Understanding gully erosion dynamics since 1965 in May Bati, Northern Ethiopia

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The Highlands of Northern Ethiopia are known for their semi-arid environment where long-lasting land degradation resulted in dense and deep gully networks. Causes are a poverty-driven unsustainable use of the land in a mountainous environment were sparse vegetation cover is unable to protect the steep slopes against intensive rainfall. As pointed out by recent studies, improved land management and gully rehabilitation programs are having a positive effect on the stabilization of gullies in Northern Ethiopia. Especially for headwater streams, where hillslope-channel links are strong, reforestation and soil- and water conservation programs are being beneficial. This study presents a detailed study of gully development in the small headwater catchment of May Bati, representative in terms of historical and recent land management dynamics in Northern Ethiopia. Furthermore, trends in land use and land management, population size and rainfall patterns were analyzed and used to understand gully erosion dynamics. Historical trends in gully networks and volumes were assessed by using terrestrial photographs (1998), aerial photographs (1963, 1974, 1994), IKONOS satellite images of 2006, interviews and field work (2008-2011). A new methodology is presented to quantify gully volumes from remote sensing material. Land use, land management and population size was studied from historical photographs, aerial photographs and LANDSAT satellite images (1972 – 2001), in combination with fieldwork. This allowed to create land use/management maps and population density maps dating between 1963 and 2010. Analyzing rainfall patterns was done by calibrating satellite derived decadal NOAA rainfall estimates with precipitation data from meteorological stations between 1996 and 2009, and by recalculating annual precipitation in the studied period. Preliminary results from aerial photographs and satellite images analysis show that a period of rapid gully network extension existed from the 1960s to the 1980s, and that since 1994 the gully network was almost fully developed. Gullies were thus particularly active before 1994. This was confirmed by a key informant residing in the study area since the 1970s, showing us how he diverted runoff to protect his farmland from flooding in the early 1980s and so accelerating the initiation of a gully. Recent trends in gully erosion are closely related to changes in land use and land management, with improved land management and increased vegetation cover resulting in gully stabilization. Only gullies developed in soils where piping occurs still have very active head cuts, which calls for specific solutions.

Key words: Aerial photographs, Environment, Ethiopia, Gully erosion, IKONOS.