Scaling effects of proximate desertification drivers on soil nutrients in northeastern Tanzania

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Abstract

We tested the scaling effects of proximate desertification drivers (i.e. soil erosion, bush encroachment and grazing pressure) on soil nutrients in northeastern Tanzania. We analyzed nutrient concentrations in the desertified and non-degraded benchmark. For the desertified landscapes we analyzed nutrient concentrations at the coarse (landscape), medium (micro-landscape) and sampling unit (fine scale) levels. Further, for the desertified micro-landscapes, we used the differences in total nutrient concentrations to identify moderately dysfunctional and dysfunctional micro-landscapes. The desertified micro-landscapes had an overall lower soil organic matter, total nitrogen and exchangeable phosphorus, and soil water, but had elevated cation exchange capacity and soluble bases compared with the benchmark. Different intensities of desertification processes, mediated by the three proximate desertification drivers, produced varied amounts of nutrients corresponding with moderately dysfunctional and dysfunctional micro-landscapes. The dysfunctional micro-landscapes had the lowest nutrient availability. The effects of proximate desertification drivers on pooled nutrients were scale-independent. For individual nutrients only pH, soil water and Mg^{++} showed scaling effects at the coarse or medium scales for soil erosion, while for grazing pressure pH, soil water, CEC, Na^{+}, Mg^{2++} and Ca^{2++} showed scale dependence. The scaling effects were interlinked with landscape processes that operated simultaneously and interactively with different drivers.

Keywords

Desertified landscapes;
Dysfunctional landscapes;
Proximate desertification drivers;
Soil nutrients;
Tanzania