

## **Environmental restoration of urban rivers in the metropolitan region of Rio de Janeiro, Brazil**

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Volume 4, 2010

Aspects de l'environnement urbain au Brésil  
Aspects of the urban environment in Brazil

URI: <https://id.erudit.org/iderudit/044883ar>  
DOI: <https://doi.org/10.7202/044883ar>

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Publisher(s)

Réseau Villes Régions Monde

ISSN

1916-4645 (digital)

[Explore this journal](#)

Cite this article

S. A. Costa, L. M., Vescina, L. & Barcellos Pinheiro Machado, D. (2010). Environmental restoration of urban rivers in the metropolitan region of Rio de Janeiro, Brazil. *Environnement Urbain / Urban Environment*, 4, 13–26. <https://doi.org/10.7202/044883ar>

Article abstract

This paper aims to expand our understanding of environmental discourses and practices in Brazil pertaining to urban water restoration, by focusing on the interrelations between environmental structure and urban occupation. For this purpose, it examines river and stream environmental restoration proposals within the Iguaçú Project located in Baixada Fluminense, in the state of Rio de Janeiro. The discussion begins with a brief description of the environmental restoration and landscape experience, followed by an exploration of the Baixada Fluminense social and environmental contexts. A program launched by the government is analyzed, emphasizing the development of riverside parks. The paper concludes by arguing that environmental restoration must be culturally specific in order to improve its efficacy.

## ENVIRONMENTAL RESTORATION OF URBAN RIVERS IN THE METROPOLITAN REGION OF RIO DE JANEIRO, BRAZIL

**Lucia Maria S. A. COSTA**  
**Laura VESCINA**  
**Denise Barcellos Pinheiro MACHADO**

### ❖ RÉSUMÉ

Cet article porte sur les discours environnementaux et les pratiques concernant la restauration des eaux urbaines au Brésil en se penchant sur les rapports entre l'environnement et l'occupation urbaine. Une analyse est menée sur les travaux de restauration environnementale des fleuves et cours d'eau entrepris dans le cadre du Projet Iguaçú à la Baixada Fluminense, dans l'état de Rio de Janeiro. Il s'agit dans un premier temps de dresser un portrait de l'expérience de la restauration environnementale et du paysage, puis de cerner les aspects sociaux et environnementaux de la Baixada Fluminense. Une discussion est ensuite menée sur l'action des pouvoirs publics sur cet espace en mettant l'accent sur le développement des parcs riverains. L'article se termine en soulignant que la prise en compte de la spécificité culturelle est essentielle pour améliorer l'efficacité des actions de restauration.

MOTS-CLÉS ■ Urban rivers; environmental restoration; riverside parks; Rio de Janeiro; Baixada Fluminense



### ❖ ABSTRACT

This paper aims to expand our understanding of environmental discourses and practices in Brazil pertaining to urban water restoration, by focusing on the interrelations between environmental structure and urban occupation. For this purpose, it examines river and stream environmental restoration proposals within the Iguaçú Project located in Baixada Fluminense, in the state of Rio de Janeiro. The discussion begins with a brief description of the environmental restoration and landscape experience, followed by an exploration of the Baixada Fluminense social and environmental contexts. A program launched by the government is analyzed, emphasizing the development of riverside parks. The paper concludes by arguing that environmental restoration must be culturally specific in order to improve its efficacy.

KEYWORDS ■ Rivières urbaines; restauration environnementale; parcs riverains; Rio de Janeiro; Baixada Fluminense

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## INTRODUCTION

Experience of the landscape is usually related to its transformation. It has largely been discussed in terms of experience gained through individual or collective values and of new meanings attributed to the landscape reflected through its reinterpretation and change. For many urban dwellers, this kind of experience is strongly associated with water. A large number of cities around the world are built along rivers or streams, which are the very reason of the settlements' existence. However, despite the undeniable significance of water in the origins and development of cities, only recently has attention been given to the analysis of the relations between rivers, cities and their populations, be it in the academic literature or in the professional practice of urban design and landscape architecture.

For many years, particularly from the 18th century onwards, the main approaches solving problems related to urban rivers both in Brazil and in other countries were focused on drainage issues. One had to contain floods and drain water meadows in order to ensure that the land was suitable for urban development. This understanding involved hard engineering of urban rivers by channelization and, often, the total displacement of watercourses, to sub surface drainage systems. This project-based culture, described as "concrete overcoat" by Penning-Rowsell and Burgess (1999), has had a great impact on how we experience the urban landscape, thus reflecting the collective values attributed to rivers.

In various cities throughout the world, this approach has gradually changed. Rivers have been reevaluated and recovered in their environmental integrity and their potential as social spaces has been reclaimed. New values and meanings have been attributed to rivers that are reflected in the way urban restoration projects consider riverine landscapes.

On the basis of this change, we can uncover new perspectives on the relations between the cities and their surrounding landscape. Initially, urban and landscape studies highlighted the rivers' significance in the formation of the landscape structures of the urban fabric. This approach has, more recently, been expanded, and contemporary studies discuss the importance of urban river landscapes from various enriching perspectives, such as those of green corridors, public open spaces, recreation and leisure, environmental services, just to name a few. This has generated a vast number of contemporary project

discourses and practices aimed at urban river restoration (see, for example, Downs and Gregory, 2004).

Urban projects have been privileged instruments of intervention in many countries including Brazil during the last quarter of the 20th century. At first, the scope of the projects was on community participation and local administration initiatives, and it was expanded to a more strategic profile – either in the formulation of the project itself or in the visibility brought to the city and its local authorities (Iplanrio, 1997). Today, incorporated as a practice of urban intervention in the contemporary city, projects have gained a new dimension. We argue that the pressing challenges facing the 21st century Brazilian city are environmental in nature, *latu sensu*, namely restoring both the environmental conditions and a sense of urbanity. As elsewhere, new approaches are developed to address the metropolitan issue, and it might be asked whether metropolises are simply extensions of cities or rather new entities calling into the question the fundamental attributes of urbanity (Ascher, 2008).

Recent literature about urban projects in Brazil reveal that, within the long-term developing plans for the metropolis, spatial strategies are articulated through large and local scales, the latter being where spaces of urbanity can be rescued. A central theme of the strategies is environmental restoration which gives special relevance to river landscape restoration projects.

The main objective of this paper is to expand our understanding of environmental discourses and practices in Brazil concerning urban water restoration, acknowledging the interrelations between environmental structures and urban occupation. To this purpose, the paper focuses on river and stream environmental restoration proposals within the Iguaçu Project, located in the metropolitan area of Rio de Janeiro. The study draws on the concept of landscape as a cultural construction, and it is based on archival research, analysis of public documents and field work. The paper begins with an examination of the urban environmental restoration and landscape experience and strategy. This is followed by an overview of the Baixada Fluminense social and environmental contexts, with a focus on its rivers and streams. The discussion follows with an analysis of a government program, emphasizing landscape design and the development of river banks for waterfront parks. The paper concludes by suggesting that environmental restoration must be culturally specific in order to improve its efficacy.

## I. ENVIRONMENTAL RESTORATION AND LANDSCAPE EXPERIENCE

In general, the idea of environmental restoration is related to the idea of process. This understanding has been achieved through groundbreaking work of Ian McHarg (1969), who developed a methodology of landscape analysis and intervention that addressed diverse scales of the environment and was based on the study of the dynamics of natural processes and of their repercussions on the landscape. When the study of landscape experiences is integrated to the study of natural processes, the complexity of the process is heightened, as a vast number of interests, appropriations and contradictions are incorporated to the analysis. As Corner (1999, p. 3) argues, nature is not “culture-free”. In other words, cultural dynamics should be taken into account in environmental restoration processes in order to improve efficacy (see also Gregory, 2006). A number of academic studies conducted in Brazil have already stressed that environmental degradation is at times directly related to cultural issues (Leonel, 1998; Costa, 2006; Martins 2006; Bueno and Martins, 2007).

Following Corner (1999) who suggests that landscape be considered as a verb and not merely as a noun, attention can be drawn to the processual character of landscape and its capacity to enrich local cultures. The landscape can thus serve as an impetus for and play an interactive role in the re-interpretative and transformative processes of space. As such, one can argue that the strategic efficiency of environmental restoration processes is contingent on the recognition of the full range of socio-environmental values associated with urban water as well as of the complicit and interactive relationship dynamics between the landscape and the different cultural groups involved.

This is apparent when we look at the environmental conservation status of Brazilian's urban fluvial landscapes, which are currently protected by environmental legislation at federal, state and municipal levels. For a variety of reasons, this protection, however, has not proven truly effective. One of the most debated issues is the difficulty in which public spheres can be constructed to provide management and environmental protection (Martins, 2006; Britto and Silva, 2006; Costa et al., 2007). Besides, to ensure effective restoration and protection, preserving environmental values is insufficient. Projects should be more responsive to the riparian inhabitants' cultural values. Due to the lack of public use, stream and river banks in large and medium-sized Brazilian cities are being occupied increasingly by informal housing (*favelas*). With the

expansion of illegal settlements, the original environmental values on which the case for legal protection is built are forgotten (Costa, 2006; Bueno and Martins, 2007).

Various studies on the occupation of stream and river banks in Brazilian urban areas have highlighted that regardless of whether they are under legal protection, they remain vulnerable as the number of poor seeking to build their home on this land is increasing (Costa, 2006; Bueno and Martins, 2007). As a result, although their value is recognized in theory, the water banks are nothing more than residual landscapes in practice, i.e. forgotten areas in the formal process of weaving the urban fabric lacking adequate urban and landscape integration as well as public visibility and access and exposed, consequently, to diverse forms of blight and degradation. On the other hand, studies also demonstrate that, when local people's values and their landscape experiences are taken into account, environmental restoration initiatives can be effective. This is the case, for instance, of the Programa Guardiões dos Rios (River Guardians Program), launched by the Municipality of Rio de Janeiro in 2001. The Program was established to ensure local community involvement in the decontamination and preservation of nearby rivers and streams, and has succeeded in avoiding regular flooding and, in the process, generating income for families in need (Costa et al., 2007).

Watershed-based river restoration projects recognize that the watershed framework serves as a strategic spatial approach for improved intervention and territorial ordination. The concept of a watershed as a planning and administration unit was introduced in Brazil not until as late as the 1990s (Cunha and Coelho, 2003). A combined study of the watershed provides for a better conceptual understanding of the range of environmental and cultural dynamics interacting with each other than a study limited to the course of an isolated river. This approach necessarily entails inter-scaling techniques to conduct an analysis of both the effects of the projects on the landscape and municipal, state and federal project management practices.

Based on an analysis of the watershed, the proposal for the revitalization of the sub-basin of the Bananal Stream, located in the outskirts of the municipality of São Paulo, involves landscape intervention projects along its banks (Pellegrino et al., 2006). A restoration plan was implemented for the sub-basin within the larger watershed context of the Cabuçu de Baixo River. It involves professionals from many fields including landscape architecture, hydrology, biology, and ecology.

Its main objectives were to address the risk of flooding, water resources contamination, and soil degradation. The rapid and haphazard development of *favelas* along river banks is one of the major problems facing the sub-basin area. In addition to displacing approximately 750 inhabitants and moving them to apartment buildings in risk-free zones, yet within the watershed, the proposal for the Bananal Stream included a network of parks and green areas connected to surface water drainage and ecological treatment systems. Initiated in 2003, it is currently in its implementation phase and relies on the participation of the local population and government bodies. Delays in the process are mainly due to difficulties of communication among agents, in particular decision-makers providing financial resources.

The project for the Paranaíba River, located in the state of Goiás, in central Brazil, presents another problem (Gorski, 2007). This revitalization project, although limited to the river's banks up to the city limits of Itumbiara, also considered the watershed in its entirety. This basin is affected by many factors including the presence of hydroelectric power plants, water pollution from agricultural activities, domestic and industrial effluents, deforestation and the high rate of soil impermeability. Initiated in 2005 at the request of the municipality of Itumbiara, this restoration project was undertaken with local people and emphasizes their connection to the Paranaíba River. It aims to reinforce and facilitate public uses related to fishing, nautical activities and other types of recreation activities, as well as the traditional religious processions held on its waters. As this river flows through more than one municipality, the implementation phase of the project relies on successful negotiations between local government authorities and is thus a slow and difficult process.

These projects and other experiences under way show how diverse the interface areas between rivers and cities are being used throughout urban Brazil. There are a number of ways of defining what constitutes a feasible urban river environmental restoration project varies according to the team of professionals, government and popular interests and the amount of available funds. Some common denominators, however, can be identified: an approach articulating the scales of the drainage basin with the local scales for specific projects; the regeneration of the rivers' banks from the standpoint of creating access and public use areas, thus pointing to the need for a combination of social and environmental values; the recognition of the difficulty of reconciling interests and conflicts during the implantation phase.

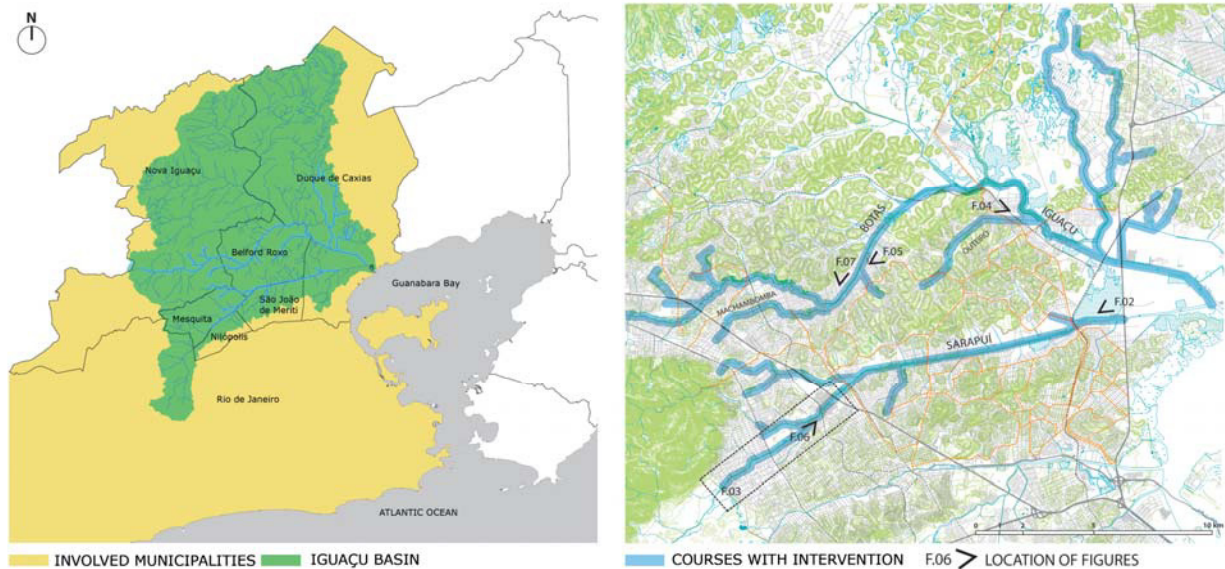
Several of these issues, which are addressed in detail in the following section, are central to the Iguazu Project. We examine this project within the context in which it is located, the Baixada Fluminense.

## 2. THE ENVIRONMENTAL AND SOCIAL CONTEXT OF THE BAIXADA FLUMINENSE

Baixada Fluminense (Fluminense Lowland) is a dynamic region undergoing landscape and socio-cultural transformations. It has experienced historical cycles of intensive development, abandonment, expansion and retraction, which have contributed to its emergence as one of the most significant areas of the metropolitan region of Rio de Janeiro. At the same time, however, the Baixada is known for its environmental conflicts, its deficiencies in basic public services and for its high level of social deprivation. During the rapid process of urbanization of the second half of the 20th century, conflicts have occurred between the demands made by developers and the need to protect Baixada's fragile ecosystem. Given the urgency of the water-related problems, actions such as fighting floods and draining and canalizing rivers were carried-out at great cost. Tremendous efforts have been made over time to "sanitize" the area and gain control over frequent floods (Sedur, 1990).

Only recently have public policies, especially at the discourse level, incorporated a more complex understanding of this watershed system and of the river within the metropolitan landscape. Various initiatives being taken, as will be discussed further, have drawn on the concept of "environmental restoration", which involves not only solving relatively simple problems related to drainage and floods but also enhancing the ecological health of water resources, restoring the riparian woodlands and, above all, contributing towards a more harmonious relation with the urban surroundings and its inhabitants.

The Baixada Fluminense, an *entre-deux*, is delimited by the Mountain Range of the Sea to the north and the Carioca Mountain Range to the south. To the east, its boundaries are defined by the Baía da Guanabara and the Municipality of Magé, and to the west, by the Guandú River. The Baixada Fluminense is a built-up area composed of several municipalities located in the northern metropolitan region of Rio de Janeiro. These includes the municipalities of Nova Iguaçu, Japerí, Queimados, Belford Roxo, Mesquita, Nilópolis, São João de Meriti and Duque de Caxias. With a total area of 1262 km<sup>2</sup>, and a population of three million inhabitants, the Baixada is home to nearly 30% of the total population of the metropolitan area and generates some 24.6% of its gross domestic product.



Source: Costa, Vescina, Pinheiro Machado

**Fig. 1 – Municipalities of the Iguaçú Basin, Guanabara Bay, Rio de Janeiro State. Water courses with intervention receiving support from the Project and location of figures**

Water dominates the landscape morphology of the Baixada Fluminense. It is basically a flat, lowland area broken up by small hills and crossed by a vast system of rivers. The Baixada lies within two major drainage basins, the Macro-basin of the Baía da Guanabara and the Macro-basin of the Baía de Sepetiba, and it is in the former watershed where urban population concentrations are greater. In the Macro-basin of the Baía da Guanabara, the largest basins are the Iguaçú, Botas and Sarapuí Rivers. These eastern-flowing rivers originate from the mountain ranges surrounding this macro landscape (Iguaçú in Tingua, Botas in Gericino and Sarapuí in the mountain range of Bangu), running through areas of different urban density before finally discharging into the Baía (Sedur, 1990; Mendes, 1950).

The landscape has been shaped over time by water flow from the rivers or the ocean. The region's soils found in the small plains flanked by mountains were formed, by sand and clay sediments, which were transported from the sea or carried by streams and surface water courses from the mountains and hills. The latter vary in height; the highest being those close to the base of the mountain range and the lowest and roundest being those found in the interior of the range. This type of landform, commonly known as *meia-laranja* (half-orange), is easily exploited by

extractive industries (quarries). Besides modifying the landscape, the combined action of extracting soil from the hills and mountains for the reclamation of flooded areas – one of the historical characteristics of the development pattern of the city of Rio de Janeiro up to the mid-20th century – heightens flood-related problems (Mendes, 1950).

During the summer months, when rainfall is heavier, torrential flows from the top of the mountain ranges gradually wane as they reach the Baixada, running in between the hillsides and flooding the lower areas, before finally reaching the Baía da Guanabara. When tides are high, the lowlands near the Baía are flooded, and the sea water invades the aquifers, in some areas up to six kilometers inland, thus forming marshes and mangroves.

Rivers continue to play a key role in the Baixada Fluminense productive cycles. As noted by Mendes (1950), the significance and role of these rivers have changed over time as the vast territory underwent several cycles of development. The first settlements were located on the shores of the rivers, which served as a major navigation route for materials and goods to and from the inland regions and the port of Rio de Janeiro. The waterways gradually declined and were replaced by rail and road transport. The port

settlements that appeared along the rivers were progressively relocated inland near the train stations. They formed the nodal points through which urban development expanded towards the rural areas and formed the centralities that are still visible today. The 20th century brought on the great roadway infrastructures and a new structural axis, which eventually created a permanent link between the Rio de Janeiro and São Paulo metropolitan areas, passing through the Baixada Fluminense and producing major transformations in the organization and development of the territory.

Sugarcane plantations were the first human activity to modify the landscape. Rural occupation patterns were well adapted to the physiographic conditions of the Baixada Fluminense: settlements were located midway up the hillsides while the plantations were established in the fertile river valleys subject to possible floods. Chapels were erected on hill tops to physically separate them from the dwellings. Nonetheless, by the end of the 19th century, the small and not so productive valleys rapidly subsided, which – alongside the abolition of slavery – led to the abandonment of the land. Following this period, the deterioration of rural activity, together with the discontinued maintenance of the rivers and canals that served the purpose of transportation, gave way to the restoration of the marshlands and to the outbreak of malaria (Sedur, 1990; Mendes, 1950).

In the beginning of the 20th century, another cycle caused further changes to the landscape: the orange cycle. From 1926, with the expansion of the European market, the rapid growth of this crop gave way to a new geometrical landscape of small lots characterized by extensive rows of orange groves and hedges. The sanitary constructions initiated by the federal government from the 1930s onwards, provided an opportunity for the extension of the plantations from the hillsides to the lowlands (Mendes, 1950).

By the late 1940s, the end of the orange “boom” in the Baixada Fluminense had no effect on the government’s plan to transform the city of Rio de Janeiro outskirts into one of the major horticultural and agricultural production areas, which would possibly supply legumes, vegetables and poultry products to the carioca population. As such, the Sanitation Commission of the Baixada (Comissão de Saneamento da Baixada) was created, through which important waterworks projects were undertaken. The construction of dams, the canalization and rectification of its rivers indisputably changed its landscape.

Little incentives for the rural occupation of the “sanitized” areas, combined with the waiving of the orange plantations, opened the way for urban expansion. Starting in the 1950s, the electrification of railways and the construction of a freeway linking Rio de Janeiro to São Paulo contributed to the spatial extension and sprawl of the capital to the Baixada Fluminense. Mendes (1950, p. 30) was one of the first to observe the formation of an urban continuum along the railroad tracks:

the former nodes of rows of houses surrounding the stations and stops in a range of 50 km from the center of the metropolis have practically come together to form as if a single city, stretching itself out as the tentacles or as the open vanes of a fan. The open areas in between the suburban nucleuses, along the railways, are already scarce and will soon all be entirely populated.

The real estate speculation that occurred in the Baixada Fluminense during the second half of the 20th century led to indiscriminate occupation, irregular development without urban infrastructure and aggravated environmental conflicts. Rivers silted up due to their abandonment by authorities and the direct discharge of untreated sewage from the precarious dwellings in addition to the waste generated by industries. In many cases, settlements were built haphazardly on the rivers’ margins. Furthermore, the total absence of waste collection services, the deforesting of the slopes and the geophagy of the hills made conditions even worse (Sedur, 1990; Mendes, 1950).

Despite the considerable amount of effort that was invested so far, their lack of coordination and efficiency has not helped to reverse the process of degradation. A series of initiatives were launched in the mid 1980s but were restricted mainly to the provision of basic sanitation and flood control (Serla, 1996). Such interventions include the provision of water supply, the construction of sewage treatment systems and stations, clean-up and sediment control in rivers and canals and the pavement of roads and related developments. Additional actions include institutional support, waste collection, and environmental education.

A series of actions were carried out under the Rio Reconstruction Project (Reconstrução Rio), which was initiated in the aftermath of major floods that struck the region in 1988. Although these efforts were directed at the macro-drainage systems, including the construction of the Gericinó dam, and helped mitigate

the effects of floods, they failed to solve the totality of conflicts. Owing to their narrow scope and the total lack of maintenance, most of the infrastructure was obsolete or inefficient once the projects were completed.

More recently, in 1994, the Baixada Alive (Baixada Viva) Program – renamed soon afterwards, New Baixada (Nova Baixada) – set out to integrate a diverse set of actions by taking into account the various boroughs that make up the city region. Unlike previous programs, these actions seek to integrate social and urban infrastructure sectors for the “sustainable development of the environment, satisfactory urban development of boroughs and the restoration of citizenship” (Serla, 1996, p18). The so-called integration was hardly achieved, and the low quality of built structures also led to the program’s demise.

The reasons that can explain why the accumulated investments of over a billion dollars have not managed to substantially improve the situation in the Baixada are complex. Porto (2003), in his analysis of the evolution of public policies over the last thirty years in the Baixada Fluminense, discusses how the process of patrimonialization and the influence of clientelism, quite distinctive in the Brazilian political context, have moved the region closer to the brink of disaster. Porto argues that the water and sanitation policies that prevailed in the Baixada played no part in the building of citizenship and in exercising this right.

### **3. THE IGUAÇU PROJECT**

In 1994, a technical commission was given the mandate of elaborating the “Integrated Master Plan of Floods in the Iguaçu-Sarapuí River Watershed” (Plano Diretor Integrado de Inundações da Bacia do Rio Iguaçu-Sarapuí), which established a framework for the management of regional water resources intended to facilitate local and state governments with coordinating public policy decision making processes. The document – later known as the Iguaçu Project (Projeto Iguaçu) – recommended a series of structural interventions to complement the initiatives put forward as part of the program Rio Reconstruction (Reconstrução Rio). Non-structural interventions for land use regulation were also included in the master plan. Coordinated by the Laboratory of Hydraulic Engineering of the Federal University of Rio de Janeiro (UFRJ), and with funding from the International Bank for Reconstruction and Development (IBRD), United Nations Development Programme (UNDP) and Caixa Econômica Federal which is a Brazilian bank, the

master plan drew on the expertise of a wide range of professionals, local and state government representatives and neighborhood associations (Serla, 1996).

The Iguaçu Project aims at “improving housing and urban infrastructural conditions in the flood affected areas of the Baixada Fluminense, as well as recovering the banks of the watercourses and their springs” (Serla, 1996, p.4). It results from the necessity of better controlling recurrent floods which are potentially hazardous for the entire population of the drainage basins. To achieve this goal, the following actions are planned: relocation of approximately 2000 families, living on the rivers’ banks in unsanitary dwellings and in hazardous areas, to nearby residential complexes; dredging and decontaminating the waters; construction of canal right-of-ways and riverside parks. The project includes community participation in all its stages, as well as generating income and jobs particularly during the implementation phase (Serla, 1996).

Actions undertaken so far have been limited due to the insufficiency of available funds. More than ten years following its launch, the Iguaçu Project was implemented with the financial support of a federal program named PAC – Program for the Acceleration of Growth (Programa de Aceleração do Crescimento). This program, which allocates funds to logistics projects in various Brazilian cities to help develop their urban and social infrastructure, invested 195 million Reais – about 97 million US dollars – in the project, which has been re-named Flood Control and Environmental Restoration of the Iguaçu, Botas and Sarapuí Rivers’ Basin (Controle de Inundações e Recuperação Ambiental da Bacia dos Rios Iguaçu, Botas e Sarapuí).

Approximately 50 km of rivers and streams running across seven municipalities are the focus of the project, which has developed a range of interventions: hydraulic macro-drainage, including the decontamination and dredging of rivers; repair of sluices; removal of barriers to navigation i.e. narrow bridges; urban and environmental remediation initiatives, including the reforestation of river banks the development of linear parkways; removal of illegally built structures on the banks and relocation of the affected families, and the construction of new secondary roads. Social actions include the registration of families and information campaigns, organization of neighborhood follow-up committees, environmental education, the raising of awareness and citizen participation (Ecologus, 2007).





Source INEA (State Institute for the Environment) archives

**Photo 1 – Informal developments along river courses. Aerial view of Sarapuí River, Duque de Caxias**



Source: BLAC, 2008

**Fig.2 – Opportunities of intervention. Remaining open spaces along the rivers. Sarapuí River**



Source: BLAC, 2008

**Fig. 3 – Opportunities of intervention. Catch basins, proposed park for Polder of Outeiro River**

Public green space within Baixada Fluminense is insufficient to meet population needs. Developing a string of open spaces along the rivers would remedy this situation and offer a new possibility for restructuring the entire territory. Green corridors along the river edges linking vacant lots and other open spaces could form a greenways network and play a variety of recreation and leisure roles while providing ecological connectivity. Connectivity could contribute to the protection and enhancement of urban biodiversity. Nevertheless, green corridors should be considered as an environmental protection measure targeting a wider range of cultural and social goals.

The proposal to develop riverside parks as part of the Iguaçú Project is part of a multi-level strategy intended to address issues related to environmental restoration, the expansion of rivers' social values, and the provision of urban infrastructure by considering environmental, cultural and urban resources.

Initiatives take into account existing realities and deal with the diversity and complexity of situations along the rivers. Opportunities for the development of green corridors are based on existing features and others brought about by the interventions: vacant and abandoned lots waiting for a new designation, informal gardens and green spaces already appropriated by the local population, improvised football fields, reclaimed land after relocation of families, and the like.

Other opportunities arise from hydraulic projects carried out in the retention basins. Owing to impermeable soils and settlements located in hazardous flood-prone areas, hydraulic projects must regulate the flow of flood waters and ensure that large areas remain as open space and are not encroached upon. In these areas, climatic conditions change drastically from very wet during the rainy season to dry the rest of the year. The variation in climate was used as an argument to create floodable parks in these areas. These parks are also designed to perform other functions, including bio-filters for decontaminating surface water. In this sense, parks can be used as large filtering structures while at the same time providing educational and recreational opportunities to the local population.

Following Manning (1997), proposals must seek to combine three features of the experiences of river landscapes: to walk along the river, to have physical access to its waters, and to cross it. In this way, potential relations between river and the local

population can be enhanced, by bringing the river back into the landscape, instead of being inaccessible and remaining hidden from view behind industries, housing and other constructions.

The first rivers to have benefited from urban and landscape projects were the Botas and Sarapuí Rivers, given their structural significance for the territory. The stretch of the Botas River, in between its mouth and the Machambomba River, with an extension of approximately 5 km, flows through the municipalities of Duque de Caxias and Belford Roxo. In the first passage, a predominantly rural area, besides dredging and dragging the river bed, the plans aim at restoring the riparian woodlands along the banks degraded by channel widening. Due to a low level of public – and, consequently, political – visibility, this particular project has not yet begun.

In the Belford Roxo stretch, however, an important section is located within areas of medium and medium-low densities. Past dredging has scared the landscape and left it in a deplorable state. Although the situation was rectified, there was no attempt at reforestation or other restoration of the river banks. On the left bank, a dike and an avenue have been built. Irregular land occupation and an informal network of dirt paths characterize the lower right bank, which is more prone to floods.

Once the dredging is completed, the project calls for the construction of a new roadway on the right embankment, sidewalks and a bike path and the reforestation of key sites to restore riparian vegetation. The water channels in this particular area are in a state of decay and as a result, installations such as sports fields or playgrounds along the river are unsuitable. Wherever possible, however, benches and small leisure areas are authorized in order to establish new links between the population and the river.

The Sarapuí River is composed of two sections. The river maintains its original winding course when flowing through the municipalities of Nilópolis, as well as Mesquita and São João de Meriti where it serves as a boundary. This low and medium-low density urban area is characterized by a mixed land-use pattern along the banks with alternating vacant areas and informal developments. High voltage transmission towers are found on the banks along the river. In certain areas, the power lines form a barrier which could constrain interactions between the river and its immediate surroundings.



Source: BLAC, 2008

**Photo 2 – Botas River, Belford Roxo, before intervention. Panoramic view**



Source: INEA archives

**Photo 3 – Sarapuí River, Mesquita. Panoramic view**



Source: BLAC, 2008

**Fig. 4 – Botas River. Illustration of the proposed intervention. Avenida Atlántica, Belford Roxo, before and after**

Further downstream, however, the situation is different. The river runs through the municipalities of Belford Roxo, São João de Meriti and Duque de Caxias at the point where it reaches a width of 60 to 90 meters. Here, the river's course has been deviated so that the waters no longer flow directly into the Baía de Guanabara but into the Iguaçú River. In addition to the diversion of the river, a dike is partially built along its right bank. This structure is currently occupied by precarious dwellings, thus forming a linear favela on the upper and safe edge of the dike.

The existence of a large open area next to the Sarapuí River serves as a paradigmatic model for the Iguaçú Project. While complex land dispossession processes are under way, current initiatives have focused on a small stretch of this river. In fact, the first of the six proposed riverside parks will be built here. The overall impact of the intervention is negligible but seeks rather to consider how local populations have occupied the area and draw on the existing buildings and other types of informal land uses. The strip of land between the river and a social housing project is a forested area informally used by the residents for leisure and recreation activities. The project integrates existing and new vegetation including both ornamental and fruit-bearing trees. Various uses are proposed: areas of rest and contemplation, sports fields and children playgrounds that form "rooms" within the park. The planning process for the riverside park proposal enabled local residents to share not only their experience of landscape but also their expectations. Public participation was key to enhance the river's capacity to function as a social space.

#### **4. FINAL REMARKS**

Interventions in the hydrological system open up a range of opportunities to explore the issues surrounding relationships between rivers, the urban fabric and local residents. This is particularly significant in metropolitan peripheral areas such as Baixada Fluminense. The potential of rivers and streams can be tapped to break the homogeneity of the surrounding urban landscape. Compared to the high density and tightly-built central urban areas where rivers have been canalized and hidden under the streets, the less populated but rapidly-growing peripheries, deprived of financial means and resources, are still endowed with free flowing rivers.

These projects aimed at improving flood control offer a unique opportunity to transform the urban fabric. The investments are justified on social and

environmental grounds. The interventions will significantly transform and bring much needed improvements in terms of infrastructure to an area which had been overlooked by public authorities for a long time.

As discussed above, urban rivers are understood today as environmental structures able to reclaim areas through which they flow. They offer opportunities to create new urban waterfronts, provide new amenities and services and introduce new land uses. Recent academic literature argues that rivers are valuable and meaningful features of urban space. Urban intervention projects emphasize the importance of rivers and their banks in the context of metropolitan level land-use planning practice.

With regards specifically to the Iguaçú Project, urban planning as a discipline plays a minor role in the process as a whole. This is a real concern particularly when projects straddle several municipalities. Isolated decision-making therefore undermines existing metropolitan administrative, political and spatial structures. The Iguaçú Project, although referred to as an interdisciplinary approach, does not differ from other similar former interventions (see Porto, 2003).

Clearly, the proposed riverside parks for the Sarapuí and Botas Rivers will be unable to grapple with the complexity of environmental and social problems specific to their basins. Once completed, the parks have the potential to improve the area, increase public access and enhance the landscape. However, in trying to deal with the complexity of the political challenges facing the Baixada Fluminense, political, socio-cultural, economic and environmental actions and strategies should also be considered.

In view of the above, we argue that environmental restoration of Brazilian cities will require an ability to contend with the complexity, diversity and divergence of a variety of stakeholders and of their views on their experience of the landscape. It implies, therefore, culturally specific interventions which address different needs (such as environmental, economic, and socio-cultural) and integrate various territorial scales (ranging from the globalized scale to the local neighborhood) in distinct time frames. By considering both time and space as heterogeneous, a series of long and short term actions must be undertaken simultaneously on the same landscape.

## ACKNOWLEDGEMENTS

The authors wish to thank CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico), FAPERJ (Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro) and CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) who provided the financial support which made this research possible. In addition, we acknowledge the critical comments of anonymous referees in shaping the final paper.

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