Historical-Geographical and Cartographic Evolution of Fundão Island – Brazil

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ABSTRACT:

The Island of Fundão, located in the city of Rio de Janeiro, RJ, corresponds to one of the largest projects of landfill of marine areas accomplished in the city, with an initial aim of sheltering the University City, according the original project, which was substantially modified. The body of the landfill allowed an area increase around 3 200 000 m², in a total area about 5 957 000 m².

The surroundings insular body, created by the eight islands that generated the Universitary Island, established by the Ponta do Galeão, Maré area and Ponta do Cajú, also suffered substantial modifications and exert larger pressures on the insular complex.

This paper shows a way, in a preliminary analysis, on the occupation process of the surrounding, showing through cartographic, geographical and historical studies, the evolution of the proceeded occupation. The analysis of maps in several periods shows how was felt the evolution of the antropic occupation. Starting from the early maps from 1560 until high resolution images, it is possible to draw a quite detailed cadastral x-ray of the area in study.

1) INTRODUCTION

The Island of Fundão was initially projected to shelter the Academical City, congregating several component schools of the University of Brazil, such like University of Medicine, in Praia Vermelha, National School of Engineering, in San Francisco Square, among others, wich was scattered in the city of Rio de Janeiro.

The conception of the construction of an only place that pondered all the activities of the university, comes from 1935, when the studies began for the choice of a place that allowed join all University Schhols in just one place. Ten years of studies (from 1935 to 1945), elaborated by several commissions, considerate several places, according to which the University should be urban and to present conditions of sheltering at a same campus all teaching, researches, culture, technical attendance, residences, sports, administration and services organizations, besides museums, libraries, gardens, etc. The places, in the area of the city of Rio de Janeiro were the following ones: Universitary island, Manguinhos, Governor Island, Fazenda Boa Esperança, Governor Island (other area), Vila Valqueire, Niterói, Quinta da Boa Vista, Praia Vermelha, Gávea e Castelo.

In 1948 it was defined to establish the Universitary City in an island created artificially in Guanabara Bay, located in the Estuary of Manguinhos, Inháuma Bay- formed by the rivers Jacaré, Farias and Timbó.

Between 1949 and 1952, eight islands: Fundão, Baiacú, Cabras, Pindai do Ferreira, Pindai do França, Catalão, Bom Jesus and Sapucaia, were landfilled and interlinked, totaling a surface of 5.9 million square meters. The president Juscelino Kubitscheck, in 1959, named, through the Ordinance 47.535, the resulting island defined by the coalition of the eight island archipelago, as Universitary City Island of the University of Brazil.
Nowadays, the Universitary City Island possesses about 60 academic units and others researches institutions, besides technical, sporting and administrative departments of University of Brazil, in a quite different structure from the original project. The urban mesh and the architectural compounds of the Universitary city occupy around 30% of the island current area. The daily population rotates around 60 thousand people, that circulate among the several organizations of the complex.

With the objective of turning the Universitary City a technological pole, several research, scientific and cultural institutions, some of which complement or complete the activities of the University. They was installed through cession agreements of use of the island areas, which are of federal administration. Thus, it was settled lat the campus important institutions, such as the Institute of Nuclear Engineering of CNEN (National Commission of nuclear energy), Research Center of and Development of Petrobrás (CENPES), Research Center of Eletrobras (CEPEL), Mineral Technology Center (CETEM), Technological Park of Rio de Janeiro (in implantation) and HQ Company of First Military Region.

For your time, the University Island surroundings are areas of great and complexes changing, so much physics so as antropics. These areas make pressures on the University Island area, producing quite adverse effects, like the one caused by the urban violence growth. This area can be demarcated today by the Complexo da Maré, Ponta do Galeão and Ponta do Cajú. Each one has specifics effects on the central element, causing differentiated impacts.

The objective of this paper is the presentation of some variables of the study, as an introductory tool of the global research. The study in itself is part of a research project, presented in the Federal University of Rio de Janeiro, with a forecast of 4 year-old.

Its purpose is to open perspectives of future studies, showing the occupation, land use, of the insular complex as well as the complex around it, based on the temporary aspect of different cartographic moments of the area.

The figure 1 presents the approximated study area, extracted of the 1: 50 000 map of Guanabara Bay.

**Figure 1 – Approximated study area**

### 2 – POSITIONING AREA LOCATION

The area is defined by the UTM projection coordinates showed by the Table 1.

<table>
<thead>
<tr>
<th>Point</th>
<th>E (UTM)</th>
<th>N (UTM)</th>
<th>Latitude</th>
<th>Longitude</th>
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<tbody>
<tr>
<td>1</td>
<td>678000</td>
<td>7468000</td>
<td>-22° 53’ 10.9’’</td>
<td>-43° 15’ 53.1’’</td>
</tr>
<tr>
<td>2</td>
<td>678000</td>
<td>7476000</td>
<td>-22° 48’ 50.9’’</td>
<td>-43° 15’ 56.4’’</td>
</tr>
<tr>
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<td>686000</td>
<td>7476000</td>
<td>-22° 48’ 47.8’’</td>
<td>-43° 11’ 15.9’’</td>
</tr>
<tr>
<td>4</td>
<td>686000</td>
<td>7468000</td>
<td>-22° 53’ 07.8’’</td>
<td>-43° 11’ 12.4’’</td>
</tr>
</tbody>
</table>

This area contains the four subareas of the evolutive study: Ponta do Galeão, Complexo da Maré, Ilha Universitária and Ponta do Caju. The figure 2 shows the areas.
The area contains the following city districts of the City of Rio de Janeiro: Cidade Universitária, Caju, Galeão (fraction) e Maré. Parts of others city districts of Penha, Ramos, Olaria e Bonsucesso will be approached by the research also.

The research encircle also the following City Administrative Regions: I Portuária, XX Ilha do Governador , XXX Maré, X Ramos e XI Penha. The figure 3 shows the study area.
3 – METHODOLOGY

3.1 – Maps

The cartographic maps that will be analyzed are of several nature, having quite different characteristics, respecting the elaboration time, construction method, cartographic projection, scale and geodetic system. One of the largest challenges the research will face, is the development of a methodology to do the compatibility of all cartographic documents, seeking its positioning and location (georreference), mainly for the oldest documents.

The map developed by Francisco João Honesto, “Plano Topographico do Porto e Entrada do Rio de Janeiro e Arredores”, in 1778, was marked as the beginning of scientific mapping of Rio de Janeiro area. It was developed with simple topographic devices and position astronomy. This map will serve as a cartographic base for other several maps, as Diogo Jorge’s Planta Hydrografica of 1810, and ”Plain de Baie of Rio de Janeiro “, after Manoel Vieira Leão. These maps already allow works of preliminary georreferencing, allowing comparisons with other maps.

Previous mappings to this time, may be classified just as outlines or indicative drawings. They will just be able only to give an idea of the occupation and changings and antropic pressures on the area. A lot of times is difficult until the approximate identification of the place, so big are the distortions showed on the maps. The map of João Teixeira Albernaz, 1666, Andréas Antonius Horaty, Saccardi and Dronet, 1711, are good examples of this maps. The figure 4 shows the map of Albernaz - 1666.

The most recent cartography, already based on scientific methods, will facilitate the geopositining work, just presenting problems about cartographic projections, scales and geodetic systems.

Some maps were already selected are the following ones: Plant of the City of Rio de Janeiro of 1890, scale 1:25000; Plant of the City of Rio de Janeiro (Governe Pereira Passos, 1910); Topographical Chart of the City of Rio de Janeiro, Geographical Army Service, scale 1:50 000; Nautical Map of Guanabara Bay, 1922, scale 1:25000; Nautical Map of Guanabara Bay, 1936, scale 1:20000; Topographical Mapping of Rio de Janeiro, scales 1:30000 and 1:20000, 1946; FUNDREM, 1975, 1:10000; topographical maps 1:25000, 1980, DSG and IPP 1998, 1:10000. are Other maps are accomplished in the National Archive, Library of Itamarati Palace, as well as private collections and in the National Library of Lisbon.

![Aparencia do Rio de Janeiro](image)

Figure 4 – João Teixeira de Albernaz 1666 map

Besides maps and charts, others informations are also being looked for in aerial photographies, mosaics, as well as the use of current high resolution images such as IKONOS and QUICKBIRD.
The study and the analysis of such information, will allow establishing a x-ray of the evolution and occupation of the area, that for your time, allied to the available historical documents, will generate, starting from the current moment, a regression of the antropic processes and pressures on the area.

The figures 5 and 6, show the area of the Island of Fundão in two moments, 1946 and 1998

These maps allow to observe the violent changes that modified the area substantially, mainly in respect to landfills and urban occupation.

3.2 – Aerial Photographs and Mosaics
Several aerial photographies in different times are being selected, as well as photogrammetric mosaics generated from those pictures. They allow a more effective vision of the processes which acted in each time. Several civilian and military organization are allowing consultates and copy of the material to be applied in the project.

As an example, the figure 7, presents the mosaic during the landfill of the Insular Complex, in 1950.

Besides aerial photos, the project already use an IKONOS high resolution image, of April 2002, that will also serve of support.

Figure 7 - Aerialphoto Mosaic of the Island of Fundão and surroundings in 1950 - Fonte ETUB, 1952
3.3 – Bibliography Research

The historical and geographical bibliography in research will allow the complementation of historical and cadaster data, necessary to the area x-ray, from past times, until the current moment.

4 – DEVELOPMENT

The cartographic research will be developed according to a tested and approved methodology by the Laboratory of Cartography - GeoCart. This methodology will be applied in different ways, in the several cartographic documents of the study area. It will be presented an abstract of the methodology, for documents already digitized, in vectorial or raster formats, as so as to the existent ones in analogical form. Each process is subdivided in sub processes, to allow the complete treatment of the information.

4.1 – Analogical Cartographic Documents Digitalization

The analogical documents are submitted to matrix digitalization, under 300dpi resolution, the graphic file is generated in TIF format. The best scanner device for this procedure, to digitize a complete map is a table scanner, however this equipment type is very hard to find in Brazil. In that way, we can use a drum scanner at the same established resolution. Small pieces of maps, can be developed in plane scanners A4 or A3. The resolution of 300 dpi is a medium resolution, but it can generate quite heavy files. A color size document of 20cm x 15cm, results in a real file of 12,5 Mb, that compacted in tif or jpg, may lower approximately for 3 or 2 Mb.

After this point, the document is submitted to colors corrections, equalization and electronic restoration, according to its degradation degree.

4.2 – Raster Documents

Those documents are just submitted to the last steps of the previous sub process.

4.3 – Document Vectorization

The raster format documents are vectorized through the following steps:
- Raster-vector transformation, according to a local 0,0 coordinate system;
- Semiautomatic vector process, in different layers of information. Those layers will be the same ones that they will be part of the database associated to the vector documents, for instance: coast line, mangroves, hidrography, heights, roads, streets;
- correction, cleaning and validation of the vector document;
- topologic association;
- Georreference. If the parameters of the cartographic projection are known, it will be executed initially a affine transformation, associating the coordinates of the projection system;
- projection transformation, to compatibility differents map projections;
- scale changing, to the scale pattern established by the project. This scale, in spite of still not to be specified, has a tendency to be defined at the scale 1: 25 000. This is a medium scale and it may join without substantial mistakes, some scale amplification, mainly around the scale 1: 50000.

Under the same optics, information involving satellite images (Landsat and SPOT), may be also added to the work, classifying, with the inherent resolution limitations to the process, the land use in more recent times.

4.4 – Adding Information from Different Sources

The acquired historical information form the historical base of the research. They will serve also to update the cartographic information of each time. That is quite important, relating to occupation and land use information, streets and road names, areas and important and prominent points, allowing to establish links of the past with the present.

An extensive historical bibliography is established, to be studied and classified according to each cartographic support time. This bibliography will be included to the complementation bases about each time.

4.5 – Space-time Database Development

All the collected information will be incorporate in a database space-time (BDET), especially projected to support the research. This database will generate for your time, data files, which will allow the use of geographical information systems, as well as the development of other products associated to the project.
5 – GEOGRAPHICAL ANALYSIS

At this moment, comparison maps are being elaborated, determining the losses and earnings caused by landfills and related problems. The digital elevation models are all designed, relating heights and bathymetry, allowing therefore a vision so much of the changing on surface, as well as about the siltation in the water of the surroundings.

On the other hand, observing the Ponta do Cajú and mainly, the Complexo da Maré, may show all the changing antropic occupation and land use of the area, as for instance, the increase of the disordered occupation (favelas), substitution of industrial areas for home areas, etc.

The smallest changing occurred on the Ponta do Galeão, but nevertheless with the occurrence of landfills, for complementation of International Airport of Rio de Janeiro.

6 – CONCLUSIONS

The project is in the initial phase of the researches, however already presenting quite promising perspectives of possibilities of studies and products, which may be generated.

The use of new technologies, such as the Multimidia, animated and WEB Cartography, open lots of possible applications, such as: animated models of physical and antropic changing, digital elevations models, CD and DVD generation with basic and complementary aspects of the research, socioeconomic database, among others.

Inside of the methodology, already consolidated by previous applications, there is hopes to an increase of the study for other areas of the Municipal district of Rio de Janeiro, in undergraduation monographs, master and doctor thesis, for the neighborhood of Urca and Praia Vermelha, Downtown and other areas. A similar Project will be developed with Governor's Island.

7 - BIBLIOGRAPHY

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Position: Geodesy and Topography Engineer
Academical Professor
Retired Colonel of Engineers Corps of Brazilian Army

PROFESSIONAL FORMATION
Doctor in Sciences in Geography - Federal University of Rio de Janeiro - 2000
Topography and Geodesy Engineer - Military Institute of Engineering - 1977
Official of Engineer Corps - Military Academy of Agulhas Negras - 1969

PUBLISHED PAPERS
64 (sixty four) papers published in Congress, Seminars and several participations.

DIDACTIC ACTIVITIES
- Teacher of the Production Center of State University of Rio de Janeiro - 1977
- Assistant Professor of Federal University of Rio de Janeiro: Undergraduation in Geography: 1994 to 2000;
- Senior Professor of the Federal University of Rio de Janeiro: Undergraduation and Graduation in Geography
- Head of Cartography Laboratory of Geography Department - UFRJ
- Advisor of 11 (eleven) doctorate theses; 25 (twenty five) master's degree theses; 32 (third three) monographs of undergraduated Geography course

RESEARCH LINES
Digital Cartography; GIS; Historical Cartography; Multimidia and WEB Cartography; Thematic Cartography

PARTICIPATION IN CONGRESS, SEMINARS
- Participation in 41 (forty one) several events

ADMINISTRATIVE POSITIONS
- Engineer – Geographical Army Service
Military Institute of Engineering
Coordinator of undergraduation course of Cartographic Engineering; Coordinator of graduation course Automated Cartography; Coordinator of graduation course of Computational Systems

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- Military medal of Silver; Medal of the Pacifier; Medal of Cartographic Merit degree of Oficial