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Soil conservation measures in the Ethiopian Highlands: The effectiveness of stone bunds on soil erosion processes

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Extensive land degradation in the Ethiopian Highlands jeopardizes rural livelihood. Intensified by increasing population pressure, farmers are forced to expand their arable land by deforestation and thus worsening the soil erosion problem. Through the application of various soil conservation measures, farmers and authorities try to prevent against further land degradation.
In this study, the effectiveness of stone bunds on soil erosion processes in the Ethiopian Highlands was evaluated by means of a field experiment in the Gumara-Maksegnit watershed in the Lake Tana Basin of Amhara Region. The study was conducted during the rainy season 2012, from June to September. At a representative hill slope two plots were situated on a farmland treated by stone bunds to observe soil erosion of one respectively two consecutive conservation bunds. Soil loss under untreated conditions was monitored at a third plot, situated on similar hill slope on farmland without conservation measures. After heavy rainfall events, surface runoff and eroded sediment accumulated in 8.0 m long, 1.5 m wide and 0.8 m deep retention ditches installed at the outlet of each plot. A DEM of the area was created by means of a detailed land survey. Soil texture was analysed using core cylinder samples and stone and crop cover was determined based on supervised photo image classification.
The plot monitoring indicated slightly reduced mean soil loss and surface runoff at the treated fields compared to untreated conditions. However, notable variation between the treated plots was observed. The highest as well as the lowest soil loss was indicated at the two treated plots which might correspond to the observed variation in soil surface cover. The highest rock fragment cover was documented at the untreated plot, whereas the two treated plots showed lower rock fragment covers. Furthermore, remarkable variation in crop cover within the two treated fields was monitored during the vegetation period 2012. In general, the field experiment in the Gumara-Maksegnit watershed indicated a positive effect of stone bunds on soil loss and surface runoff. Nevertheless, soil surface cover strongly impacts soil erosion and might exceed the positive effect of the stone bunds.