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ASSESSMENT OF GULLY EVOLUTION IN THE UPPER AWASH BASIN, CENTRAL ETHIOPIAN HIGHLANDS

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Water erosion represents the main cause of extensive soil erosion and mass wasting phenomena in Ethiopian Highlands. Permanent incised gullies are the most spread and intensive process of water erosion in the Central Ethiopian highlands. Our study area is a part of the Upper Awash basin. It is located in the vicinity of the western escarpment of the main Ethiopian rift around 40 km SW from Addis Ababa. In this area gully headcuts are characterized by an abrupt drop in elevation with near vertical banks and often coming along with piping. The gully development here is particularly related to silty textured soils. The gully channels are typically incised in the substrates consisting of tuffs, which are described as Lower-Middle Pleistocene welded ignimbrites. The rainfed agriculture practiced in the area contributes heavily to the gully erosion since land surface is left without canopy in the early rainfall season. The dry season span from September till January, with the presence of storms between april and march generally the most destructive in terms of splash, sheet and rill erosion, the main rainy season is between June and August.

In this study we aim at the derivation of erosion rates including headcuts retreat and hence, soils losses, from a time series of high resolution ortho-images and digital elevation models (DEM). For the terrain reconstruction we applied the Structure from Motion (SfM) Approach using aerial photographs provided by the Ethiopian Mapping Agency from acquisition campaigns in 1957 and 1972. Additionally we processed satellite stereo triplet ALOS/PRISM from 2008 to capture the present situation. In this way we obtained three sources of elevation covering the last 50 years. A high resolution ortho-image was generated for each acquisition date to facilitate mapping of the gullies.

To identify the main rainfall trends we used precipitation record for the last 40 years from Awash Melka Kunture and Boneja meteorological stations 12 and 15 km far from the study area respectively. The further goal is to model the gully evolution and finding gully initiation/expansion thresholds in slope steepness, land use changes and particular rainfall events. Preliminary analysis of a test site revealed an increase in gully area from 0,13 to 0,15 km^2 between 1957 and 2014 which represents 17% increase. Results show how to quantify gully dynamics in data scarce regions with a limited field access. Considering the strong rural economy of the study area, an efficient and effective gully erosion control should entail the stakeholder involvement and it should focus on: i) piping control, ii) land use and agricultural management practices regulation, iii) the reforestation of areas affected by the rapid expansion of gully erosion.