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Runoff and soil erosion for an undisturbed tropical woodland in the Brazilian Cerrado

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The Brazilian Cerrado is a large and important economic and environmental region that is experiencing major loss of its natural landscapes due to pressures of food and energy production, which has caused large increases in soil erosion. However the magnitude of the soil erosion increases in this region is not well understood, in part because scientific studies of surface runoff and soil erosion are scarce or nonexistent in undisturbed Cerrado vegetation. In this study we measured natural rainfall-driven rates of runoff and soil erosion for an undisturbed tropical woodland classified as "cerrado sensu stricto denso" and bare soil to compute the Universal Soil Loss Equation (USLE) cover and management factor (C-factor) to help evaluate the likely effects of land use change on soil erosion rates. Replicated data on precipitation, runoff, and soil loss on plots (5 x 20 m) under bare soil and cerrado were collected for 55 erosive storms occurring in 2012 and 2013. The measured annual precipitation was 1247.4 mm and 1113.0 mm for 2012 and 2013, resulting in a rainfall erosivity index of 4337.1 MJ mm ha^{-1} h^{-1} and 3546.2 MJ mm ha^{-1} h^{-1}, for each year respectively. The erosive rainfall represented 80% of the total precipitation and was concentrated in the wet season, which generally runs from October through March. In the plots on bare soil, the runoff coefficient for individual rainfall events (total runoff divided by total rainfall) ranged from 0.003 to 0.860 with an average value and standard deviation of 0.212 ± 0.187. Moreover, the runoff coefficient found for the bare soil plots ($\sim$20%) indicates that the soil in the study area (sandy soil) has a great infiltration capacity. In forest areas the leaf litter and the more porous soil tend to promote the increase of infiltration and water storage, rather than rapid overland flow. Indeed, runoff coefficients ranged from 0.001 to 0.030 with an average of less than 1% (0.005 ± 0.005) in the plots under undisturbed cerrado. The soil losses measured under bare soil and cerrado were 15.68 t ha^{-1}yr^{-1} and 0.24 t ha^{-1} yr^{-1} in 2012, and 14.82 t ha^{-1} yr^{-1}, 0.11 t ha^{-1} yr^{-1} in 2013, respectively, with means of total soil loss during the study period of 15.25 t ha^{-1} yr^{-1} and 0.17 t ha^{-1} yr^{-1}. The erosivity–weighted C-factor for the undisturbed cerrado vegetation was 0.013. Previous studies have shown that, in general, the C-factors for Brazilian crops cover an approximate 10-fold range, from 2 to 39-times greater than the C-factor for undisturbed cerrado. Our results suggest that though soil erosion under undisturbed Cerrado is important, shifts in land use from the native to cultivated vegetation may result in orders of magnitude increases in soil loss rates. These results provide benchmark values that will be useful to evaluate past and future land use changes using soil erosion models and measurements.