DIAGNOSTIC AND PROPOSAL OF RECOVERY OF THE LAKE MANACÁS WATERSHED, CAMPUS OF THE FEDERAL UNIVERSITY OF JUIZ DE FORA, MINAS GERAIS

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INTRODUCTION

The world environmental degradation, and specifically, the third world degradation, has become an issue of magnifying concern. In searching of development, rural and urban areas are becoming highly affected, both in biotic and physical terms. One can observe several examples of bad use of water and soil resources. Impacts as soil erosion and compaction, desertification, sedimentation and water contamination are common aspects in Brazil, pointing to the urgency of multidisciplinar actions targeting to the establishment of environmental equilibrium and sustentability conditions (DIAS & GRIFFITH, 1988).

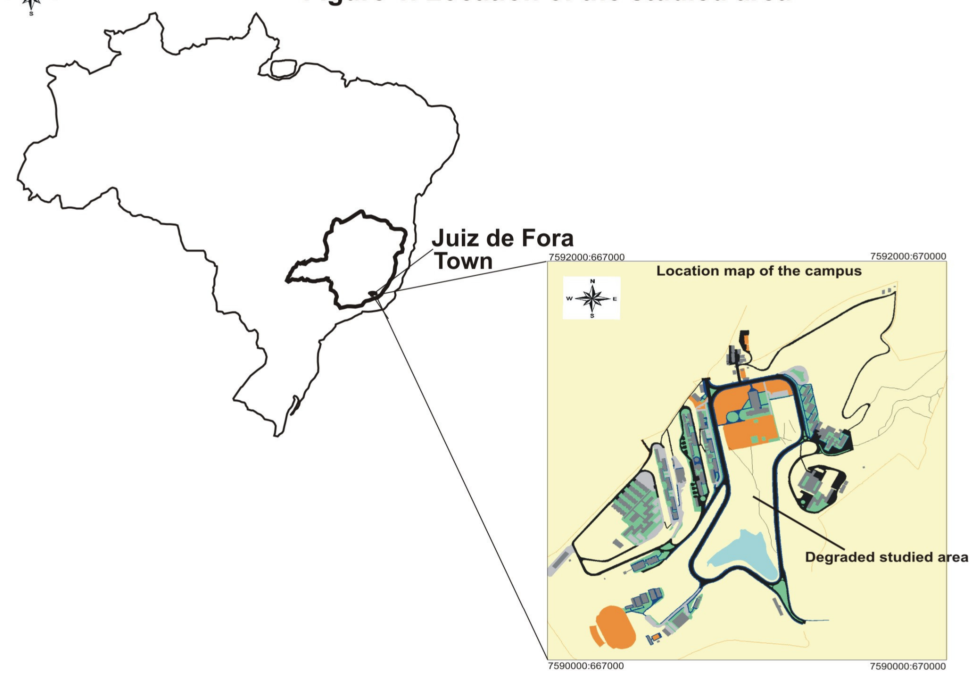
Inside this environmental scenario there is the recuperation of degraded areas, important topic of the sustainable development. Since the beginnings of the 1980 decade, with the development of the ecology of restoration as a science, the researchers have focusing more precisely on this theme (KAGEYAMA, 2003). In Brazil, the law only demands recuperation actions in the mining activities. But, in recent years, the literature shows an increasing interest about the impacts of agriculture, engineering and inadequate occupation of urban areas. DIAS & GRIFFITH (op cit) define the recuperation of degraded areas as a assemblage of actions targeting to reestablish the initial environmental conditions of equilibrium and sustentability of that areas.

In this way, the objective of this work is to propose a plane of recuperation of the Manacás Lake watershed, a system highly impacted and located at the campus of the Federal University of Juiz de Fora, Minas Gerais state, in Brazil.

CHARACTERIZATION OF THE STUDIED AREA

The Manacás Lake is situated at the central part of the Juiz de Fora University, at 21^0 45’ S and 43^0 21’ W, in the municipality of Juiz de Fora, Minas Gerais, Brazil (figure 1). After ROCHA et al (2003), the lake is an artificial system that occupies 2 ha in area and has 5 meters of maximum depth. This system is nourished by springs located in its own area, but is also receives rainy water drainage “enriched” with solid wastes from the campus. ALMEIDA (1996) points out that the campus area has Cwa climate (Koppen’s system of classification), characterized by mesotermic, with rainy and hot summer and dry winter. The medium yearly temperature is 18, 7^0 C, and the medium yearly precipitation is 1496mm. The altitude of the lake is approximately 720 meters.

Figure 1. Location of the studied area



The degradation of the Manacás Lake is linked to the urban expansion of Juiz de Fora town, and to the construction of the campus itself. The municipality history passes by the cutting of the original forest (Atlantic Tropical Forest) as a way to implant the coffee plantations in the end of the nineteen century. The coffee exploration finished at the 20’s and 30’s decades, and were substituted by pastures. And finally, the construction of the campus gave the final format of the lake environment, with increasing degradation of the area.

METHODOLOGY

First of all, it was made the environmental assessment of the area, including studies of the soils, vegetation and erosion characteristics.

For the soils it was described and sampled seven soil profiles, with horizons separation, and morphology and environment characterization. It was made analysis of texture, structure, porosity and consistency, following the procedures indicated by LEMOS & SANTOS (1996).

The lake system is impacted by erosion and sediments deposition inside the lake, factors that were quantitatively measured with characterization of depth and width of linear erosions. It was used erosion pegs (DE PLOEY & GABRIELS, 1996), a simple and efficient method to monitoring soil erosion. These pegs, with 40 cm long each one, were graduated cm by cm, and buried in the soil until a zero graduation have coincide with the soil surface; it was installed eight pegs. Above and below the zero the graduation was marked. In doing so, when there was erosion, the soil surface obviously was below zero, and when there was sedimentation, the soil surface was above the zero graduation. It were made two measures, the first one after the rainy season, and the second one in the dry season. It was also determined the grains diameter of the sediments that arrived into the lake in three different points.

Characteristics as drainage, relief and use of soil were also studied, defining springs, forest remainings, slope and waterlogged spots.

The work was done at scale 1:2000, using aerial photographs to make a digital map of the area. In this map it was plotted the drainage system, springs and vegetation.

This environmental evaluation showed the main aspects of the degradation, furnishing data to the proposal of recovery of the area. This proposal is showed at the end of this work.

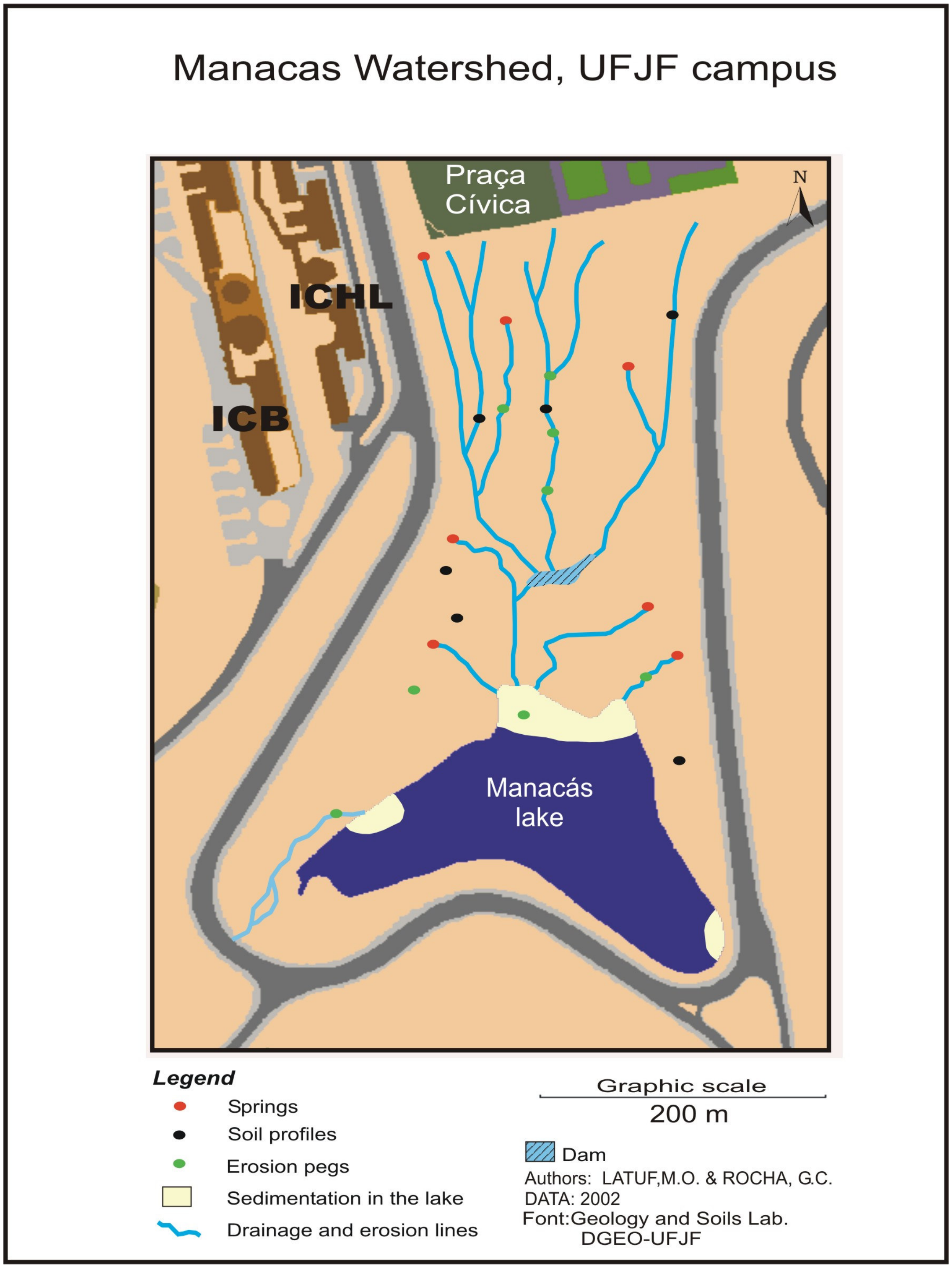
RESULTS AND DISCUSSION

The results obtained after the environmental assessment show a scenario of intense degradation of the studied area. The figure 2 displays the main physical characteristics that were mapped.

Figure 2– Monitoring of the erosive dynamic of the studied area

Erosion Pegs	First Measure March 23, 2001		Second Measure June 21, 2001	
	Precipitation: 222,9mm		Precipitation: 98,1mm.	
	Erosion	Deposition	Erosion	Deposition
Peg 1	Wc	Wc	1cm	-
Peg 2	4cm	-	2cm	-
Peg 3	8cm	-	Wc	Wc
Peg 4	-	16cm	4cm	-
Peg 5	-	0,5cm	-	0,5cm
Peg 6	*nd*	*nd*	*nd*	*nd*
Peg 7	-	4cm	-	1cm
Peg 8	0,5cm	-	*nd*	*nd*

Nd– No data Wc- Without change



Several aspects can be cited related to the degradation of the area. At the drainage channels one can observe the severe impacts of erosion. The channels expose the soil profiles, where it can be noted the absence of A horizons, denoting intense laminar erosion. The channels itself are clear results of linear erosion, in the form of furrows, ravines and gullies, that follow the north/south linear erosion direction. Besides that, the strong soil compaction is another aspect of degradation, resulting in decreasing of soil permeability, and, in this way, increasing the run off and consequent erosion and transport of sediments to the lake.

In table 1 it can be observed the quantitative data of the erosion dynamics of the area. More details can be obtained in ROCHA et all (2003).

It can clearly be observed the mechanisms of erosion and deposition that took place in the area, registered with the pegs. The measures and calculus realized at the main erosion systems of the area showed the carrying of sediments to the lake The first measure after the rainy season denoted the movement of 56 m^3 of sediments, and the second measure registered 21m^3 of earth movement. It is interesting to note that even in the dry season occurred erosion and deposition.

The grain size analysis of the lake sediments pointed out the predominance of the fine sand fraction (more than 60% in all samples), indicating the high energy of erosion. It was detected several plant species, predominantly Pteridophytas (Gleichenia spp), tree Angiosperms (quaresmeira), and also grass and herbs as juá (physalis angulata) and fruta de lobo (solanum gradifloram). It was also identified fauna species as several birds, small animals as opossum, marmoset, long-haired prehensiel tailed porcupine, snake-necked turtle, and some reptiles.

The relief of the area is heterogeneous, varying from plane (1% slope) until strong undulated (20%). The soils are predominantly represented by chemically poor and clay rich oxisols, but there are spots with man made formations, resulted from embankments made during the campus construction.

PROPOSAL FOR RECOVERY OF THE DEGRADED AREA

The proposal follows the classic proceedings of degraded areas recovery, including erosion control, rehabilitation of the limnology vital functions, as well as the sustentability of the local ecosystem. For achieving that, it is suggested mechanical and vegetative conservation practices.

The first phase, a mechanical one, targets a change in the physical environment, reestablishing the soil physical quality:

1. Drainage deviation – the drainage must be deviated from the linear erosions. It is suggested the construction of terraces, in a way to intercept the rainy waters and to force its infiltration. It is proposed the choosing of terrace Nichols type, due to the characteristics of the area.

2. Destruction of soil compacted horizons – it is important to broke the compacted soil horizons for the vegetation growing. In the area it is not possible to use machines, so the actions must be done by human strength, using pickaxes and hoes.

3. Use of small contentions inside the linear erosions – the holes formed by erosion must be also vegetated. So it is interesting to make small transversal contentions, using bamboo as raw material. In Brazil this technique is called "rip rap", and it has been successful in recuperation actions.

4. Soil transposition – complementary technique, consisting in bring soil surface horizons from other areas and covering the degraded area already prepared. It is worthy to remember that the soil contains real banks of seeds and micro fauna. Also it is important to make chemical analysis of the soils, in a way to know its nutrient status and replenish the lacking elements.

The second phase is represented by the vegetative process, which can be proceed in two possible different ways, but with the same final result. The difference between them relies in the cover time of the recovery soil:

The first way is the use of the ecological blankets, a kind of carpet or layer of grass that is put over the soil. The objective is to diminish the direct impact of the rain drops on the soil, blocking the erosion of mineral and organic particles. This method is very rapid but it is expensive.

The second way is the hydroseeding or direct seeding, using the called perennial grass "cocktail" (as avena, Secale cereale, Setaria) and leguminosae. It is a cheaper technique.

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