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Quantifying lavaka (gully) density and extension using freely accessible satellite imagery

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Land Degradation in Madagascar is a complex challenge due to spectacular gullies (called lavaka) that have a number of undesirable effects. Lavaka have been observed for a long time. Nevertheless their real nature and contribution to total soil loss is still unclear. This is probably due to the fact that they occur in great number and size in the Highlands of Madagascar, therefore their quantification and study is very hard making field surveys time consuming.

The aim of this study was to quantify the lavaka density at various parts of the Highlands of Madagascar using satellite imagery. To this end 10 test areas of size of 250-300 km^2 has been selected. In these areas we were able to identify, classify and map the approximate extent (length and width) of the gullies from Google Earth images. Gully location and characteristics (type and size) were integrated in a conventional GIS. Gully abundance maps were created for each study area by inspecting the available imagery at 1 km x 1 km grid cells. These maps were then examined against several raster and vector data layer representing various landscape variables such a slope angle, elevation and relief (derived from SRTM) as well as geology, soil precipitation and the possible human influence.

Visualization of imagery showed that lavaka density in the studied areas varies greatly, even locally from one cell to another. The average lavaka density is 2.2 lavaka per km^2 with a maximum of 30 lavaka per km^2. Lavaka size also shows great diversity, reaching up to 1000 m in length and few 100 m in width.

Results show a strong relationship between gully presence, tree cover, elevation, relief and slope angle. Geology, soil and precipitation seem to be less important in a medium scales notwithstanding with the fact that many studies dealing with lavaka emphasize their importance in lavakization process. Most of the lavaka seem to be a natural part of the landscape and this assumption was supported by lavaka-like features interpreted as paleolavaka found while inspecting imagery.

Further studies will concentrate on the role of the spatial and temporal distribution of precipitation.

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