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# **LINEAR EROSION IN THE REGION OF THE SOURCE AREA OF ARAGUAIA RIVER: CONDITIONINGS AND CORRECTIVE AND PREVENTIVE CONTROL**

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## **INTRODUCTION**

The development of the Earth landscape occur before the action of many factors and processes on the time. The man interference also influences on this dynamic when we talk about the exploitation of the natural resprings. Consequence of this is the intense process of urbanization and industrialization, beyond the intensification and expansion of the farming, mining and others activities.

The high speed, each time bigger, between the changes of energy in the environment, related to the use of the natural resprings, reflects in direct way in the return of the residues to the environment, characterizing problems in the environment because of the unsatisfactory incorporation to the new environment produced by the organization of the geographic space.

The farming development in savanna, that in this paper we will go to call “Cerrado”, was induced for exploring all the possible spaces, through the implantation of improved pastures as well as of the agricultural activity based in the production of grains, what occurred together with intensive and indiscriminate deforestation with the substitution for the called modern farming. (SILVA, 2000; FARIA, 2001; MEDEIROS, 2002; BARBALHO, 2002).

The reason of this paper is to show the geoambiental characteristics and the evolutive and current use of the area of the spring of the Araguaia and Araguainha rivers, located in the south extremity of the basin area of the Araguaia River that encloses a 367,2 Km<sup>2</sup> of area

(Fig. 1). The delimitation of this area was motivated, mainly, by the raised concentration of erosive focus associated to Hidrographical Basin of the Araguaia and Araguainha rivers, located along the fluvial canals and has as main objective to identify more susceptible areas and areas of bigger risks to the linear erosive processes.

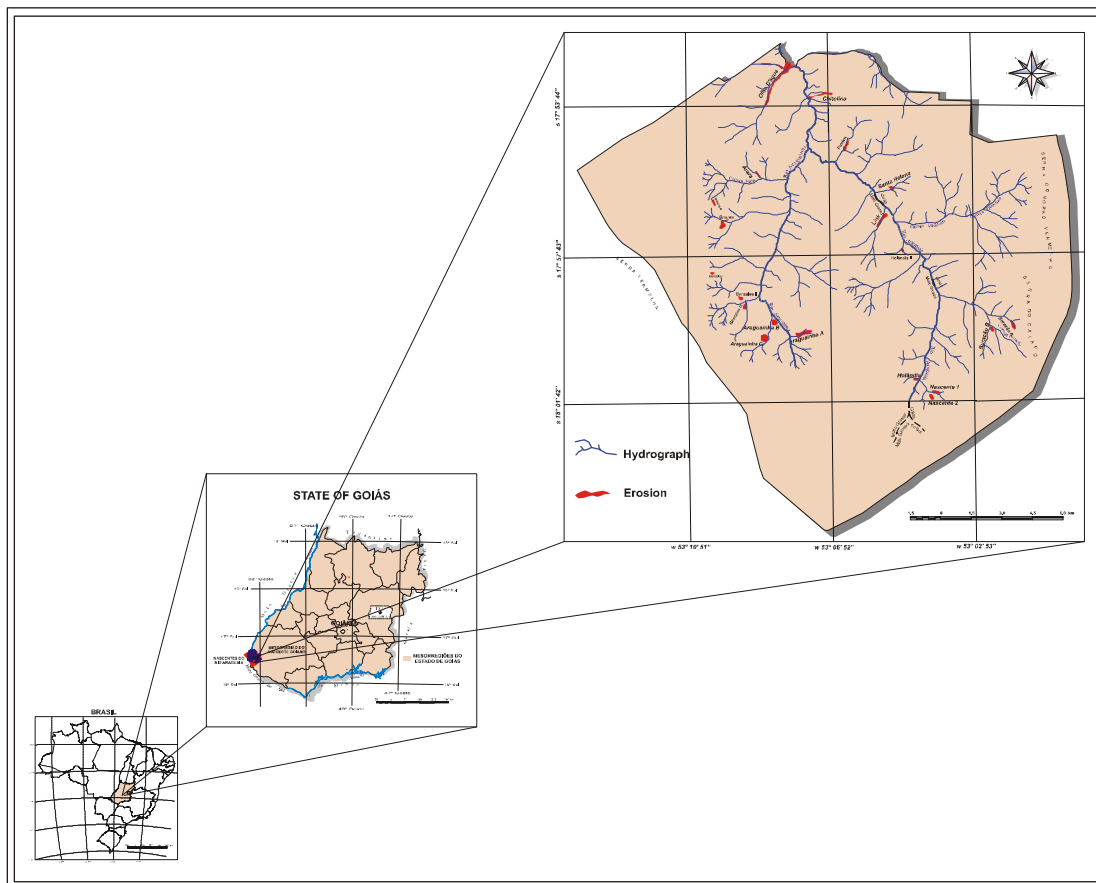


Fig. 1. - Localization of the spring of Araguaia and Araguainha rivers

## MATERIALS AND METHODS

For the execution of the research searching to confection the Maps of Natural Susceptibility and Risk to the Linear Erosion as spring of information to the geoambiental planning of the south sector in the High Basin of the River Araguaia, initially it was made the revision and compilation of the cartographic datas of works developed in the region, planning to select the most important thematic information (soil, geomorphology, geology, declivity, altimetry, forms of the relief, use of lands for the years 1976 and 2003).

The Map of Susceptibility to the linear erosion consisted in the division in class of the susceptibility to the linear erosion proposed and adapted initially for the DAEE/IPT-SP and Salomão (1999) establishing the following class:

- Extremely susceptible to ravines and gullies - areas very favorable to the installation of phenomenon of piping. It happens because of the existence in these places of high underground hydraulic gradients, associated to materials of the zone of percolating of the phreatic with characteristics that allow the removal and transport of particles. In general these areas place in springs, deep of valleys and shead of valley, especially if these headboards present forms of concave hollow areas. Sectors of springs are also included that present water sheet, that may develop ridges and ravines. With the deepening of these erosions the phreatic can be intercepted, developing the piping;
- Very susceptible to ravines and little susceptible to gullies - areas favorable to the concentration of water flows, where the processes of ravines develop themselves from small concentration of waters of superficial draining. The phenomenon piping, conditioning the development of gullies, is only observed when the ravines get deeper intercepting the phreatic. In general, these areas are placed in lands with some declivity, that allows the easy concentration of waters of superficial draining, as observed in the Podzólicos (according to Brazilian soil classification);
- Moderately susceptible to ravines and lower susceptible to gullies - areas of dispersion of water flows, good drained, and with raised permeabilities until great depths, facilitating the fast infiltration of rain waters. However, consisting of little firm soil, allows easy removal of particles for draining of superficial waters. The erosive processes for ravines occur conditioned to the great concentrations of waters of superficial draining. Phenomenums of piping, developing gullies, only occur with the deepening of the ravines intercepting the phreatic, common situation in the inferior positions of springs, next to the deep of valleys and shead of valley. In general they are areas with declivities enough to allow the draining of superficial waters, consisted by the soil of sandy texture and medium texture, Arenosols and the Latossolos (according to Brazilian soil classification) of medium texture. These areas present deep soil usually very, so, when the ravines or gullies happen, they can present great dimensions;
- Susceptible to ravines and not susceptible to gullies - areas favorable to the concentration of water flows; however, the soil covering presents relatively small depths and with phreatic absence. The erosive processes for ravines occur conditioned for the declivity of the hillsides, that favor the concentration of waters of superficial draining;

- Not Susceptible to ravines and gullies - areas of not degradation of lands with declivities practically not existent, disabling the draining of superficial waters, and that present low underground gradient, incapable to generate phenomenon of piping. In general, these areas are placed in the edges of the flooding plain water courses consisting.

The map of risk to the linear erosion followed the model adapted for CANNIL (2000), through the overlapping of the units of classification of the map of susceptibility to the linear erosion and that of the use of the land, indicating still, for each class of risk, aptitudes and restrictions for the planning of the use of lands. They follow the respective class:

- Very low risk – areas with practically null declivity, and where the type of use of the land is characterized for the preservation of the original vegetation;
- High risk - area where the concentration of water flows and the declivity favor the natural susceptibility to the ravines, but that the adequate use and handling minimize the linear erosive processes;
- Average risk - areas consisted of sectors of the spring next to the deep of valleys and with enough declivities for the superficial draining, demanding a handling level that can stop the linear erosive processes;
- High risk - areas favorables to the concentration of the water flows and where the erosive processes develop themselves in function of the type and handling of the use of lands;
- Imminent risk - areas where the functioning of the water flows occurs naturally as concentrator of draining, such as draining headboards, the hollow areas and edges of escarps.

The crossing matrix that gave the risk class is presented below.

Susceptibility to Erosion Use of Lands					
	Esrg	MsrIg	Mosrlg	Srnsg	Nsrg
Savannas Wood	<b>I</b>	<b>H</b>	<b>H</b>	<b>L</b>	<b>VL</b>
Savannas Open Tree	<b>I</b>	<b>H</b>	<b>HR</b>	<b>HR</b>	<b>VL</b>
Riparian Areas	<b>I</b>	<b>H</b>	<b>HR</b>	<b>L</b>	<b>VL</b>
Savannas Field	<b>I</b>	<b>H</b>	<b>H</b>	<b>HR</b>	<b>VL</b>
Savannas Humid Field	<b>I</b>	<b>H</b>	<b>HR</b>	<b>L</b>	<b>VL</b>
Pasture	<b>I</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>L</b>
Culture	<b>I</b>	<b>H</b>	<b>H</b>	<b>HR</b>	<b>L</b>

Where:

Classes de Suscetibilidade à Erosão Linear	Classes de Risco à Erosão Linear
<b>Esrg</b> – Extremely susceptible to ravines and gullies <b>Msrlg</b> – Very susceptible to ravines and little susceptible to gullies <b>Mosrlg</b> – Moderately susceptible to ravines and lower susceptible to gullies <b>Srnsrg</b> – Susceptible to ravines and not susceptible to gullies <b>Nsrg</b> – Not Susceptible to ravines and gullies	<b>VL</b> – Very low risk <b>B</b> – Low risk <b>M</b> – Average risk <b>A</b> – High risk <b>I</b> – Imminent risk

## RESULTS AND QUARREL

The evaluation of the environment impacts in the south sector of the high course of the Araguaia River, that are relationed to the linear erosive processes searched, in the sistemic boarding, ways to the integrated study of the components of the environment, considering itself that the behavior of lands beyond the starting of the erosive processes is determined by its relations and functioning. So, its analysis worked as subsidy to the geoambiental planning that, in turn, supports the adoption of more adequate politics of handling, as preventive as corrective of the impacts.

Until the end of years 1970, they were the “Cerrado” that dominated. Later, they were brutally reduced while their lands had been appropriated and substituted by the intensive farming activities. This process, in this time, based on the high increasing of farming production, contributed for the prominence that today the region of the “Cerrado” has in the national scene with the production of grains, specially the soy, and of cattle. This expansion of the agricultural border, however, happened to the costs of an intensive and indiscriminate deforestation of the “Cerrado”.

The Fig. 2 reveals the intense discrepancy in the vegetal covering between the years of 1976 and 2003. In 1976 great part of the area was covered by the natural vegetation, being distinguished the “Cerrado” with trees (dense) that remains little degraded in the part center-south of the area, protecting, together with bushes of springs, shead of valleys and the own springs of the Araguaia and Araguainha Rivers. The bushes galleries, also in continuous abundance, are preserved in big part of the main canals, and can be met together with the “Cerrado” in the majority of the little canals in this area. Already in 2003 the majority of areas were destined to agriculture and to the pastures in relation to the ones of remaining vegetation.

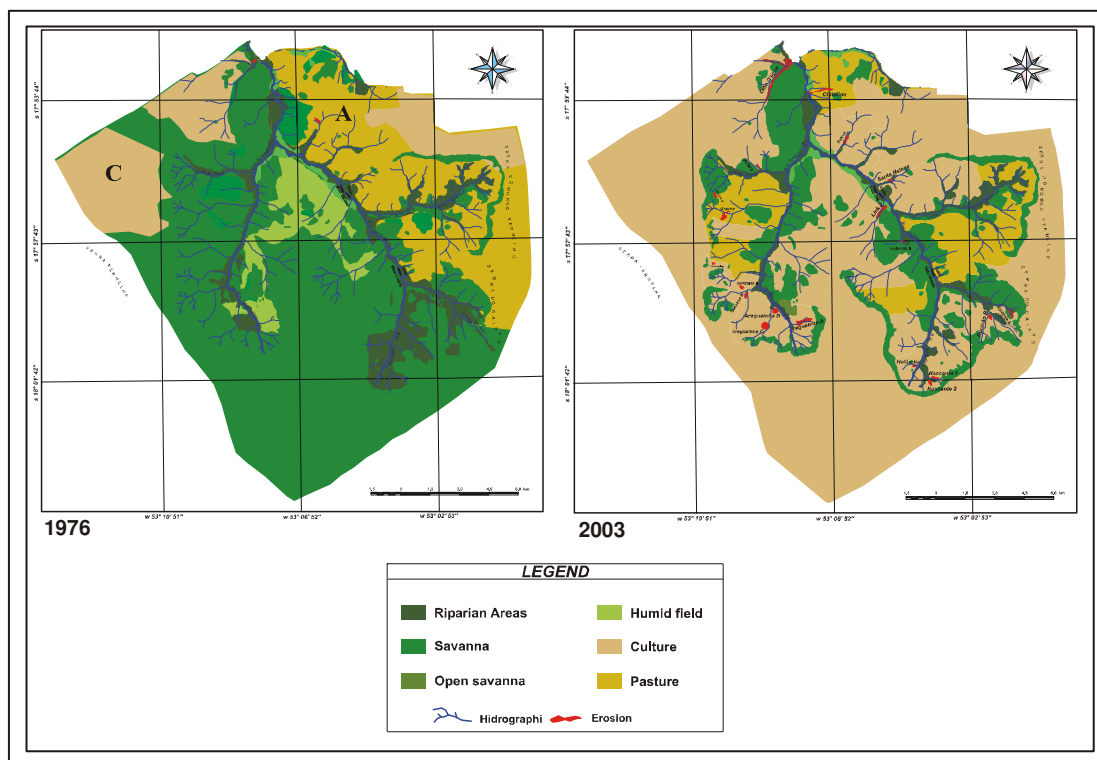
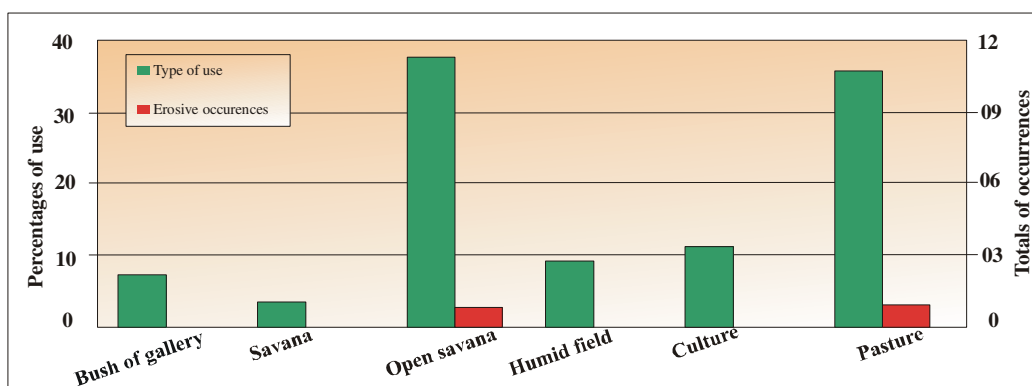
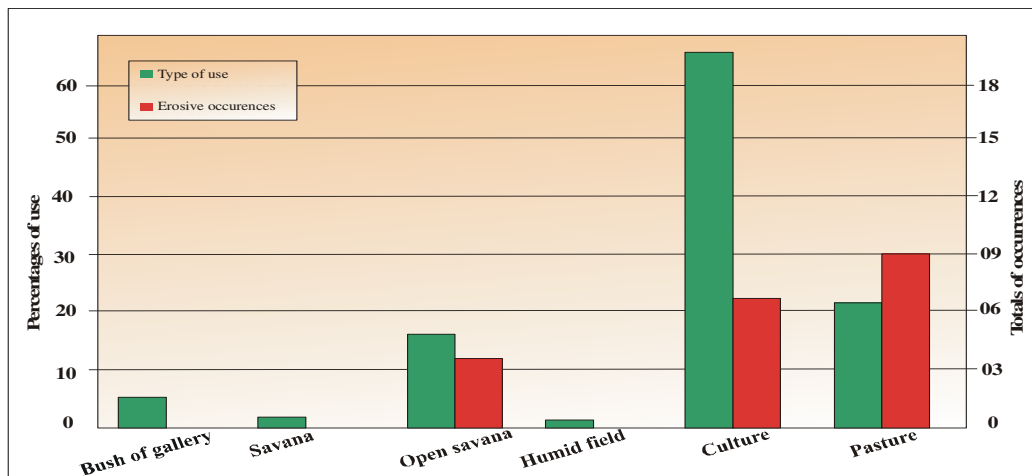


Fig. 2. - Use of lands 1976 and 2003

In the area of the springs practically there was not any erosive focus in 1976, on the other hand, in the year of 2003 already are 21, as are showed in the graphs 1 and 2



Graph 1. Erosive distribution of use of lands and occurrences in 1976.



Graph 2. Erosive distribution of use of lands and occurrences in 2003

With relation to the erosive susceptibility (Fig. 3), it can be seen that the majority of the area presents some type of susceptibility to the linear erosion, being able to variate from susceptible to extremely susceptible. The areas moderately susceptible to ravines and little susceptible to gullies are characterized for presenting convex soil and slope very long with declivities that variate between 3 and 12% and Neossolos Quartzarênicos. They are moderately susceptible for favoring the superficial particle removal, specially for the free displacement of superficial waters and the increase of the speed of the torrents that have great erosive power.

With concave relief predominance relationed to the concentration of water-flows, the areas very susceptible to ravines and little susceptible to gullies predominate the hollow areas presenting Neossolos Quartzarênicos, specially hidromórficos, beyond gleissolos, where the phreatic levels are flat or aflorantes. They are extremelly susceptible to ravines and gullies the shead of valley, the erosive scarps and the deep of valleys for being connected to the biggest declivities and altimetric unevennesses conditioning fast Fig.-water ande with great erosive power. Finally, the areas not susceptible to ravines and gullies correspond to the ones of plain relives of the area and are related with low declivities in 3%, where dominate the Latossols, in the tops of the Plateau.



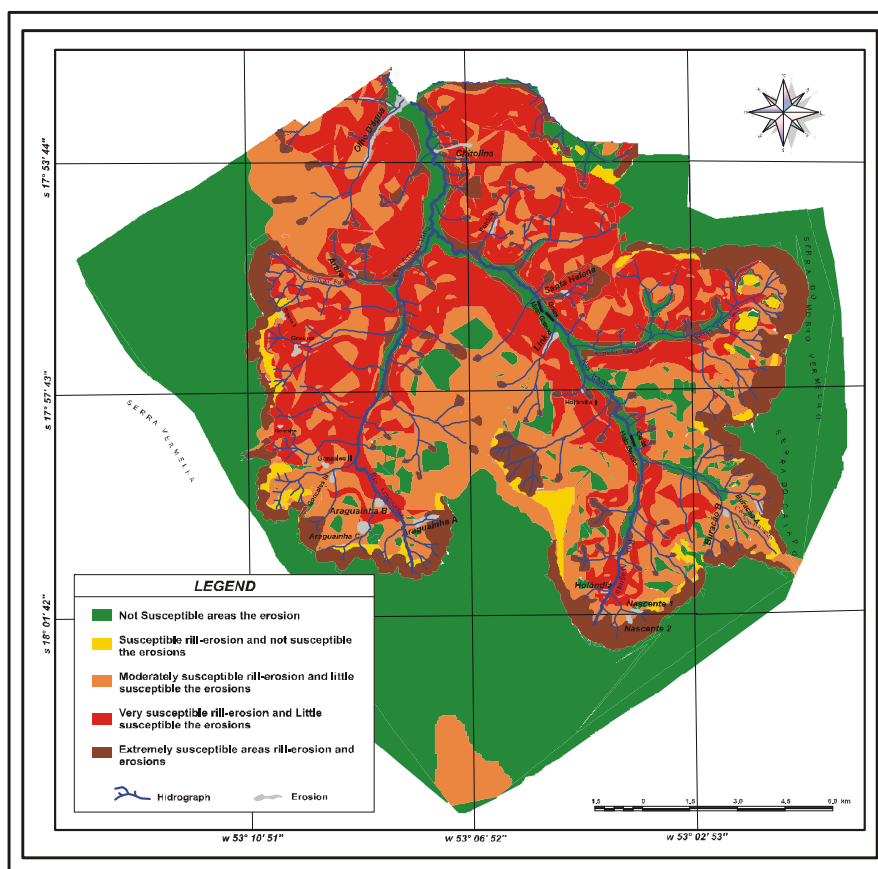


Fig. 3. - Map of susceptibility to linear erosion.

As it can be observed in Fig. 4, the areas of very low risk to the linear erosion are predominant in fluvial plains of the canals of drainings, that morphologically are associated to the concave valleys preserved by riparian areas and “cerrado of open trees”. In the areas of low risk, the susceptibility to the linear erosion variates from not susceptible to susceptible a ravines and gullies where the farming use in sectors of softer slopes, whose declivity does not exceed 6% and develop the Latossolos themselves. They relation themselves, still, to the plain regions in the sectors next to the scarps, that in its majority do not preserve the area of ambiental protection as the laws say. The agricultural use of the lands predominates, that is favored by the low declivities and type soil. However, the inadequate handling can induce to the erosion.

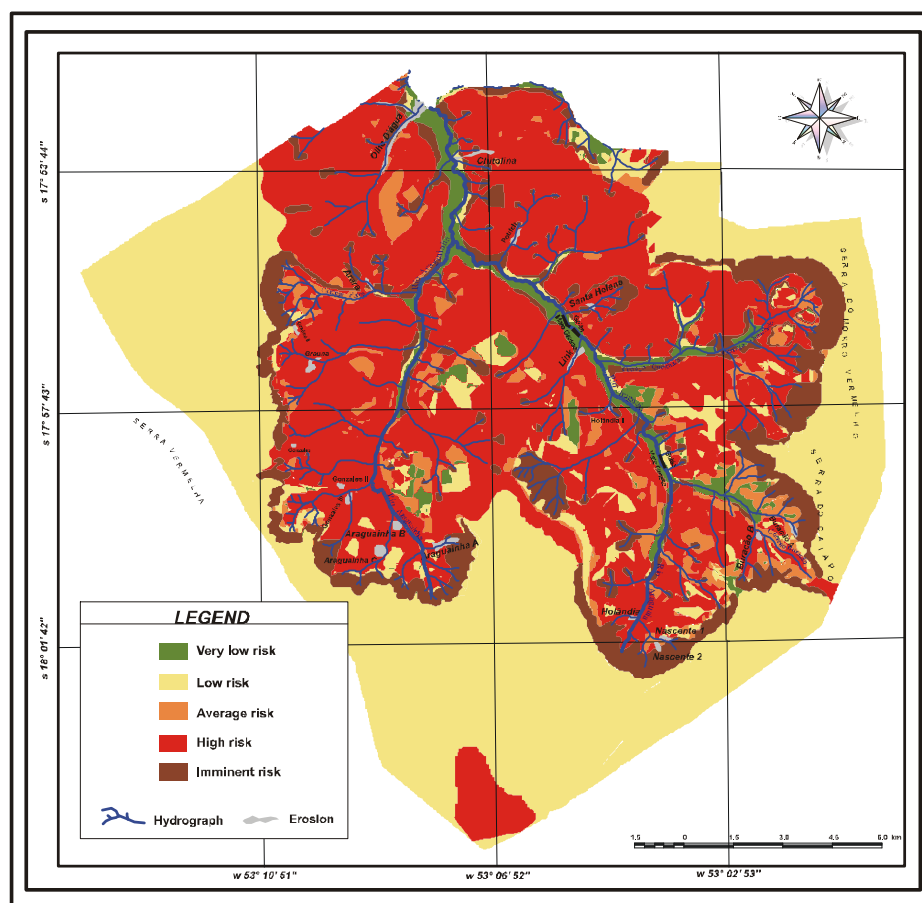


Fig. 4. - Map of risk to the linear erosion.

The class of average risk is related to the “cerrado of open trees” and to the Neossolos Quartzarênicos (according to Brazilian soil classification). Generally, concave relieves occur, that although to present natural vegetative remainders, have become average susceptible to ravines and gullies, mainly in the chanel of draining, that in these points concentrate water-flows in sandy soils. The areas of high risk and imminent risk, that together represent more than a half of the area, are those that deserve more concerns, because they concentrate 18 erosive focus and are associated to the concave relieves, to erosive scarps and shead of valley, specially in the areas with over 6% declivities and farming use.

## CONCLUSION

About the geoambiental planning of the analyzed area, it is evidenced the necessity of a plan of handling of the use of lands to change the forms of use, with exception of the Areas of Permanent Preservation, motivated for the limitations imposed by the susceptibility and risk to the linear erosion. So, there are also critical sectors that need change of use.

The suggestion is that the handling plan and the changing of use shall be made by country property, however in a context of hidrographic microbasin, in order to guarantee the application of the actual National Plan of Hidrografic Microbasin. So, it'll be necessary the implantation of a Managing Plan of Control of Erosion that contemplates specially, the preventives actions, closely relationed to the handling of use of the land.

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