Geophysical Research Abstracts
Vol. 16, EGU2014-5452, 2014
EGU General Assembly 2014
© Author(s) 2014. CC Attribution 3.0 License.

Effectiveness of soil and water conservation structures in reducing runoff and soil loss for different land use and slope gradients: Case study from northern Ethiopia

Gebeyehu Taye (1,2), Jean Poesen (2), Bas Vanwesemael (3), Matthias Vanmaercke (2,4), Daniel Teka (1,3), Jozef Deckers (2), Tom Goosse (2), Willem Maetens (2), Jan Nyssen (5), Vincent Hallet (6), and Nigussie Haregeweyn (7)

(1) Department of Land Resources Management and Environmental Protection, Mekelle University, P.O. Box 231, Mekelle, Ethiopia (gebex2005@yahoo.com), (2) Department of Earth and Environmental Sciences, K.U.Leuven, Leuven, Belgium (matthias.vanmaercke@ees.kuleuven.be), (3) Georges Lemaître Centre for Earth and Climate Research, Earth and Life Institute Universite Catholique de Louvain, Louvain-la-Neuve, Belgium, (4) Research Foundation Flanders, Brussels, Belgium, (5) Department of Geography, Ghent University, Ghent, Belgium, (6) Department of Geology, University of Namur, Namur, Belgium, (7) Arid Land Research Center, Tottori University, Tottori, Japan

Land degradation and recurrent drought are the major threats to rain-fed agriculture in the semi-arid Ethiopian highlands. To mitigate drought and to ensure food security in the Tigray region, water harvesting using reservoirs for irrigation development has become a priority since 1990. However, the success of water harvesting in reservoirs is limited due to the reduced inflow. As a result, less area is irrigated than originally planned. The aim of this study is to investigate the effectiveness of soil and water conservation (SWC) structures in reducing runoff and soil loss under different land use types and slope gradients. Six runoff measuring sites, corresponding to three slope gradients (5%, 12% and 16%) were established for cropland and rangeland in the Mayleba catchment (Tigray). In total, 21 large runoff plots (with lengths of 60 to 100 m and widths of 10 m) were monitored daily for runoff production and soil loss during the main rainy season (July–September) in 2010. For each site in cropland, three plots were installed and treated with stone bunds and stone bunds with trenches in addition to a control plot. At each site in rangeland four runoff plots were installed: a plot treated with stone bunds, a plot treated with trenches, a plot treated with stone bunds and trenches as well as a control plot. Overall uncertainties on the runoff and soil loss measurements were estimated by means of Monte Carlo simulation techniques. The results show that the seasonal runoff coefficient (RCs) was much higher for rangeland ($0.38 < RCs < 0.50$) compared to RCs-values for cropland ($0.11 < RCS < 0.15$). Seasonal soil loss (SLs) values were five to six times larger on rangeland ($28.6 <$ SLs < 50.0 ton ha-1) compared to that for cropland ($4.6 <$ SLs < 11.4 ton ha-1). All tested SWC structures are effective in reducing runoff and soil loss compared to control plots. However, reduction in RCs were relatively much smaller than reductions in SLs. Trenches and stone bunds with trenches are more effective in reducing runoff and soil loss compared to stone bunds in rangeland. On all study sites, stone bunds with trenches were found to be the most effective in reducing RCs and SLs. With the same SWC structures installed, RCs and SLs for both rangeland and cropland tend to decrease with increasing slope gradient. This is mainly due to a corresponding increase in rock-fragment cover at the soil surface. The effects of SWC structures on runoff production and soil loss are considerable. Hence, it is crucial to consider these effects for optimal design of water-harvesting schemes such as micro-dams that collect and store surface runoff.