

Effects of Potential Land Use Changes on Runoff and Soil Loss under Subtropical Conditions

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The agriculture and pasture land expansion can destroy natural ecosystems such as Brazilian savannas (cerrado), an important regulator of energy and mass exchanges between surface and atmosphere. The consequent increase in the occurrence of pasture, sugarcane and bare soil land covers in areas before occupied by native cerrado may cause significant changes in soil erosion processes, impacting the environment in several ways. Here we investigate how the present dynamic of land use changes in Brazil influences the occurrence of erosive processes at a local scale. Thus, this study aims to evaluate the water erosion in experimental plots (20 m length, 5 m width, and 9% slope) in the context of potential land use changes: cerrado, sugarcane, pasture and bare soil. The research was conducted during four years in an experimental site, located in the Itirapina municipality, inside the State of São Paulo, Brazil. Hence, meteorological variables, soil loss rates, and runoff were monitored inside experimental plots containing different land covers (Figure 1).

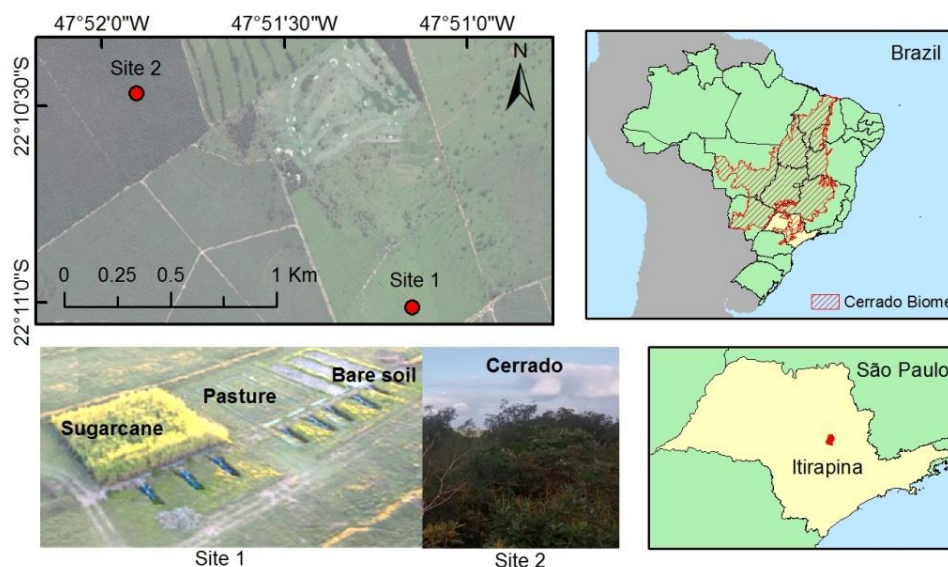


Figure 1. Experimental site location and layout.

The results show that during 2014, due to the drought conditions (Getirana, 2016), runoff and soil loss rates decreased. During the rainy years (2012 and 2015), the rates increased.

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However, in spite of the similarities in total rainfall depths in 2012 and 2015, the 2015 soil loss rate was greater on bare soil than in 2012. Soil loss and runoff were also higher for sugarcane in 2012, as it was the first year of site operation and the soil had been recently tilled. In general, considering both runoff and soil loss rates, bare soil values were at least an order of magnitude greater in comparison with all others treatments (Table 1).

Table 1. Yearly results from runoff and soil loss monitored data in Itirapina, São Paulo, Brazil.

| Year | Rainfall (mm) | Runoff (mm yr ⁻¹) | | | | Soil loss (t ha ⁻¹ yr ⁻¹) | | | |
|------|---------------|-------------------------------|---------|---------|-----------|--|---------|---------|-----------|
| | | Sugarcane | Cerrado | Pasture | Bare soil | Sugarcane | Cerrado | Pasture | Bare soil |
| 2012 | 1589 | 141 | 15 | 91 | 609 | 1.57 | 0.25 | 0.17 | 16.8 |
| 2013 | 1487 | 31 | 6 | 163 | 424 | 0.25 | 0.10 | 0.06 | 13.0 |
| 2014 | 1112 | 12 | 2 | 27 | 140 | 0.39 | 0.06 | 0.06 | 6.24 |
| 2015 | 1497 | 36 | 7 | 232 | 551 | 0.87 | 0.24 | 0.23 | 43.8 |

Figure 2 shows that sugarcane soil loss rates had higher variability due to the crop management (always harvested in November). Pasture and cerrado rates were lower than sugarcane, and had similar values, as previously suggested by Oliveira et al. (2015). In addition to this, pasture had higher runoff values than cerrado and sometimes sugarcane, but its soil erosion was the lowest among all treatments.

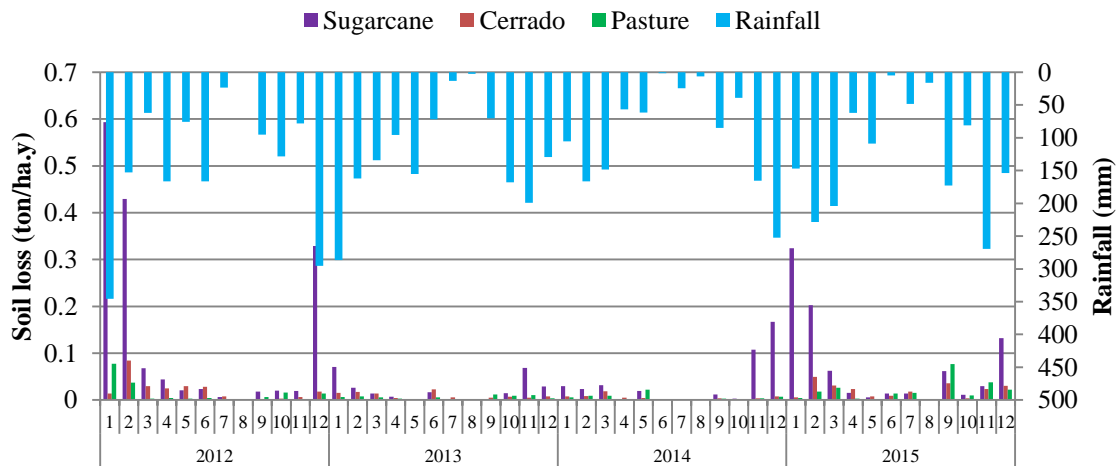


Figure 2. Monthly rainfall and soil loss rates for sugarcane, cerrado and pasture.

References

- Getirana, A. 2016. Extreme water deficit in Brazil detected from space. *J. Hydrometeorol.* 17(2): 591-599.
- Oliveira, P.T.S., M.A. Nearing, and E. Wendland. 2015. Orders of magnitude increase in soil erosion associated with land use change from native to cultivated vegetation in a Brazilian savannah environment. *Earth Surf. Process. Landforms* 40: 1524-1532.