Geoprocessing apllied in the description of the classes of land use capability in the watershed of Alto Capivara, aiming its environmental sustainabiliy

Sérgio Campos[1], Katiuscia Fermandes Moreira[2], Teresa Cristina Tarlé Pissarra[3], Muriel Cicatti Soares[4], Marina Granato[4], Monica Yuri Mashiki[5], Junia Karst Caminha Ruggiero[5]

Abstract

The determination of the land use capability is very important to the land use planning, since the land use which is inappropriate and without planning causes low culture yield. This work aimed to determine the land use capability classes of the Alto Capivara - Botucatu (SP) watershed, aiming to the planning of practices of soil conservation on the area. The watershed with 4551,19 ha lies between the geographic coordinates 22° 51' 57" to 22° 57' 55" of S latitude and 48° 21' 58" to 48° 26' 38" of W longitude Gr. The map of land use capability of the watershed was obtained by the cross-check of the slope and soil maps with the table of soil use capability judgment and the constant recommendation on the utilitarian survey of the physical environment and the classification of the land in the capability of use system. The Geographic Information System enabled to verify that the watershed is constituted by the subclass IIIe,s (1/3) and by sandy soils of low to medium fertility (99,11%). The area is constituted by almost 2/3 of soil Nitossolo Vermelho Distroférrico (59,3%).

Key words: Soil unit; slope classes; river basin

Introduction

The survey of the land use in a certain region is of major importance to the comprehension of space organization patterns. Independent on the space organization of the land use in a certain period, it is rarely permanent. Thus, there is a need of constant actualization of the registers of land use, in order to analyze the trends and use the soil in the most technical and rational way as possible (PINTO et al., 1989).

The land classification by the use capability is based in the quantitative land classification, focused on their limitations and their use, according to principles of soil conservation (LEPSCH et al., 1991).

The inappropriate land use and the lack of planning impoverishes it in an irreversible way, causing low culture yield, which brings in certain regions as consequence the low socioeconomical and technological status of the rural population.

The knowledge of the soil type of each bowl plot is essential to any conservational plan. Only by knowing the nature and the soil characteristics, one will be able, with safety, to write norms for its conservation. Any plan of rational exploration of soil will have to be based on the knowledge in a deep way (SILVA and PIEDADE, 1993).

The deployment of appropriated agricultural policies need reliable and updated information of the land use and occupation in order to structure and enable the local or regional agricultural planning.

This way, the ideal soil use in order to protect it against erosion and to develop increasingly its productive capability requires a previous planning.

The erosion intensity increases with the decrease of the vegetal cover in soil, connected to each type of plant community, according to POLITANO et al. (1988), mainly in sandy soils.

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1 Prof. Adjunto*, FCA/UNESP/Botucatu – SP.

2 Professor of Forest Engeneering, FCA/UNESP/Botucatu – SP

3 Prof. Dra., FCAV/UNESP/Jaboticabal – SP.

4 Student of Agronomy, FCA/UNESP/Botucatu – SP

5 Master's degree student in Agronomy, FCA/UNESP/Botucatu – SP
*Brazilian academic degree

In this context, the knowledge of the aspects connected to the soil conservation in the Alto Capivara - Município de Botucatu (SP) watershed is of main importance to the protection of water bodies. Thus, the present study aimed to elaborate a map of land use capability of the watershed through the Geographic Information System – IDRISI, serving as subsidies to future rural and urban planning of natural resources and agriculture.

Material and Methods

The present work was developed in the Alto Capivara watershed, located in the Municipality of Botucatu (SP), since it is an important and representative part of the municipality where the landscape has undergone a visible transformation, as well as since it contains the urban area of the Municipality. The area is geographically located between the coordinates 22º 51' 57" to 22º 57' 55" of South latitude and 48º 21' 58" to 48º 26' 38" of West longitude of Greenwich, covering 4551.19 ha.

The predominant climate in the studied area, classified according to the Köppen system, is of the type Cfa – temperate rainy climate and the predominant wind direction is the southeast (SE).

According to PIROLI (2002), the soils in the area were classified as: Argissolo Vermelho-amarelo Distrófico (PVAd1), Latossolo Vermelho-Amarelo Distrófico (LVAd1), Nitossolo Vermelho Distroférrico (NVdf), Gleissolo Háplico TB (GXbd), Neossolo Litólico Eutrófico (RLe) e Latossolo Vermelho Distroférrico (LVdf)[1].

The study of the land use capability was made by the methodology proposed by LESCH et al. (1991), through the cross-check of the slope and soil maps with the table of soil use capability judgment, according to FRANÇA (1963), BELLINAZI et al. (1983) e ZIMBACK and RODRIGUES (1993).

Results and discussion

The slope classes (Figure 1 and Table 1) show that there was a higher amount of areas with 6 to 12% of declivity, which represents 19.56% of the watershed (1800.24 ha). According to CHIARINI and DONZELLI (1973), these areas should be destined to plant annual cultures with the use of simple practices of soil conservation.

The slope class from 0 to 6% occupied more

1 Brazilian soil classification

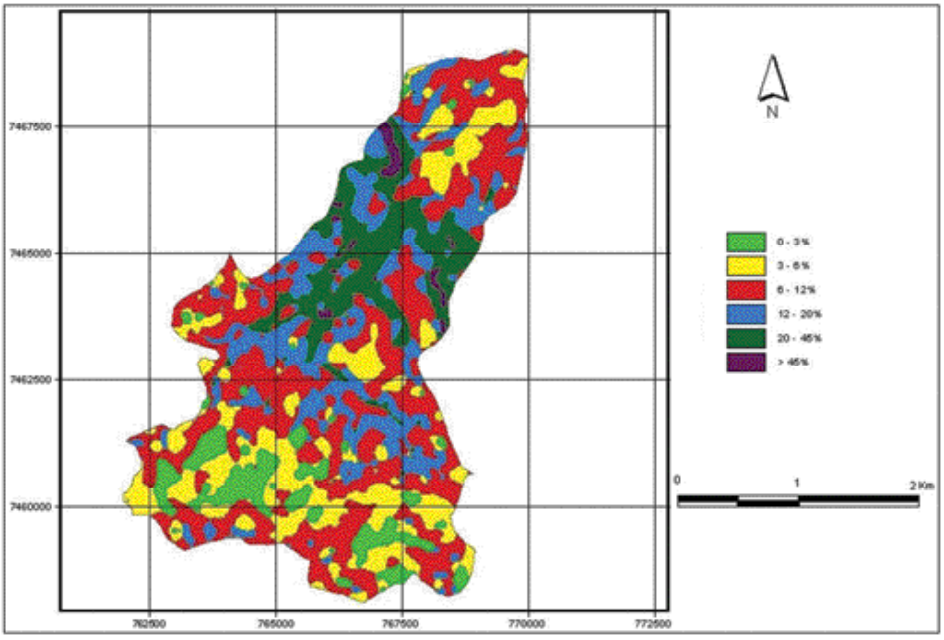

Figure 1. Clinographic map of the Alto Capivara – Botucatu (SP) watershed.

Table 1. Slope classes existent in the Alto Capivara – Botucatu (SP) watershed.

Slope classes	Watershed area	
	ha	%
0 to 3	369.00	8.11
3 to 6	933.32	20.51
6 to 12	1800.24	39.56
12 to 20	789.74	17.35
20 to 40	602.14	13.23
> 40	56.75	1.24
Total	4551.19	100.00

than 28% of the area. These areas were classified as plain to wavy relief by CHIARINI and DONZELI (1983) and LEPSCH et al. (1991) define them as areas destined to plant annual cultures with the use of simple practices of soil conservation, once that the planting itself regarding the culture already controls the soil erosive process. This class comprehend 369 ha (8.11%) with slope class ranging from 0 to 3% and 933.32 ha (20.51%) with slope class from 3 to 6%. Thus, it can be said that the slope class from 0 to 12% predominate in more than 60% of the total watershed area.

The strongly wavy relief (12 to 20% slope) is indicated to permanent cultures, which require a lower soil mobilization, providing lowest risks of erosion as coffee, sugarcane, pasture, etc., according to LEPSCH et al. (1991), predominated in 17.35% (789.74 ha).

Only 602.14 ha (13.23%) presented accidented relief, according to CHIARINI and DONZELLI (1973), i.e., have slope from 20 to 40%, and may be used for the development of the cattle and silviculture, or still, be destined to the environmental preservation, avoiding thus the soil erosion (LEPSCH et al., 1991). The areas with slopes above 40% were minimum, since they represented 1.24% (56.75 ha).

The soil units which occur in the studied area are predominantly of low to medium apparent fertility (99.11%). These are represented by the soils Argissolo Vermelho-Amarelo Distrófico (3.45%), Latossolo Vermelho-Amarelo Distróférrico (20.73%), Nitossolo Vermelho Distroférrico (59.3%), Latossolo Vermelho-Amarelo Distrófico (15.63%) and Gleissolo Háplico Tb (0.00%).

The most significant soil found in the watershed was the Nitossolo Vermelho Distroférrico (NVdf) with 2698.74 ha (59.3%). This is an unit of low fertility (Figure 2 and Table 2).

These data show that the Alto Capivara – Botucatu (SP) watershed is constituted essentially by soils with low to medium fertility, susceptible to erosion, very deep and softly wavy.

The subclasses of land use capability (Table 3) of the Alto Capivara – Botucatu (SP) watershed were obtained by cross-checking the information of the slope and area soil maps, based on the characteristics of each one and using the table of soil use capability class judgment, elaborated by FRANÇA (1963), LEPSCH et al. (1991) and ZIMBACK and RODRIGUES (1993).

The analysis of the Figure 3 and the Quadro 3 enabled to verify that the subclass IIIe,s with 1537.69 ha (33.79%), was the most significant, since it occupies 1/3 of the area. These lands are improper for the implementation of annual cultures, and are more appropriate for perennial cultures (pasture and/or reforestation), since they present problems of erosion with frequent deep furrows (gully). This subclass comprehend lands proper for crops in general, but that, when cultivated without special cares, are subject to severe risks of deterioration, mainly in the case of annual cultures. It requires intense and complex measures of soil conservation, aiming to enable the secure and permanent cultivation, with medium and high yield, of adapted annual cultures. It presents moderate slopes, relief slightly wavy to wavy, with rapid runoff, with severe risks to the erosion when the soil is without vegetation cover, and may present moderate laminar erosion and/or frequent superficial and swallow furrows.

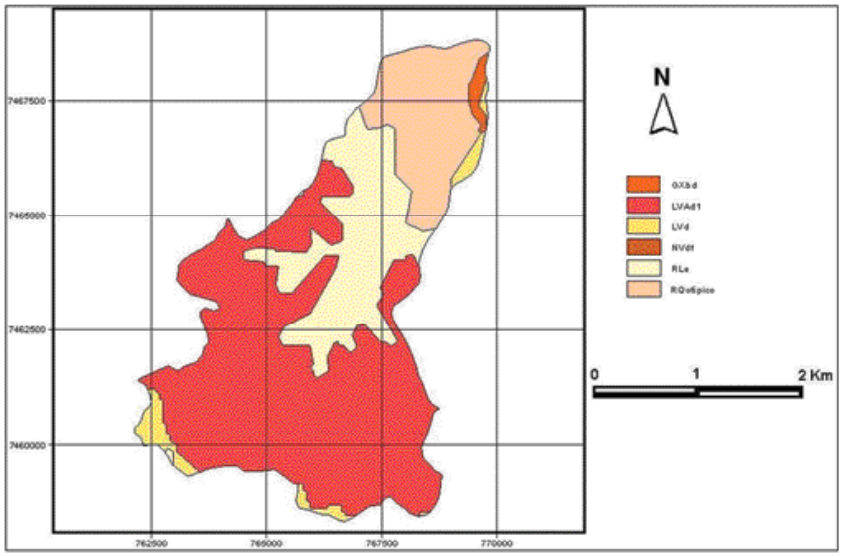

Figure 2. Soil classes which occur in the Alto Capivara – Municipality of Botucatu (SP) watershed.

Table 2. Soil units which occur in the Alto Capivara – Botucatu (SP) watershed**.**

Soil unit	Acronym	Area in relation to the watershed	
		ha	%
Argissolo Vermelho-amarelo Distrófico	**PVAd1**	156.92	3.45
Latossolo Vermelho-Amarelo Distrófico	**LVAd1**	711.29	15.63
Nitossolo Vermelho Distroférrico	**NVdf**	2698.74	59.30
Gleissolo Háplico TB	**GXbd**	0.16	0.00
Neossolo Litólico Eutrófico	**RLe**	40.68	0.89
Latossolo Vermelho Distroférrico	**LVdf**	943.40	20.73
Total		4551.19	100

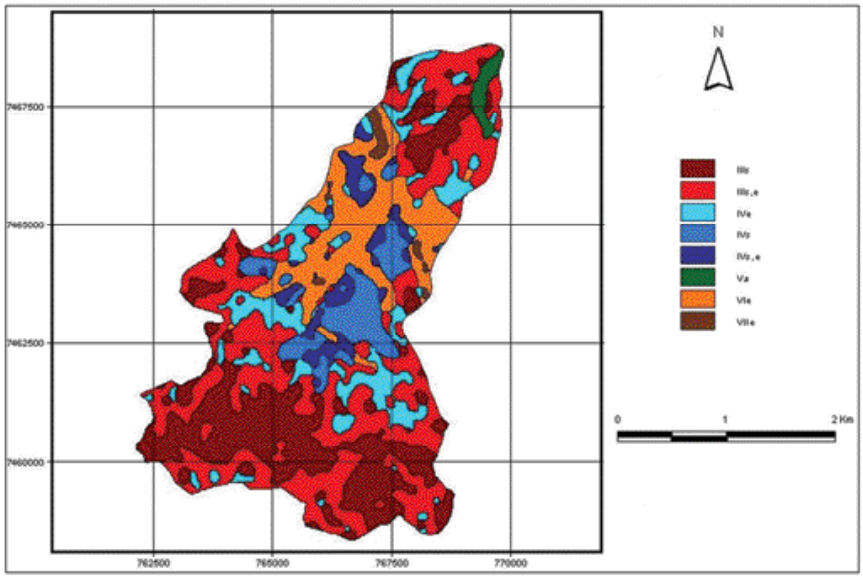

Figure 3. Land use capability mal in the Alto Capivara – Botucatu (SP) watershed.

Table 3. Land use capability classes of the Alto Capivara de Botucatu (SP) watershed.

Use capability classes	Watershed area	
	ha	%
IIIs	1174.03	25.80
IIIs,e	1537.69	33.79
IVs	355.44	7.81
IVs,e	210.86	4.63
IVe	547.51	12.03
Va	58.03	1.27
VIe	622.96	13.69
VIIe	44.67	0.98
Total	4551.19	100.00

The use capability class IIIs, the second more important, predominate in 25.8% (1174.03 ha) of the area. This are farmable lands with complex problems of soil conservation, with lands proper to crops in general, but which, when cultivated without special care, are subject to severe risks of depletion, mainly in the case of annual crops. They require intensive and complex measures of soil conservation, aiming to be cultivated in a secure and permanent way, with medium to high yield of adapted annual crops.

The subclass Vie with 622.96 ha (13.69%) comprehends improper lands to annual cultures, but that can be used for the production of certain permanent crops which are economically useful, as pasture, artificial forests and, in some cases, even to some permanent crops which protect the soil, as rubber trees and cocoa, since they are appropriately managed. The use of pastures or permanent protective cultures must be done with moderate restrictions, with especial practices of soil conservation, once, even with this kind of vegetation, they are moderately susceptible of damage by the impoverishment of the soil. They present relief strongly wavy and steep slopes, providing moderate to severe runoff with severe difficulty of mechanization, by the topographic conditions, with risk of erosion which can reach very severe; presence of erosion in very frequent shallow furrows or frequent deep furrows.

In the subclass IVe are the lands which present permanent risks or limitations that are very severe when used to annual crops. Soils can have natural fertility good or moderate, but are not appropriate for intensive and continuous crops. Usually, they must be maintained with pasture, but they can be sufficiently good for certain occasional crops in the proportion of a year of cultivation to each four to six of pasture or for some annual crops, although with very special care. They are lands severely limited by risk of erosion to intensive crops, generally with steep slopes, with a very rapid runoff, and may present very frequent erosion in superficial furrows, frequent in swallow furrows and occasional in deep furrows. This subclass represents 12.03% of the lands of the total area, i.e., represent 547.51 ha.

The subclasses IVs, IVe,s, Va and VIIe represent a little more than 14% of the area.

Conclusions

According to the methodology used and with the results obtained for the study proposed in the elaboration of the land use capability map of the Alto Capivara – Botucatu (SP) watershed, it was possible to obtain the following conclusions: the watershed is constituted by sandy soils of low to medium fertility (99.11%); the subclasses of land use capability IIIe,s (33.79%) and IIIs (25.8%) predominate in more than 50% of the watershed are farmable lands with complex problems of soil conservation. The area is constituted by almost 2/3 of soil with low fertility, Nitossolo Vermelho Distroférrico (59.3%).

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