Rio Tietê, São Paulo, Brazil: From 19th to 21st Century, Challenges For Resilience

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Abstract

Historical course of urban development linked to rapid industrialization phenomenon have influenced both landscape transformation and relations between water resources and society in São Paulo. Harmonious coexistence among urbanized areas and water has been a major challenge. This paper illustrates how successive sanitation plans in Tietê river have followed a car-oriented city policy which has favored urban sprawl since its implementation. Tietê river has suffered intense morphological changes together with accumulation of environmental problems that collaborate to socio-spatial segregation in urban landscape. Gradual loss of sports, recreational and fishing activities have taken place due to the conversion of this river into a rainwater and sanitary drainage channel. A sequential analysis of maps and projects of interventions carried out in this river points out the continuity of design and management practices based on a logic already surpassed by cities that aim to constitute resilient urban environments. It is time to highlight more integrated approaches of river waters and public spaces in order to achieve environmental quality and resilience in urban landscapes. This megacity still awaits for other important spheres of city life, such as cultural and social, to be added to operational functionalities related to urban water management.

Keywords: Urban historiography, Urban sustainability, Water sanitation, Urban resilience, Tietê river.

1. Introduction and methodology

This study aims to understand how historical evolution of the Tietê river plans is related to the transformation process of São Paulo from a colonial village into a modern city, which today is one of the world’s biggest metropolises. The river stretch chosen for analysis has played a fundamental historical part in this relation. The retrospective research identified key aspects of São Paulo’s urban structure that constitute challenges to overcome by design for a more resilient urban environment. Methodology used in this study followed three steps: data collection, cross-referencing and analysis. Firstly, there was a bibliographical research on the concept of resilience and on the history of São Paulo city’s urbanization, from its foundation to the present, describing the role of the Tietê river within its process. Secondly, a documentary research in public archives in São Paulo city provided primary sources for historical analysis, such as official cartographic documents.

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AutoCAD 2015 and Photoshop CS5 softwares aided in highlighting relevant points for critical reflection on
the maps and images to hold a dialogue with the literature reviewed on sanitation and on urbanization. This
study contributes to the historiography of Tietê river’s course changes together with the build up of a modern
São Paulo. It also seeks out elements to discuss the future of this river in terms of urban resilience.

2. Urban development, resilience and future vision for sustainable use of urban waters

In a world where 54.5% of its total population inhabits urban areas (UN, 2016), increasing demands of
freshwater resources create an urgent need to research on water management improvements (JACKSON et al., 2001). The Global South houses 24 of 31 world’s megacities and the next 10 cities expected to turn into
megacities by 2030 are all located in developing countries (UN, 2016). Problems related to infrastructure and
urbanization in these countries, especially in Latin America, result in inadequate environmental
circumstances that reduce population’s health conditions and quality of life, cause environmental impacts
and are limiting factors for development (TUCCI, 2008). The megacity known as Great São Paulo
congregates 39 municipalities and gathers 21,242,939 million inhabitants (IBGE, 2016), which means 12.1%
of total Brazilian urban population (UN, 2016). Its Gross Domestic Product (GDP) accounts for about 18% of
Brazil's total and more than half of São Paulo state’s GDP (55.47%). Despite the undoubted economic
importance of this city, a serious water crisis that hit São Paulo state in the years 2014 and 2015 showed
that there is much to improve in water governance (ROCHA, 2017). Shortage of water supply in dry season
cocexist with recurrent floods in rainy seasons, which cause material damage, spread diseases and threaten
human lives (G1, 2017). As signatory to the 2030 Sustainable Development Agenda, Brazil has committed to
take measures for increasing quality of life, improving natural resource use efficiency and reducing global
environmental impacts (UN-HABITAT III, 2016). The resilience concept deals with interrelationships among
peoples and the built and natural environments on local, regional and global scales. In the dynamics amid
these entities, there is a need to understand and strengthen a city’s ability to mitigate, to adapt, and to
recover from internal and external shocks and tensions (UN-HABITAT III, 2016). As Melosi (2000) points out,
sanitation (or environmental) services such as fresh water supply, sewage and solid waste disposal systems
have been and remain indispensable for city functioning and growth. Most of the problems related to water in
urban environment result from a limited vision of urban land management and its infrastructure integration
(TUCCI, 2008). Thus, achieving urban sustainability and resilience does not mean to abandon progress, but
to change ways of thinking and planning cities to incorporate key aspects of resilience into urban design
(UN-HABITAT III, 2016). Resilient cities do not turn their backs to urban waters, on the contrary, they must
embrace protection and preservation of water resources in order to build urban infrastructure based on
nature and to contribute to water and food security (UN, 2016).

3. Urbanization advance over Tietê’s floodplains

São Paulo city is located along the Tietê river, a metropolitan scale perennial river, the largest one in São
Paulo state (TEIXEIRA, 2015). This river springs at an altitude of 1,030 m and 96 km away from the city
(DAEE, 2015). It crosses São Paulo state’s territory from east to west, flowing inland (TEIXEIRA, 2015).
Tietê river and its tributaries led the way to the colonization of the hinterland and were determinant of
settlement location for São Paulo village and regional economic development (DAEE, 2015). Thus, we
understand that this river has been the soul of São Paulo city since its foundation. Fig. 1 locates the São
Paulo state in Brazil (map 1); São Paulo city in the state (map 2) and the Tietê river stretch under analysis
(map 3). The reach highlighted on map 3 (Fig. 1) was selected for its simultaneous relevance in São Paulo
city’s urban expansion and in metropolitan scale territorial structuring. Therefore, it is an object for study of
historical, technical, environmental and cultural aspects related to urban and regional planning.
For about three centuries, the configuration of the hydrographic basin in which São Paulo has been installed suffered minor changes (JORGE, 2012). Until the mid-19th century, there was little economic stimulus to justify major interventions in urban rivers (JORGE, 2012). However, from the late 19th century to early 20th century, ongoing São Paulo state’s coffee production and export expansion stimulated rail infrastructure development to link inland plantations to the coast, passing through the state capital (CAMPOS, 2004). The coffee chain together with the railway network inaugurated a new territorial organization to the region (CAMPOS, 2004, COSTA, 2014). Structural changes in Brazilian society coincided with efforts to transform the old colonial city into a modernized state capital. The republican regime instituted in 1889 initiated political articulations with landowners and military interested in making big investments in global markets (BERNARDINI, 2006). In the early 20th century the composition of political, economic and social forces created conditions to effectuate the city plans for a modern society (BERNARDINI, 2006) through the work of urban agents such as doctors, engineers, administrators, and politicians (JORGE, 2012). Urban planning has become an important asset for capital investment in cities. Major urban intervention plans targeted lowlands because they were areas prone to flooding and unhealthiness that urged solution and were also strategically relevant to city growth. Also, proximity to railroad tracks helped lowlands to be chosen as site construction of a large industrial park that would later establish São Paulo both in national and international panorama (TEIXEIRA, 2015). São Paulo’s transformation into a industrialized city occurred rapidly along with demographic explosion and urban expansion resulting in very precarious conditions of hygiene and public health in the new urban environment (JORGE, 2012; CAMPOS, 2004). Concentrated production of human waste and other debris were discarded on the streets, in watercourses or, at best, deposited in pits (TUCCI, 2008), meaning that urban growth implied water quality deterioration. As a consequence of the inefficiency of the sanitation services offered by the water and sewage company, in 1886 São Paulo city was being plagued and then necessity of water supply and distribution systems improvement uprose discussion about public hygiene (COSTA, 2005). Improved water supply and distribution systems applied into São Paulo city correspond to the hygienist phase (TUCCI, 2008), which followed the linear paradigm of water abstraction, use and rapid drainage and focused on quickly removing both rainwater (to avoid flooding) and sewage (to avoid disease) through channels systems. Immediately, such works had a positive impact, reducing disease rates and mortality (TUCCI, 2008). Urban morphology characterized by wide horizontal city expansion made it difficult and costly to install an efficient sewage collection and treatment system (JORGE, 2012), what left significant part of urban area without sanitation. Water resources preservation and human supply in the midst of continuous urban growth has become a clear conflict since then (ROCHA, 2017). Table 1 shows the demographic evolution of the city of São Paulo. It is worth noticing that the city has grown not only in size and number, but also in its political, social, technological and economic importance over the decades. According to Costa (2003), the goal was to build up a city that enabled economic and social development of São Paulo’s emerging bourgeois society.
Table 1. Demographic growth of the city of São Paulo (1872-2016) based on Jorge (2012) and Brasil (2016).

<table>
<thead>
<tr>
<th>Year</th>
<th>Habituants</th>
<th>Importance</th>
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<tbody>
<tr>
<td>1872</td>
<td>31 thousands</td>
<td>Political center (state / provincial level)</td>
</tr>
<tr>
<td>1900</td>
<td>239 thousands</td>
<td>Political, financial, mercantile and railway center (regional level)</td>
</tr>
<tr>
<td>1920</td>
<td>579 thousands</td>
<td>Political, financial, mercantile and railway center (regional level) and industrial center (national level)</td>
</tr>
<tr>
<td>1940</td>
<td>1,32 millions</td>
<td>Political, financial, mercantile and railway center (regional level) and industrial center (national level)</td>
</tr>
<tr>
<td>1970</td>
<td>5,97 millions</td>
<td>Political center, financial, industrial pole and population attractor (national level) and road (metropolitan and regional level)</td>
</tr>
<tr>
<td>2016</td>
<td>12,04 millions</td>
<td>Political, financial, industrial, technological and road center (metropolitan, national and international)</td>
</tr>
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4. Plans and urban interventions for the Tietê River

Fig. 2 highlights in yellow the first rectification plan projected between the years 1897 and 1905.

Fig. 2. Rectification plans for Tietê river (1897 and 1952) and actual configuration (2015).
Until 1924, smaller interventions were made in the river stretch highlighted in red (Fig. 2) while major changes would occur only between the years 1957 and 1977 with the Avenues Plan. In early 20th century Saturnino de Brito proposed sanitary improvements for Tietê river that showed a greater understanding of natural flooding dynamics by designing human approachable ponds integrated to the rectification plan (TEIXEIRA, 2015). Although his vision was better integrated to the environmental needs, it did not fully converge to dominant social sectors’ intentions in city transformation. Political alliances of municipalities, state, companies, concessionaires, and private entrepreneurs that have marked Brazilian urban interventions since then (CAMPOS, 2004) were consolidated with the execution of the Avenues Plan designed by engineers Ulhôa Cintra and Prestes Maia (COSTA, 2014). The rectification of the river was one of the factors responsible for segregation and socio-spatial exclusion that accompany the history of sanitary interventions in São Paulo, since sanitarium urbanism has a direct link with the land market (COSTA, 2003).

Several interventions for the Tietê river planned by renowned Brazilian architects such as Ruy Ohtake (1977), Oscar Niemeyer (1986), and Paulo Mendes da Rocha (1980) proposed readings of the Tietê river closer to Saturnino de Brito’s vision but none of them were implemented (TEIXEIRA, 2015). On the other hand, works in early 21st century (Fig. 3) carried out by São Paulo State government express no change of thought in relation to what was done in the Avenues Plan, almost fifty years later. New technologies were applied in the Tietê river, but still within the old paradigm. In the year 2000, Phase I of the project focused on containing the river overflows. In 2006, Phase II works in 2006 expanded marginal freeways and roadways for vehicles only, therefore it did not include special lanes neither for collective transportation nor bicycles. According to Teixeira (2015), the Tietê River has been converted into a division line between the center and periphery in São Paulo and today can only be spied from afar, at high speed. Thus, Phase I and II interventions exemplify how contemporary technological advances failed to incorporate the river into the urban landscape and drove the Tietê River even further away from the people. Automobile mobility undoubtedly persists on territorial structuring today (MARICATO, 2012). Fig. 3 shows waterproofed area by marginal lains and limited visual improvement achieved by the latest projects. The attempt to revegetate the riverbank (highlighted in green) ended up imposing a visual barrier to the river, as if the intention of the project was to hide urban waters away from sight.

![Fig. 3 Tietê river’s overview after Phase I and II interventions in early 21st century.](image)

Human action and urbanization have altered landscapes dramatically. Modernization has destroyed urban rivers ecosystems and suppressed all water uses that did not meet the needs of car-oriented industrial progress. Tietê river conversion into rainwater drainage and untreated effluent channel has cancelled several social functions as well as its capacity to provide food (JORGE, 2012) and it did not succeeded in preventing floods permanently (G1, 2017). Gradual loss of sporting, recreational, fishing and sailing activities discouraged people from approaching Tietê’s waters, which have become associated to pestilence and danger. Even though Marginal Tietê freeway is a front door to Brazil’s biggest city, its actual condition discourages symbolic association of the river to local identity or pride.
5. Conclusion

The Tietê river symbolizes how much São Paulo needs urban resilience to meet the demands of urban infrastructures, transportation systems and water and energy resources in the 21st century. In addition to demographic growth in previous decades (Table 1), today São Paulo faces historically accumulated environmental damages along with frequency increase of severe climatic impacts. Design, planning and management decisions of the resilient city should be based on long-term vision (UN-HABITAT III, 2016). It is necessary to change the horizon of the long-term vision, since the plan adopted in the past had a long-term vision oriented to automobile industry growth and the profitable urban land expansion. Local public policies have relegated projects tuned with natural ecosystem dynamics of the Tietê river. In the analyzed stretch, the capacity of the city to reduce risk of disasters and to adapt to climate change is dubious. Firstly São Paulo needs to cease the discharge of untreated effluents, to decontaminate and to protect Tietê’s waters in order to recover a wide range of potential water uses lost through time. Secondly, the city must rethink car use, as it favors urban sprawl, helps to emit greenhouse gases, and blocks people access to urban water. Finally, the urban design should be adapted to accommodate floodplain natural dynamics, since the current system overloads in rainy seasons. In this context, resilience concept can be understood beyond planning the city to survive, adapt and grow from a functional point of view. From an interdisciplinary perspective, it seems the river as a public space which needs revitalization to reconnect people to urban waters. The analyzed stretch offers enormous opportunities to initiate a process of paradigmatic change that could reestablish the Tietê river from the inside out and thus vivify the soul of São Paulo. In the past, this exact place was transformed and irradiated an urbanization model for the rest of the country. In the future, São Paulo could use this same stretch to act as a precursor of sustainable urbanism in Brazil.

References