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Catchment rehabilitation and hydro-geomorphic characteristics of mountain streams in the western Rift Valley escarpment of Northern Ethiopia

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The catchments in the western Rift Valley escarpment of Northern Ethiopia are highly responsive in terms of hydro-geomorphic changes. With rapid deforestation in the first half of the 20th century, dense gully and scar networks developed, exporting huge amounts of runoff and sediment down to the fertile and densely populated Raya Valley. Consequently, threatening the environment and the livelihoods of the people both in the upstream and downstream areas. To reverse this problem, catchment-scale rehabilitation activities were initiated in the mid-1980s. In this study, we examine the hydro-geomorphic response of streams after catchment rehabilitation. Scar density was digitized from Google Earth imagery (2005) in 20 adjacent catchments and was explained in terms of its corresponding Normalized Difference Vegetation Index (NDVI) and slope gradient. This was accompanied by analysis of incidental repeat photographs and field observations. As evidenced by the series of repeat photographs, the vegetation cover of the catchments decreased up to 1975 and rapid reforestation occurred thereafter. A multiple regression analysis ($R2=0.53$, $P<0.01$) showed that scar density is negatively correlated with NDVI and positively with average gradient of very steep slopes (>60%). Moreover, due to reduction in discharge and sediment flow from the rehabilitated catchments, stream adjustments were observed in the field: previously braided stream channels have changed to single-thread streams, many lateral bars are stabilized and covered by vegetation, stream channels are incising due to clear water effect and the size of boulder deposits decreases. Therefore, the study shows that, land degradation activities in the upper catchments resulted in changes in hydro-geomorphic characteristics of the streams and reduction in runoff and sediment transport to the Raya Valley.

Key words: scar density; NDVI; stream incision; soil and water conservation; stream adjustment; land use change.