

THE (IN) SUSTAINABILITY OF THE TERRITORY PLANS IN THE FEDERAL DISTRICT:

The case of the Housing Sector Taquari, at Lake Paranoá Basin

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Abstract

In general, the Master Plans of Brazilian cities have been faulty in fostering an integrated approach which would bring together the sector and environmental policies and, at the same time, do not take into consideration the potential of urban morphology. In the Federal District, new urban expansion projects were proposed, without an adequate study of land use and densities regarding the reading of the urban grid and the aspects of environmental vulnerability. Such was the case at Housing Sector Taquari. The urban planner Lucio Costa (the author of the project for the Pilot Plan of Brasília) intended to create an expansion area at Lake Paranoá's Basin (Environmental Protection Area of Paranoá Lake), in the "New North Wing". This region, however is of great environmental sensitivity, once it has several bodies of water that refill the Lake Paranoá, and the lake is currently undergoing an aggradation process. Based on such premises, the present paper seeks to analyze the guidelines present in the territory plan for the expansion area in order to evaluate the environmental and spatial sustainability performances by means of cross referencing the maps of environmental sensitivity integrated with the axial maps articulated to the social logics of the urban space. The results show that the area which is more integrated to the existing infrastructure is not receiving proposals for increasing density and mixed uses. On the other hand, the new developments proposed in the most sensitive areas should not be implemented or need to follow the model of low density, according to the principles of sustainability and keeping the existing rural features it already has, due to the low values of integration and the existing environmental frailties. Our intention is to demonstrate the need for seeking a multidisciplinary approach that encompasses ecological urban planning, articulating different strategies.

Keywords: Urban planning, environmental sustainability, spatial sustainability, Space Syntax, natural movement.

Theme: Urban Space and Social, Economic and Cultural Phenomena

1. INTRODUCTION

This paper aims to analyze the guidelines present in the territory plans of the Federal District (Brasília/Brazil) for the Housing Sector Taquari and the new occupation proposals developed by the Companhia Imobiliária de Brasília (Brasilia Real State Agency) TERRACAP. We intend to evaluate the environmental and spatial sustainability performance by crossing the environmental sensitivity map and the axial map that evaluates the social logic of the urban space (Space Syntax). Thus, we intend to contribute with studies for the future expansions and increased urban density in the areas previously designed by Lucio Costa for this purpose in 'Brasilia Revisited' as the New North Wing (Figure 1).

The main focus of this study is to discuss how to expand the city without causing more impact to the territory of the Federal District and Lake Paranoá, and ensure the environmental and spatial sustainability. This brings about the need for discussing the urban planning and design with a broader and systemic view that can contribute with studies about new occupations in which there would be a harmonious connection between then needs of the urban population, the ecosystem and the capacity of the urban system and its surroundings in supplying this need.



Figure 1 Polygon markings of the Housing Sector Taquari and the areas to be urbanized.

2. THEORETICAL AND METHODOLOGICAL ASPECTS

2.1. Spatial sustainability and Environmental sustainability

The configuration of urban structure has intrinsic properties that the analysis of the primary spatial structure, the street network, can clarify in terms of sustainability for the proposal of multifunctional and dynamic spaces (Hillier, 2009). The articulation of the street network in itself is able to create different movement patterns, being that the way the streets connect interfere in how people choose to move through space (Hillier, 1996; Medeiros, 2006).

According to Hillier (2009), through the Space Syntax Analysis, it is possible to identify the variations in hierarchy of the urban structure, enabling us to draft global and local analysis that

explain the interaction between the aspects of structure and the social, economic and environmental factors. The studies carried out point to a conclusion that the structure of cities results from social, economic and environmental forces, and that the cities with a good syntactic performance end up responding adequately to these forces, therefore the properties of the grid can influence urban sustainability.

Hillier (2009) argues that the Space Syntax brings to light the generic dual form of the city: foreground of centers connected in all scales, from a pair of stores and a café, in a smaller scale, up to an internal sub-city, in a greater scale, within a background network of predominantly residential spaces. The two networks (foreground and background) interact through generic spatial patterns. When relating these two grounds to the environmental, economic, social and cultural forces, we obtain the concept of "spatial sustainability" with a focus on understanding the primary spatial structure of the city, the street network.

Regarding environmental sustainability, Andrade (2005) researched the conflicts of the territory plans, with regard to the features of the Brown and Green Agendas, revealing a lack of integration between the guidelines of these plans and the strategies that result in sustainable cities. As a result, sustainability principles for urban settlements were drafted, based on a systemic view of the cities, aiming to better integrate those plans and contributing for the implementation of sustainable urban settlements. Such principles are based in authors who study the systemic view of human settlements and the city such as: environmental protection (biodiversity and permaculture), increased urban density, urban revival, implementation of neighborhood centers and development of local economy, implementation of sustainable transportation and economically viable housing, communities with a sense of neighborhood, alternative sewage treatment, integrated water management, alternative energies and 3Rs policies (reduce, reuse, recycle).

According to Andrade (2005) for implementing the sustainable cities it's necessary to build a map of Ecocity based on Register (2001) with the characteristics of the city are surveyed, such as its land use and its infrastructure, so as to allow the identification of the areas to be recovered. After that, a zoning map is drafted, where the areas with greater density are strengthened and the areas with higher dependence on automobiles are removed from the most central areas. In this case, the spatial sustainability analysis becomes paramount.

The zoning map of the Ecocity must take into account various pieces of information about the natural environment: where it lies, its history, flora, fauna, weather, water resources, geomorphology, kind of soil, old buildings and local culture. The information contained in the zoning map must be contrasted to the urban planning, so as to contribute for more sustainable solution for the city, reducing the use of cars, diversifying the uses and densities. In this case, the reading of the street network using the Space Syntax is a very important tool for integrating spatial and environmental sustainability.

2.2 Methodology

This research started with a thorough evaluation of the Housing Sector, considering the new expansion areas by cross referencing the environmental sustainability evaluation (analysis of the guidelines and environmental sensitivity maps of the territory plans) and the spatial sustainability (Space Syntax analysis, relating the land use and density with the properties of the street grid). Thus, it was possible to verify whether the proposed pattern is helping with the creation of more sustainable urban spaces.

First, the following documents were analyzed: Master Plan from the Territory Ordering of the

Federal District - PDOT - 2009; Environmental Zoning of the Environmental Protection Area of Lake Paranoá - ZAA; Environmental-Economic Zoning of the Federal District - ZEE; Preservation Plan of the Urban Set - PPCUB; Master Plan for Urban Drainage - PDDU; and Plan for Integrated Management of Water Resources - PGIRH. From these analyses, the guidelines, maps of land use and environmental vulnerabilities were taken, one from each document, concerning the area under study.

The maps used to get environmental information from the region are those shown in Table 1.

Table 1 Plans used for gathering environmental information from the region.

PLANS	MAPS
ZAA	Risk of contamination of the aquifer, present in the ZAA.
ZEE	Sensibility to soil erosion; Sensibility of the aquifer to refill and water production; Integrated environmental sensitivity;
PDDU	Erosive features of the Federal District.
PDOT 2009	Demographic density.

The construction of maps for analysis was developed with the intersection of information on land use by TERRACAP, company that manages the distribution of lands in this region, and environmental sensitivity by overlapping the maps from the images present in the digital archives of the plans and zoning studied, using SICAD with *dwg* extension, already with the plans and studies for the expansion of Taquari. The zones contained in the plans were transformed in polygons and the overlapped with the urban polygons.

The next step was the use of some Space Syntax tools, making simulations in the software Depthmap in order to identify the relational properties of the urban grid in the proposed areas of expansion and measure the performance of the spaces in terms of integration, according to the logic of “natural movement”.

For the syntactic analysis, the axial maps for the occupied areas in Taquari and the project of Expansion of Paranoá were built, considering the potential of the foreground and background. After the axial map of these areas was drafted, the parts were cross referenced with the axial map of the Federal District¹ and surroundings.

Afterwards, the global integration analysis or Rn (radius n) and the choice measure in the radius R 500 meters, R 2.000 meters and R 5.000 meters were carried out. These measurements correspond to the reasonable distances when walking, biking and using motorized transportation (public or private). The choice measures tend to reveal the smaller structures of the city and do not show in the global analysis; they are the local centralities that, together, make up a network of small city centers - diffuse centralities - composed of streets that concentrate movement, once they have more chance to be chosen as a trajectory by the population.

¹ Provided by the research group DIMPU/UNB.

3. RESULTS FROM THE EVALUATION OF THE SPATIAL AND ENVIRONMENTAL SUSTAINABILITY OF HOUSING SECTOR TAQUARI

The urban expansion policies in the Federal District have sought to occupy the urban voids and increase the density of the city where there is ready or nearby infrastructure. The filling of the urban voids is, in principle, a positive action to improve the relations between the parts of the city. However, in some places, this expansion is supposed to happen in areas whose natural elements are more prone to a process of degradation.

In the particular case of Housing Sector Taquari, although the plans and zoning describe the area as environmentally sensitive, and important to the preservation of Lake Paranoá and refill of the aquifer, they only indicate the importance of local preservation, but do not define clear guidelines of how the region could be used with minimal impact, as available at the Master Plan for Urban Draining (PDDU) and the Plan for Integrated Management Water Resources (PGIRH).

In a scenario in which Lake Paranoá becomes the supplier of part of the city's water demand, the reductions in the production capacity of the aquifers and in the storage capacity of the lake may result in lack of water in the quantity and quality needed to supply the demand.

The integrated environmental sensitivities map consists in the spatial integration of the sensitivity to erosion, to damages in the refill capacity of the aquifers and the loss of native vegetable coverage. Here, with the exception of Taquari 1, high levels of environmental sensitivity were identified, requiring care in the implementation of settlements, so they do not trigger great environment damages (Figure 2).

The overlapping of the zoning layers present in the aquifer contamination risk maps have revealed that an area south of Taquari 2 is of very high risk. Within the polygon of Taquari Phase 2 there is also a "very high risk" stretch, and in it there are "high" risk areas (Figure 2).

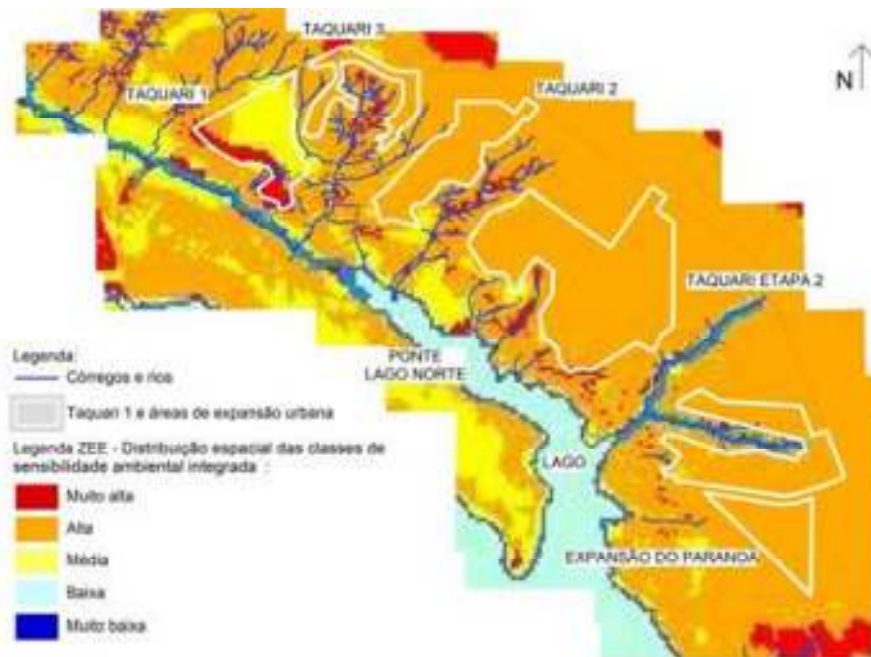


Figure 2 Map of integrated environmental sensitivities and polygons of the areas to undergo urban development in Housing Sector Taquari. Source: Jamil Tancredi.

The map of soil sensitivity to erosion has revealed areas of “high” and “very high” sensitivity to erosive processes along the streams, positioned respectively between the areas of Taquari 3, between the areas of Taquari 2 and Taquari Phase 2, and in between two stretches of Taquari Phase 2. In the stretch below the Taquari polygon, along the Lake Paranoá, a large area sensitive to erosion can be found, and it may suffer from the consequences of paving the soil and increasing the flow of rain water.

The overlapping of the urban development areas with the areas sensitive to the refill of aquifers and water production has revealed that, except for Taquari 1 which was already implemented, all other areas are of high sensitivity. Thus, the areas destined to receive new settlements, once paved, will result in damage to the availability of water resources in sufficient amounts, once the refill of aquifers will be reduced.

In the map of erosive features, gullies and areas of exposed soils are found in Taquari 3 and Taquari Phase 2, in the area closest to the expansion of Lake Paranoá and at the borders of the polygon. The urban development and paving processes may lead to an increase in the existing gullies and the appearance of new ones, further increasing the process of aggradation of the lake.

Studies previously carried out by Andrade and Medeiros (2010), using the concepts of Space Syntax in a parts of the Housing Sector Taquari, have demonstrated that the new settlements are being designed in disagreement to the properties of the urban grid and the principles of environmental and spatial sustainability, thus compromising the local environment and the urban dynamics.

The analysis of new and more elaborated axial maps helped prove that. When overlapping the global integration map to the densities of PDOT, it was possible to observe that the area intended for average density in Taquari 2 and 3, had low values of global integration. The context reveals low integration to the urban grid of the Federal District as a whole, and consequently with the Pilot Plan, where most jobs and offers of services and commerce are concentrated, being a point which attracts a great number of trips (Figure 3).

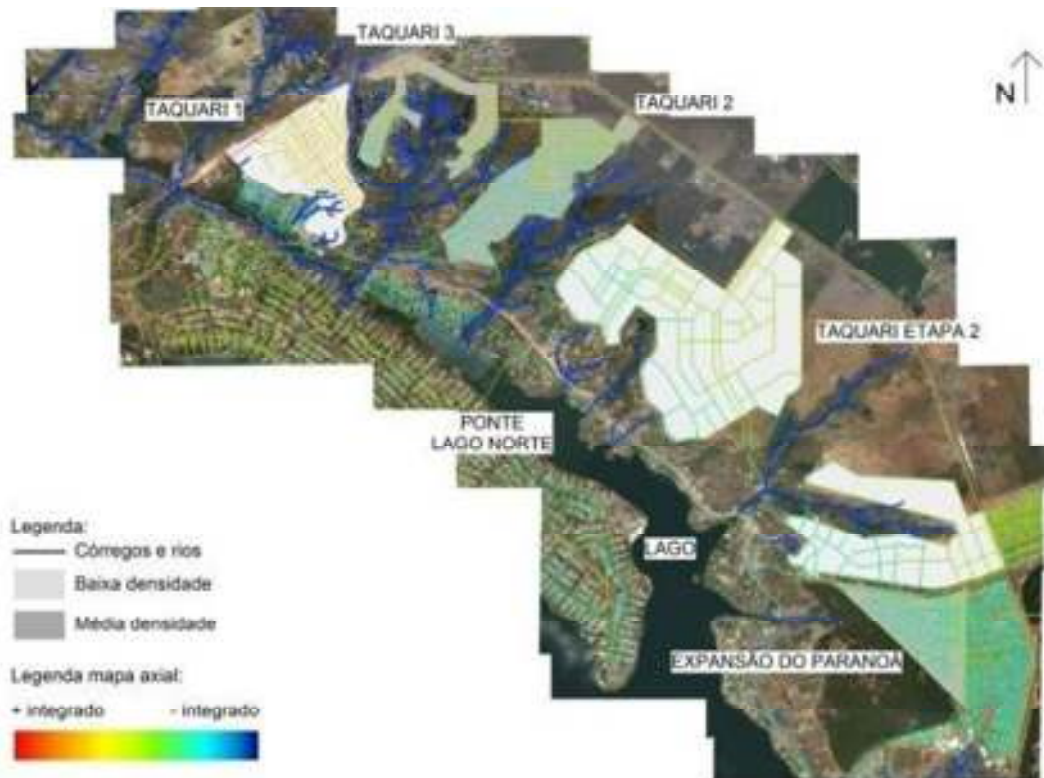


Figure 3 Integration map versus demographic density. Source: Jamil Tancredi.

In Taquari 1, defined as an area of low density, the best global integration results were found, with its streets being shown in yellow, orange and red. For this reason, Taquari 1 can be seen as an integrating core (a set of lines more connected to the system). It would be, therefore, the adequate performance scenario for spatial sustainability, by becoming the proper place for concentrating higher demographic densities.

However, in Taquari Phase 2, defined as a low density area, there are plots reserved for both one family and multifamily housing in the project provided by TERRACAP. In this region the global integration values were low (not as low as stretches 2 and 3) even with the addition of Lake Bridge North, indicating a situation that goes against the concept of spatial sustainability.

It is necessary to highlight that Taquari Phase 2 is still under study and that the plant analyzed does not contain all the local streets, so a new analysis must be carried out with the final project for more accurate results. In the Expansion of Paranoá, of average density, low values of global integration were found, as it was expected due to the distance in relation the most integrated streets of the Federal District and its segregation in relation to the grid, with few connections.

The result of the analysis of the choice measure with a radius of 500 meters corresponds to a reasonable distance to be covered on foot. This distance is calculated based on the routes with a higher chance of being chosen, therefore concentrating movement. In the case studied only the expansion of Paranoá presented good values, integrating with the existing grid (Figure 4).

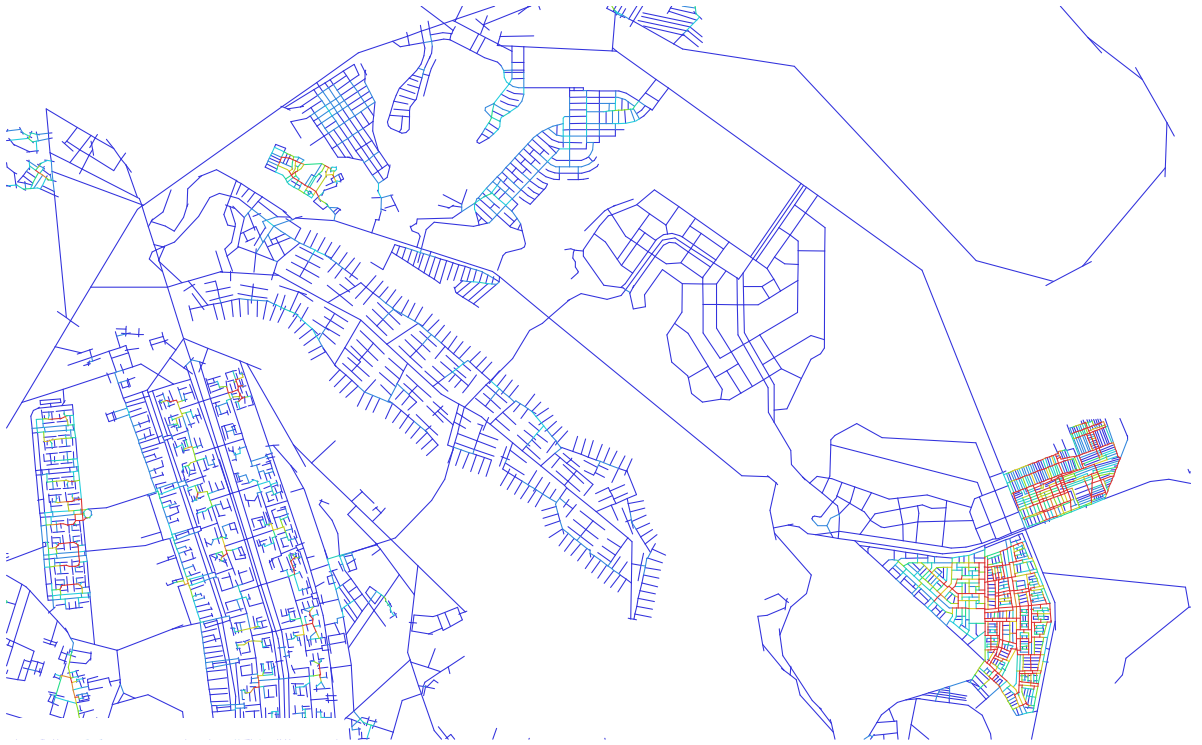


Figure 4 Map of the chosen measure with a 500 meter radius and the polygon areas to undergo urban development in Housing Sector Taquari. Source: Jamil Tancredi.

In the analysis of the 2.000 meter radius, corresponding to the internal routes to be covered by bicycle or fast trips by motorized vehicles, once again the Expansion of Paranoá presented axis with higher values. In the analysis of the 5.000 meters radius only some streets in the Expansion of Paranoá presented high values, revealing that the other areas to be occupied do not present the potential for the creation of local centralities, the diffuse centralities, important for a greater city dynamic and spatial sustainability.

In summary, the analysis carried out overlapping the information contained in the maps, even if still exploratory, reveal the lack of integration between the Plans and Zoning of territory, while they make evident the several environmental sensitivities of the region. Actions to improve the integration in the city by filling the urban voids were identified in the PDOT-2009; however the syntactic analysis revealed low levels of global integration performance.

The regulations established were also not able to create situations for the potential development of local centers, which fosters part of the demands for commerce and services for the population, reducing the need for great displacements.

The results obtained by the syntactic and environmental analysis indicate that the stretch 1 of Taquari is the place more prone to receive a higher density, receiving multifamily housings, services and commerce, due to its good global integration, proximity to the Pilot Plan and for being environmentally less sensitive, and being able to take advantage of the existing infrastructure.

In regard to stretch 2 and Phase 2 of Taquari, due to the low levels of global integration and the environmental frailties, the implementation of settlements according to the sustainability principles and the permaculture with food production would be an option to consider. The third stretch of Taquari, due to the bad syntactic performance and the environmental conditions found there cannot have its implementation justified. This settlement would probably bring

damage to the nearby bodies of water and few benefits to the social and economic dynamics of the city.

4. FINAL CONSIDERATIONS

The exploratory analysis carried out point to a repetition of some patters of land occupation found in the Federal District, such as the increase in density in an area which is not integrated to the urban grid and the occupation of environmentally sensitive areas. The effect is the creation of a design which does not take advantage of the properties of the grid, resulting in an inefficient public transportation system, long commuting distances and environmental damages, especially to the water resources.

In this research it was possible to demonstrate that there is a lack of integration of the territory plans and the lack of communication between the theories of urban planning and urban design. In a multidisciplinary and transdisciplinary approach, the universities should establish a common language for the courses which involve the planning of territory with an “Ecological Urban Planning”, considering these at the same time as the result of how the social production and its contradictory basis, being the environmental events products of these human activities. In addition to that, it is important to also consider the actions that may avoid or minimize environmental risks, undertaking the field of “Ecological Urbanism” capable of understanding the most profound relation between the natural and urban environments and foster social and environmental justice and the resilience of the communities in face of an uncertain future.

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