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Uphill Land Degradation is the Driver for Gully Erosion in Valley Bottoms in the Ethiopian Highlands

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Sediment concentrations in rivers have been increasing in the humid Ethiopian highland during the last 50 years, despite large-scale efforts by donors and the Ethiopian government to install soil and water conservation practices. One of the culprits responsible for increased sediment concentrations are gullies that have formed in the periodically saturated vertisols in the valley bottoms. These gullies can be 10 m deep and 30 m wide with banks collapsing due to the high water table. In one small 50-ha an equivalent erosion rate of 5 cm in one year was observed. These gullies negate any reduction in sediment concentration from soil and water conservation practices installed upstream.

The cause of the gullies is land degradation. The degradation began during the communist Derg regime in the nineteen eighties, or shortly thereafter, when forests were cut. With the increasing population, shifting cultivation disappeared and was replaced by continuous cropping that caused organic matter content to decrease and cations to leach. Subsequently, soils became finer and sediment concentrations increased in both the runoff and the infiltrating water. The sediment in the infiltration water accelerated harpan formation blocking the original deep flow paths, completing the degradation process some 30-40 years after deforestation. Compared with the original soil, the degraded soil had a smaller water holding capacity and lateral and surface flow was increased at the expense of baseflow. In this process, gullies are formed to carry of the excess water, because they are the most energy efficient way to connect the degraded upland soils with the river. Gullying will stop once a new equilibrium is established. Early intervention by treating the shallow gullies involving communities and establishing downstream control points can likely be used to reach the equilibrium sooner and decrease the otherwise extreme soil loss.