

Abstract

Land use change, especially conversion of native forests can have large impacts on water resources. Large scale conversion of native forests to agricultural land has occurred in the last few decades in the Mau Forest region. To quantify and understand landscape hydrologic responses, this study aimed at evaluating the effects of land use on soil infiltration, saturated hydraulic conductivity, bulk density, sorptivity, and soil moisture retention. A total of 136 plots representing five different land uses (native forest: $n = 39$, forest plantations: $n = 14$, tea plantations: $n = 24$, croplands: $n = 23$ and pasture: $n = 36$) were sampled in three catchments with similar parental material in the Mau Forest region, Western Kenya. Native forest topsoils (0–5 cm) had a bulk density of $1.0 \pm 0.2 \text{ g cm}^{-3}$ which was similar to values found for topsoils of forest plantations ($1.1 \pm 0.2 \text{ g cm}^{-3}$), but significantly lower than topsoils from croplands ($1.4 \pm 0.2 \text{ g cm}^{-3}$), tea plantation ($1.3 \pm 0.3 \text{ g cm}^{-3}$) and pastures ($1.4 \pm 0.2 \text{ g cm}^{-3}$). Similarly, soil infiltration rates were higher in native forest ($76.1 \pm 50 \text{ cm h}^{-1}$) and in forest plantation ($60.2 \pm 47.9 \text{ cm h}^{-1}$) than in croplands ($40.5 \pm 21.5 \text{ cm h}^{-1}$), tea plantations ($43.3 \pm 29.2 \text{ cm h}^{-1}$) and pastures ($13.8 \pm 14.6 \text{ cm h}^{-1}$). Native forest had the highest topsoil organic carbon contents ($8.11 \pm 2.42\%$) and field capacity ($0.62 \pm 0.12 \text{ cm}^3 \text{ cm}^{-3}$), while the highest permanent wilting point was recorded for pasture soils (mean of $0.41 \pm 0.06 \text{ cm cm}^{-3}$). The highest plant available water capacity was recorded for soils in native forest (mean of $0.27 \pm 0.14 \text{ cm cm}^{-3}$). Our study indicates that land use changes result in a significant degradation of soil hydraulic properties, which has likely resulted in changes of the regional water balance. Given the magnitude in which managed land use types have changed infiltration rates in our study area, we conclude that changes in land use types occurring in our study region in the last decades have already affected the hydrological regime of the landscapes and the compositions of flow components. The reduction in infiltration and hydraulic conductivity could result in increased surface run-off, erosion and frequency of flooding events