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Recovery of forest patches in central Mongolia after fire: Which role does soil hydrology play?

Florian Schneider, Michael Klinge, Jannik Brodthuhn, and **Daniela Sauer**
University of Goettingen, Institute of Geography, Physical Geography, Germany (florian.schneider@uni-goettingen.de)

The distribution of forest patches in the foreststeppe of central Mongolia reflects the interplay of several environmental factors that together control the vegetation pattern of the landscape. Since the mean annual precipitation of this semiarid area rarely exceeds 300 mm, the existence of forest strongly depends on the hydrological properties of the system. Only north-facing slopes provide suitable conditions for the growth of larch trees (Larix sibirica Ledeb.) due to their reduced evapotranspiration. Plains and south-facing slopes are covered by open steppe.However, after disturbance of the forest patches by fire, the regrowth of larch trees does not proceed equally in all areas. During fieldworkat the northern edge of the Khangai Mountains, we identified areas that seemed to havesimilar site conditions but neverthelessshowed different regrowth of larch trees after fire, ranging from intensive regrowth to no regrowth at all.Thisobservation stimulated us to carry out a comprehensive study of soils, vegetation and landscape development in field campaigns in 2017 and 2018, followed by laboratory analyses of soil samples.Through this work, we aimed at identifying the role of soil hydrology for forest succession in this sensitive ecotone.

We described and sampled 57 soil profiles, including sites (i) under forest, (ii) under steppe, (iii) on sites with succession after forest fire, (iv) on sites without succession after forest fire. In the field, we carried out measurements of water conductivity (by use of a compact constant head permeameter). In the laboratory, we analyzed particle size distribution and carried outkfand pF measurements.

These analyses showed that the dominant grain size of the soils was sand, whereby soils with forest regrowth had slightly loamier texture than those without regrowth. We concluded that already slightly loamier texture may be important for water storage during dry periods and thus for forest regrowth.Soils with forest regrowth had higher hydraulic conductivity in the first 25 cm and lower conductivity below.Soils without forest regrowth showeda reverse depth pattern of hydraulic conductivity. We concluded that quick drainage through the upper horizons supports forest regrowth, as it reduces competition for water with grass roots in the upper part of the soil.Soils with forest regrowth hadgreater plant-available water capacity than those without regrowth. We conclude that under the given climatic conditions, storage of plant-available water is a key factor for regrowth / no regrowth of forest after disturbance.