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Reaggregation of Secondary Grassland Top Soils in the South African Highveld: A Chronosequence Study

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Abstract

Prolonged arable cropping in subtropical sandy grassland soils results in substantial losses of water-stable aggregates. This accelerates turnover of soil organic matter, leads to substantial soil organic matter losses and facilitates erosion. We hypothesised that restoration of these grassland ecosystems must involve the re-establishment of soil structure. To test this supposition we sampled chronosequences of degraded arable land (more than 20 years of cropping) that had been converted to secondary pastures between 1 and 52 years before present in three agro-ecosystems of the South African Highveld. Primary grasslands in the savannah also used as pastures served as controls. Arable land top soil was sampled for comparison. Samples from the surface soils (Plinthusthalls; 0–10 cm) were fractionated according to aggregate size by wet sieving (8000–2800 μm , 2800–2000 μm , 2000–500 μm , 250–500 μm , 250–53 μm and < 53 μm). All fractions were analysed for their respective content of soil organic carbon and total nitrogen and corrected for sand content. The first results show that reconversion of arable land into pasture does indeed recover parts of the soil organic carbon and nitrogen in these soils, which is accompanied by at least partial reaggregation. Ongoing analyses are evaluated to elucidate to which extent the restoration of soil organic matter and aggregation in the secondary grassland is possible in the three agro-ecosystems in comparison to the primary grasslands. Nevertheless, it can already be stated by now that the original state of the primary grassland is not easily reached, thus rising the question whether at least some of the former ecosystem services maybe lost irreversibly upon land degradation within post-industrial time-scales.

Keywords: Land use change, secondary grassland, soil aggregation, soil organic matter restoration