

Influence of various grazing intensities on soil stability and water balance of a steppe soil in Inner Mongolia, PR China

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Abstract

In Inner Mongolia grassland the production of sheep and goats, including meat, milk and wool, especially the valuable cashmere-wool, is of major economic importance. During recent decades grazing intensities have been increased, which has led to a broad degradation of grassland soils along with growing sensitivity to water- and wind erosion, thus loss of nutrients and water. These effects harm productivity and ecological functioning in this region, where water supply is a main limiting factor and dust emissions can affect areas beyond the regional scale.

In this study the effects of four different grazing intensities (heavily grazed, winter grazed, ungrazed since 1999, ungrazed since 1979) on a steppe soil, classified as Calcic Chernozem (FAO), were investigated. For this purpose disturbed and undisturbed soil samples (sampling cylinders, soil aggregates) were analysed concerning their mechanical and hydraulic properties under laboratory conditions. Precompression stress under static and cyclic loading conditions, shear resistance, bulk density, texture, carbon-content, saturated hydraulic conductivity in vertical and horizontal direction, water retention characteristics and the hydrophobic properties of aggregate surfaces and homogenised soil material were measured. The measured data was partly used to model one-dimensional water movement in a grazed and an ungrazed soil profile.

The results prove an influence of grazing on soil stability, soil structure and soil hydraulic functions and properties, which had mostly negative effects concerning soil water balance and sensitivity to wind- and water erosion. The repeated loading-unloading-reloading events as encountered due to grazing animals was compared to static loading in oedometer tests and a dependency of precompression stress on the loading path during the experiment and the mechanical history of the soil could be shown. The study could furthermore demonstrate the complex interrelations between soil mechanical and hydraulic properties and functions exemplarily.