

# SOIL DEGRADATION AND DEVELOPMENTS OF THE SANDS IN IBICUI BASIN – RS – BRAZIL

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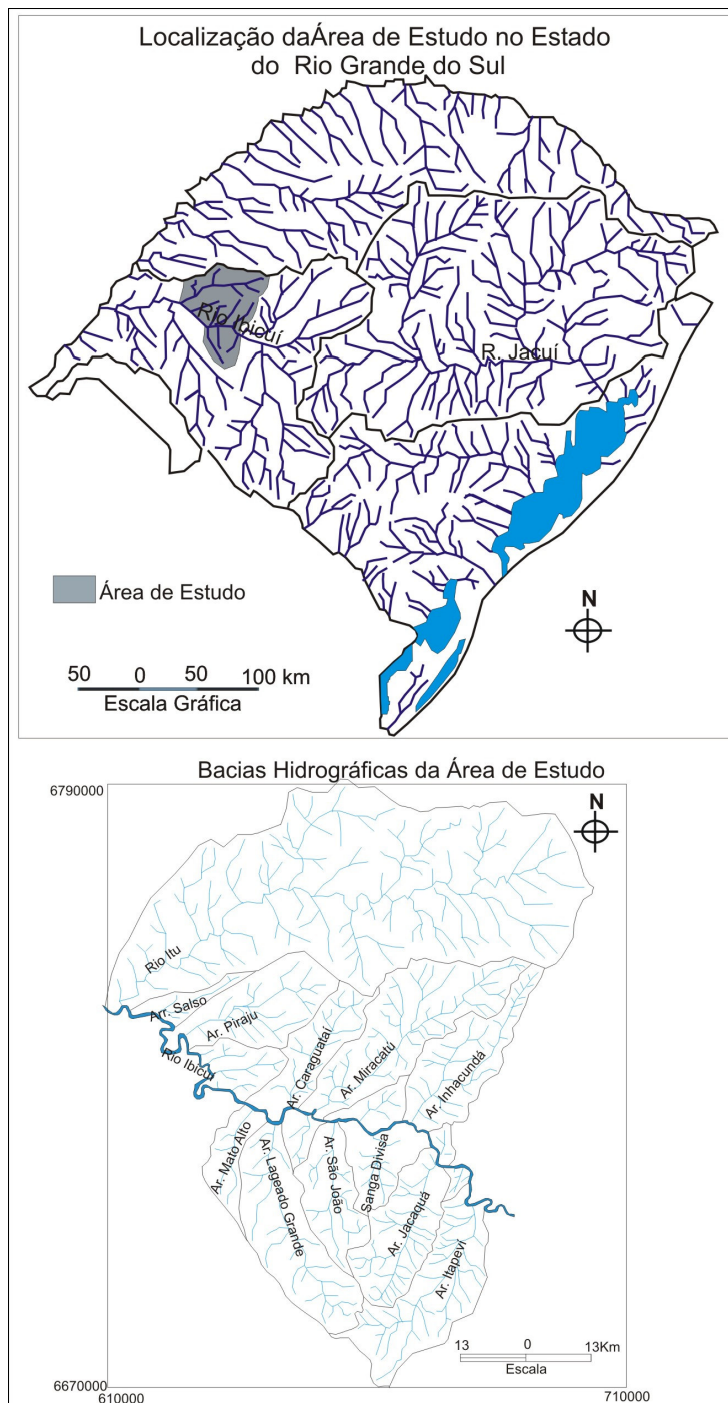
## INTRODUCTION

The study of the environment, knowing its resources and frailties, has been the work of the Laboratório de Geologia Ambiental (Environmental Geology Laboratory) (LAGEOLAM) – UFSM during the last 10 years.

The West-southwestern region of Rio Grande do Sul State in the Hydrographic Basin of Ibicuí River (picture 1) represents an area of high environmental degradation, which is linked to accelerated erosion, engendering ravines, gully erosion, and sands processes of soils.

In this context, the study of the region has been developed in order to identify, mapping, or simply describe objects of the landscape which, because of natural forces or through human influence, has occasioned environment degradation through the augmented superficial dynamics which occurs in that areas.

In the bibliography, we can highlight countless works made about those areas. Emphasizing geology, we cannot forget mentioning those one made by Maciel Filho, Menegotto, and Sartori (1971), in São Francisco de Assis municipal district and the most recent works by Scherer et al. (2002). One of those that distinguishes itself as a pioneer work in the region is that by Medeiros *et al.* (1989), that approaches the Mesozoic of the western part of the Rio Grande do Sul State, more specifically in São Francisco de Assis and Alegrete municipal districts. Studying the flora of the region, we can highlight the works by Marchiori (1992, 1995, 1997). In order to obtain answers about the origin of sands and development processes of the southwestern part of Rio Grande do Sul, it is possible to emphasize the research of Souto (1985).



**Picture 1** – Localization map

In the realm of Geography, many studies and researches may be registered, as it is the case of Ab'saber (1977), who has studied the multiple forms of desertification, among which that of the Western part of the State. Suertegaray (1992) deals with all problems of that area, analyzing factors of the formation and development of sands by the geomorphologic approach in the publication of the book 'Deserto no Rio Grande do Sul: Controvérsias' (Desert in Rio

Grande do Sul: Controversies). Through satellite images, Suertegaray *et al* (2001) have elaborated an atlas, in which they aim to map the main sands areas and gather data about some hydrographic basins of the region.

### **General Characteristics**

According to the Geologic Map of the Rio Grande do Sul State, the area which is being studied integrates itself to an arenitic-basaltic province, placed on the Geomorphologic Provinces of Depressão Periférica and Planalto Sul-riograndense.

The relief is characterized by smooth slope, predominant declivities from 5 to 8% and average amplitudes about 60m, presenting a predominant form of ample hills.

In relation to vegetation cover, the most remarkable characteristic of that region is the large predominance of campestrial formations. The savage vegetation limits itself practically by slopes of ridge of arenit, moreover by the north of Ibicuí river, as well as zones which follow the main waterstream, being in the two cases habitats which are favored by a regular supply of water.

### **Erosive Accelerated Processes: The Sand Fields**

The sand fields indicate an accelerated form of soil erosion and has been suscitated concerning in the region. According to Ab'Saber (1970), in a landscape area characterized by high moistness degree, by extensive “coxilhas” (fields with little hills and covered by grass), slim subtropical forest, rock decomposition, and little mamelonization and pseudomamelonar forms, mainly due to the coluviation, are placed sands zones of Rio Grande do Sul.

Sands process associates itself to the hills with deep soils, which are well drained, acid, excessively drained, very friable, with low purports of organic matter and bases, and low capacity of moistness retention. They present an important correlation to the geologic substrate. Sands in the region occur on the sandstones with texture, thin and median sand, predominately with dispersed granules of silica. They form crossed stratum of low angle, being classified as fluvial environment. The rocks are from reddish to yellow, which is a result of the pigmentation produced by iron oxide.

Near the fissure zones, those sandstones are silicificated, what confers large cohesion and erosive resistance. But many times the resistance to erosion occurs by the existence of an iron oxide covering, linked to the grains.

In relation to sand pit position, out two typical conditions were found: i) low slope near the water streams, compounding deposit of the kind of too sandy headspring-terrace; ii) adjacent hills to hillock slope and to degrees with rock emerging on the middle slope.

In picture (2) and (3), it is observed the important relation between the occurrence of sands and areas with rock exposure, constituting Hillocks or stairs on the slope.



**Picture 2** – Sands in Lajeado Grande Basin, Alegrete City



**Picture 3** – Sands in Itu Basin, Maçambará City

The Picture (4) shows a sands on low slope, near the drainage, forming a slope-terrace deposit. The sands occurs associated to the most resistant portions of arenite and deposits of pebbles, where archaeological clues were found (Alves et al. 2000) which one are identified as Archaeological Site - RS I 05 – Rancho Guajuvira.



**Picture (4)** – Sands near Lajeado Grande Streams

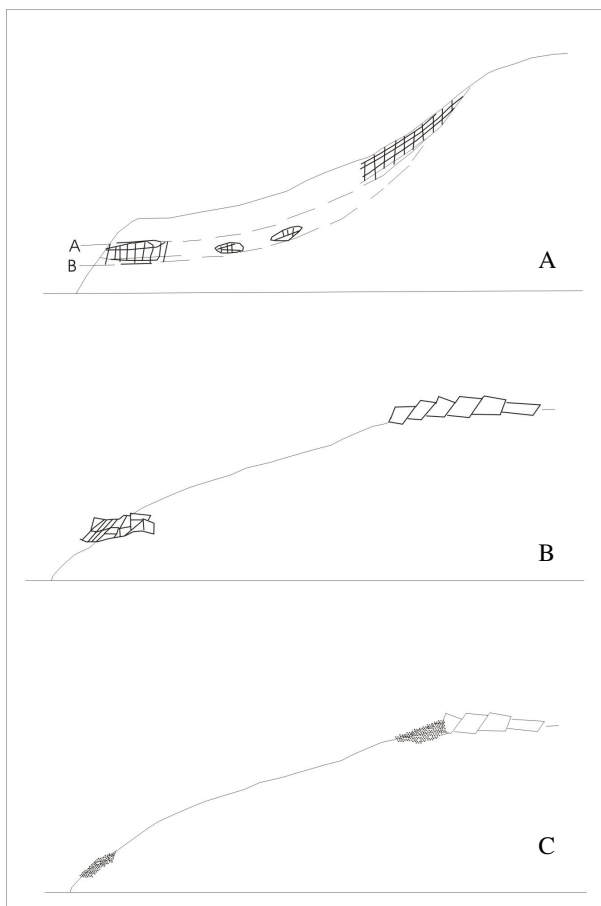
On sands one of the most conspicuous plants of the area exists, according to Marchiori (1992) the “butiazeiro-anão” (*Butiá paraguayensis*), occurring on zones of many hectares (picture 5), always in close dependence to the soil characteristics. It deals about one of the most peculiar species of regional vegetation, by the color green-gray of its big painted leaves and because of being the only case of dwarf Palm-tree in RS flora. It is possible to highlight, according to Marchiori (1995), that this vegetable habit is frequent in Savannah

palm-trees, as it occurs on the Savannah of Central Brazil portion and on the Venezuela's Llanos.



**Picture 5** - The “butiazeiro-anão” (*Butiá paraguayensis*), occurring on zones of many hectares one of the most peculiar species of regional vegetation.

The emerging of sandstones, compounding lenses and discontinuous strata of monticules of rocks and, sometimes, forming hillocks, were the results of the environment during the last dry climatic period, which has affected the territory of the RS state. In that conditions of humid climate in recent, the rework of the crust and iron coverings happens. As that iron oxide stratum is reworked, rock loses cohesion and is easily desegregated by pluviometric action, engendering sands residue (picture 6).



**Picture 6** – (A) In climatic conditions with the existence of dry and humid well defined seasons the concentration of iron and aluminium oxides exists on zones controlled by the freatic mantle. The iron and aluminium oxides exert an intra-aggregated agglutination in the grains; (B) The erosion emerging of sandstones, compounding lenses and discontinuous strata of monticules of rocks and, sometimes, forming hillocks; (C) The change to the humid conditions the iron oxide stratum is reworked, rock loses cohesion and is easily desegregated by pluviometric action, engendering sands residue

Higher velocities of the wind becoming themselves into strong windstorm are identified in the months of July, August, and part of September, which is a period of higher windy activity, known as “Minuano” wind, in which are identified the intensifications of forming processes of sand fields in the Southwestern boundary of Rio Grande do Sul State.

The constant action of wind in the west region augments the extension of sands areas on hills and engenders portions, in which concentration of pebbles, gravels, and granules happens, which are present on the rock and associated to terrace. They form, in a lower scale, deposits being similar to the serir<sup>1</sup> surfaces which occur on deserted environments (picture 7).



**Picture 7** - portions, in which concentration of pebbles, gravels, and granules happens, which are present similar to the serir surfaces

### **Climatic Change engendering sands process**

Changes in the equilibrium have occurred due to the climatic changes in the quaternary period, and, more recently, produced by antropic action.

Climatic oscillation in the quaternary has left marks on landscape, verified by concretion and ferruginous nodules, crust and coverings with given cohesions by agglutination of oxides, crushed rocks and by erosive forms of incision and sands at river slope and valleys.

In climatic conditions with the existence of dry and humid well defined seasons, the concentration of iron and aluminium oxides exists on zones controlled by the freatic mantle. The iron and aluminium oxides exert an intra-aggregated agglutination in the grains silt and a high superficial cohesion between grains with sand weight. That capacity of agglutination engenders crusts and a major resistance to the rock. That major resistance reflects itself at the formation of rock pavements on the landscape. In that period, morphoclimatic activities of slope erosion would have been ruled by lateral degradation processes, engendering plain surfaces.

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<sup>1</sup> Serir surface are concentration of coarse-grained, mainly gravel, pebbles and coarse sand which occur on the plain areas on deserted environments.

The change to the nowadays humid conditions develops a dissection vertical phase which forms the relief unities predominating, softly and mildly dissected with hills of long slope and low inclination and units associated to portions more cohesive, constituted by alluvial coluve ramp between more dissected portions, placed on the borders of low elevations or degrees of more resistant, which can form hillocks and little hills.

According to Suertegaray (1995), rounding configuration of the present relief evidences characteristics of a most humid clime than the latter. That humidification has contributed to the formation of semimamelonar relief and has promoted the changing of steppe and expansion of trees and shrub species, which have begun to recover the fluvial valleys and the more humid and lower slopes.

Thus, the landscape frailty defines itself, identifying itself as a landscape in the process of constitution of pedogenetic and new vegetation.

### **Antropic action and Degradation Process Soils**

The presence of sands in the Southwestern part of Rio Grande do Sul is previous to the beginning of the colonization and its cause due to ecosystem frailty. But according to Souto (1885), in the 1960s and 1970s, it was verified a big accentuated governmental stimulus, through credits incentives towards agricultural and cattle rising activities, what propitiated facility in the acquisition of insumes and agricultural tools. Influenced by the wheat/soybean succession, which permitted intensive use of machines, farmers augmented their agricultural areas until the limit of their possessors.

With that, the West-southwestern region of RS, which had as predominant activity the extensive cattle rising until that moment, is incorporated to the agricultural logic with the successive and intensive use of soils. It is necessary to highlight yet that soils originated from volcanic substrate obtained more income than soils on the arenitic substrate, due to the superiority of their natural pasture. That has make the farmer opting for renting of the less apt soils to the agricultural activity, what has developed erosive activity.

Besides that, many cattle rising farmers of the region fire the pasture residues around middle August, in order to obtain an anticipated spring off of that one. That practice, besides leaving the ground complement exposed during a certain period of time, it eliminates the best pastures, because they have their roots very superficial which ones are burned by fire.

Another question that must be evaluated, as states Marchiori (1995), is that when the first Europeans arrived at the state, the fito-sociological structure of fields were enough diverse than that we know nowadays in the so called 'native fields' – they dominated macegas

(a damage grass) so tall in a large part of the region, that they reach the gaucho's<sup>2</sup> legs in their riding horses. The main herbivores existing in that time, as capibaras and queers, they have exerted limited influence and on restricted areas, such as cultivated plains and wood borders, respectively. However, cattle has exerted a homogeneator on natural landscape, contributing to populacional reduction of numerous species and extinction of others. Although they were not so much known, that indirect antropic action, resulted from the cattle rising, was one of the most radical interventions on the of Rio Grande do Sul State landscape, mainly if we take into consideration the extension of the area submitted to that process.

The most usual practice, used in the moment, in order to control sands processes is planting trees, eucalyptuses and pine-trees (Picture 8), which serve as a barrier to avoid wind action and permit economical utilization of land.



**Picture 8** -Planting trees, eucalyptuses and pine-trees in order to control sands processes.

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<sup>2</sup> Therm utilized by call local dwelling



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