Scalar mismatches in metropolitan water governance
A comparative study of São Paulo and Mexico City
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5. THE IMPLEMENTATION OF IWRM/IRBM IN SÃO PAULO

5.1 INTRODUCTION

This chapter examines how different drivers and institutions at multiple levels of the river basin governance regime shape water-related challenges experienced in the Metropolitan Region of São Paulo (MRSP). It uncovers the causal chains behind these water challenges and the effectiveness of existing policy instruments. It reviews the relevant historical and geographical context of Brazilian river basin governance and the driving forces on the river basin from the local to the global level (see 5.2); explores how IWRM actors and institutions at multiple levels address water challenges at the basin scale (see 5.3); analyses the related instruments according to their stated mandates, their effect on actors’ behaviour and their impacts on inclusive and sustainable water governance (see 5.4) and draws conclusions on how more appropriate instruments could be (re)designed for the São Paulo (see 5.5).

5.2 CONTEXT AND DRIVERS OF SÃO PAULO’S RIVER BASIN CHALLENGES

5.2.1 CONTEXT IN RELATION TO THE RIVER BASIN

Although Brazil is water abundant in absolute terms, with about 12% of the world’s surface water resources\(^{23}\), water is unevenly distributed (Formiga Johnsson and Kemper, 2005). Most of these resources are concentrated in the humid and sparsely populated Amazon rainforest, while most Brazilians live within 300 km of the coast. The country also has extremely dry regions such as the Northeast.

São Paulo is located near the Tietê River’s springs, in the Alto-Tietê Basin (ATB)\(^{24}\), a sub-basin of the Tietê River. Despite being only 22 km from the Atlantic Ocean, the coastal escarpment forces the river to flow inwards (see Map 2.1). The river crosses the MRSP and flows 1136 km until it joins the Paraná River.\(^{25}\) The ATB is a heavily urbanized sub-basin that virtually overlaps with the MRSP. Due to the MRSP’s population size, water is relatively scarce (Interviews-B4/B5/B28). Water availability per capita here is just above 130 m\(^3\) per year\(^{26}\) (SABESP, 2017) and is aggravated by the severe contamination.

5.2.2 MAIN DRIVERS OF SÃO PAULO’S RIVER BASIN CHALLENGES

Many driving forces at multiple levels directly or indirectly shape water-related challenges in the MRSP and its river basin (see Table 5.1 for overview).

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\(^{23}\) Per capita water availability reaches 40,000 m\(^3\)/inhab./year

\(^{24}\) Alto-Tietê means Upper-Tieté

\(^{25}\) The waters of the Tietê River discharge into the Atlantic Ocean in the Paraná Delta north of Buenos Aires.

\(^{26}\) Regions face absolute water scarcity if renewable water resources are below 500 m\(^3\)/inhab./year (FAO 2012).
Table 5.1 Multi-level drivers of water-related challenges on the river basin

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
</table>
|                                 | Local                             | Regional / global 
|                                 | Urbanization                      | Urbanization                        |
|                                 | Local                             | Regional / Global                   |
| Land use change                 | Urbanization (especially informal)|                                   |
|                                 | Agriculture                       |                                     |
| Demographic                     | Population growth in urban periphery | Growing water demand for public supply |
|                                 | Growing water demand for public supply | Rapid population growth during 20th century |
|                                 | Rural/urban migration              | Population growth in nearby regions |
| Economic development            | Industrial (water use and contamination) | Water demand for hydropower |
|                                 | Mining (contamination)             |                                     |
| Climate                         | Heat island effect                 | Climate variability and change       |
|                                 | Drought of 2013-2015               |                                     |

Source: Author

Climate

São Paulo has a humid sub-tropical climate. Heavy summer precipitation causes frequent floods. However, winters are dry, and the city regularly experiences longer dry spells. Forest fires in São Paulo State have reportedly increased in recent years (Interview-B14). Between 2013 and 2015, Brazil’s Southeast, including São Paulo, experienced a record-breaking drought. Unusually high temperatures and low precipitation levels contributed to an almost complete exhaustion of the metropolis’ water reservoirs (Nobre et al., 2016).

Although it is difficult to establish clear causality between extreme weather events, such as the recent drought, and global anthropogenic climate change, scientists expect these events to become more frequent as a result of the latter. Since the early 20th century, the country is warming on average (Nobre, 2001; Marengo et al., 2007). Several climate change scenarios indicate warming trends up to 4-6°C in parts of the country, particularly in the Amazon region, by the end of the century (Nobre, 2001; Gosling et al., 2011). Precipitation in the Southeast (where São Paulo is located), is projected to decrease overall (up to 5%) but with more intense and irregular rains (São Paulo Legislative Assembly, 2009; Gosling et al., 2011; Angelo and Feitosa, 2015). A rise in extreme weather events could both aggravate water scarcity and lead to more floods and mudslides. In addition, São Paulo State’s Participatory Adaptation Plan claims that there are insufficient studies on Brazil’s (and consequently São Paulo State’s)
vulnerability to climate change (São Paulo Legislative Assembly, 2009). Although climate change is acknowledged as a risk multiplier, public managers remain sceptical (Interviews-B5/B8/B24/B33).

Scientific models estimate that deforestation in the Amazon rainforest contributes to higher temperatures and decreases in precipitation (São Paulo Legislative Assembly, 2009; Nobre, 2014). Nonetheless, São Paulo’s State Secretary for Sanitation and Water Resources dismissed this link citing the heavy rains and floods of 2016 and blaming natural variability (Watts, 2017).

**Demographics**

São Paulo experienced explosive population growth during the 20th century (see 2.2.2), a process that has slowed down. The Municipality of São Paulo currently grows 0.55% a year, and the metropolis as a whole, 0.73% (Seade, 2019). Moreover, the population has also grown beyond the MRSP, leading to the definition of the Macro-metropolitan region of São Paulo. In 2009, São Paulo State was 94% urban (São Paulo Legislative Assembly, 2009).

During the second half of the 20th century, the Brazilian population increased exponentially from 51.9 million inhabitants in 1950 to 190.8 million in 2010 (IBGE, 2010). National population growth has slowed down to 0.8% a year, and projections indicate that this trend will continue in the coming decades (IBGE, 2018). Parallel to this, Brazil’s urban population rose from 31.24% in 1940 to 84.36% in 2010, pushed by rural to urban migration (IBGE, 2010). By 2005, 42.8% of Brazilians lived in metropolitan regions (Braule Pinto, 2007).

**Land use changes**

Before the region was transformed by Portuguese settlers, it was an ecotone – a transition area between several biomes – composed of Atlantic rainforest, wooded grasslands, wetlands, and vegetation typical of the South, the coastal area and the central West region of Brazil (Cardim, 2018). This led to a rich variety of native flora and fauna. It is estimated that 80 km of wetlands extended along the rivers that crossed what is today the MRSP (Del-Rio et al., 2015). Not only has most of this original landscape disappeared, but within the small pockets of vegetation that are left, 90% of the plants are non-native (Cardim, 2018). São Paulo’s accelerated pace of urbanization during the 20th century, has been characterized by a lack of planning. Expansion at the margins of the metropolis and irregular occupation of the green belt and areas of springs led to water contamination (Interviews-B4/B5/B14/B19/B33).

While rapid, unplanned urban growth significantly deteriorated the river basin’s water quality and decreased water availability for public supply, the demand for water grew exponentially (Jacobi et al., 2015). The relative scarcity of water further drove water use conflicts between public/urban use, industrial use, agriculture and energy production within the MRSP and with neighbouring regions.

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27 São Paulo’s first master plan dates from 1972, when the MRSP had over 8 million inhabitants (São Paulo City, no date; Saconi and Entini, 2013).
In addition, land use changes within the broader region, such as deforestation, agricultural expansion or intensification and unplanned urbanization (in particular inadequate drainage and sewage discharge\textsuperscript{28}) can cause or contribute to erosion, which deteriorates soils and leads to siltation, ultimately aggravating risks of mudslides and floods (Jacobi \textit{et al.}, 2015; FABHAT, 2016) (Interviews-B17/B19). The lack of adequate soil conservation in rural areas further aggravates these risks (Interview-B17).

Urban growth across Brazil has been characterized by a lack of planning, which led to increased inequalities in Brazilian cities, including in the distribution of risks derived from precarious construction (Jacobi and Sulaiman, 2017). Throughout the 20\textsuperscript{th} century, there was a legal and policy vacuum regarding urban planning, with no general guidelines.

\textit{Economic development}

In colonial times, the Tietê River was strategic for exploration and served as an integrating element within the state (Paganini, 2008). The need for water resources for the population and industry, as well as the need for space for urban expansion, led to a transformation of the regional hydrology, as rivers were channelled, rectified, diverted and/or buried. Many of the Tietê’s tributaries were buried (e.g., Tamanduateí and Anhangabaú Rivers), becoming invisible and forgotten (Gouveia and Moroz-Caccia, 2016).

Although the public-urban and industrial sectors dominate water use in the ATB, irrigation accounts for 65\% of water use at state level (DAEE, 2009). However, WRM in the region first developed for energy generation. The Tietê River’s hydropower potential was first explored in the late 19\textsuperscript{th} century through dam construction (Paganini, 2008). The Serra do Mar (Sea Mountains) project, an ambitious project which began in 1927, transformed the natural flow of the Pinheiros River, a tributary of the Tietê River and the second most important river in São Paulo (see Figure 5.1). This transformed the Pinheiros River into a canal diverting water to the newly built Billings dam. From there, water flows towards the coastal cliffs, generating power through a 750m drop (Braga \textit{et al.}, 2006) (Interview-B19). This increased the region’s energy capacity from 16MW to 480MW in the early 1950s, supporting the MRSP’s rapid urbanization and industrialization (Braga \textit{et al.}, 2006; Paganini, 2008).

\textsuperscript{28} Erosion can be caused by large volumes of effluents that are concentrated and discharged in one location, in a stream that is not channelled (Interview-B17).
5.3 THE INSTITUTIONAL FRAMEWORK FOR IWRM/IRBM IN SÃO PAULO

This section examines which formal institutions and organizations at multiple levels shape river basin governance in the MRSP.

5.3.1 GLOBAL LEVEL

International institutions finance mega-projects. The World Bank (partially) funded the ‘Programa Mananciais’ (Headwaters Program), which aims to preserve water sources and surroundings ecosystems.29 The Inter-American Development Bank (IDB) funded the ‘Tietê project’, together with SABESP, which aims to clean the Tietê River by expanding sewage treatment services in the MRSP (see Box 6.1).

5.3.2 TRANSBOUNDARY LEVEL

The MRSP is not located within a transboundary river basin or aquifer. However, the Guaraní aquifer, measuring over one million km$^2$, reaches approximately 200 km from the city of São Paulo (DAEE, no date). Municipalities in the Western part of São Paulo State heavily rely on the aquifer. It is the world’s largest aquifer and is shared by Brazil, Argentina, Paraguay and

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29 Although this programme being on hold for lack of funding, it received USD$ 10 million in 2016 and 5 million in 2017 (SABESP, 2016, 2017).
Uruguay. While an integrated management agreement was signed in 2010 by the four nations, it did not include institutional arrangements for its implementation (Silva and Barbosa Pereira, 2018).

5.3.3 **NATIONAL LEVEL**

During the military dictatorship that started in 1964, Brazil experienced a process of centralization that eliminated elections at state and municipal levels, and reduced their fiscal autonomy (Abers and Keck, 2004). Water management was fragmented between national line ministries and between government departments at state level, while also centralized, technocratic and top-down (Abers and Jorge, 2005; Kellas, 2010; OECD, 2015c).

The democratic shift of the 1980’s promoted political and financial decentralization and civil society participation, which became important characteristics of new Brazilian federalism (Eghrari, 2012). The 1988 Constitution engendered widespread reforms across sectors and substantial revenues were transferred from federal to state and local governments (Abers and Keck, 2004). The Constitution states that all waters within the national territory are public, belonging to the nation if they cross state borders, and to a specific state if they are contained within its borders (Arts. 20 and 26, Federal Constitution). The Federal government is responsible for instituting a national system for WRM and defining criteria for water allocation (Art. 21). This only concerns surface water as all groundwater resources are under the exclusive domain of the states (Art. 26).

Enacted in 1997, the National Water Law (NWL) (Federal Law nº 9.433) instituted the National Water Resources Management System (SINGRH). This was based on São Paulo State’s Water Law, adopted in 1991 (see 5.3.4). It moved towards IWRM, as it considered the multiple uses of water and suggested a multilevel governance system, including integration, decentralization to the basin level and stakeholder participation (see Table 5.2). River basin committees are responsible for managing each basin through inclusive arrangements for stakeholder participation (equal representation of state government, municipalities and organized civil society) (Brazil, 1997: Art. 1) (see 5.3.5). The Law recognizes water as a public good with economic value, and a limited natural resource –contrary to Brazil’s traditional vision of water’s inexhaustibility (Benjamin et al., 2005). This framework therefore promoted a shift in the national discourse on water and introduced new instruments (see 5.4).

The SINGRH sets national water management objectives, which it pursues through several key entities (for a detailed overview see ANNEX E - MAIN ACTORS IN SÃO PAULO'S METROPOLITAN WATER GOVERNANCE). The National Council on Water Resources (CNRH) is a multi-stakeholder platform for river basins of Federal domain. The National Water Agency (ANA) regulates bulk water use and water use permits for water bodies under federal jurisdiction.

Although this model of WRM is over two decades old, power asymmetries remain and

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30 Federal basin committees are created for river basins of federal domain, and state basin committees for basins of state domain.
maintain a centralized power structure in practice at the state level (Porto and Porto, 2017). Environmental politics more broadly have suffered from the deterioration of the relationship between the State and civil society organizations (CSOs) and a focus on mega-infrastructure projects and expanding natural resources extraction (de Castro and Motta, 2015).

Table 5.2 Main aspects of the National Water Law of 1997

<table>
<thead>
<tr>
<th>Approach to water</th>
<th>Public good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limited natural resource with economic value</td>
</tr>
<tr>
<td></td>
<td>WRM provides for the multiple uses of water</td>
</tr>
<tr>
<td></td>
<td>Water for human and animal consumption have priority in times of scarcity</td>
</tr>
<tr>
<td></td>
<td>River basin as the territorial unit for policy implementation</td>
</tr>
<tr>
<td></td>
<td>Decentralization of WRM and participation of the Public Authority, users and communities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goals</th>
<th>Ensure current and future generations the necessary water availability in quality standards appropriate to their uses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rational and integrated use of water resources, including waterway transport, aiming for sustainable development</td>
</tr>
<tr>
<td></td>
<td>The prevention and defence against critical hydrological events of natural origin or arising from inappropriate uses of natural resources</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key actors</th>
<th>The National Council of Water Resources (CNRH)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The National Water Agency (ANA)</td>
</tr>
<tr>
<td></td>
<td>The River Basin Committees for national rivers</td>
</tr>
<tr>
<td></td>
<td>The State and Federal District Councils on Water Resources</td>
</tr>
<tr>
<td></td>
<td>The federal government, state, municipal and federal district bodies whose responsibilities relate to WRM</td>
</tr>
</tbody>
</table>

*Source: Federal Law n° 9.433, 1997*

5.3.4 State level

In 1991, São Paulo State adopted IWRM through State Law 7.633 (São Paulo State Water Resources Policy), inspiring the 1997 NWL. This policy includes principles of decentralization, participation and integration. Integration concerns surface and groundwater, quantity and quality, and stakeholders (users, the Public authority and Civil Society).31 The State Water Law created the State Council on Water Resources, which defines the water resources policy for water bodies under State domain and is responsible for its supervision and regulation. Other key state entities are the DAEE, SABESP, CETESB, EMAE and the Public Prosecutor’s office:

The DAEE (Department of Water and Hydropower), a parastatal agency of the State Department of Sanitation and Water Resources (SSRH), implements the State’s WRM policy. Created in 1951, it is an autonomous agency that oversees quantitative aspects of water management (i.e. dams for water supply, water use permits, macro-drainage and flood control)

31 Unlike the principles of decentralization and participation, the principle of integration does not have clearly defined mechanisms.
(DAEE, 2018). It allocates water by defining criteria for water use, issuing water use permits and regulating water uses (see 5.4.2). It is seen as technocratic, focusing on hard engineering and large works to control water, dominated by aging engineers and lacking in renewal and innovation (Interview-B6).

SABESP is the state Wat&San (Water and Sanitation) company, providing services to most MRSP municipalities and around half of those in São Paulo State (see 6.3.3). Due to its size and dominance within the MRSP, it also plays a key role in WRM. It has built multiple reservoirs that constitute the ‘Integrated Metropolitan System’ (see 5.4.1).

Another State agency, the Environment Department (SMA) is responsible for environmental policy. It addresses issues of water quality and, to a lesser extent, climate change mitigation and adaptation. CETESB (São Paulo State Environment Agency), an autonomous branch of the SMA, monitors and licenses activities that could cause pollution. More specifically, its activities include the ‘green agenda’ (suppression of forests, vegetation), ‘grey agenda’ (pollution sources, sewage and water treatment plants, landfills) and ‘blue agenda’ (areas of springs). CETESB works with municipalities, as this cooperation facilitates licensing and pollution control (CETESB, no date). It focuses exclusively on contamination but ignores issues such as climate change (Interview-B8).

The State office of the Public Prosecutor aims to defend the rights of citizens and the public’s interest (MPSP, no date). Through special groups it acts on issues such as environmental crime and irregular land parcelling. It has been particular active on the issue of untreated wastewater discharge (Interviews-B22/B23).

Finally, the EMAE (Metropolitan Company for Water and Hydropower) is a state company created in 1998 that operates several hydropower plants (EMAE, no date). It operates in close collaboration with the DAEE and SABESP (Interview-B19).

5.3.5 River basin level

The 1991 State Water Resources Policy promoted the creation of basin committees across São Paulo State. The ATB committee was established in 1994 (SIGRH, no date) (see ANNEX E - MAIN ACTORS IN SÃO PAULO’S METROPOLITAN WATER GOVERNANCE). This basin overlaps almost entirely with the MRSP’s boundaries, leading many to refer to it as the ‘metropolitan committee’ (Brandeler, 2013). The area’s complexity justified the formation of six sub-committees to manage the ATB’s sub-basins (Campos, 2009).

The basin committee has no direct influence on water allocation, which is the DAEE’s responsibility. However, it sets the fees for bulk water use and can therefore impact water demand (see 5.4.3). It also has limited say on the planning and construction of large-scale

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32 The EMAE originated in 1899 in the creation of the São Paulo Railway, Light and Power Company, a Canadian company that provided public transportation services and lighting São Paulo City (Custódio, 2012).
33 The first was the Piracicaba-Capivari-Jundiaí basin committee, a region with a history of strong participation regarding WRM.
34 Only the Alto-Tietê basin has this division.
infrastructure for WRM. The river basin committee emphasizes the role of municipalities in containing urban expansion in areas that are still undeveloped, particularly those that contain springs (FABHAT, 2016). The committee’s role in this is to support local actors in appropriating knowledge, information and actions developed at regional level (Interview-B6). Its own powers are limited as its decisions are not binding.

The basin agency (FABHAT) leads the elaboration of the basin plan, which establishes priorities for actions and projects (see Box 5.1), the water resources situation report, which monitors water quantity and quality indicators in the basin, and provides grants according to the criteria established by the committee (SIGRH, no date) (Interview-B20). These grants are available through the FEHIDRO fund (State Fund for Water Resources) (see 5.4.3).

**Box 5.1 Alto-Tietê basin plan**

The basin plan must have a 12-year planning timeframe, with short, medium and long-term goals (Deliberation 146, CBH-AT, 2012). The plan in place at the time of fieldwork (2017) was for 2009-2012, and was widely criticized for being outdated, and disproportionally focused on flood risks and piece-meal environmental education programmes (Interviews-B6/B7/B17/B24). Water quality was not granted significant attention (Interview-B7).

The basin plan was under revision at the time of fieldwork through a more inclusive and multidisciplinary process. This included developing the plan ‘in-house’ so that committee members would be familiar with it and ‘own’ it (Interview-B7). It was discussed with a wider group, including through public hearings (Interviews-B6/B7/B20).

Finally approved in 2018, the new plan includes a wider range of concerns, including climate change, adaptation, water demand reduction, water losses, wastewater recycling, (a much greater emphasis on) water quality, land use and development matters and lessons from the water crisis (although no contingency plan thus far) (FABHAT, 2016) (Interviews B6/B19/B20). It considers Wat&San services and supports municipalities in developing their own (Interview-B11/B12). The plan aims to go beyond diagnostics and provide concrete planning and actions, including for the protection of areas of springs (see 5.4.4) and for flood risk management (see 6.4.2) (Interviews-B6/B7). The new plan identifies the interconnection of water supply systems within and beyond the basin as a potential, though short-term, solution to water shortages, and it supports further research on the potentiality of aquifers (FABHAT, 2016). The sub-basin committees develop plans separately, and these were not necessarily coherent with the main basin plan.

### 5.4 INSTRUMENT ANALYSIS

#### 5.4.1 INTER-BASIN WATER TRANSFERS

**Design**

The MRSP mostly uses surface water sources. As water availability within the ATB became insufficient (or too contaminated), SABESP’s unofficial strategy for ‘water security’ shifted to importing water. Construction began in 1966 of an inter-basin water scheme (the Cantareira System) from the neighbouring PCJ (Piracicaba-Capivari-Jundiaí) river basin (Braga et al.,
Of the 81 m³/s of water used in the MRSP, 33 m³/s were imported from the Cantareira System (see Table 5.3) (FABHAT, 2016; SABESP, 2019). A small section of the PCJ basin is within neighbouring Minas Gerais State, but the springs in that area produce close to half of the basin’s water (ANA, no date).

The São Lourenço system, inaugurated in 2018, has contributed another 6.4 m³/s to the MRSP from a river basin Southwest of the ATB. In 2018, SABESP also inaugurated an inter-connection between the Cantareira system and the Jaguarí dam in the Paraíba do Sul river basin, located Northeast of the MRSP (SABESP, 2017). This allows for diverting up to 8.5 m³/s towards the Cantareira system or 12.2 m³/s to the Paraíba do Sul system, depending on which is in greater need.

Table 5.3 SABESP Water production systems within and outside the Alto-Tietê Basin

<table>
<thead>
<tr>
<th>System</th>
<th>Approximate production (m³/s)</th>
<th>Percentage of total production</th>
<th>Population supplied (in millions)</th>
<th>River basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cantareira System</td>
<td>33.0*</td>
<td>40.62%</td>
<td>7.5</td>
<td>Piracicaba-Capivari-Jundiaí</td>
</tr>
<tr>
<td>Alto-Tietê</td>
<td>15.0</td>
<td>18.46%</td>
<td>4.20</td>
<td>Alto-Tietê</td>
</tr>
<tr>
<td>Guarapiranga</td>
<td>15.0</td>
<td>18.46%</td>
<td>3.70</td>
<td>Alto-Tietê</td>
</tr>
<tr>
<td>Rio Grande / Billings</td>
<td>5.5</td>
<td>6.77%</td>
<td>1.20</td>
<td>Alto-Tietê</td>
</tr>
<tr>
<td>Rio Claro</td>
<td>4.0</td>
<td>4.92%</td>
<td>2.06</td>
<td>Alto-Tietê</td>
</tr>
<tr>
<td>Alto Cotia</td>
<td>1.2</td>
<td>1.48%</td>
<td>0.36</td>
<td>Alto-Tietê</td>
</tr>
<tr>
<td>Baixo Cotia</td>
<td>1.05</td>
<td>1.29%</td>
<td>0.42</td>
<td>Alto-Tietê</td>
</tr>
<tr>
<td>Ribeirão da Estiva</td>
<td>0.1</td>
<td>0.12%</td>
<td>0.04</td>
<td>Alto-Tietê</td>
</tr>
<tr>
<td>São Lourenço</td>
<td>6.4</td>
<td>7.88%</td>
<td>1.4</td>
<td>Ribeira de Iguape e Litoral Sul</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>81.25</strong></td>
<td><strong>100.00%</strong></td>
<td><strong>20.9</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from SABESP, 2019.

*Approximately 8 m³/s are used within the PCJ basin.

Inter-basin transfers require water use permits (see 5.4.2). The water transfers from the PCJ and the Paraíba do Sul basin spread across multiple states35, and their permits involve agreements at federal level (SABESP, 2015) (Interviews-B2/B4). Water imports are contingent on sufficient water availability within water supply reservoirs and are compensated through water use fees (see 5.4.3).

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35 The Paraíba do Sul basin spreads across the states of São Paulo, Rio de Janeiro and Minas Gerais.
Effectiveness on actors in terms of mandated goals

As of 2018, the MRSP received water from nine different water supply systems that interlinked to form SABESP’s Integrated Metropolitan System. Different parts of the MRSP can be supplied by two or more systems, depending on the reservoirs’ water availability (Interview-B4). Reliance on inter-basin transfers and the interconnection of water systems accelerated after the 2013-2015 water crisis, and according to SABESP representatives, this increased water security through increased reservoir capacity, but also by adding redundancy and flexibility to the system (Interviews-B4/B5/B33).

However, many non-state actors have argued that these large-scale works are only a temporary fix and that insufficient emphasis has been given to reducing water use, contamination and losses, or prioritizing certain uses (São Paulo (Estado), 2017, p. 178) (Interviews-B12/B14/B30/B31/B32/B33/B34). The Alto-Tietê basin plan was not coordinated or made coherent with the basin plans from donor basins, limiting knowledge sharing and potential synergies (Interview-B20). SABESP’s strategy also ignores drivers of climate change and population growth. As the MRSP expands, so will water demand and the need to search for more distant water sources at increasing costs. Climate variability and change, meanwhile, can both lead to increased water demand due to rising temperatures, and decreased availability with higher evaporation in dams and more frequent droughts. In the longer-term, exclusive reliance on this strategy is unsustainable.

Impact on inclusiveness and sustainability

Inter-basin transfers increased water supply in the short-term, but also caused environmental degradation while affecting aquatic species from changes in water flows. News reports from July 2018 claimed that after beginning operations, the Jaguarí dam dropped by 4m in 20 days (Lira, 2018). Land use changes around the dams, such as deforestation, can affect the springs that recharge them. The construction and maintenance of basin transfers was also expensive, but no cost-benefit analysis about this approach versus alternatives was publicly available.

Moreover, since the Cantareira System was built, the demand for water for public/urban use and irrigation within the PCJ basin increased significantly, causing tensions between the two basins over water allocation (Braga et al. 2006). It also represented a challenge for maintaining minimum environmental flows in drier periods (Ibid).

The MRSP’s economic weight for Brazil and its dependence on water imports led the DAEE and the ANA to prioritize it in inter-basin transfer negotiations to guarantee continued supply, often at the expense of other urban areas (Interviews-B4/B34). Interference by agencies at higher levels may also be inevitable due to the contrasting interests of the two basins, which make decentralized management of such transfers unrealistic (Interviews-B2/B4/B5/B11/B12/B22/B23). Such interference may also lead to the centralization of power and the side-lining of the basin committee and local governments (Interviews-B22/B23/B32). An example of how the imbalance in power relations impacts water allocation is that the Cantareira water use permit – which guarantees the transfer of 30m$^3$/s of water to the ATB – was renewed in the
middle of the 2013-2015 water crisis in a top-down manner with little transparency or
collection for environmental impacts (Interview-B32/B33). The water use fees (see 5.4.3)
that the PCJ basin received in exchange for the transfer were insufficient to compensate for the
lost economic opportunities and environmental costs (Demajorovic et al., no date).

SABESP’s scale and resources have enabled its own plans to effectively become the State’s
Wat&San policy and to consolidate its conceptualization of water security as a supply-side
problem (Interviews-B6/B11/B14/B22/B23/B31/B32/B33/B34). The basin committee
considers SABESP’s plans for its basin plan, but not vice versa, and there is no other WRM
plan at any level that is utilized by the basin committee, municipalities, utilities and state actors
(Interview-B16).

5.4.2 WATER USE PERMITS

Description

The 1997 NWL aimed to ensure quantitative and qualitative control over water resources by
introducing water use permits and wastewater discharge permits (for the latter, see ANNEX G –
ADDITIONAL INSTRUMENTS). Water use permits concern derivations or abstractions from
surface or groundwater for various uses. Permits were granted if the volume in question could
sustainably be abstracted from a certain water body. This process required data on water
availability in terms of quantity and quality, as well as on users upstream and downstream of
the abstraction point (Braga et al., 2008).

Permits were granted by the DAEE or ANA, depending on whether the water resources
were of state or federal domain (Brazil, 1997 Art. 14). They were registered to a specific holder,
abstraction point and type of use, and were subjected to inspections. Permits could be
transferred to other holders for an administrative fee (DAEE, 2017). They were valid for a
maximum of 35 years but could be renewed, and they were subject to the water use priorities’
ranking established in the state water resources plan. Each state defined its own criteria for
issuing water use permits. São Paulo State applied the ‘Q7,10’ method to define the minimum
environmental flow: the drought flow over a period of seven consecutive days that occurs
approximately once every 10 years (São Paulo State Legislative Assembly, 1994). Holding a
permit is a prerequisite for obtaining an environmental license from CETESB for activities or
enterprises that affect waterways (either through abstraction or discharge). The environmental
licensing process involves an environmental impact assessment (EIA). The basin committee
and agency had no role in granting water use permits (Interview-B20).

Effectiveness on actors in terms of mandated goals

Water permits allowed the State to control water use, and improved on the existing situation of
private appropriation of water resources with no accountability (Menezes Da Costa and
Tybusch, 2015). Permits had to be compatible with the state’s water resources plan, which

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36 Sustainable abstraction depends on the effect on the water stock or flow.
ensured that it was consistent with water use priorities defined by participants. Moreover, as
permits were a prerequisite for obtaining an environmental license, WRM could be coordinated
with environmental management.

Nevertheless, despite relative water scarcity, there were no quantitative restrictions to
obtain a permit beyond the ‘Q7,10’ method standard in the ATB. São Paulo State holds areas
with restrictions on extractions due to quantity or quality concerns, generally where
groundwater extraction is more widespread. Nonetheless, there were zones with restrictions on
extractions due to quantity or quality concerns, but there were no restrictions in the ATB
(Interviews-B16/B20). Agricultural users do not have water metres, encouraging wasteful
irrigation practices, and the DAEE lacks capacity to adequately monitor users and ensure
compliance with allocated volumes (Interviews-B5/B6/B8/B16).

There were also no substantial qualitative or environmental criteria for granting water use
permits (Interviews-B5/B6/B29). The CETESB was not involved in this process (Interview-
B10). Although the new river basin plan also aimed to reduce water demand, this topic was
still marginal within the basin committee’s discussions (Interview-B14). In certain
circumstances, such as environmental degradation, a permit could be suspended (Brazil, 1997
Art. 15). However, the DAEE eased regulation by only requiring users to have the necessary
paperwork required for a permit and not necessarily verifying it (Interview-B16).

Impact on inclusiveness and sustainability

Although the water permit system gave the DAEE greater control over who had access to water,
it did not reduce overall water allocation. In the MRSP and surroundings, the majority of water
permits were for surface water resources, and groundwater use was often dismissed as
irrelevant by respondents (Interview-B19). However, it was estimated that around 11m$^3$/s of
groundwater were extracted across the MRSP, and clandestine groundwater use was estimated
to be significantly above registered use (FABHAT, 2016; OECD, 2017) (Interviews-B4/B5/
B20/B28). Registered and unregistered wells increased significantly during the water crisis,
particularly by residential and commercial buildings in the (wealthier) centre of the city, with
often no quality regulation, exposing users to potential public health risks (Interview-
B6/B7/B19).

Municipal utilities could obtain permits for water resources beyond their borders, but this
required agreements with the state government and the municipalities where water would be
abstracted, as well as large infrastructure investments to transport this water (Interviews-

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37 However, the issuing of new permits was temporarily suspended during the 2013-2015 water crisis.
38 A SABESP official specified that users will not receive permits for water of low quality, but criteria around
this are not formally defined (Interview-B5). Further, there were no criteria that restrict groundwater use near
potential pollutant sources such as gas stations.
39 The Guaraní Aquifer is too far from the MRSP to be used (with current infrastructure and technologies), while
the aquifer below the MRSP had limited capacity and is susceptible to contamination.
40 A SABESP official claimed that there were around 5000 registered groundwater use permits out of an estimated
12,000 total wells (Interview-B5). Unregulated wells could be located in areas at risk of contamination (e.g. near
gas stations) (Interview-B10).
B22/B23). As a result, if they needed to import water, they bought it from SABESP. According to some respondents this created a dependency on the state and pushed municipalities to delegate water services to SABESP (Interview-B36).

5.4.3 WATER USE AND WASTEWATER DISCHARGE FEES

Description

River basin committees can choose to charge bulk water use fees to users holding water use permits within the basin (i.e. user-payer policy), except those of the energy sector (CEDE, 2015).41 Water use fees aim to: (a) recognize water as an economic good and give users an indication of its value; (b) incentivize rational water use; and (c) obtain financial resources to fund programmes and interventions defined in the basin plan (Brazil, 1997 Art. 19). The fees should not significantly increase costs but be sufficient to promote behavioural changes inducing rational water use and constitute a financial reserve for rehabilitation actions within the basin (CEDE, 2015).

After years of debate, this system was implemented in the ATB in 2013/2014.42 The fees include an abstraction, consumption and discharge component43 and reflect the relationship between availability and demand (MMA, 2010). Their value is discussed and agreed on within the basin committee, and the collected fees go to the State Fund for Water Resources (FEHIDRO) (Interview-B20). This fund must be used within the river basin in which it was collected, to finance studies, programmes, projects and works and to pay administrative expenses (Brazil, 1997 Art. 22). The river basin committee members decide how the funds are used, based on the goals and actions outlined by the basin plan, reviews by the technical boards and voting in plenary sessions (Interview-B20). All committee members can propose projects, which are then reviewed by the technical boards of the committee.

The PCJ Committee charges an additional fee (0.02 Real/m³) if water is not returned to the basin – as is the case with inter-basin transfers. However, SABESP negotiated a 50% discount on this fee for imports from the Cantareira System to the MRSP in a 2006 agreement (when the PCJ implemented water use fees) (Consórcio PCJ, 2018). SABESP’s aim was to limit the impact of the transfer fee on water tariffs in the MRSP.

Effectiveness on actors in terms of mandated goals

The implementation of water use fees has led to a slightly greater awareness of the value of water but limited increase in rational water use. However, collecting the fees is difficult. When

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41 The energy sector pays a “financial compensation for water use for electricity generation”, which aims to indemnify states, the Federal District and municipalities for liabilities caused by this activity.
42 The PCJ basin, where the Cantareira system is located, was the first to implement it, and many basins are yet to follow suit (Interviews-B5/B29).
43 The abstraction fee is 0.01 Real/m³, the consumption fee is 0.02 Real/m³ and the discharge fee is 0.10 Real per kg of Organic Water Pollutant (Interview-B20).
first implemented, it was estimated that the total collected fees would sum up to USD 10 million per year, but in 2015 the collected total amounted to just over half of that (FABHAT, 2016). Users must send proof of their water meter reading and, if they fail to comply, they are charged the full amount they are authorized to use according to their permit (FABHAT, 2017). They therefore lack incentive to declare uses above their permitted use. Water utilities and industries pay the same fees. If utilities have a ‘Water Losses Master Plan”, and industries a rational water use programme, they pay 20% less (São Paulo State, 2010). However, agricultural users do not pay any water use fees (Interview-B6). As agricultural use is relatively low in the ATB, as most of the land is either urbanized or protected, urban and industrial users were the main contributors (Interviews-B1/B6/B10). Moreover, due to high levels of urban and industrial use, the ATB collected higher fees than most basins, and therefore had a more substantial budget (Interview-B25).

The value charged was too low to lead to substantial reductions in water use (e.g. for large industrial users it was often not even 1% of their advertising costs) (Interviews-B7/B11/B25/B29/B32). Estimates indicate that, in 2017, SABESP paid around USD 19 million in bulk water fees within São Paulo State out of its USD 3.6 billion revenue (Interviews-B11/B29). Moreover, the rate per cubic metre decreases as the volume used increases, which incentivizes wasteful practices (Interview-B29). In recent years, the PCJ Committee has attempted to renegotiate the discount fee for inter-basin transfers and strengthen the shared management of the Cantareira System (Consórcio PCJ, 2018). Additional funds would be destined to the economic sustainability of municipalities upstream of the Cantareira system, and the protection of springs.

Another challenge concerns uncertainty around the cost of treating wastewater discharge to the quality standards required (see 0). With better knowledge of these costs, a more adequate system of fees can be designed that could decrease water use or increase wastewater treatment (Da Silva and Rios Ribeiro, 2006). Some industries were reported to have reduced their permit’s allocated volume of water, reduced their water use and adopted measures such as wastewater reuse, although these cases still seemed marginal (Interviews-B7/B20/B34).

Impact on inclusiveness and sustainability

The implementation of these fees has increased the committee’s budget tenfold and revived participants’ interest in the basin committee (Interview-B16). While the fees charged were not large for SABESP, they can strengthen the committee and allow for capacity-building and investments in protecting water resources (Interviews-B4/B6). However, the FEHIDRO fund cannot be used to address land use and housing-related issues in areas of protected springs that significantly contribute to water-related challenges. This falls under the mandate of other actors, who are not integrated with the basin committee (Interview-B15).

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44 A member of the committee and civil society representative estimated that SABESP and large industrial users contributed approximately 60% to the budget (Interview-B35).
Furthermore, at the time of fieldwork, the basin plan, which determines the priorities for actions financed by the FEHIDRO fund, was outdated and widely criticized for being inadequate (Interview-B29). Potential recipients (e.g. municipal departments) often lack the technical capacity to elaborate projects that comply with the criteria (CEDE, 2015). There was also disagreement within the basin committee on whether to spend FEHIDRO funds on investments in sanitation. While progress is urgently needed on the latter, this is the mandate of Wat&San utilities and not the basin committee.

Tensions have risen between the ATB and PCJ committees, as the latter claims greater compensation for the use and transfer of its water resources. The importance of the MRSP at national level has contributed to top-down intervention by SABESP, the DAEE and the ANA to ensure its access to subsidized bulk water.

5.4.4 AREAS OF PROTECTION AND REHABILITATION

Description

In 1975-76, São Paulo State adopted legislation for the protection of areas surrounding springs, streams, reservoirs and other water bodies of interest in the MRSP, with the aim to protect these areas’ water production services by regulating land use and land occupation, Wat&San services, and natural resources management (São Paulo State, 1997) (Interview-B10). However, as the city grew, real estate and political interests in developing these areas were high, and these laws were not adequately enforced, resulting in informal occupations (FABHAT, 2016) (Interviews-B5/B7/B14/B17/B19/B33/B36). There was no public policy to address regional inequalities and unequal urbanization (Interview-B33), nor metropolitan-level planning for these areas.

Hence, in 1997, a new State Law (nº 9.866) was adopted setting guidelines and norms for the protection but also the recovery of areas of springs of regional interest in São Paulo State (São Paulo State, 1997). This led to the creation of four Areas of Protection and Recovery of Springs (APRMs), located within the ATB and corresponding to 55% of its territory (FABHAT, 2016) (see Map 5.1). APRMs aim to 1) preserve and rehabilitate springs of regional interest for public supply; 2) harmonize these actions and environmental protection more broadly with land use and socio-economic development; 3) promote participatory management; 4) decentralize the springs’ planning and management; and 5) integrate housing policy with environmental protection (São Paulo State, 1997). Sub-basin committees are responsible for developing specific plans for each APRM, aligned with the basin plan (Interview-B6). These plans must establish policy guidelines on housing, transportation, environmental management and infrastructure that interferes with the springs’ water quality.

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45 A large proportion of funds were spent on small-scale, scattered environmental education projects or other local projects, with insufficient transparency on project selection, spending and impact assessment (Interviews-B5/B17/B29).

46 This concerns water treatment, stormwater drainage, flood control, solid waste management, sewage management and the transmission and distribution of electric energy.
Within the APRMs, there are three categories of ‘Intervention Areas’: ‘Areas of Restriction to Occupation’, which have the highest level of protection; ‘Areas of Directed Occupation’, which may be developed for urban or rural uses if these comply with a number of criteria for environmental preservation, and; ‘Areas of Environmental Rehabilitation’, which compromise the areas of springs and require corrective intervention (São Paulo State, 1997). Each of these areas have guidelines and norms.

**Map 5.1** Expansion of urbanization towards areas of protected springs in the MRSP

*Source: Author*

*Effectiveness on actors in terms of mandated goals*

This focus on areas of springs is a more pragmatic approach that allows for regularization and slum upgrading in some cases. It differentiates between areas that are more and less important to the protections of the springs and reservoirs. The installation of sewage infrastructure is possible even in the most restrictive ‘Intervention Areas, but must be approved by CETESB, and the discharged effluents must be compatible with the classification of the receiving water body (São Paulo State, 1997). The CETESB is focused on environmental issues and land occupation is not its priority, which limits the integration between the two policy areas (Interview-B15). The lack of integration between different mandates and goals favours the maintenance of the status quo in practice, with environmental actors reluctant to regularize settlements or approve basin infrastructure (Interview-B5/B15/B20).
As with the previous legislation, the APRMs require constant monitoring and interventions, and municipalities lack such capacity (FABHAT, 2016) (Interview-B14). They were often blamed for their lack of planning and control over developments within their borders, while utilities were criticized for their lack of sewage treatment (Interviews-B5/B10/B22/B23). Even if they can install sewage collection infrastructure, connecting households to sewage treatment plants remains a challenge (Interview-B10).

An important hurdle is the incompatibility between municipal master plans and the APRM’s specific laws. Comparing zoning maps of APRMs with municipal zoning maps reveals different delimitations and land uses for the same areas (Nascimento, 2019). In many cases, municipalities did not update and harmonize their master plans with the APRM legislation (Interview B30). This confusion facilitates and obscures inadequate land use.

In addition, neighbouring municipalities within APRMs often did not coordinate preservation adequately as land use management is a municipal responsibility (Interview-B20; B30). This made common policies difficult to agree on.

**Impact on inclusiveness and sustainability**

Some municipalities of the MRSP have large portions of their territory within APRMs, which restricts their ability to obtain environmental licenses from CETESB for development, condemning them to poverty and informality (Interview-B7). The new legislation is more permissive and has allowed for regularization in some areas and thereby the installation of basic urban infrastructure and sanitation services. Between 2008 and 2015, over 1000 km of sewage pipes were installed in the APRMs (FABHAT, 2018). Despite this, the effects on slum upgrading and the reservoirs’ water quality have been subpar (e.g. phosphorus levels in effluents remain significantly above targets). In 2013/2014 studies reported cases of water-borne diseases within the Guarapiranga and Billings APRMs and showed that contamination levels remained significantly above the target levels (FABHAT, 2016). In 2015, the CETESB registered high mortality rates in fish and other aquatic fauna (FABHAT, 2016). Moreover, urbanization growth is higher within the APRMs than in the rest of the basin (FABHAT, 2016), indicating that not enough is done to prevent new informal settlements from developing in these areas. However, as the plans for the APRMs were implemented only in 2006 and later, it may be too early to conclude about their success.

5.5 INSTRUMENT ASSESSMENT AND REDESIGN

The instruments employed in river basin governance in the MRSP show mixed results, both in terms of their ability to change actors’ behaviour and to foster more sustainable and inclusive water governance (see Table 5.4).

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47 17 municipalities of the MRSP have at least 50% of their territory inserted in an APRM, and 6 are entirely contained within one (FIA, no date).
Table 5.4 Assessment of IWRM/IRBM policy instruments in the MRSP

<table>
<thead>
<tr>
<th>Instrument design</th>
<th>Effect on actors in relation to mandate</th>
<th>Impact on sustainability and inclusiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-basin transfer</td>
<td>[+ Aims to increase water supply and redundancy through integration Donor basin is compensated]</td>
<td>Ecol: [+] Externalities are transferred to donor basin Soc: [+] Access to drinking water is high Econ: [-] Positive for MRSP but negative for donor basin, and costs are transferred to future generations Rel: [-] Donor basin has little voice in the process and its own development is affected</td>
</tr>
<tr>
<td>Water permits</td>
<td>[+ Dependent on water availability, considering minimum environmental flow and priorities ranking]</td>
<td>Ecol: [-] Greater quantitative control of water resources, but no reduction of overall water allocation. Irregular (groundwater) use is high Soc: [-] Lack of qualitative control, with health risks Econ: [-] Irregular uses have short-term costs (i.e. loss of fees) and long-term costs (i.e. depletion) Rel: [-] The MRSP exports its water scarcity</td>
</tr>
<tr>
<td>Water use and wastewater discharge fees</td>
<td>[+ Reflect availability, promote rational use and are redistributed within basin]</td>
<td>Ecol: [+] Limited impact, but as the fees’ value rises it is expected that users will reduce use (assuming improved enforcement) Soc: [++] Utilities are charged lower fees than industries. The funds from the fee can also be used to support poorer municipalities Econ: [++] The basin committee’s funds have increased, allowing it to invest more Rel: [++] As funds increased, interest in the basin committee rose and gave it more influence at regional level</td>
</tr>
<tr>
<td>APRMs</td>
<td>[0] Pragmatic approach to preservation and rehabilitation and more inclusive of marginalized residents</td>
<td>Ecol: [+] Legalizing areas, allowing for sanitation infrastructure, may improve water quality more than full protection (with no compliance) Soc: [+] If implemented adequately, residents in these areas will have greater access to services Econ: [+] Legalisation adds paying water services consumers. If contamination is reduced, local water bodies become usable, reducing reliance on imports Rel: [+] It has potential for better integrating marginalized areas within the MRSP</td>
</tr>
</tbody>
</table>

Relative assessment scores: ++ Very positive; + Positive; 0 Neutral; - Negative; -- Very negative (See Section 2.4)
Redesign

Based on the evaluation of the above instruments, the following redesign options are recommended.

No additional inter-basin transfers: The conceptualization of water security must integrate demand-side measures and the preservation of ecosystems in order to be sustainable. As SABESP depends on water sales for its revenue, it lacks incentive to reduce these. If bulk water in other basins becomes more expensive, through higher bulk water use and inter-basin transfer fees, users may have an incentive to reduce imports and improve the quality of nearer water sources. The cancellation of SABESP’s discounted inter-basin fee – potentially over the course of several years to allow it to adjust – could incentivize water conservation and investments in alternative strategies (e.g. wastewater reuse, rehabilitation of the ATB’s water bodies by expanding wastewater collection and treatment), while increasing revenue for the PCJ basin committee preserving the Cantareira System and sustainable economic activities around it. The PCJ Committee and other stakeholders from donor basins require a greater voice in decision-making processes that involve water transfers, to negotiate outcomes that benefit both donor and receiving basins.

If the aim is to achieve sustainable and inclusive development, alternative measures to additional inter-basin transfers can be explored. Those that are in place will be in use for a long time (lock-in effect), but as water demand is expected to increase with urban growth and climate change, this allows for a slow transition while other measures such as wastewater treatment and reuse and water saving equipment are progressively scaled up.

More scrutiny on the issuing of water permits: Although more water is allocated to public supply than other uses, the allocation of permits to intensive industries, a use of lower priority than drinking water consumption, could undergo more rigorous scrutiny of costs and benefits. Incentives can be put in place to nudge industries towards water reuse. For instance, flexibility can be introduced in permits so that users could still receive part of their water through the public supply, subsidies could be granted for investments in the necessary technology, and reuse could be incorporated into certifications or labelling schemes recognizing greener industries. Industries could also establish partnerships with sewage treatment plants, if located nearby (e.g. receiving treated wastewater at a discounted price, or for free in exchange for their water use permit). These measures require adequate risk assessments.

In addition, water abstractions without permits must be addressed. A starting point can be industries and commercial or large residential buildings, as they are more likely to use groundwater. More reliable and easily accessible quantitative and qualitative data is also necessary to prevent over-abstraction, as it would enable more effective monitoring of users. Groundwater use is practically ignored by key actors despite estimates of significant (unregulated) use, and this could receive greater attention if groundwater management was effectively included within water resources management. Furthermore, despite the need for inter-basin transfers, water use permits continue to be granted to new users. The DAEE could introduce a restriction zone within the ATB, increasing requirements for obtaining a permit (e.g. through environmental and social impact assessments, compensation mechanisms), and
potentially creating a moratorium on new permits, where users can still transfer existing permits.

**Expand water use fees (progressively):** The return of water use fees to the basin committee, to be spent on projects within the basin, according to priorities that were set in a collaborative manner, has strengthened participatory basin management. The fees are still too low to have a significant effect and nudge users towards conservation or reuse. A sudden increase in rates would mainly create difficulties for smaller users. However, a progressive, annual increase (as was done in other cases, such as in French basin agencies) would allow users time to adjust, for instance by adopting water saving technologies or switching to water reuse. To prioritize water for public supply, an increase in water use fees can be part of a differentiation between types of users. Large, lucrative industrial and commercial water users could be charged a higher fee. Agricultural users could be charged a fee, albeit significantly lower, to discourage wastewater irrigation practices. Efforts could also be made to increase the proportion of water users that pay these fees, which is linked with enforcing water permits.

**Integrating APRMs in regional, inter-sectoral planning:** The APRMs represent a more pragmatic approach to preserving BESS within and around the mega-city. Although concrete results are still limited, with proper implementation this instrument has potential to keep uncontrolled urban growth in check. One obstacle is the incoherence of plans and mandates at different levels of governance and across sectors. Municipal actors must reconcile state-level environmental policies with their constituents’ demands for housing and basic infrastructure and services, with often limited human and financial capacity. The new basin plan aims to support municipalities to make their municipal Wat&San plans and drainage plans compatible with the basin plan, and thereby with the APRMs. As an incentive, municipalities that do so could receive points within the point system for applying for FEHIDRO funds, which would increase their qualification for receiving funds. If municipal Wat&San plans are coordinated with land use management and urban planning, they could identify parts of informal settlements that can be legalized, that can be upgraded with certain services or that must be relocated (e.g. areas at risk or where no form of sanitation can be installed).

Moreover, regional planning could identify areas to direct urban growth and densification, with shared efforts towards the protection of environmentally valuable areas so that it does not fall disproportionally on the shoulders of peripheral municipalities with limited budgets. Such regional spatial planning has greater potential if it is linked to the granting of environmental licenses, and thereby to water use and discharge permits. The Integrated Urban Development Plan for the Macro-metropolis (see 6.3.4), under development at the time of research, aims for regional planning on land use, Wat&San, environmental matters, water resources, housing and more. It remains to be seen whether it will develop instruments promoting a shared regional vision and a fairer distribution of the costs of preserving crucial ecosystem services.

**Missing instruments**

In addition to the changes above, the suggestions below could be incorporated into the instrument mix.
The research found that no significant suasive instruments were in place. The basin committee and other organizations had supported environmental education initiatives and awareness campaigns, but these tended to be small-scale and piece-meal, and they had not been assessed to examine results. On the other hand, during the water crisis, media reports, documentaries and other sources were effective in spreading awareness about the need to drastically reduce water use. In Spain, campaigns to promote awareness on the need for rational water use and the use of water-saving technologies have had major impact on reducing water consumption (Tortajada et al., 2019). The challenge in São Paulo is the state government’s own reluctance to discuss water scarcity. The basin committee could partner with multiple NGOs (and even the private sector) to develop a more comprehensive, large-scale awareness campaign.

PES programmes have been implemented in some parts of Brazil, but not in the ATB. Their effective implementation presented several challenges, such as continuity if they depended on donations. However, with stable funding, they could be used to help preserve areas of springs. They can link users to the ecosystems that they rely on and help make this relationship more visible and valued. If FEHIDRO funds increase, through the collection of water use fees, a portion could be allocated in this way and be linked to the APRMs.

The NWL originally included financial compensation to municipalities (for land use and development restrictions due to environmental and zoning regulations) as one of its instruments, but this was ultimately vetoed. Several respondents mentioned that a financial compensation instrument would not only be fair, considering the disproportionate negative externalities put on peripheral, poorer municipalities for benefits in the urban core. This could be linked to wastewater discharge fees or to taxes on real estate developments and industries. This could also make polluting more costly and incentivize polluters to invest in sewage treatment, reuse and other measures.