



A curve number simulation of gully cut-and-fill cycles: impact of agro-management on gully activity in the Tigray Highlands

Sil Lanckriet (1), Elise Monsieurs (2), Amaury Frankl (1), Gebrekidan Mesfin (3), Katrien Descheemaeker (4), and Jan Nyssen (1)

(1) Department of Geography, Ghent University, Krijgslaan 281 (S8), B-9000 Ghent, Belgium, (3) Department of Civil Engineering, Mekelle University, Mekelle, Ethiopia, (4) Department of Plant Production Systems, Wageningen University, Droevendaalsesteeg 1, NL-6708, Wageningen, The Netherlands, (2) Department of Earth Sciences, Royal Museum for Central Africa, Leuvensesteenweg 13, Tervuren, Belgium

Gully cut-and-fill dynamics are often thought to be driven by climate and/or deforestation related to population pressure. However, in this case-study of nine representative catchments in the North Ethiopian Highlands, we find that neither climate changes nor deforestation can explain gully morphology changes over the 20th century. Firstly, by using a Monte Carlo simulation to estimate historical catchment-wide curve numbers, we show that the landscape was already heavily degraded in the 19th and early 20th century – a period with low population density. The mean catchment-wide curve number (>80) one century ago was, under the regional climatic conditions, already resulting in considerable simulated historical runoff responses. Secondly, 20th century land cover and runoff coefficient changes were confronted with 20th century changing gully morphologies. As the results show, large-scale land cover changes and deforestation cannot explain the observed processes. The study therefore invokes interactions between authigenic factors, small-scale plot boundary changes, cropland management and sociopolitical forces to explain the gully cut processes. Finally, semi-structured interviews and sedistratigraphic analysis of three filled gullies confirm the dominant impact of (crop)land management (tillage, check dams in gullies and channel diversions) on gully cut-and-fill processes. Since agricultural land management – including land tenure and land distribution – has been commonly neglected in earlier related research, we argue therefore that it can be a very strong driver of 20th century gully morphodynamics.