

Impact of soil and water conservation measures on soil loss and hydrology in May-Zegzeg catchment

Jan Nyssen¹, Mitiku Haile², Jean Poesen³, Wim Clymans³, Ine Vandecasteele⁴, Katrien Descheemaeker⁵, Matthias Vanmaercke³, Amanuel Zenebe², Nigussie Haregeweyn², Jan Moeyersons⁶, Jozef Deckers³

1 Department of Geography, Ghent University, Gent, Belgium

2 Department of Land Resources Management and Environmental Protection, Mekelle University, Mekelle, Ethiopia

3 Department of Earth and Environmental Sciences, K.U.Leuven, Heverlee, Belgium

4 Institute for Environment and Sustainability, JRC, Ispra, Italy

5 CSIRO Ecosystems Sciences, Glen Osmond, Australia

6 Royal Museum of Central Africa, Tervuren, Belgium

*Corresponding author. Email: jan.nyssen@ugent.be

Changes in the sediment and water budgets in response of the management of the 200-ha May Zegzeg catchment has been investigated. The management included various soil and water conservation measures such as the construction of dry masonry stone bunds and check dams, the abandonment of post-harvest grazing and the establishment of woody vegetation. Land use and management were mapped and analysed for 2000 and 2006, whereby particular attention was given to the quantification of changes in soil loss due to the abandonment of stubble grazing. Discharge measurements at the catchment outlet indicated a runoff depth of 5 mm or a runoff coefficient (RC) of 1.6 % in the rainy season of 2006. Combined with runoff measurements at plot scale, this allowed calculating the runoff Curve Number (CN) for various land uses and land management techniques. The pre-implementation runoff depth was then predicted using the CN values and a ponding adjustment factor, representing the abstraction of runoff induced by the 242 check dams in gullies. Using the 2006 rainfall depths, the runoff depth for the 2000 land management situation was predicted to be 26.5 mm (RC = 8 %), in line with current RCs of nearby catchments. Sediment yield was also measured at the catchment's outlet. A combination of decreased soil loss (from 14.3 t ha⁻¹ y⁻¹ in 2000 to 9.0 t ha⁻¹ y⁻¹ in 2006) and increased sediment deposition (from 5.8 to 7.1 t ha⁻¹ y⁻¹) has led to strongly decreased sediment yield (from 8.5 to 1.9 t ha⁻¹ y⁻¹) and sediment delivery ratio (from 0.6 to 0.21). Emerging wells and irrigation are other indicators for improved water supply in the managed catchment. Cropped fields in the gullies indicate that farmers are less frightened for the destructive effects of flash floods. Due to an increased soil water content, the crop growing period is prolonged. It can be concluded that this catchment management has resulted in strongly decreased sediment output, a higher infiltration rate and a reduction of direct runoff volume by 81 % which has had a positive influence on the catchment water balance.

Key words: Catchment management; Runoff coefficient; Water balance; Watershed; Soil erosion; Soil and water conservation