

## **Sustainable Urbanism in Coastal Environment: an applied project to expanding urbanized zone of Aracaju City, Sergipe, Brazil.**

Sustainable Urbanism in Coastal Environment: an applied project to expanding urbanized of the zone of Aracaju City, Sergipe, Brazil.

Marina Gonçalves Garcia, University of Vale do Rio dos Sinos, Brasil.  
Antônio Jorge Vasconcellos Garcia, Federal University of Sergipe, Brasil.

### **1. Introduction**

The beaches are coastal environments with deposits of unconsolidated material, formed by the interaction of the continent (rivers that arrive in port material to the coast) and the sea. The main process includes reworked sediments by waves, tides, coastal currents and wind processes. The beaches are dynamic and sensible environments and responsible for important functions, mainly a special protection for adjacent ecosystems, where lived many species of animals and plants (Souza et al; 2005).

Despite of the human occupation, one of the crucial factors for degradation of natural coastal environment, other factors also operate to the occurrence of degradation processes. Thus, it is necessary to know the sediment dynamics of the beaches and the natural and anthropogenic mechanisms that interfere with coastal processes. After these to be achieved the proposition of preservation program will be important to environments preservation during the urbanization project implementation.

The Sergipe State follows the global trend of occupation and use of the coast for various activities (Carvalho and Fontes, 2006). On coastline of Sergipe, especially in the stretch where they understands the estuaries of Japaratuba and Vaza-Barris rivers, is located the higher income and higher population densities in the state. In this excerpt comprising just over 50km of coastline are located with industrial complex, port, tourism and housing.

Besides the strong anthropic occupation in the area, it is also characterized by the occurrence of mangroves, dunes fields, sandbanks recovered by xerophytic vegetation, sand beaches, becoming this area very sensible under the coastal dynamics. This complex human and natural system asked by multi-disciplinary studies to understand the relationship between the anthropogenic and natural aspects over the coastal zone.

The first approach was carried out field surveys and data requests for recognition and mapping of processes occurring on the beaches over the coast line between the estuaries of Japaratuba and Vaza-Barris rivers. The estuary of Sergipe River, that is located Aracaju City, is located between these both. The results of this investigation identified some critical erosion points, with serious problems of retreat of the shoreline and environmental degradation. Our studies are related to coastal line situated between the Sergipe and Vaza-Barris rivers, where is localized the Expanding Zone of Aracaju City.

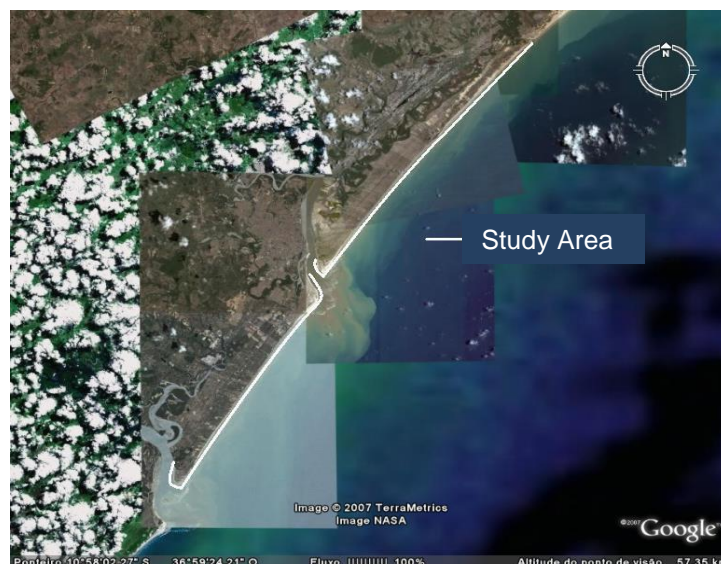


Figure 1: Image representing coastal study. Source: Google Earth, 2004, modified.

## 2. Environmental Impacts

The human occupation is being one of the natural environments through the construction of urban areas that must rigorously be preceded of studies of Ambient Impact. The Expansion Zone of the Aracaju City (Figure 2), in Sergipe State (Brazil), as well as come being busy without concern with the consequences, in terms of actual damages to the flora and fauna, to the proper environment (coastal dunes and lagoons integrated to the littoral ecosystem) and hydrological systems (underground water and lagoons). Many of the projects that today are implanted in the studied area are compromising the ambient sustainability of the region, making impracticable the pluvial and underground water draining, improving the proliferation of human contaminants agents in the groundwater and of superficial waters (lagoons and mangroves).

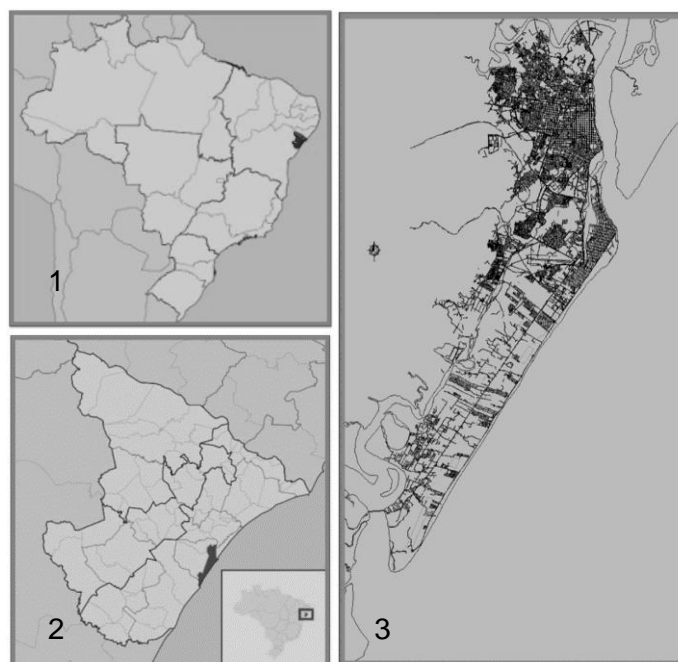


Figure 2: Geographical context of the city of Aracaju highlighting the main routes of connection between the center and Expansion Zone (3), Sergipe (2) Brazil (1).

### 3. Diagnostic Aspects

The “geoenvironmental urbanism” is a reply to urbanism developed in areas of recognized environmental fragility, as littoral and coastal zones.

The search for solutions that add skills to modify the environment without interfering drastically with the sustainability is the major challenge to be overcome by the society in such contexts of territorial occupation.

The proposal to "urban adequacy of the Aracaju City", Sergipe, Brazil, aims to bring sustainable urban development to the expansion zone, located in a coastal environment defined by 20.70 km<sup>2</sup>.

The coastal area where Aracaju City is located has high environmental fragility. A complex of sand dunes and coastal lagoons, associated at salt marsh vegetation and sandbank, represents a fragile coastal ecosystem that must be maintained and integrated into the process of urbanization.

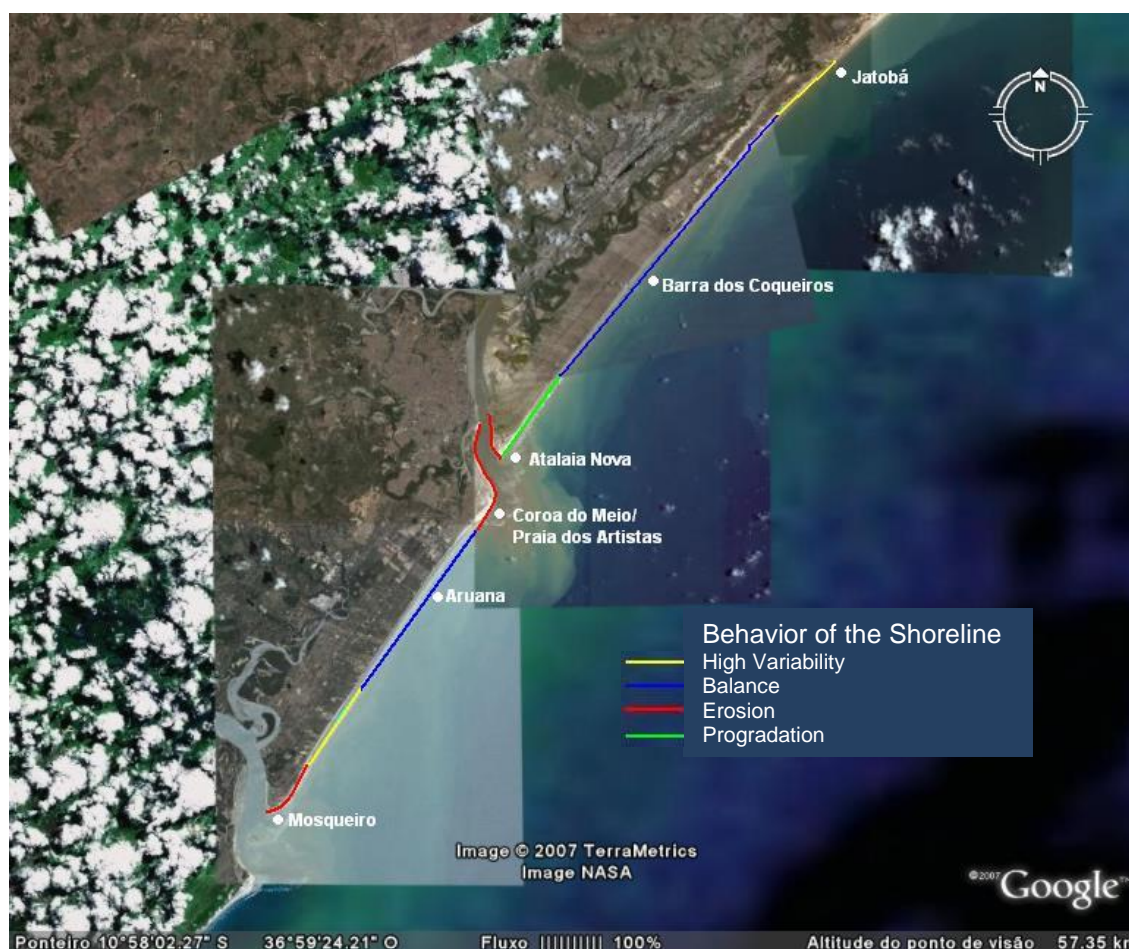


Figure 3: Real behavior of the shoreline in the studied area. Source: Google Earth, modified.

Based on observations and conclusion of this work is possible to conclude that in some areas with greater human interference the biggest problems occur related to the retreat of the coastline, caused due to the changes in the dynamics of these coastal sites. The most critical areas are associated with the estuaries of the three rivers that cover the study area (Japaratuba, Sergipe and Vaza-Barris rivers) (Figure 3).



#### 4. Methods

The diagnosis of problems promoted by disorganized urbanization need to consider the present relationship between the urban and the natural elements destroyed. The mapping of the current state of urbanization and the remnants of natural environments possible to be used as reference points need to be considered to the Sustainable Planning to Aracaju City.

These natural elements were analyzed by aerial photographs (source: performed by ortophotomap Base Aerial Photography and Projects SA), mapping the distribution and height of sand bodies forming dunes and ridges of lagoons and sandbanks areas, and especially the distribution of flora and fauna in each eco-system identified (Figure 4).

The geological and biological knowledge need to be contributed to the proposed distribution and suggestion of new buildings and access roads, in order to ensure the survived of ecosystems and of the ecological ways between ecosystem environments. Another important aspect to be considered is the dynamic of hydrologic flow, both surface and underground, in order to maintain the natural runoff and prevent flooding by the damming of the flows generated by human works, as now recorded without proper planning.

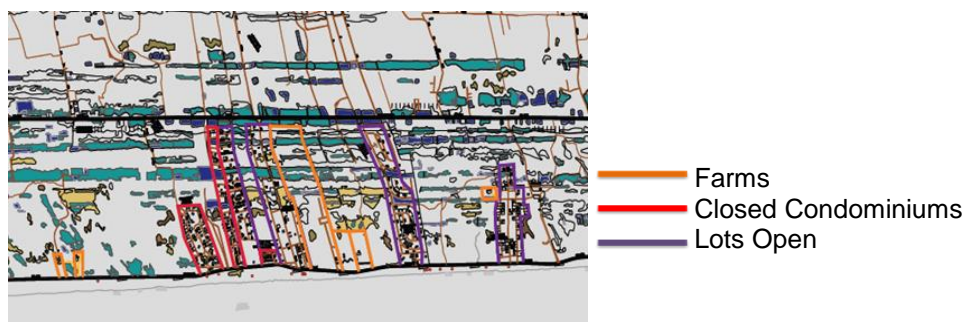


Figure 4: Mapping of the main economic enterprises established in the expansion zone of of Aracaju and targets of the presented suggestions of adequacy in this work.

#### 5. Indicative of Environmental Risk

##### 5.1 Sergipe River Estuary:



Figure 5: Comparative image of the estuary of Rio Sergipe. To observe the occurred changes in the morphology of the mouth of a river. Photos of the years of 1979 (satellite Landsat 2) and 2004 (Google Earth), respectively.

The estuary of the Sergipe River (Figure 5) is the most complex area and further altered by humans across the coastline encompassed by this work. Since the year 1975 the estuary

undergoes modifications to enable the occupation of areas of the mouth. The intervention occurred was the largest landfill of sandbanks that bordered the river banks to make possible the occupation of the neighborhood of Coroa do Meio Urbanized Area (Carvalho and Fontes, 2006).

Among the changes in the dynamic coastal jetties causes, the main ones are: (a) modifying the conditions of the local longshore introducing wave patterns completely foreign to the environment, (b) altering the dynamics in the distribution of sediments, (c) almost completely interrupting the longshore; (Dias, 1993).

All these elements that compose the impacts generated by piers occur in the estuary of the River Sergipe. It was observed that the jetties, events associated with high tides and strong winds aggravate increasingly the retreat of the shoreline in Atalaia Nova and Coroa do Meio, more precisely in Praia dos Artistas (Figure 6).



*Figure 6: Advance of the sea on the bars of the Beach of the Artists.*

### **5.2 Atalaia Beach - Aruana Beach - Naufragos Beach - Jose Sarney Beach:**

These four beaches, situated between the estuary of Sergipe and Vaza Barris rivers, represent important touristic points. Hotels, restaurants and others commercial and habitation edifications are distributed along these four beaches.

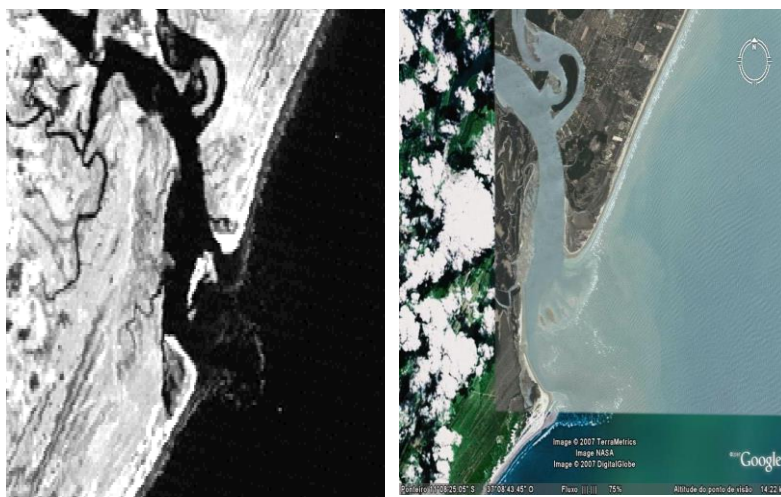
Two of these beaches need special attention, the Náufragos and Jose Sarney beaches., because a large part of the commercial areas is located just a few meters of the influenced zone by the sea during the high tides (Figure 7).

The same problem occurs in parts of the Jose Sarney Highway that was constructed on a dune field's area and very closed to the sea. This highway was completely destroyed near to the Vaza-Barris River estuary (Figures 8 and 9).



*Figure 7: This photo evidences the proximity of the comertial point of the beach of the Sarney in relation to the sea during the high tides.*

### **5.3 Vaza-Barris River Estuary:**



*Figure 8: Comparative image of the estuary of the river Vaza-Barris, years of 1979 (satellite Landsat 2) and 2004 (Google Earth) respectively.*

The estuary of Vaza-Barris River is characterized as very dynamic coastal environment (Figure 8). The wave actions and coastal currents in the region inhibit the development of mangroves, facilitating the movement of sands and the erosion of the mouth of the river (Carvalho and Fontes, 2006). The construction of the highway did not considers the geologic knowledge about the area (Figure 9 and 10).





*Figure 9: Destruction of the track that of the access to the lighthouse of the Mosqueiro. 2007/08/12.*



*Figure 10: This photo shows the emptiness that was left by the destruction of the highway. 2007/08/12.*

## **6. The Next Step: A Proposal of Urban Adequacy - Aracaju Integrated To the Environment**

The Dra. Augusta Maria Vargas, manifest in the following way with regard to the urban development of Aracaju: “Planned in the current days, Aracaju would be vetoed by the ambient evaluation of the current law. However, the construction of a sustainable city is possible and only viable with the elimination of the agreement of the untouchable nature, that “would congeal” Aracaju, as well as of the agreement of the unwanted natural environment, to be conquered and to be artificialized”.

The south region of Aracaju, close to the border with the Bahia state, presents great potential for investments that are being planned and developed, therefore, is a region that needs of a urbanely adequacy plan.

The socio-economic stagnation to the process of urban development to Aracaju city at this area would be as catastrophic as the damage caused to the environment if this development won't happens to be sustainable.

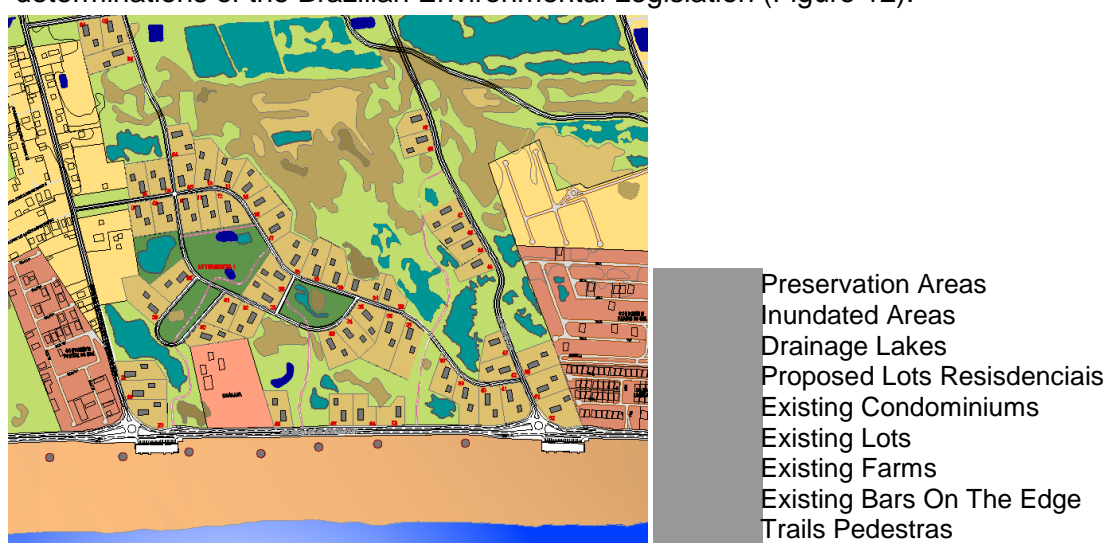
Some Integrated Project could be suggested in advance.

### 6.1 Residential Condominiums

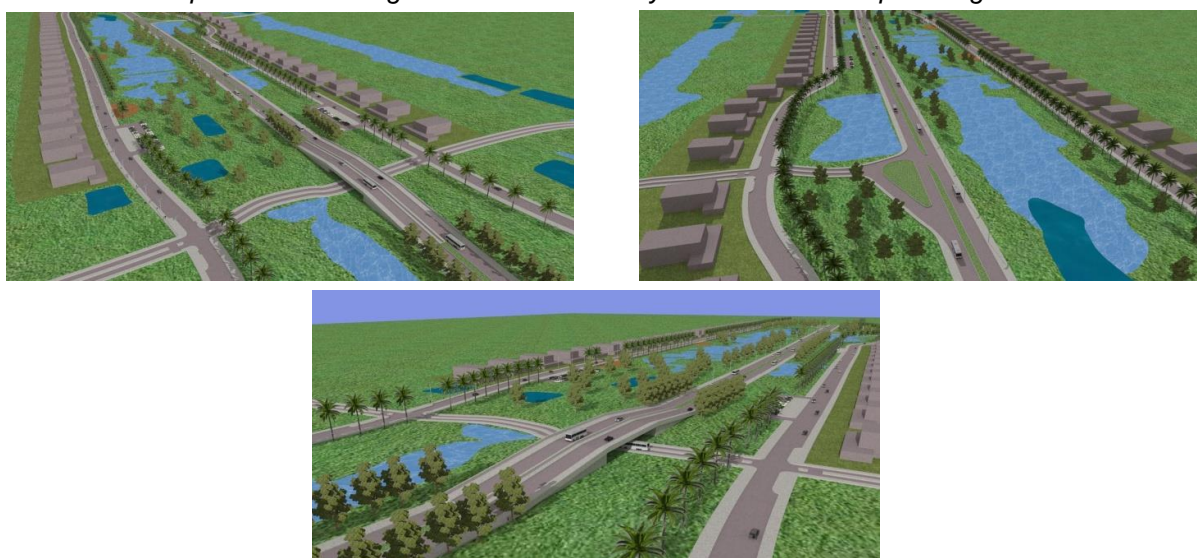
The concept of “closed condominiums” (Figure 11) is in opposition at the concept of “opened cities”, where the distribution of the building and roads want to be harmonic with the topography and the natural elements as dunes, natural lagoons, coastal and mangrove vegetation. These elements shelter a specific and fragile fauna and flora assemblage.

The territorial divisions adopt three basic principles: 1- The first one that consider the environment, biological and hydrologic aspects; 2- The second one that consider the occupation of the spaces harmonized with the physic environment; 3- and the last one in according with the Brazilian Environmental Legislation (Federal and Local). In this way, the considered territorial divisions must present enough irregular aspects that allow the distribution of the lots of well adjusted form to the environmental aspects.

The natural elements such as dunes, lagoons and vegetation were considered as part of the urbanism project in each territorial division, thus making possible, the preservation of the natural elements and in some cases, its proper revitalization, in according with the determinations of the Brazilian Environmental Legislation (Figure 12).



*Figure 11: Model of “open condominiums” in urban environment, assuring the sustainable urbanism in coastal environment to zone of expansion of the Aracaju City. Area of environmental preservation integrated with access ways and commercial polar regions.*



*Figure 12: The Highway of access to the built zones must be planned in order to allow to the flow of vehicles and pedestrians without intervening with the flow of waters (underground and superficial).*



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