



Evidence of how roads and trails contribute to gully erosion in drylands

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Drylands with episodic storms are susceptible to gully erosion. Anthropogenic practices such as heavy grazing, roads, and trails can exacerbate gully erosion by concentrating overland runoff onto limited areas. Here we examine such processes in the dry savannas of northern Queensland, Australia, using high resolution digital elevation models (DEMs) based on LiDAR and drone surveys to depict detailed surface flow pathways employing a threshold contributing area of 50 m². By constructing these hydrological pathways within several gully catchments, we illustrate the influences of unpaved roads and cattle trails on surface runoff concentration into the heads of gully systems. Indices of hydrological connectivity (IC) throughout drainage areas above and downstream of these gully systems were calculated as the ratio of upslope to downslope sediment routing functions, based on upslope area, mean slope gradient, a weighting factor related to impedance to overland flow, and flow path distance (for the downstream function). Mapping IC within the heavily grazed Weany Creek catchment (13 km²) of northeast Queensland show that existing unpaved roads and cattle trails can significantly increase hydrologic connectivity to gully systems. Our remote sensing findings support field observations of numerous cattle trails converging above gully heads as likely contributors to gully initiation or extension. These findings can also contribute to better management practices for grazing and road location, not only in the dry savannas of Australia, but also in other drylands that are susceptible to gully erosion.