Resizing Plots and Terrace Spacing in Sugarcane Areas

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Terracing is a common practice for soil conservation in agricultural areas. However, when constructed in a field plot, the terraces interfere with machine efficiency. An alternative is to use the terraces to delimit field plots, but depending on the spacing between the terraces, the resulting areas can become very small (Lombardi Neto et al., 1994).

This study aimed to determine the spacing between terraces based on the value of soil loss limits (Oliveira et al., 2008) using the Universal Soil Loss Equation (USLE; Wischmeier and Smith, 1978) and redesigning the plots in an agricultural area of sugarcane fields, and then comparing the results with existing terraces and plots in the area.

The study was conducted in an area of 133.7 ha, located in Bom Jesus de Goiás, Brazil, in field with an Oxisol soil, that was in a 5-year sugarcane rotation, with broad-based terraces. We conducted a planimetric survey to obtain the perimeter of the area, perimeter of the stands and elevation data with a vertical accuracy of 0.1 meter used to generate a Digital Elevation Model (DEM) with 1-meter cells. The measurement data were imported into a GIS environment, and the USLE rainfall/runoff (R) erosivity parameter was calculated according to Morais et al. (1991), soil erodibility (K) factor determined based on Silva et al. (1997), and the land use and management (C) and conservation practices (P) factors determined according to Amorim et al. (2009). The slope length (L) factor was calculated with methodology proposed by Desmet and Govers (1996), using the TauDEM tool (Tarboton, 1997) to generate the flow direction values and flow accumulated with the "Deterministic Infinity" method. The slope steepness (S) factor was calculated using the method developed by Nearing (1997).

In the raster of soil loss calculated by the USLE for the whole area, we created a mask with values above the soil loss limit, and with this mask, we found the position of the maximum height value in the DEM. The maximum height was used to generate an isoline which corresponds to the location of the terrace, which was then used to generate the polygon of the plot. Erasing the area of the dimensioned plot, we calculated the soil loss of the remaining area, and then the next plot was generated, and the others followed this sequence until there were no longer any values above the soil loss limit.

Figure 1 shows the existing and dimensioned plots and terraces, and their soil loss values. We found that the existing terraces were not level, with elevation differences more than 2 m in the same terrace, thus indicating low effectiveness in controlling erosion. Moreover, in many parts of the existing plots the calculated USLE soil loss values were greater than the limit (12.3 Mg ha^{-1} yr^{-1}), even when we considered the existing terraces in the calculations. In the newly dimensioned plots, there were no areas with predicted soil loss values above the established limit.

For the original field situation, average predicted soil loss was 6.55 Mg ha^{-1} yr^{-1}, with a total annual estimated loss of 876 Mg yr^{-1}, while the newly designed field area had an average soil loss of 4.14 Mg ha^{-1} yr^{-1} and total annual estimated loss of 553 Mg yr^{-1}, which indicates greater efficiency with the resizing. Moreover, the original area still had terraces within the plots, while the new field design only had terraces located on the plot boundaries.

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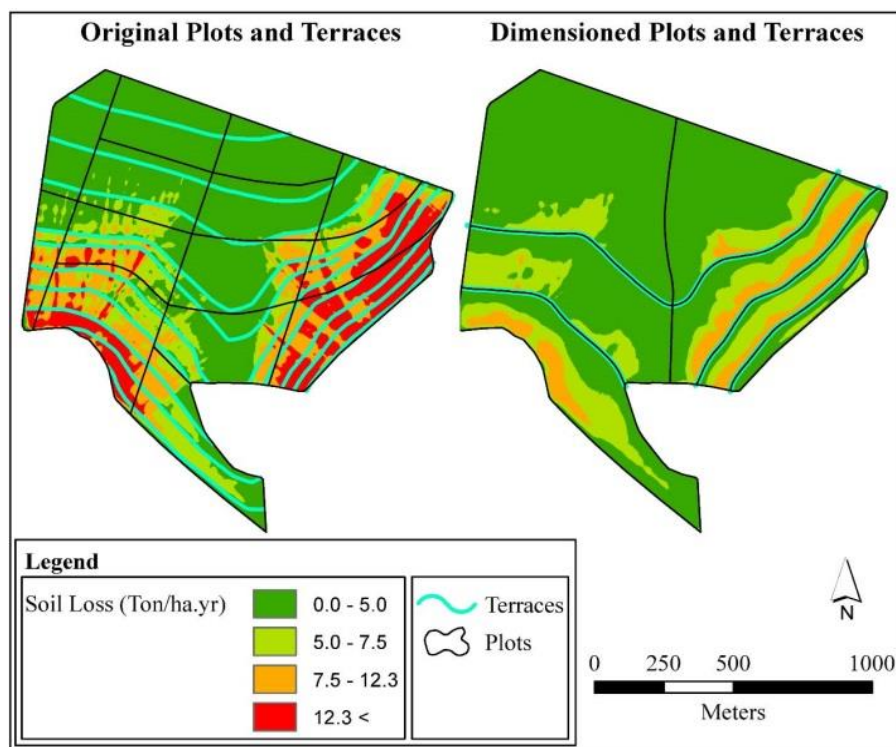
Figure 1. Map with the existing and dimensioned plots and terraces, and spatial soil loss values.

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