

Tagungsnummer

V83

Thema

Kommission IV: Bodenfruchtbarkeit und Pflanzenernährung
Landnutzung und Kohlenstoffhaushalt

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Titel

Conversions of woodland to smallholder agriculture decreases soil organic carbon and nutrient stocks in semi-arid southern Africa

Abstract

Southern African drylands are characterized by rapid deforestation, among others, related to the ongoing conversion of woodland to smallholder agriculture through slash-and-burn practices. However, empirical data on the impacts of this land-use conversion on soil fertility is rare. Our study in NE Namibia and SW Zambia aimed at quantifying the changes in soil organic carbon (SOC) and nutrient stocks upon the conversion from woodland to smallholder agriculture.

We selected a total of 11 sampling clusters with a 1-km radius from two landscapes that differed in soil characteristics. Each cluster contained one or two 30 m x 30 m plots in agricultural fields and one plot in woodland, which was the reference land use. Plots within a cluster were carefully selected to have similar topographic- and soil characteristics. The selected agricultural fields ranged in age from 2 to 26 years, here age was based on the first year of agricultural usage. Moreover, we only selected agricultural fields that were established immediately after clearing of the woodland. In each plot, we measured SOC and N, and other nutrient (P, K, Ca, Mg and Na) contents and stocks down to 1-m and 0.4-m depth, respectively.

In both landscapes, we found that conversions from woodland to smallholder agriculture in NE Namibia and SW Zambia decreased the topsoil (0-10-cm depth) contents and stocks of SOC and the soil nutrients N, Ca and Mg. The SOC and soil nutrient losses increased with increasing age of the agricultural fields. Soil K and Na contents did not significantly differ between woodland and agriculture. The effect of this land-use conversion on P content was not consistent between the studied landscapes.