

**The use of geotechnology to determine areas with forestall potential: an approach about water availability**

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**ABSTRACT**

Soil loss through water erosion is one of the most serious problems in relation to productivity loss, whether agricultural or forestry. Knowing the environmental conditions of the area where the culture will be implanted is just as important as knowing the necessity of each culture for its development. That said, the present study aimed to analyze potential soil losses of forestall production at the Cachoeira Cinco Veados Watershed, RS, based on the Environmental Zoning of Silviculture for RS. The maps of potential soil losses are based on the Universal Soil Loss Equation (USLE), with the help of ArcGIS 10.5 Software, the maximum losses admitted were of 100 ton.ha<sup>-1</sup>.year<sup>-1</sup>. The areas of use with forest cover totaled 46,38 km<sup>2</sup> (4.638 ha), approximately 3% of the total area. According to the RS Forestry Zoning, the Cachoeira Cinco Veados Watershed, RS, comports the total of forestall area allowed (10,8%). The use of geotechnologies allowed to observe the analyzed variables.

**1 INTRODUCTION**

Brazil has a total area of 851 million of hectares, of each 450 million correspond to natural forests (GUIMARÃES et. al., 2006) and 7,83 million of hectares (1% of national territory) are occupied with planted forests, centered mainly in southeast region. The reforested area existing in the State of Rio Grande do Sul is of 493.252 ha, which correspond to 1,75% of the state total area, most of which consists of eucalyptus plantations (62,6%) (INDÚSTRIA BRASILEIRA DE ÁRVORES, 2018).

The environmental zoning is part of a set of environmental actions elaborated to guide the sustainable use of natural resources and focuses on dividing an area in homogeneous portions, with similar physiographic and ecological characteristics, in which are indicated some uses and activities and advised against others (ROCHA, 1997). An environmental zoning needs to advocate a model with simple formulations guided by the aimed goal (SCHOENHOLTZ et. al., 2000). The potential fitness zones can be determined by a model which incorporates a big set of data, developed in regional scale, as a tool to evaluation of alternative scenarios of forestall ordination (FLORES, 2011).

To the effectuation of a zoning pointed to a certain activity, first it is indispensable to determine the factors that somehow will affect the success or otherwise of such an enterprise (FRANCELINO et. al., 2012), as the type of soil, fertility, hydraulic conditions of the culture implantation site, suitable temperature for the culture, among others. That said, the present study has aimed to determine the passible areas of use with forest/reforestation, considering the potential soil loss by erosion for the Cachoeira Cinco Veados Watershed, RS.

**2 OBJECTIVE**

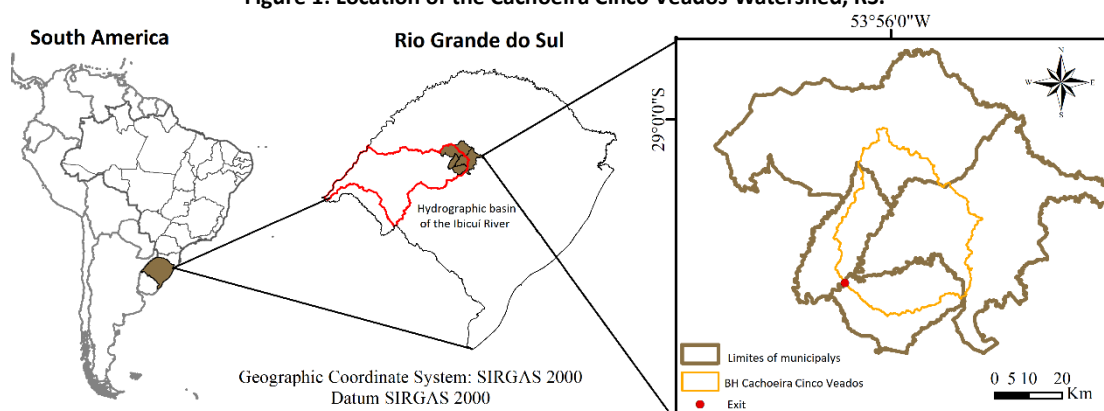
The study aimed to determine the areas that can be used with forest / reforestation, considering potential loss of soil by erosion to the Cachoeira Cinco Veados Watershed, RS.

**3 METODOLOGY**

Belonging to the water of Ibicuí River, the Cachoeira Cinco Veados Watershed, RS, (Figure 1), is situated at the Hydrographic Region of Uruguay and embraces four cities: Tupanciretã, Quevedos, Júlio de Castilhos and São Martinho da Serra. Its coordinates are 29°00'

and 29°30' of South latitude and 53°39' and 54°06' of West longitude, those being under the SIRGAS 2000, base for the whole mapping realized in the study.

**Figure 1: Location of the Cachoeira Cinco Veados Watershed, RS.**

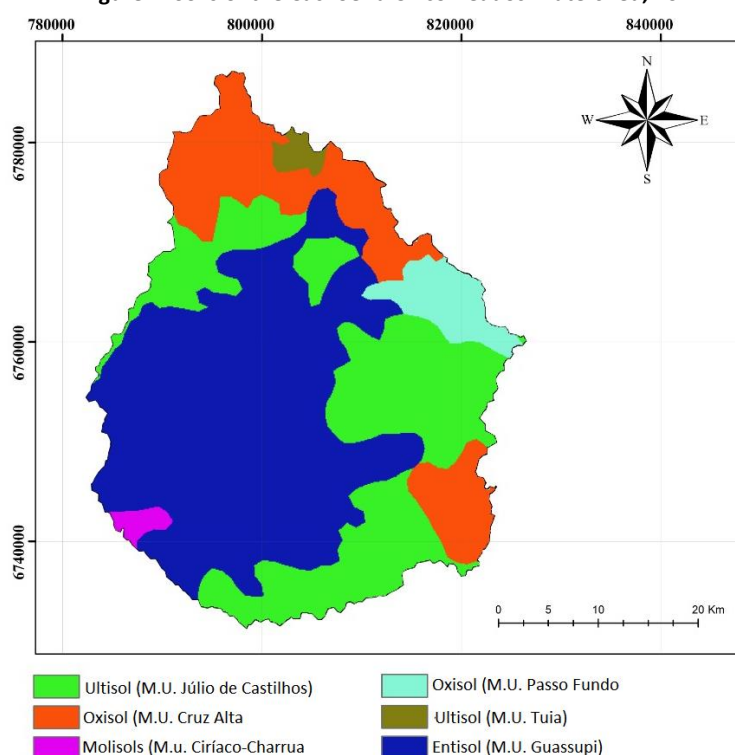


Source: AUTHORS, 2019.

The drainage area of Cachoeira Cinco Veados Watershed, RS, is of 1.514,9 km<sup>2</sup>, highlighting the Toropi and Guassupi river (WEILER, 2017), and the Watershed exit is located at the coordinates 29°25'38,755\" S and 54°3'13,991\" W, distant about 90 km from Federal University of Santa Maria, Santa Maria, RS.

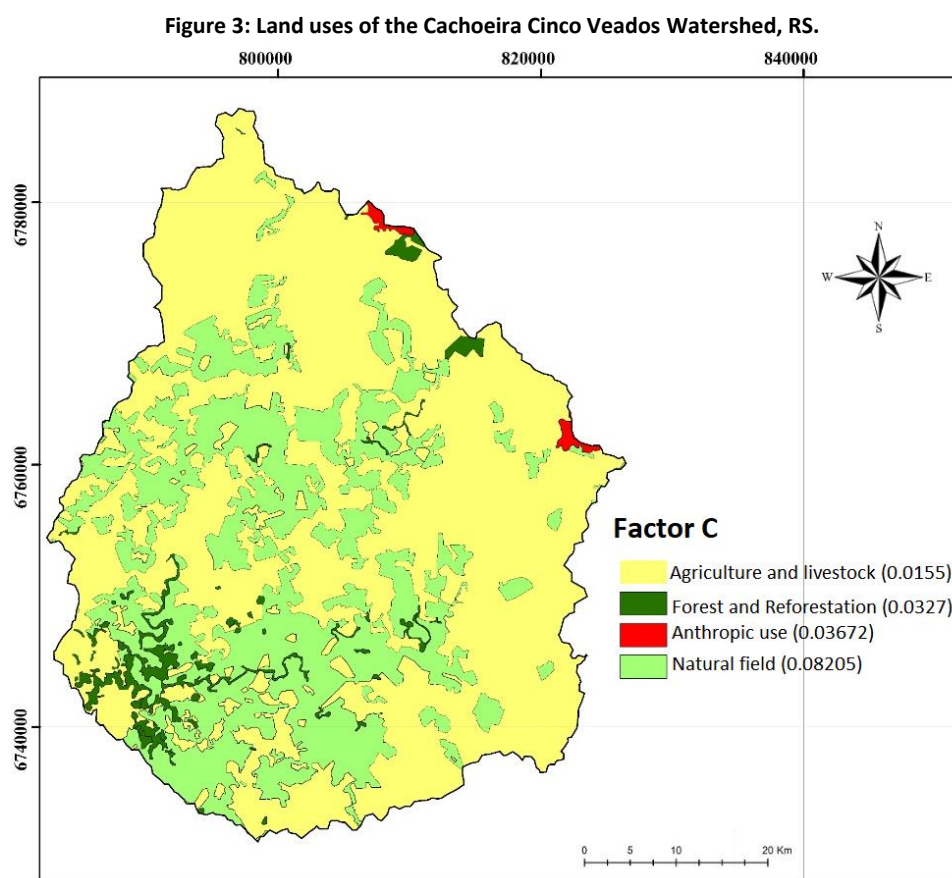
The Watershed soils are mostly of Entisol M.U.. Guassupi (47,89%), corresponding to 738,06 km<sup>2</sup>. Around the Watershed exit prevails the Molisol M.U. Ciriaco-Charrua, with area of 13,8 km<sup>2</sup> (0,89%) (Figure 2).

**Figure 2: Soils of the Cachoeira Cinco Veados Watershed, RS.**



Source: AUTHORS, 2019.

The soil use is predominantly agricultural, which areas were, previously, covered by steppe savanna, typical biome where is inserted the Watershed (Figure 3).



Source: AUTHORS, 2019.

To decide the areas liable to use with forest/reforestation, it was determined that the maximum potential soil losses admissible for this use were of  $100 \text{ ton} \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$ , that is, for all the areas with such losses or less, it is possible the implantation of forest cultures. The potential soil loss was calculated by the Universal Soil Loss Equation (USLE), through the ArcGIS 10.5 Software and the Map Algebra – Raster Calculator tool, as follows:

$$A = R K L S C P \quad \text{Equation (1)}$$

Where:  $R$  = Rain erosivity

$K$  = Soil erodibility

$L S$  = Ramp length and slope

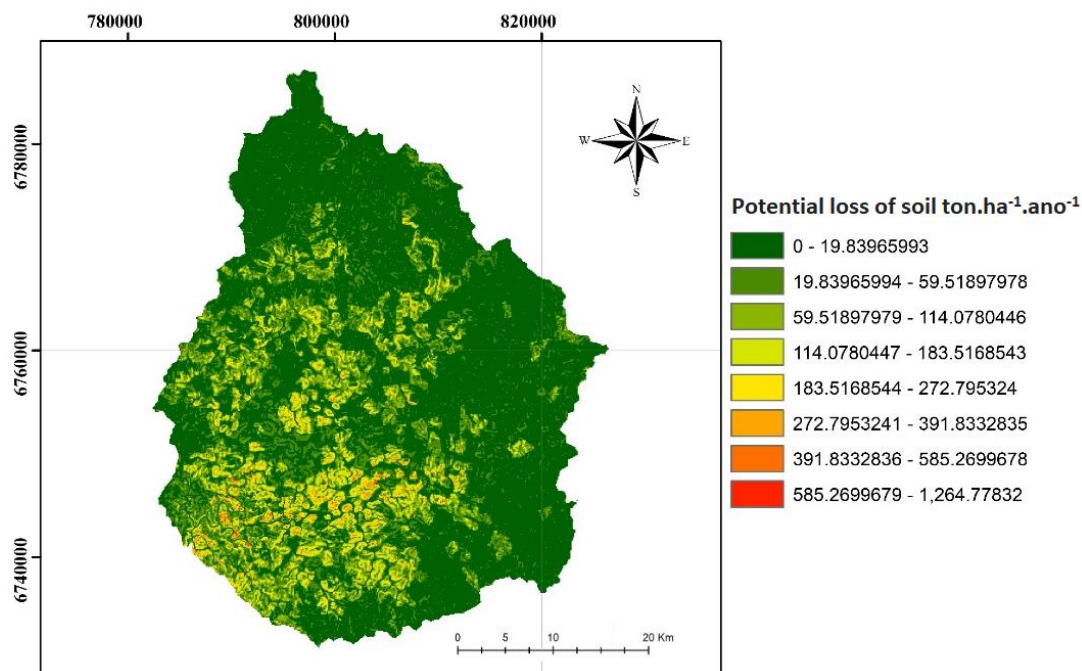
$C$  = Land use and management

$P$  = Conservationist practices.

#### 4 RESULTS

The potential soil loss map (Figure 4) was elaborated in function of the current soil uses for the Cachoeira Cinco Veados Watershed, RS, for medium rains. It is observed that the areas localized close to the Watershed outlet are more fragile when considered potential soil losses, effect caused by the soil erosion, mainly in the areas with bigger declivity and accentuated anthropic use. The occurrence of areas with steep topography and with the presence of soils with high erodibility favor the erosive water processes, that in sites with a strong rain erosivity, it creates a high natural potential of erosion scenario (PAES et. al., 2010).

**Figure 4: Potential loss of soil for the Cachoeira Cinco Veados Watershed, RS.**

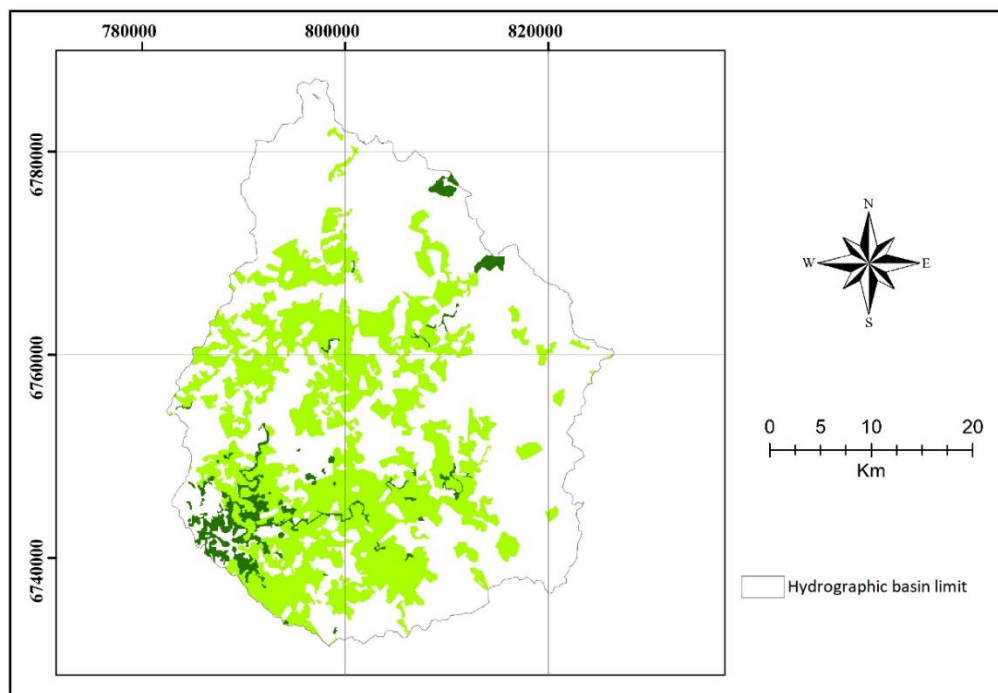


Source: AUTHORS, 2019.

After the determination of potential soil loss, within the use of geotechnologies, it was pointed the areas where such losses haven't reach the value of 100 ton.ha<sup>-1</sup>.year<sup>-1</sup>, becoming the liable ones for the forestall cover use. It was considered as well the areas already covered by forests, whereas the losses do not surpass the pre-determined value. The previous determination of fit areas to receive the eucalyptus cultivation, for example, allows a reduction of cost and time when compared to the traditional zoning methods, as it reduces the area to be assessed in terms of aptitude (FRANCELINO et. al., 2012). The South Region of Brazil practically does not present none of the restrictive conditions to the Pinus taeda development, as the ones observed in its region of origin, as hydric deficit and low temperatures to the north, being that the species can survive in most parts of the region, but with low productivity, far short than those observed in the sites where the weather and soil are favorable (HIGA et. al., 2008).

The use with forest/reforestation, that comprehends the Silviculture areas, totalize 46,38 km<sup>2</sup> (4.638 ha), representing 3% of the Watershed total area (1.5451,9 km<sup>2</sup>) (Figure 5).

Figure 5: Areas with forest / reforestation use and subject to this use.



Source: AUTHORS, 2019.

The Environmental Zoning of Silviculture in Rio Grande do Sul points that the Landscape Unit PM9, in which is inserted the Ibicuí Hydrographic Watershed, represented by the initials U50, comports a maximum percentage for Silviculture of 10,8%, with forest massifs of maximum size of 16 km<sup>2</sup> (1.600 ha) and a minimum distance between the massifs of 1,4 km (DE FARIA CORREA, 2010). From that information, it is possible to affirm that the new areas of the study case Cachoeira Cinco Veados Watershed, RS, can be converted in areas for Silviculture.

## 5 CONCLUSION

The use of geotechnologies associated to the Universal Soil Loss Equation have allowed identifying the classes of potential soil losses for the study area. It was possible to identify the areas with forestall productivity potential, being that the Watershed presents positive potential, given the climatic conditions.

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