

# **URBANIZATION AND ACCELERATION THE EROSION PROCESS IN SANTA MARIA CITY – RS – BRASIL**

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## **INTRODUCTION**

In the stage of development in which contemporary society meets up with the globalization process dominates the world. One of the consequences of that process is the aggravation of social differences and urbanization manner of peripheral countries, which has as characteristics the pronounced spatial concentration and the accelerated rhythm of increase, tending to present big agglomerations, many times wanting infra-structural basic services. The result of that process is social spatial segregation of urban area.

According to Coelho (2001), human beings in meeting in a determined physical space accelerate the environmental degradation processes. Following this logic, degradation grows up in proportion to populational concentration increases. So, cities and environmental problems create between them a rigid cause-effect relation.

In Santa Maria, that process becomes evident in many places of the city, where the establishment of lots with irregular occupation of environmentally fragile areas have been occurring. Herewith, parts at the headwater in the western part of the city were incorporated to the urban area of the municipal district. One of those areas in the region is known as Nova Santa Marta, where happen problems related to physical environment which has enlarged together with the urban occupation of the area, that those ones linked to erosion in the shape of gully erosion in the headstreams are more significative.

In that context, this current work aims to study the influence of the antropic action, especially urbanization, in the unchaining and evolution of the accelerated erosive processes in Nova Santa Marta.

## **METHODOLOGY**

The developed work has followed the methodology proposed by Libault (1971), which is based on four interconnected levels. The compilation level, which consists by data collecting and compilation about the place in different times (1966, 1980, 1991, and 2001); the correlating level, that aims to relate natural order and antropic factors, which have occasioned the emergence of gully erosion; the semantic level, in which occupation process of Nova Santa Marta was approached; and the normative one, in which the events with regard to the theme of the research were identified and characterized. The achieved conclusions help as subsidy to risk mitigation actions and urban planning.

## **LOCALIZATION AND CHARACTERIZATION OF THE RESEARCHED AREA**

The researched area consists of the occupation, which is known as Nova Santa Marta, placed on the northwestern part of Santa Maria City (Picture 01).

The relief is constituted by hills, defined by Robaina et all. (2002), as pertaining to the unity of landform of hills near the “Rebordo do Planalto”. The altitude varies from 142 to 155 meters. The altimetric amplitude of the hills changes from 36 to 50 meters, the declivity, from 5% to 12%, and the ramp extent from 700 to 1500 meters.

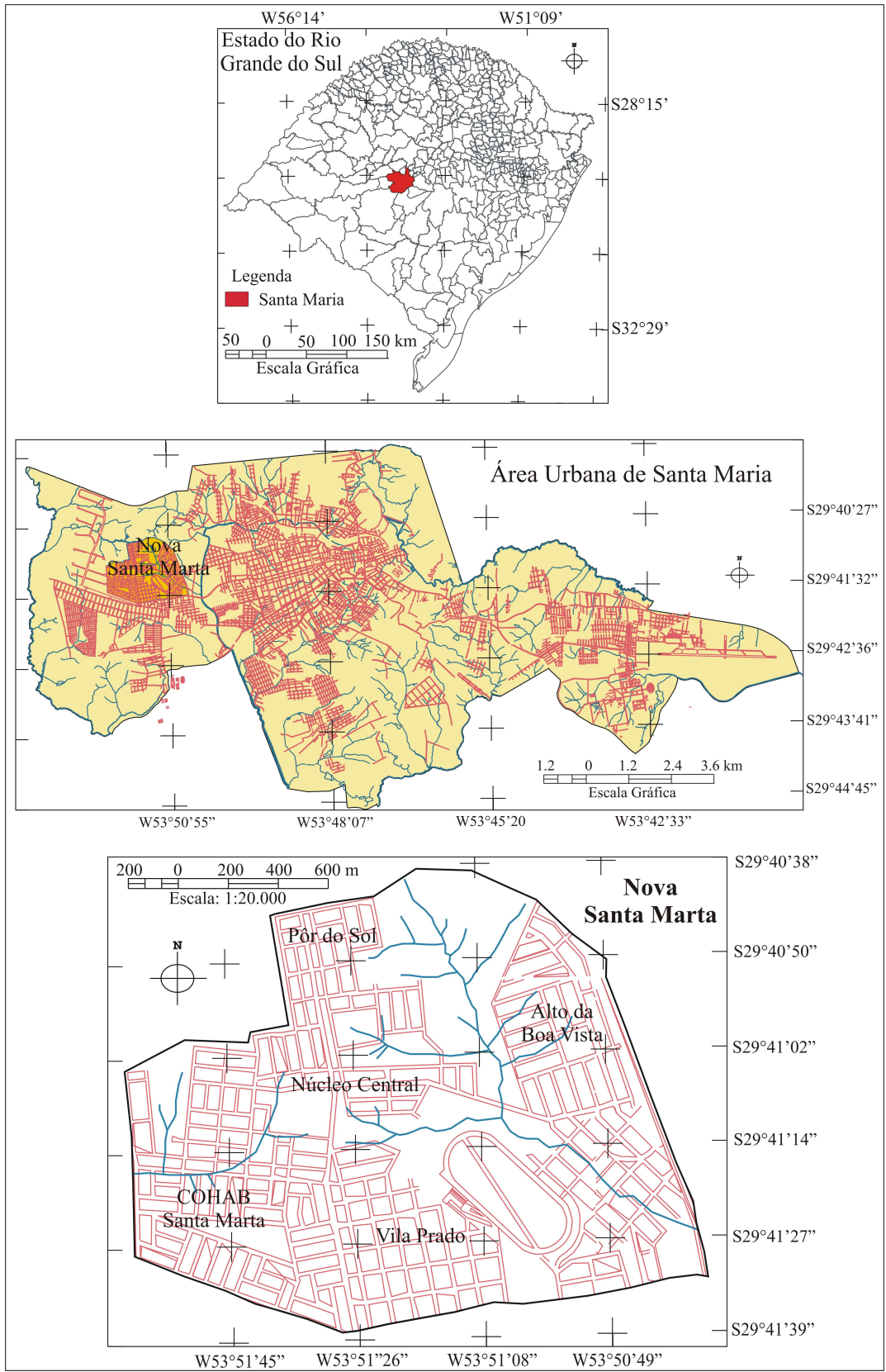
The bedrock is formed by sandstones with pebble of quartz e fragments of muds, highly friable, of rose color, and with well visible streambeds and thickness that varies from 3 to 8 meters. It presents laminas forming mud balls and silica grains in bigger shapes than sand and mica, which have smaller quantities.

The base is formed by cohesive muds that form tablet. The reddish color and the thickness changes from 2 to 5 meters. It occurs iron and manganese nodules in some portions.

In contact with these two lithologic sequences, both superficial water and groundwater flow have a differentiated behavior, engendering a hydraulic pressure because the difference permeability.

The soil is constituted by superficial horizon of an average of 80 centimeters of thickness, with reddish color, sandy with gradual transition towards a reddish B horizon, with thickness from 1 to 1,5 meters, muddy with iron nodules.

According to Maciel Filho (1990), soil erosion resistance of those sequences is low and besides saprolite resistance is less lower, so retiring from superficial soil the erosion grows up rapidly.



Picture 01: Localization Map of Nova Santa Marta.

## **Analysis of erosive processes in Nova Santa Marta**

Nova Santa Marta has a hill relief where erosive processes are associated to dynamics of headwater, once deep gully erosion occurs in the area, which are in expansion and whose evolution is accelerated by the antropic action.

According to Bigarella & Mazuchwski (1995), gully erosion constitutes a channel of drainage with abrupt walls and fleeting or sometimes small flows. It also has an intense erosion and a steep and scarped headwater. Intermingled gully erosions would be associated to hypodermic and/or groundwater flowage that would be considered a 1<sup>st</sup> order channel.

Ravines and gully erosions development is connected to the channel drainage channels development, which is associated itself to the formation of concave features, that consist of convergence zones of water and sediments flows. In drainage systems, the superficial and subsurface water flowage converges towards a canalized drainage channels.

According to Fendrich (1991), gully erosion development occurs from erosion in the channel itself (talweg) caused by concentrated water flow and soil cohesivity lost in the shape of gully erosion. The author points out that, once created a erosion step, this one tends to deepen itself rapidly until a basis level. In this process a headwater portion is transported towards the downstream.

Generally cohesion forces among soil particles, which were in the depths before and now they would be in the open air, are diminished when exposed to both solar radiation and wind making easy desaggregation and conduction when will happen precipitation.

In the development of gully erosion processes, groundwater action by the slope is essential. The slow percolation of water, which occurs itself by the gully erosion walls, is undermining the slope bottom, which gives sustentation to a lot of walls. The retrogressive inner tubular erosion (*piping*) does not work just around the talus. It can develop itself along hundreds meters length form the erosion, weakening the soil and establishing regions of percolation which engenders lowering to the upstream.

The erosive processes in this study are conditioned by natural characteristics of the area and accelerated by modifications, that are provoked by different utilizations of the land. In Nova Santa Marta the use for agricultural activities causes the first alterations in the environment, associated mainly to the vegetation withdrawal, which has happened all over the area, including by the drainage channels and on areas of emergence in the headwater. The aerial photographs taken in 1966 (picture 02) show the agricultural utilization that whithdraw the vegetation and the existence of vicinal street in the water divisor, which accumulates pluvial waters and increases the erosive capacity of the rains.

In the end of the 1970s and beginning of the 1980s, a remarkable event occurred in the region: the establishment of urban occupation in South portion of studing area. In the process of implantation of the settlement, modifications at the downstream were established, as soil and rock movement, and drainage and ways works. The obstructed of the main drainage because of the works and waste and sediment load deposited, it caused changes in the upstream portion.

However, the most relevant action in the development of erosive processes, which is seen in the photographs of 1980 (picture 02), is the movement of the soil in order to obtain lending material in the hill top nearby the drainage flows. That movement intensified the erosive processes by desestructuring soils and exposing their most erosion susceptible horizons.

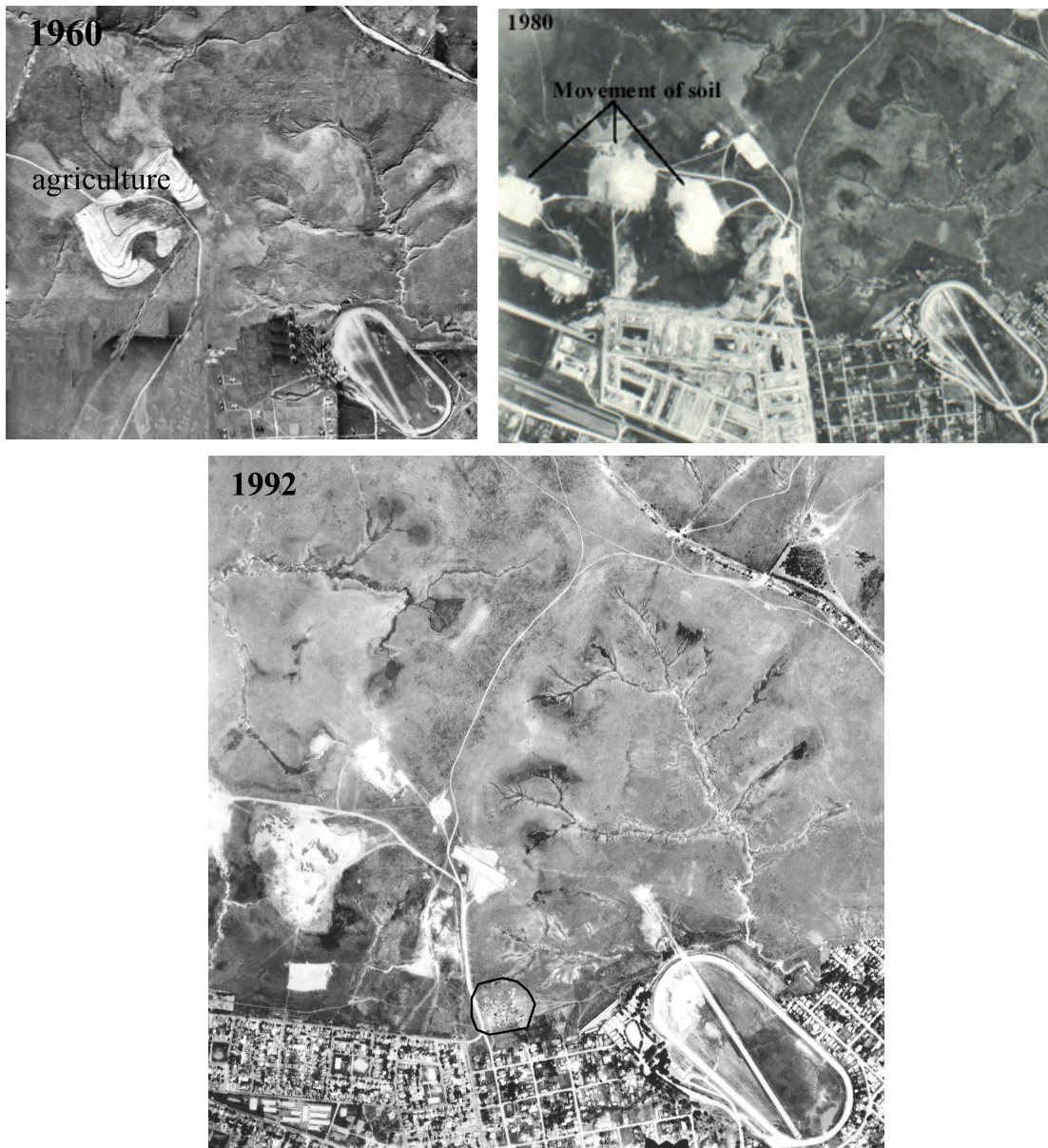
In the very beginning of the 1990s, a new phase of using ground began, which is the urban occupation of the area in the end of 1991 by families with low amount of rent (picture 02).

The urban occupation of Nova Santa Marta began from an irregular land occupation, in December 1991, by the members of the “Movimento pela Moradia e Sem-Teto” (Dwelling and Non-Home Movement) on an area of the call Santa Marta Farm. This residential ensemble rejoins many villas of the region known as “Sem-Teto” (Non-Home) (SANTOS, 2000).

At the end of 1991, seventy-four families were set in that place. In 1995 happened the first occupation register; realized by UFSM (Universidade Federal de Santa Maria) pointed out the existence of 3700 families on Nova Santa Marta area. From January 1999 on, the state government began a project of land regularization, which was coordinated by the Secretaria de Habitação do Estado (State Habitation Secretaryship), COHAB (Habitation Cooperative), Santa Maria City Hall and UFSM.

The occupation without adequate technical criterion has caused traces without way plans with concentration of the rainfall and served water throwing directed in the land increse the runoff. The withdrawal of soil to construction has increse the erosive action.

The pictures 03 and 04 show example of occupation increase erosion process where rainfall water and directed served throwing at the drainage have increase the erosion to downstream. Moreover, deepening of vertical and headward erosion provoke the evolution of gully erosion to the upstream which begins to risk their own way. For minimizing the situation of installed risk, trash and rubbish in the gully erosion are thrown, which is to increasing the environmental degradation.



Picture 02: 1966 - show the agricultural utilization that withdraw the vegetation in headwater area; 1980 – Show implantation of the occupation in South and the movement of the soil in area; 1992 - Show in indicate area the began from an irregular land occupation Nova Santa Marta.

The thickness of that occupation on the next grounds to the erosive occurrences multiples the risk of accidents and increase the environment fragility.





Picture 03: Trash and rubbish in the gully erosion are thrown increasing the environmental degradation



Picture 04: Water flowing of the street direct throwing at the streams have increase the erosion.

The 2001 aerial photographs (picture 05) show conditions near to nowadays ones, where geomorphologic risk areas and areas were installed, in which occupation may draw on installation of risky situations.

On Nova Santa Marta region were identific the existence of five places with erosive processes in development, connected to the headwater. The existent rocks in the area help the erosive processes and the gully erosion advancement, mainly due to the low cohesion of them.

The presence of a lot of trash deposit in the border of the streams channels can also aid the mass movement in their riverside, causing the augmenting of the gully erosion channels.



Picture 05: The 2001 aerial photographs show conditions near to nowadays ones, where geomorphologic risk areas and areas were installed.

Robaina et al. (2001), point out the transformation, which has occurred in the vegetation cover in the western part of Santa Maria City, has contributed to change the hydrologic conduct, creating favorable conditions to a biggest development of the erosive processes, once the water flows off by the zones rock contact with different permeability, it occasions the subterranean erosion, forming inner spaces which can cause the soil undermining. The same author still highlights that the augment of deep linear erosion is associated to the increase of flowage of superficial water through the street, of sewage collecting system, and of channeled water poured directly in the soil.

The urban expansion in Nova Santa Marta has propitiated river waters concentration at headwater, and so it causes erosive processes following the own streets ensemble and the river



water conducts; thus there is no adequate structures of adduction, conduction and flowage of rainfall and served water.

So, the present portrait of linear erosion in Nova Santa Marta contributes to environmental degradation at the headwater of the streams of Cadena and Ferreira, and imposes hazards to the community, threatening homes and the existent infra-structure.

As government actions have been very limited, risks tend to augment due to lacking of an adequate work in relation to the streams of the area.

## **FINAL CONSIDERATIONS**

The structuring of urban centers provokes changes in the environment, which in most of times damage life quality of their dwellers. Urban environmental thematic is so much complex and, in order to improve and control its degradation, is necessary to comprehend its dynamics.

The urban erosion upon Nova Santa Marta is associated to lack of planning, which concerns particularities of environment, socioeconomic conditions of population and tendencies of development of this area. The occupation has augmented constructed and paved areas, and in this way it has increased of runoff, which approaches themselves in the drainage, that being not dispersed, concentrate runoff, accelerating development process of ravines and gully erosion, which are associated to the drainage system.

Thus, it is possible to infer that erosive processes in Nova Santa Marta are linked to the land use and were identified with urban occupation of the region. The control of those processes is slow and complex, once the solution of problems provoked by urbanization process interpose themselves as a challenge to local society and depend on many factors, mainly on the social and economic ones.

## **BIBLIOGRAPHY**

BIGARELLA, J. & MAZUCHOWSKI, J. Z. Visão integrada da Problemática da Erosão. In: 3º Simpósio Nacional de Controle de Erosão. **Anais...** Maringá: ADEA/ABGE, 1985.

COELHO, Maria Célia Nunes. Impactos Ambientais em Áreas Urbanas. In: GUERRA, Antonio José Teixeira; CUNHA, Sandra Baptista da. (Org.). **Impactos Ambientais Urbanos no Brasil**. Rio de Janeiro: Bertrand Brasil, 2001, p. 19-45.

FENDRICH, Roberto. Erosão Urbana. In: FENDRICH, Roberto et al. **Drenagem e Controle da Erosão Urbana**. 3. ed. São Paulo: IBRASA, Curitiba: CHAMPAGNAT, 1991, p. 15-41.