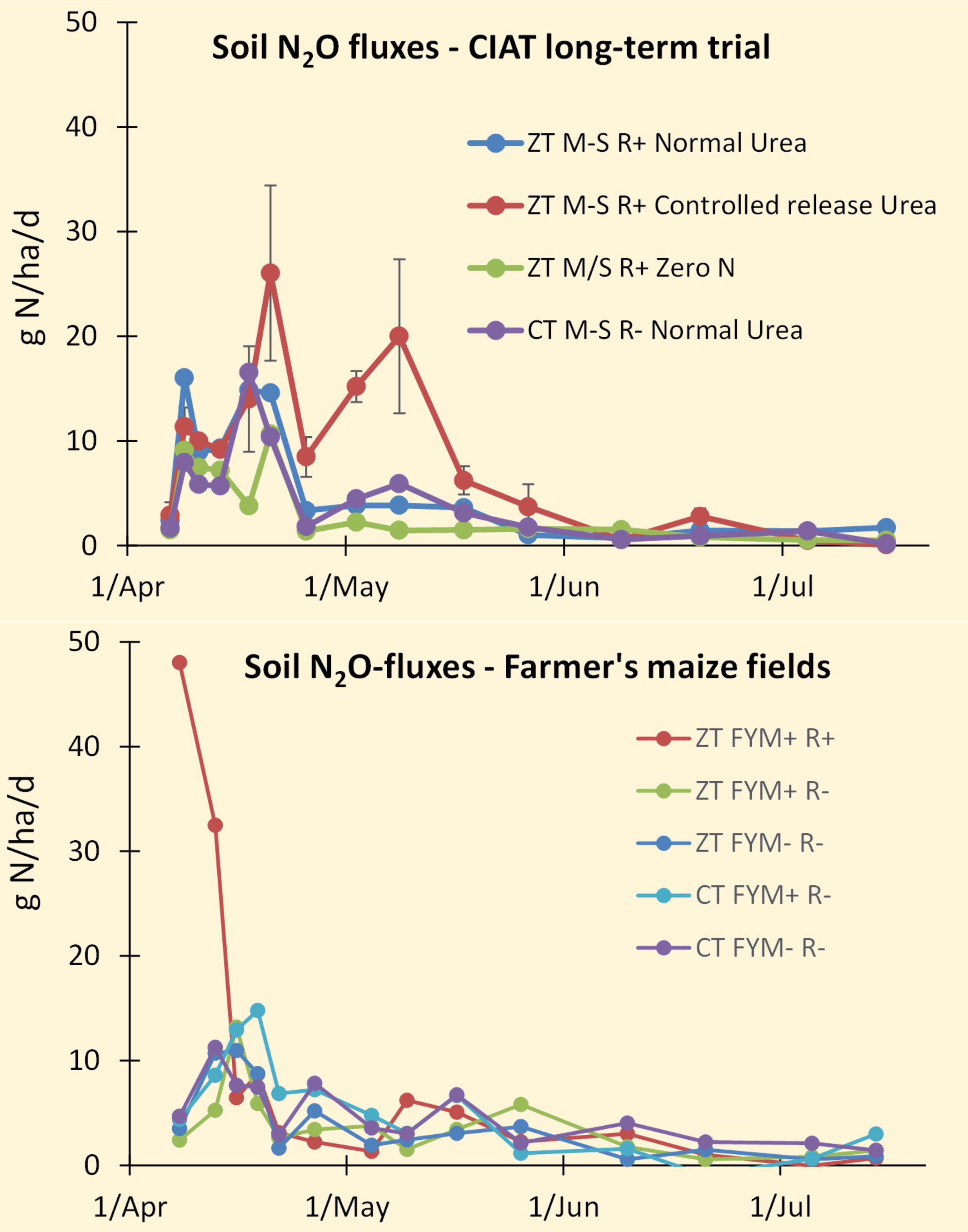

Figure 1: Nitrous oxide emissions (g N_2O-N/ha/d) from soils of CIAT long-term trials and farmer's fields

Soil macrofauna species richness:

Macrofauna was quantified in soil samples from 0-15 cm depth.

- Farmer practice, which often returns very low residues to the soil, led to a decrease in species richness.
- Species richness was similar after 13 years of crop residues retained irrespectively of the tillage system applied.

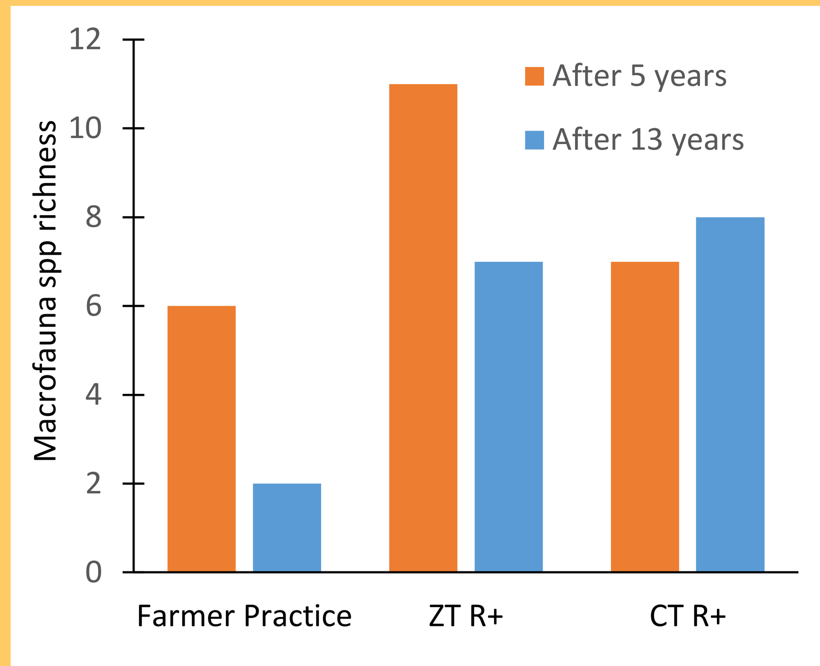

Figure 2: Macrofauna species richness in response to soil management

Impact of liming on phosphate availability:

Most soils in Western Kenya (Typic Kandiudox) are acid (pH_{CaCl2}=4.4), and liming is recommended to improve soil fertility. We tested the impact of increasing lime application on P availability (anion exchange membrane, AEM, and $NaHCO_3$-extractable labile P).

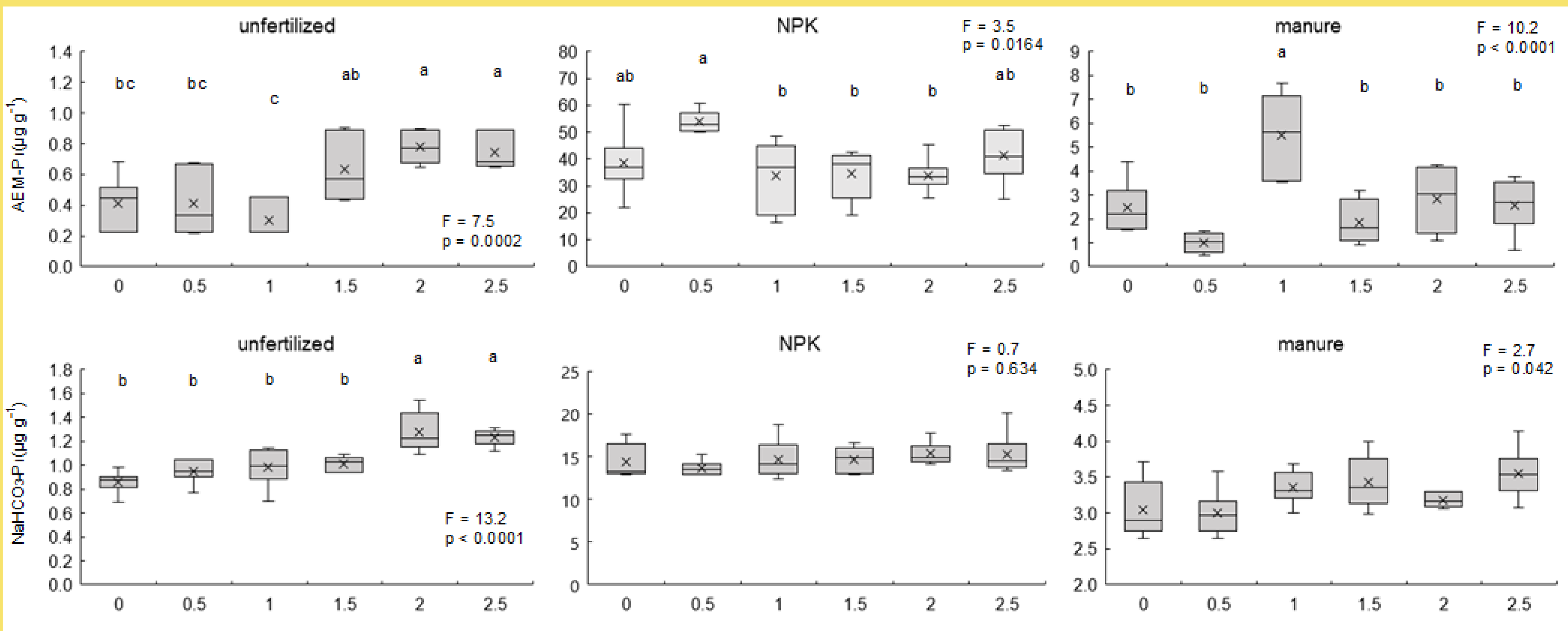

Figure 3: Impact of application of lime – expressed in Mehlich lime requirement equivalents – on P availability; rates correspond to $CaCO_3$ amounts of 0, 1.5, 3.0, 4.5, 6.0, and 7.5 t/ha

- Liming nearly doubled labile P in soils which had not received any fertilizer for 12 years, but that still did not bring these soils out of severe P deficiency.
- Fertilized soils with comparably higher initial available P did not show such trend.

Soil mineral N:

To test whether treatments could lead to a potential lock-up of nitrogen, mineral N was repeatedly measured at three depths (0-10 cm, 10-25 cm and 25-50 cm) in the same long-term trial treatments. At 0-10 cm we observed:

- Little variation between treatments, even after 12 yrs. of cultivation without mineral N fertilizer inputs.
- A sharp decline in mineral N from 13 to 16 days after planting.
- Slightly reduced mineral N concentrations under controlled-release Urea.

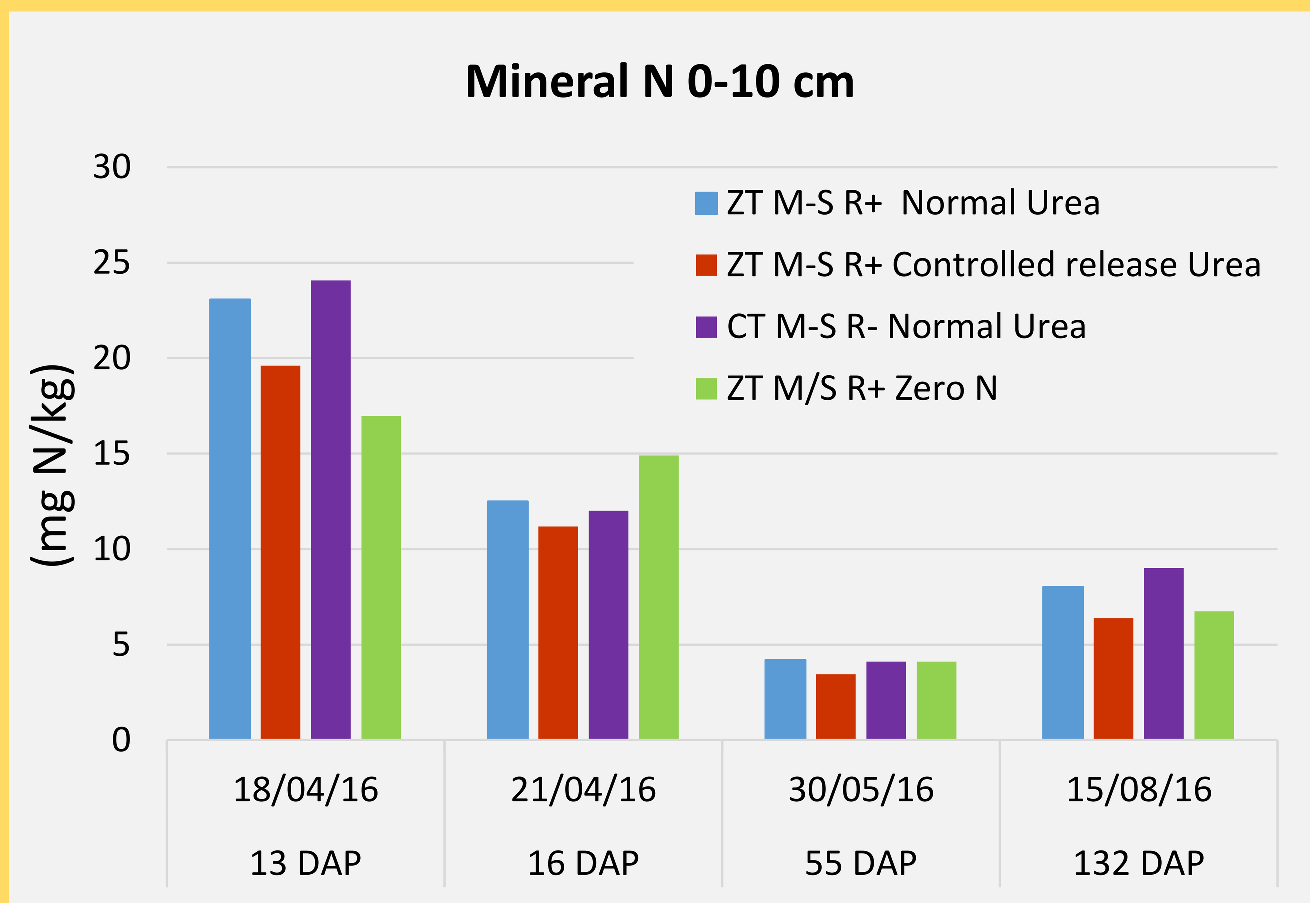

Figure 4: Mineral N (mg/kg) in 0-10 cm depth in response to contrasting management practices

Conclusions

- Nitrous oxide emissions from weathered tropical soils in Western Kenya are low to start with; soil management has little impact, unless N-inputs are notably increased.
- Slow release N-fertilizer does not mitigate nitrous oxide emissions. As these are first results of such kind, measurements need to be intensified to provide certainty.
- Liming of acid and P-fixing soils is not a substitute for application of sufficient amounts of organic or inorganic P-fertilizer.
- Increasing organic matter inputs to soils improves macrofauna species richness; an indicator of soil health.
- A lock-up of mineral N in soils was not observed. Sampling could not reveal notable systematic differences in N-dynamics in response to the imposed treatments.

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