Geophysical Research Abstracts
Vol. 20, EGU2018-7037, 2018
EGU General Assembly 2018

Factors controlling and triggering urban gullies in the high town of Kinshasa (DR Congo)

Fils Makanzu Imwangana (1,2,3), Jan Moeyersons (1), Pierre Ozer (4), Médard Ntombi (2,3), and Olivier Dewitte (1)

(1) Royal Museum for Central Africa, Department of Earth Sciences, Tervuren, Belgium, (2) Centre de Recherches Géologiques et Minières, Kinshasa, DR Congo, (3) Université de Kinshasa, Département des Géosciences, Kinshasa, DR Congo, (4) University of Liège, Department of Environmental Sciences and Management, Arlon, Belgium

Soil erosion has multiple linkages to land planning, environment changes and urbanization in developing countries. Gully erosion is also reported as an emerging hazard connected with the rapid development of Sub Saharan towns in Africa. Since the start of urbanization in the 60s', the high town of Kinshasa (DR Congo) has been the place of an important gully erosion. Here we show that in 2007, Kinshasa is affected by 308 mega-gullies having $\sim$100 Km of cumulated length. The accumulated length evolution between 1957 and 2010 is exponential. The gully density varies from 0.4 to 2 Km/Km^2. The average depth and width are 7 and 21 m respectively. The causal relationship between urbanization and gullying shows that gullies develop with a delay of less than ten years after the built up of urban sectors lacking an adequate drainage system. There are nearly no gullies outside of the urban zones. Analyzing the gully distribution and morphology with regard to the local topography and the road network, we found that their spatial occurrence in this newly urbanized environment is controlled by two factors: (1) there is a topographic control, given by the relation S= 0.00008A^{-1}.459,with S being the slope gradient (mm^{-1}) of the soil surface at the gully head and A the drainage area (ha) above the head. (2) There is a 'road' control, expressed by S= 22.991Lc $-$ 1.999, with Lc being the cumulated length of roads in the basin above the gully head. The co-existence of both controls reflects the fact that the local sands are highly permeable and hence roads are the most important generator of continuous runoff. The S–A relation noted above should not be applied outside the town where the road network is less dense. In contrast, the S–Lc relation may be used in both the town and rural areas underlain by porous soils where roads are the only generators of continuous runoff. We further conclude that the high town is one of the most vulnerable places for gullying, and gullying can potentially transform the town into badlands. As last step in our investigation, we assess, through field-based measurements, site- and rainfall-specific runoff coefficients to be expected for a given period of the year in the trigger zones of the gullies. We show that differences in land use/land cover reply in a different way to rainfall characteristics and that these differences due to vegetation cover disappear gradually with decreasing slope. Currently, the critical rainfall for gullying in the high town is 24.9 mm with a mean intensity of 21.8 mm h-1. Roads generate by far most runoff and, therefore, are considered as the primary reason for gullying. The other soil uses lead most of the time to much smaller runoff coefficients, but their relative contribution to the supply of gullies grows with rainfall increase in height and intensity. The results provide material for gully management and adaptation strategies and open perspectives for the development of an early warning system in the region.