URBANIZATION AND ENVIRONMENTAL DISRUPTION OF CATCHMENT BASINS AS A RESULT OF HOUSING DEVELOPMENT AT CIDADE OPERARIA AND ADJACENCIES, MARANHAO ISLAND

Izis Deise Silva de Sousa[1]
izisdeise@yahoo.com.br
Geiza Paula de Sousa Veloso[1]
geizaveloso@hotmail.com
Luiz Jorge Bezerra da Silva Dias[2]
luizjorgedias@ig.com.br

ABSTRACT

The Industrial Revolution was followed by an increase in the rates of urbanization, particularly after the second-half of the 20th century. In this context, Sao Luis, the capital city of Maranhao State, adopted a housing development policy that was aimed at reducing the housing deficit in the municipality. The construction of the Cidade Operaria housing complex was a response to these explicit social needs, which have intensified since the 1970s. The occupation of the complex, however, resulted in considerable damage to the ecological integrity of the adjacent habitats. The complex is located in the catchment basin of the Paciencia and Santo Antonio rivers, at the center of the Maranhao Island. This study analyzes the spatial and temporal dynamics of the area's urbanization process, which occurred in three phases: the period between 1976 and 1981 saw the removal of the original vegetation cover in some areas, as a result of the first settlement in Parque Zelandia. During that period, subsistence agriculture was common practice along the margins of streams and rivers. The second phase corresponds to the construction of the Cidade Operaria housing complex, which occurred between 1981 and 1988. During that time, 860 ha of land were cleared and urbanized, resulting in considerable environmental damage. Changes of relief, due to grading and earthmoving activities, lead to irreversible modifications in the course of rivers and streams; many tributaries of the rivers Paciencia and Santo Antonio had theirs springs smothered by earthfills; construction of houses and the use of asphalt on roads reduced soil permeability, increasing the depth of the water table; the release of untreated sewage contaminated the drainage basins. During the third phase, which started in 1988, the environmental degradation was intensified by the occupation of areas adjacent to the housing

[1] Students of 5th period of the Course of Geography of the Univerdidade Federal do Maranhão
[2] Geógrafo, mestrando in Sustentabilidade de Ecossistemas of the Universidade Federal do Maranhão

complex. This model of urbanization has caused irreversible damage to the hydrology and water quality in the study area, and this article aims to provide an incentive for the creation of land-use planning and management strategies that include protective and restorative measures to reduce degradation of catchment basins as a result of urbanization.

Keywords: Urbanization. Ambient problems. São Luís. Cidade Operaria and adjacencies.

INTRODUCTION

The second half of the 20th century is marked by the technical, scientific and industrial advance, contributing to remarkable urban development. At the centre of this development it is the city, characterized by a space in which a high concentration of tertiary activities is observed, as well as housing developments for people that depend on such activities.

The geographic conditions of a given location are an important factor in its economic valuation, as it refers to the flow of production, that is, the logic of the capital. Ports constitute a considerable attraction for many capitalistic companies, and the Maranhao Island, which used to comprise only the municipality of Sao Luis, became a target for many enterprises. Its geographic location includes protected bays, fluvial channels, and floodplains, as well as excellent depth of its internal channels and easy ocean access.

As a consequence, the municipality became a magnet for migrants coming from the countryside looking for work. The increase in population triggered the State government to adopt a housing development policy that was aimed at reducing the housing deficit in the municipality (DIAS, 2004), resulting in the construction of the Cidade Operaria housing complex. This development, in other hand, resulted in significant pressure to local habitats, as the area is located in the catchment basins of the rivers Paciencia and Santo Antonio, at the heart of the Maranhao Island (DIAS, 2004; DIAS AND FERREIRA, 2004).

CHARACTERIZATION OF THE STUDY AREA

Geomorphology is of prime importance to the understanding of a given area and, therefore, should be included in any land use analysis. The geomorphological system should be viewed as an open and cyclic system that includes many forms, processes and interactions, in an integrated model of geologic, climatic, pedological, hydrological, and anthropogenic factors that participates in the geomorphic subsystem, and in the environmental dynamic.

According to Silva (2000, p. 79), "the knowledge of the environmental dynamic, which includes the geomorphic processes, contributes to effectively attain a sustainable development". The catchment basin, the area drained by a particular body of water, "appears at the core of the problem of conservation of natural resources, due to the interdependence of its biotic and abiotic attributes" (RESENDE, 2002, p. 238), making it essential to anticipate, to control and to monitor the effects in areas upstream of the basin, in order to maintain the harmony with the total environment.

Dias (2004) has shown that the Cidade Operaria housing complex and adjacencies (Figure 1) are located on top of one of the main water divides of the Paciencia and Santo Antonio watersheds. Regarding its geomorphic characterization, this paper reveal a disagreement with the physiographic attributes of the Maranhao Island reported by PINHEIRO (2002, p. 78), which considers that this portion of the Golfao Maranhense present structural slopes and terraces as the exposed character of their regional geomorphology.

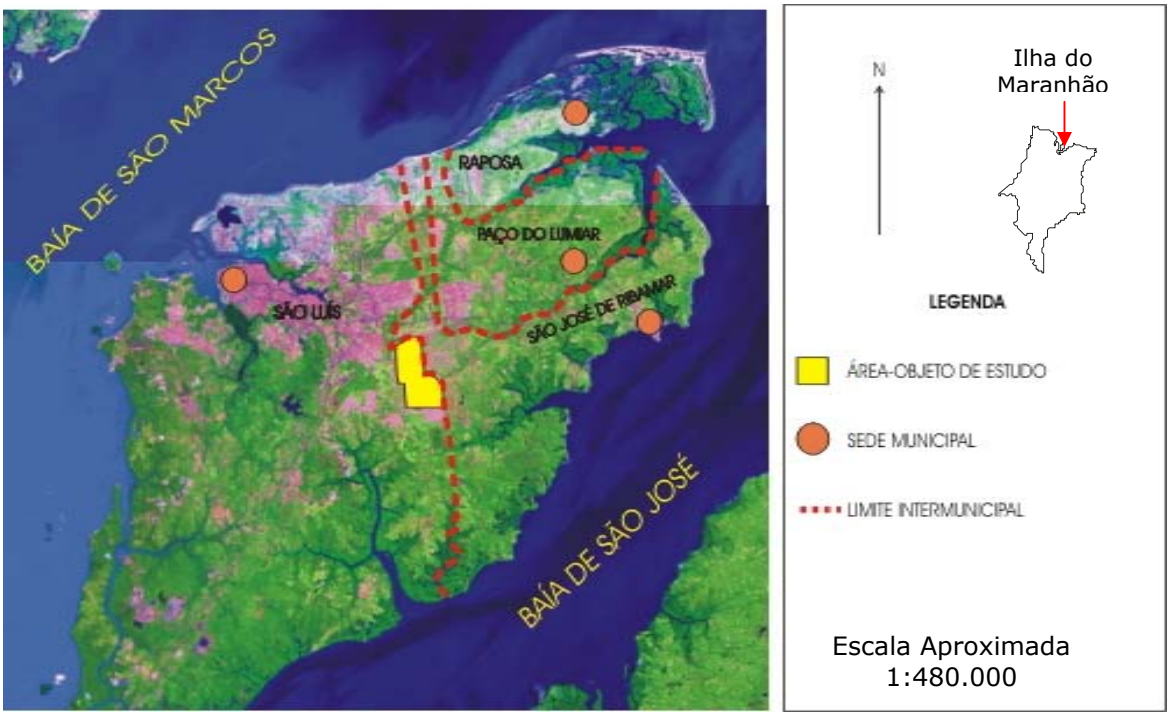

FIGURA 01: Localization of Cidade Operária and adjacences, central area of the Maranhão Island.
Fonte: Fotografia de Satélite LANDSAT TM-5, montada a partir de mosaico disponível em: http://www.zee.geplan.ma.gov.br, acesso em 15/12/2001.

According to Dias (2004) and Dias & Ferreira (2004), these slopes and terraces, literally sedimentary (once they are formed by exposed sedimentary rocks, either from the Cretaceous – Itapecuru Formation –, the Tertiary – Barreiras Formation – or the Quaternary – Acui Formation), which are found in central areas of the Maranhao Island, should be characterized by its original forming and modifying processes (whose nature is

morphosculptural and not morphostructural)[3], as in fluvial slopes and terraces, inferior slopes and terraces (those who are located in river floodplains), or a central platform with dissected columns (characterized by the joint action of exogenous geomorphic factors, specially fluvial or pluvial action, which are found in areas of watershed divides), according to the definitions found in GUERRA & GUERRA (2003, p. 601-608).

ENVIRONMENTAL IMPACTS CAUSED BY URBANIZATION IN THE STUDY AREA

In order to survive, mankind need to occupy the land and appropriate its resources, which include soils, water, fauna and flora, rocks, ores and minerals. Such appropriation generates environmental impacts which, without preventive or protective measures, can be irreversible. In the study area, the environmental degradation is maximized by the presence of catchment basins.

As suggested by Dias (2004), it is possible to describe the dynamic of the urbanization process in three phases: the period between 1976 and 1981 saw the removal of the original vegetation cover in some areas, as a result of the first settlement in Parque Zelandia. Subsistence agriculture was common practice along the margins of streams and rivers. During this phase, the hydrographic basins remained relatively well preserved. The soils, however, were considerably impacted by land clearance through induced fires.

The second phase corresponds to the construction of the Cidade Operaria housing complex, which occurred between 1981 and 1988. During that time, 860 ha of land were cleared and urbanized, resulting in considerable environmental damage. Changes of relief, due to grading and earthmoving activities, lead to irreversible modifications in the course of rivers and streams; many tributaries of the rivers Paciencia and Santo Antonio had theirs springs smothered by earthfills; construction of houses and the use of asphalt on roads reduced soil permeability, increasing the depth of the water table; the release of untreated sewage contaminated the drainage basins.

During the third phase, which started in 1988, the environmental degradation was intensified by the occupation of areas adjacent to the housing complex, which occurred

[3] Before the displayed one, Christofoletti (1980, p. 84), affirm that it is important to emphasize that it has significant differences between the morphostructural and morphosculptural elements, has seen the classifications of its terraces, being of nature sculptural the derivatives of the actions differentiated of agents climatic-intempéricos on to one given area submitted the determined morfoclimático domain. Its rocky substratum generally is constituted of friáveis rocks (susceptíveis to the shear), while the terraces of structural order are composites for rocks of more resistant characteristics.

without any planning or control. The social demand for housing was growing faster than the rate at which houses were built and slumps started developing in the outskirts of housing complexes like the Cidade Operaria.

As a result of this model of development, the catchments of the rivers Paciencia and Santo Antonio have suffered considerable morphological changes. In addition, many tributaries were used for the disposal of untreated sewage, considerably affecting the water quality.

One of the tributaries of the Paciencia River, located between the units 203 and 201 (02º34'14"S e 44º11'57"W), has been channeled with concrete to receive and drain pluvial waters from the housing complex. It also receives considerable flux of solid waste, facilitating the proliferation of pathogens. Its spring can be identified by the arrangement of the houses in a concentric display that indicates the configuration of the original relief. This area also presents the highest elevation within the valley (Figure 2).

Figure 2: Tributarie of the Paciencia River.
Source: SOUSA, Izis Deise Silva de; VELOSO, Geiza Paula de Sousa; DIAS, Luiz Jorge Bezerra da Silva, 12/02/2005. Research of Field.

As we move towards the mouth of the stream, the medium course becomes visible (02º34'14"S e 44º12'00"W) due to a steep change in the declivity of the river bank. The housing development in this area is clearly disorganized, and has caused considerable vegetation clearing along the river lower course (02º34'14"S e 44º12'23"W), leading to erosion of the banks, and earthfilling, as well as acting as a repository for domestic effluents (Figure 3).

Figure 3: Confluence of the Paciencia River and the tributarie.

Fonte: SOUSA, Izis Deise Silva de; VELOSO, Geiza Paula de Sousa; DIAS, Luiz Jorge Bezerra da Silva, 12/02/2005. Research of Field.

Impermeabilization of soils, as a result of urbanization, has reduced the infiltration of pluvial waters, increasing surface runoff. To avoid flooding, new ditches had to be constructed parallel to the original river bed. This unplanned development continues to happen as the areas surrounding the original housing complex continue to receive new settlers.

These settlements without minimal infra-structure have considerably increased the volume of untreated sewage being released in the streams and rives, adding to the sources already established at the localities of Jardim America, Vila Janaina, Units 103, 105, and 205 of the Cidade Operaria, Recanto dos Passaros and Geniparana. These effluents are released right in the Santo Antonio River, approximately 250m downstream from its spring (Figure 3).

Figura 4: Dejeção of sewers in the high course of the River Santo Antonio – Recanto dos Pássaros.
Fonte: DIAS, Luiz Jorge Bezerra da Silva, 31/12/2003. Research of Field.

CONCLUSIONS

At the Maranhao Island, the equilibrium of the natural dynamic (at all temporal scales, geologic, social or historic) was and continues to be altered by predatory human interference on the environment. Associated to that is the use of biodiversity as an economic factor of exploration, besides the predation for mineral resources and the indiscriminate use of soils. All together, these factors are causing increased modifications to the Maranhao Island natural environment, at all scales.

The environmental damage caused by urbanization, as seen in this study, aim to support the development of land-use planning and management strategies that include protective and restorative measures to reduce degradation of catchment basins. Nevertheless, a more detailed analysis of the problems in relation to their Urban Geomorphology is needed. Also lacking is the analysis of the effects of such urban development in the social stratum of the study area. Further studies should focus on data collection to establish a consistent and georeferenced database for the region, which will provide a powerful tool for managers and decision-makers, facilitating the implementation of policies that will address the real needs of the local population.

In conclusion, detailed knowledge of local urban geomorphology, when supplemented by remote sensing and geoprocessing techniques, may provide the necessary tools for the development of sustainable urban planning procedures. It can also help to identify critical habitats that need special protection, as well as areas in need of restorative measures, within the Cidade Operaria housing complex and adjacencies.

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