



Integration and adaptation in the Alto Tietê Basin (São Paulo): the role of the State Water Resources Fund in the protection and recovery of watershed areas

Integração e adaptação na Bacia do Alto Tietê (São Paulo): o papel do Fundo Estadual de Recursos Hídricos na proteção e recuperação das áreas de mananciais

Amauri POLLACHI^{1*}, Sandra MOMM¹, Rosana Laura da SILVA¹

¹ Federal University ABC (UFABC), Santo André, SP, Brasil.

* Contact email: apollachi@gmail.com

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ABSTRACT: The Integrated Water Resources Management (IWRM) model is a reference for water governance in Brazil. Since the 1990s, the state of São Paulo water policy has advocated the integration between environmental and socioeconomic systems and a transition to a more sustainable and resilient way of using water resources. Nowadays, considering the scenario of climate change and its impacts, Adaptive Management (AM) based on theories of resilience is evidenced as a new model for managing uncertainties. However, the implementation of these modes of management and governance is incomplete, for several reasons, and consequently unable to advance successfully in the construction of a transition to sustainability. Starting from these normative and theoretical assumptions, the article addresses one of the main IWRM instruments: water use charges, which provide financial for the State Water Resources Fund (FEHIDRO). Using a qualitative-quantitative methodology, the research identified the main results of the investments financed in the Alto Tietê River Basin (BAT) by FEHIDRO from 2007 to 2018. The objective was to evaluate the impact and effectiveness of the application of funding for the recovery and environmental protection of the BAT's water catchment areas. Despite its limitations in the scale of resources, FEHIDRO has the potential to play a role as a source of promotion to contribute to the integrated and adaptive management of water resources and as an incentive for innovation in socio-technical systems and for participatory processes in the multi-level perspective of water governance.

Keywords: integrated and adaptive management of water resources; sociotechnical transitions; Water Resources State Fund (FEHIDRO); Alto Tiete River Basin; watershed areas.

RESUMO:

O modelo da Gestão Integrada de Recursos Hídricos (GIRH) é uma referência para a governança da água no Brasil. Desde os anos 1990, no estado de São Paulo, a política de águas preconiza a integração entre sistemas ambientais e socioeconômicos e uma transição para um modo mais sustentável e resiliente no uso dos recursos hídricos. Na atualidade, em cenários das mudanças climáticas e seus impactos, a Gestão Adaptativa (GA) alicerçada em teorias de resiliência evidencia-se como um novo modelo para a gestão de incertezas. No entanto, a implementação desses modos de gestão e governança se mostram incompletos, por diversas razões, e, consequentemente, incapazes de avançar em bom termo na construção de uma transição para a sustentabilidade. Partindo dessas premissas normativas e teóricas, o artigo aborda um dos principais instrumentos de GIRH – a cobrança pelo uso da água – que fornece os recursos financeiros para o Fundo Estadual de Recursos Hídricos (FEHIDRO). Por meio de uma metodologia qualiquantitativa, a pesquisa identificou os principais resultados dos investimentos financiados na Bacia Hidrográfica do Alto Tietê (BAT) pelo FEHIDRO de 2007 a 2018. O objetivo foi avaliar o impacto e a eficácia da aplicação dos financiamentos para a recuperação e a proteção ambiental das áreas de mananciais da BAT. Apesar de suas limitações na escala de recursos, o FEHIDRO possui potencial para desempenhar um papel como fonte de fomento para contribuir para a gestão integrada e adaptativa de recursos hídricos e de incentivo para inovação nos sistemas sociotécnicos e para os processos participativos na perspectiva multinível de governança da água.

Palavras-chave: gestão integrada e adaptativa de recursos hídricos; transições sociotécnicas; Fundo Estadual de Recursos Hídricos (FEHIDRO); Bacia Hidrográfica do Alto Tietê; áreas de mananciais.

1. Introduction: discussing integration and adaptation for a transition in water resources use

Integrated Water Resources Management (IWRM) is a reference for the governance of water resources in Brazil and in the State of São Paulo. According to Benson et al (2015, p. 1921), "IWRM has been widely adopted since the 1990s by international policy organizations, such as the European Union and the United Nations (UN), and lending institutions" (e.g. the World Bank), and is defined as a "process which promotes the coordinated development and management of water, land and related resources to maximize economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems and the environment" (GWP, 2018).

In general, IWRM presupposes the adoption of institutional principles of management interaction and civil society participation, at the river basin

scale, encouraging integration with other public policies related to water and also its economic valuation. IWRM is realized as a "way to integrate all relevant environmental, social and economic issues, to reflect the biophysical reality, to integrate all stakeholders" (Gupta *et al.*, 2013, p. 575).

The final declaration of the International Conference on Water and the Environment, held in Dublin in 1992, is a cornerstone for IWRM that inaugurated the consensus of nations for the efficiency in water resources management and recognised, in its fourth principle, water as an economic good (UN, 1992). The insertion of the economic dimension to water, despite the argument focused on its protection and conservation, takes place in the context of regulatory restructuring in capitalism, which began in the 1970s with neoliberal predominance. Brenner (2018, p. 164) conceptualizes this restructuring as a trend of regulatory change that "prioritises market-based, market-oriented or market-disciplined responses to regulatory problems; it makes an effort to

intensify commodification in all domains of social life (...)". Associated with the economic role of water in the regulatory context of neoliberalization, it is worth highlighting as relevant the discussion on the commodification and private appropriation of water based on the condition of scarcity in a large part of the planet, as well as in several watersheds.

Currently, conflicts and tensions around water scarcity and quality are rising with new models, such as Adaptive Management (AM) associated with IWRM principles. AM is based in theories of resilience and involves managing uncertainty through formal experimentation and social process-based learning (Engle *et al.*, 2011). The evolutionary trend for water resources governance is towards merging the principles of AM with IWRM.

Still on governance perspectives, Gupta *et al.* (2013, p. 577) highlight the importance of managing water resources in a coherent and consistent way, "in which good governance includes a focus on effectiveness, efficiency, legitimacy and participation". In this direction, multilevel governance is associated, which was mainly disseminated by the Organisation for Economic Cooperation and Development (OECD) to enhance coordination among actors in order to address challenges mainly at subnational levels (Abrúcio & Sydow, 2018). For these authors (2018, p. 52), "such approach has currently been used to improve the integrated action of water and climate change policies". The perspective of adopting IWRM precepts associated with the GA, in a multilevel perspective, necessarily implies some level of transition.

In a trajectory analysis, between 1972 and 1992 the Brazilian environmental socio-technical system – the basis for planning and governance practices – was undeniably inspired by the ini-

tatives of countries in the Global North, in order to establish environmental policies to control and reduce the degradation of natural resources, especially water (Granziera, 2000; Pereira, 2002; Aith & Rothbarth, 2015), as well as to launch the basis for assigning an economic value to water. The comparative evolution of planning systems and cultures in global perspective is also observed in Zimmermann & Momm (2022). Sociotechnical systems have a high resistance to change (Geels & Schot, 2007), as they result from a regime as the specific configuration of practices - material and social elements - reinforced over time. Changes in these regimes can be called socio-technical transitions (Geels, 2002, 2011).

However, socio-technical transitions are non-linear and complex processes (Geels, 2002, 2011). These processes dialogue with the sharp criticism of the adherence to sustainable management models that ignore the complexity of their implementation (Acsehrad, 2009), local particularities (Castells, 2009) and socio-technical characteristics (Geels, 2002), compromising the viability of projects and, consequently, their potential to contribute to sustainable economic development. Moreover, the sought multilevel governance, as overlapping scales (municipal, state and the water resources management unit), and the heterogeneity of the territories that make up the watersheds are factors that affect the ability of alignment between actions planned in the land use planning plans, as in the case of the watershed laws and in the water resources plans. For Momm *et al.* (2021), changes in the culture and systems of land planning and water management are necessary for a transition or they will follow a path of maintaining the status quo and, in an integrated and adaptive perspective, with low resilience to

extreme events and disasters. The recent case of water scarcity in the Metropolitan Region of São Paulo (MRSP), addressed in the aforementioned article, is exemplary to illustrate the tensions placed on planning and governance systems, as well as exemplify the challenges of ensuring justice in water-related projects in socio-technical transitions (Travassos & Momm, 2022).

Although Brazilian water availability is among the largest on the planet, its spatial distribution is quite uneven, since 80% of surface water flow is in the Amazon Basin (ANA, 2021). In a climate crisis scenario, there is evidence of the occurrence of higher compromises to availability in the southeastern region of the country and, consequently, to the water supply where there is a higher concentration of population and demand (ANA, 2021). In the period between April 2013 and the end of 2015, a very severe drought, with precipitation well below the historical average observed until then, significantly impacted the inflow to the water supply systems reservoirs of the most populated regions in the state of São Paulo, compromising the supply for millions of inhabitants. This water crisis was perhaps the best opportunity to put São Paulo's water resource governance to the test, including as to a possible trajectory towards integrated and adaptive management.

For Barbosa *et al.* (2016, p. 11), the implementation and effective application of water resource management policies in the state of São Paulo faced challenges in four dimensions: institutional and governance; political; financial; and technical, since "stakeholders believe that the challenges of the governance, institutional and political dimensions are more important than the technical and financial ones". For several authors (Jacobi *et al.*, 2015; Fracalanza & Freire, 2016; Momm *et al.*, 2021),

coping with this extreme climate event has highlighted management and planning problems, given the insufficiency of institutional responses and the underestimation of the severity of the situation for political and electoral reasons. Although the reduction in the amount of water available was associated with the reduction in the inflows to the reservoirs due to a prolonged drought, it was a reflection of the inadequate strategic planning that occurred in the Region's water supply system over the previous 10 years (Côrtes *et al.*, 2015).

The control of the state government over the narratives and measures adopted to face the crisis, using a technical and centralizing discourse, removed "any integration with the population, pruning the involvement of society in the discussion, both of the cause of the crisis, as well as the possible solutions to face the problem" (Jacobi *et al.*, 2015, p. 36). For Sinisgalli *et al.* (2018, p. 82), "the lack of water in quantity and quality, resulting from the water crisis in the municipality of São Paulo, led to a sharpening of the social conflict over the use of available water".

In short, during this period of water scarcity, public questioning was sidelined and the collegiate bodies set up by the São Paulo management were excluded from the "discussions and decision-making processes to address the crisis" (Torres *et al.*, 2020, p. 72). For Gupta *et al.* (2013) the evolution towards integrated and adaptive management should understand that a water crisis is primarily a governance crisis that will not be solved through depoliticization and technocratic engineering and management processes, because it is deeply political in its essence, from the global to the local scale.

Pahl-Wostl *et al.* (2005), understand that stakeholder participation is a key element in the transition to more adaptive management regimes. To meet this

participation, transparency through access to public and available information is fundamental, that is, "individuals impacted by the actions of third parties have the right to know what risk they are exposed to and the potential impact on their health" (Empinotti *et al.*, 2017, p. 149).

Thus, in this water crisis, the permanence of the development pattern was observed, especially when the measures implemented from the crisis focused on short-term structural actions, leaving out, for example, the protection and recovery of water-producing areas (Momm *et al.*, 2021). In summary, according to Pollachi (2021, p. 62), when looking at the context of the 2013-2015 water shortage, the "structure designed to meet the precepts and practices of IWRM in a democratic, decentralized, participatory and integrated environment and with potential for adaptive evolution" revealed a governance pattern that faces obstacles to its full exercise, "notably on the issue of participation".

The uncertainties associated with the climate crisis potentialize the return of similar or even more drastic events when compared to 2013-2015. Therefore, there is a challenge for the management of water resources to provide responses to conflicts due to the climate crisis and to socio-economic conditions, challenges that will require the application of new management practices towards transition.

As a way of identifying the level of transition towards a more sustainable model, with a view to linking IWRM and AM, the concepts of efficiency and effectiveness are also mobilized. In public management, "effectiveness results from the relationship between achieved goals versus intended goals and efficiency means doing more with fewer resources" (Souza, 2008 apud Sano & Montenegro-Filho, 2013, p. 39). Thus, inputs allocated to

the action of a given process (efficiency) generate results that favorably transform a situation (effectiveness). Therefore, the article associates to IWRM the concepts of Adaptive Management and sociotechnical transitions, as theoretical and methodological framework for the documental analysis. For the case under study, they are respectively defined as:

(i) efficiency, compliance with the stages of the financing process with contractual completion and delivery of the agreed product;

(ii) effectiveness, when the efficient undertaking generated a positive result for the purpose of the Water Resources State Fund (FEHIDRO) and the environmental protection of the Alto Tietê River Basin (BAT) water catchment areas.

Based on this section, which addressed conceptual and contextual aspects, the following briefly describes the context of water resources governance in the BAT, through the Alto Tietê Hydrographic Basin Committee (CBH-AT), as well as the structure, modus operandi, history and evolution of FEHIDRO's main sources of resources. The main results of the empirical research on the Fund's investments in the BAT in the period from 2007 to 2018 are presented, focusing on the evaluation of the effectiveness of this application for the environmental protection of the water catchment areas.

Finally, the article, which results from a dissertation that researched and analyzed the application of FEHIDRO for the effectiveness of environmental protection of the water catchment areas located in the Alto Tietê Basin (Pollachi, 2019), presents considerations on possibilities for the transition of water resources management to a more resilient mode of

governance in the face of climate change in the BAT and, by extension, in the state of São Paulo.

2. Regulatory integration and instruments for the protection and recovery of water catchment areas in the Alto Tietê River Basin

The Alto Tietê River Basin (BAT), located in the state of São Paulo, concentrates in its territory of 5,775 km², about 21 million inhabitants occupying 70% of the territory and housing 99.5% of the population of the Metropolitan Region of São Paulo (MRSP). With only 1% of residents in rural areas and intense conurbation among the 40 municipalities that compose it, it extends from the sources of the Tietê River, in Salesópolis, to the Rasgão Dam, in Pirapora do Bom Jesus (CBH-AT, 2019a). By concentrating a large population densification and strong economic activity, the BAT has internal water availability of only 179.58 m³/inhab/year, that is, a condition far below the reference values adopted in the State of São Paulo, which considers a critical basin when it has less than 1,500 m³/inhab/year (CBH-AT, 2019a). Therefore, to supply about half of its demand for urban public supply, water transferred from neighbouring basins is used.

The BAT is inserted in the São Paulo Macrometropolis (SPMM), a metropolitan urbanization arrangement consisting of a set of metropolitan regions and urban agglomerations, which contains 174 municipalities and concentrates more than 30 million inhabitants in 53 thousand km². This terri-

tory, although not fully institutionalized, is used as a spatial scale for planning when it comes to the demands of sanitation and water resources (Zioni *et al.*, 2019). Figure 1 shows the insertion of the BAT in the delimitations of the SPMM and MRSP.

Just over half of the BAT area corresponds to eight water catchment areas destined for public supply: Guarapiranga, Billings, Alto Juquery, Alto Tietê Cabeceiras, Alto Cotia, Guaió, Cabuçu and Tanque Grande. The progressive expansion of the urban spot, coupled with the emptying of central areas and gentrification processes (CBH-AT, 2019a), worsens the environmental degradation of the territory of the water catchment areas, as a representative consequence of the intense conflict between the right to housing and environmental sustainability (Santoro *et al.*, 2009). In response to such degradation, as of the 1970s, successive laws for the protection and recovery of watershed areas have been drafted¹, seeking to plan and contain the disorderly urban expansion and establish parameters for restricting the use and occupation of the soil.

Conceived under a metropolitan agenda, in a multi-level perspective, these laws are linked to the hydric resources policy and attribute certain management and planning functions to the Alto Tietê Hydrographic Basin Committee (CBH-AT). This collegiate of the hydric resources management system is responsible, in its area of coverage, for indicating undertakings financed by the State Fund for Hydric Resources (FEHIDRO). This is a public fund, linked to the governance of water resources in the state of São Paulo, mostly supplied by the collection of fees for the use of water resources.

¹ The Watershed Protection Areas (APMs) were created by State Laws No. 898 of December 18, 1975 and No. 1.172 of November 17, 1976. Based on Law No. 9866 of November 29, 1997, the APMs transformed into Watershed Protection and Recovery Areas (APRMs) are: Guarapiranga (Law no. 12,233/2006), Billings (Law no. 13,579/2009), Alto Juquery (Law no. 15,790/2015), Alto Tietê Cabeceiras (Law no. 15,913/2015) and Alto Cotia (Law no. 16,568/2017). The two smallest areas Guaió, Cabuçu and Tanque Grande still remain as APM.

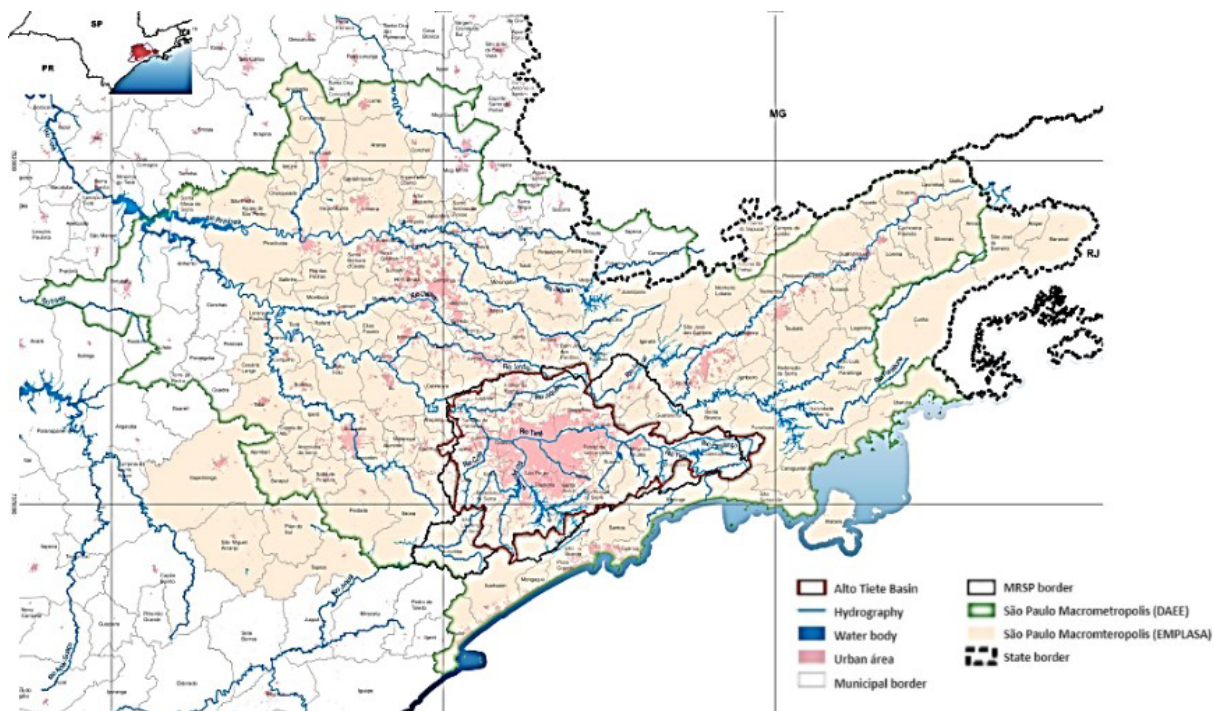


FIGURE 1 – Location of the Alto Tietê River Basin.

SOURCE: CBH-AT (2019b).

In order to protect, recover and mitigate the degradation caused by urban occupation in the water catchment areas of the BAT, investments in the order of billions of reais are required, planned and implemented under a long-term articulation and an agreed governance among political and social players. As part of this agreement, there is a legal obligation to invest at least half of the investment resources resulting from the charge for the use of water resources in the conservation, protection and recovery of the BAT's water catchment areas for a period of ten years starting from 2015, as provided in Article 3 of the Transitory Provisions of Law No. 12,183/2005 (São Paulo, 2005).

2.1 The structuring of the Alto Tietê Hydrographic Basin Committee for integrated management

Based on the Federal Constitution of 1988 and the State Constitution of 1989, the state of São Paulo established its Hydric Resources State Policy in Law No. 7.663 of December 30, 1991, in tune with IWRM and under the principle of decentralized, participative and integrated management. It is carried out through the Integrated Hydric Resources Management System (SIGRH), with the financial support of FEHIDRO for the implementation of programs, projects, services and works for the management, recovery and protection of hydrogra-

phic basins, foreseen in the Hydric Resources State Plan (PERH) and in the Hydrographic Basin Plans (PBHs) (São Paulo, 1991).

The State of São Paulo was divided into 22 Hydrographic Units for Water Resources Management (UGRHI), a geographic cutout where the hydrographic basin is "the most appropriate territorial delimitation to carry out an effective management" (Stern, 2010, p. 65). Each UGRHI corresponds to a Hydrographic Basin Committee (CBH), except for UGRHI 20 (Aguapeí) and 21 (Peixe), grouped under the Aguapeí-Peixe CBH. The CBHs are deliberative in nature and have the power, within their geographic area of influence, to elaborate their respective PBHs, propose charging values for the use of water resources and apply financial resources, among others. They can constitute technical chambers, for advisory purposes on specific themes and institute a Basin Agency, a non-profit foundation that manages the FEHIDRO resources pertinent to the hydrographic basin and operates the charging for the use of water.

The CBHs are submitted to the deliberations and norms of the State Council of Hydric Resources (CRH), for example, for the standardization of the PBHs and the approval of the committees' proposals regarding investment programs and charging amounts, and to the Guidance Council of the State Fund of Hydric Resources (COFEHIDRO) that supervises the management of FEHIDRO. The composition of the CRH, COFEHIDRO and CBHs obeys a tripartite and equitable representation of organs and entities representing the State, Municipalities and Civil Society segments.

The first period of life of the CBH-AT, from 1994 to 2006, is characterized as an initial stage of formation and configuration of processes and struc-

tures, in which the deliberative and consultative instances were consolidated, the Alto Tietê Hydrographic Basin Agency Foundation (FABHAT) was created and the first Alto Tietê Hydrographic Basin Plan (PBH-AT) and the revision of the legislation on water catchment areas were elaborated. The closure of this cycle can be established with the first initiative to implement charging for the use of water resources in the BAT, in 2006.

The second period is marked by events such as: implementation of the charge; reformulation of the structure; enactment of the priority water catchments laws; floods of 2010; water crisis of 2013-2015; and more rigorous selection for the indication of projects. This period, from 2007 to 2018, was established as the temporal cut-off of the research, as it expresses a greater diversity of themes and stage of maturity of the CBH-AT.

The responsibility of the CBH-AT in the FEHIDRO investment process occurs in two stages:

- (i) receipt of proposals, analysis, ranking and indication by deliberation;
- (ii) registration of the projects indicated in SINFEHIDRO. The stage of selection and indication of projects to the Fund was subject to successive improvements, "observing a much more mature hierarchization" (Anjos, 2017, p. 121) notably in the second period of the CBH-AT.

The Hydrographic Basin Plan is an essential instrument for directing investments, since the actions provided for in its planning horizon must be assumed in the objects of the undertakings indicated by the Hydrographic Basin Committee.

In the three PBHs of the BAT, there is a significant evolution in the focus dedicated to the water

catchment areas. In the first one, of 2002, this theme was treated in a very simplistic way, only to point out that "the municipal attribution on the administration of the use and occupation of the soil is the root of the difficulty of protection" (CBH-AT, 2002, p. 14). On the other hand, "the great metropolitan complexity places the management of water resources in a secondary position", as a spectator of the degradation of the water catchment areas (CBH-AT, 2002, p. 63). Consequently, the investment programme of the 2002 PBH only proposed the application of legal compensation to municipalities in watershed areas, as provided for in Law 8,510 of December 29, 1993, which deals with the portion belonging to municipalities of the product of ICMS collection, and Law 9,146 of March 9, 1995, which creates financial compensation mechanisms for municipalities with specially protected areas by the State.

The second PBH of Alto Tietê, in force from 2009 to 2018, made explicit the need for control and use of the soil in the Guarapiranga and Billings water basin areas, "without which the risks of compromising the quality of the water will be very high" (CBH-AT, 2009, p. 25). Incentives are foreseen for the water catchment areas:

- (i) studies, projects and works in protected areas;
- (ii) recovery of degraded areas and restoration of vegetation;
- (iii) rural development and adaptation of urban infrastructure;
- (iv) urban adaptation and land regularization.

The third PBH, approved in 2018, brings new approaches to the management of water resources in the Alto Tietê Basin, by transforming the reactive

posture with a conformist bias for water resources in the face of metropolitan complexity to a search for "the promotion of inter institutional governance, with agreements and partnerships between the CBH-AT/FABHAT and other actors" (CBH-AT, 2019c, p. 39). There is provision for specific actions for the water catchment areas with a more comprehensive range of proposals of an institutional, management, works and services nature based on the Development and Environmental Protection Plans (PDPA) of these BAT's areas, prepared between 2015 and 2017.

2.2. The role of the State Water Resources Fund and integrated and adaptive management

Considering the IWRM model that inspired the national water resources policy and the resilience achievements coming from the AM, with some level of innovation coming from the crises, the State Fund for Water Resources (FEHIDRO) offers financial support to the water resources policy in the state of São Paulo. This funding ranges from the cost of running the collegiate executive secretariats to the execution of undertakings for the management, recovery and protection of hydrographic basins through direct reimbursable or non-reimbursable funding. Among its 11 legally established sources of resources, only two of them account for almost the entire operation of the Fund: the federal contribution Financial Compensation for Hydroelectric Generation (CFGH) and the Charge for the Use of Water Resources (COB) adopted by the CBHs.

From a multi-level perspective, the CFGH is fed by two revenues:

(i) the payment of royalties for the Itaipu Hydroelectric Plant, a financial compensation for the use of the Paraná River hydraulic potential, distributed to 347 municipalities, five states and the Federal District (Brazil, 1990); and

(ii) the Financial Compensation for the Use of Water Resources for the Purposes of Electric Power Generation (CFURH) (Brazil, 1989), a payment by the operators of hydroelectric power plants to reimburse the federative entities where there are facilities intended for the production of electricity or flooded areas by hydroelectric power reservoirs, which benefits 722 municipalities, 21 states and the Federal District (ANEEL, 2021).

As of 2018, the reduction of the sharing percentage to the states in the CFURH (Brazil, 2018) and the authorization to untie 30% of tax revenues, fees and fines (Brazil, 2016), have been reduced federal contributions to FEHIDRO for application throughout the state territory from R\$ 63.6 million in 2015 to R\$ 21.2 million in 2019 (COFEHIDRO, 2015, 2019).

The COB, on the other hand, enshrined by Brazilian legal regulations, is aligned with the principles and guidelines of international organizations, since:

- (i) recognises water as an economic good and gives the user an indication of its real value;
- (ii) it encourages the rational use of water; and
- (iii) it obtains financial resources to finance the programs and interventions contemplated in hydric resource plans (Brazil, 1997).

It is "a financial instrument, aimed at the realization" of the Water Resources Policy and gives

"water an economic value" (Granziera, 2000, p. 73), making it an instrument "to control the sectorial appropriation of this public good, avoiding waste and encouraging treatment and adequate use" (Jacobi & Fracalanza, 2005, p. 44).

The institution of the São Paulo State COB (São Paulo, 2005) has an important link with the IWRM principles as it guarantees the credit of the collection in a sub account of the FEHIDRO linked to the basin where the revenue took place, whose application is defined by the respective CBH for costs and investments in the basin which generated the revenue. The implementation of the revenue is proposed by the Committee based on the registry of users of the basin's water resources and on the guidelines of the CRH, which approves it and forwards it for approval and the establishment of the amounts by state decree. The full implementation of the COB in all São Paulo's committees "foresees R\$ 156.8 million annual revenue for 2023" (SIMA, 2020, p. 86), while the amount for "investments foreseen in the PERH from 2024 to 2027 is of R\$ 14.2 billion" (SIMA, 2020, p. 91). Therefore, the charge for the use of water resources corresponds to about 4% of the planned volume of investments.

Regardless of the origin of the resources contributed to FEHIDRO, it is allowed to spend up to 10% with maintenance and personnel expenses, and at least 90% with investments in actions foreseen in the PERH or in the PBH (São Paulo, 1993). The following are eligible for financing:

- (i) direct and indirect state or municipal administration;
- (ii) providers of sanitation, environmental or water resources services;

- (iii) inter-municipal consortia;
- (iv) private non-profit entities operating in water resources or environmental protection;
- (v) basin agencies;
- (vi) private legal entities, users of water resources;
- (viii) legal entities that use water supply services, to apply in consumption reduction.

The diagram in Figure 2 shows FEHIDRO's investment operational process.

A previous step to the initial stage, which is the responsibility of the basin committees, is the approval of the criteria for the analysis and hierarchization of the projects to be indicated to FEHIDRO, in which the priorities of the respective PBH direct the concentration of investments in certain sets of

actions. The clarity and coherence of the content of this deliberation by the committees confer greater or lesser convergence of the indicated undertakings with the planning of the water resources policy at the hydrographic basin and state scales.

From 1995 to 2018, FEHIDRO financed more than R\$ 1.4 billion, distributed among municipalities (70%), state (17%) and civil society (13%), through more than 6,500 project contracts, on average 282 per year (Correnteza, 2018). However, a study to restructure FEHIDRO found its application performance below expectations, with pulverization of resources and contracts executed in very elongated terms, when not, canceled without the conclusion of the object (COFEHIDRO, 2016).

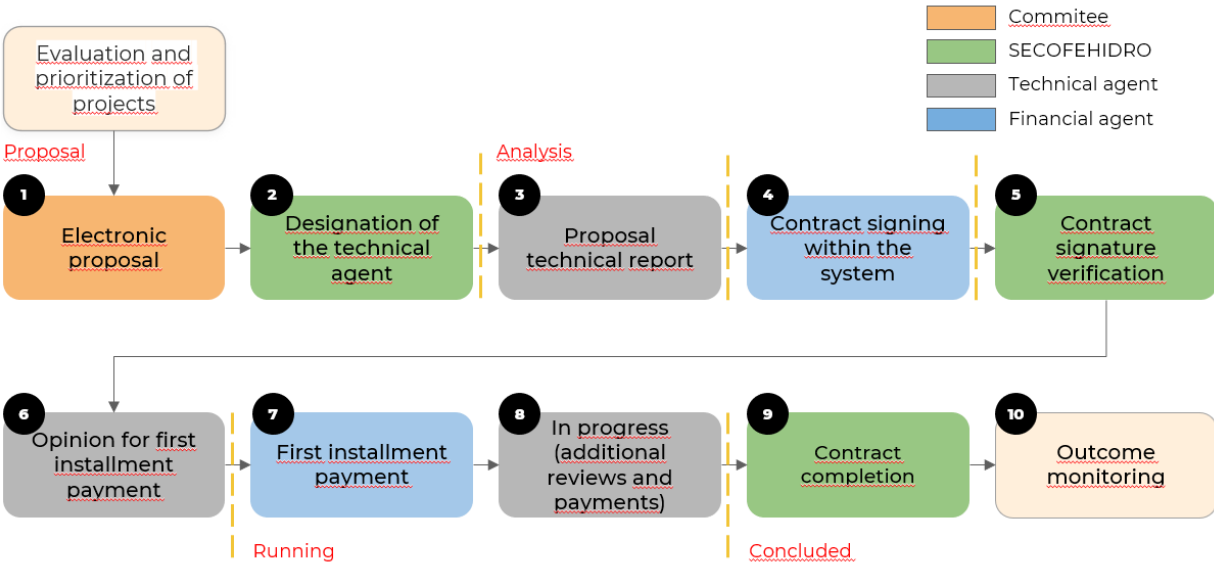


FIGURE 2 - Simplified scheme of the State Water Resources Fund (FEHIDRO) investment process.
SOURCE: SSRH (2016).

In the CBH-AT, from 2007 to 2019, the amount of the CFGH available for investments had "an average value of R\$ 12.4 million per year" (Pollachi, 2019, p. 112). However, with the reduction caused by the federal contribution and the state budget restrictions, the CRH adopted a new methodology for the distribution of this source of revenue among the 21 São Paulo State CBHs, improving the volume of investments in the CBHs in which the revenue of the COB is low and, on the other hand, reducing the allocation of the CFGH to the CBHs with higher revenues in which, comparatively, there is lower impact on the application of the CFGH (CRH, 2021). Thus, in 2022, the CBH-AT was allocated about R\$ 610,000 (COFEHIDRO, 2022).

In April 2014, the CBH-AT was the sixth São Paulo State committee to issue revenue slips, through FABHAT. In 2021 there were 2,829 users registered for water resources charges in the BAT reaching R\$ 54,993,676.00 of revenues, 90% concentrated in three users providing public sanitation services (FABHAT, 2021). Based on the table of revenue values with the water use charge in the Alto Tietê basin (FABHAT, 2022), the COB revenue obtained since 2015 plus the projection of an average annual investment of R\$ 43.2 million from 2021 to 2024, it could reach about R\$ 399 million for the first 10 years of the charge. Then, considering the legal obligation to allocate at least half of this amount to the conservation, protection and recovery of the BAT's water catchment areas, the CBH-AT should invest about R\$ 200 million for this purpose by 2024, already deducting operating costs and expenses.

3. The application of the State Fund for Water Resources and the impact on the protection and recovery of water catchment areas

Annually, the CBHs establish a public call for proposals for projects to be financed through the FEHIDRO, observing the CRH and COFEHIDRO guidelines. In the CBH-AT, Pollachi (2019) showed that 235 projects were indicated from 2007 to 2018, of which 149 were contracted for financing with a total value of R\$ 192,421,275.67.

Of these 235 projects, 61 covered the entire Basin, 37 the sub-basins and 137 were limited to municipalities. In Figure 3, which shows the quantitative distribution of the undertakings per BAT municipality, it is evident an unequal distribution of financing: smaller municipalities - such as Francisco Morato, Itapevi, Pirapora do Bom Jesus and Taboão da Serra - which did not receive investments, while the municipality of São Paulo received 18 indications for financing.

In the survey, it was found that almost half of the projects indicated by the CBH-AT were canceled or disapproved, while only 24% had been concluded. The public entities of the State segment obtained better execution performance and an expressive predominance in obtaining resources for financing, when compared to municipal entities and civil society organizations.

According to Pollachi (2019), hypothetically, the State may have benefited from a better quality in its proposals, as well as from greater cooperation between the State administration borrowers and the technical agents responsible for analyzing the projects, since both belong to the same federative entity.

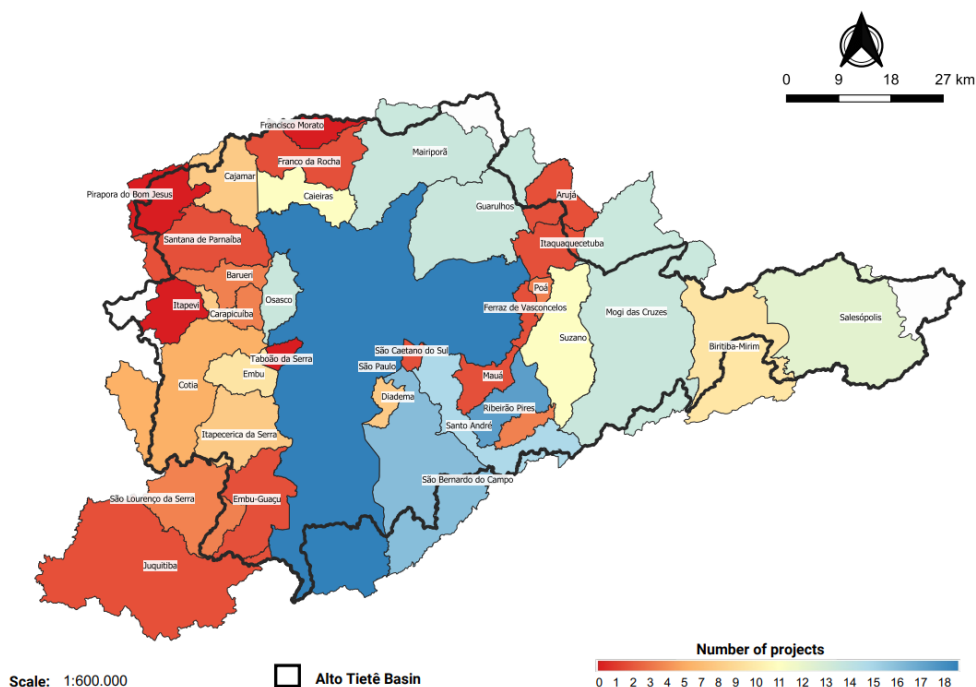


FIGURE 3 - Distribution of projects by municipalities in the Alto Tietê River Basin, São Paulo State, Brazil.

SOURCE: SINFEHIDRO (2019). Prepared by Rosana Laura da Silva (LaPlan/UFABC), 2019.

It was found that there were 20 projects indicated from 2008 to 2013 still under execution, eight with financial execution greater than or equal to 75% and three with the last parcel paid by 2011. Among the 57 concluded projects, seven had financial execution below 50%, indicating that their products had been partially delivered or had been breached. The largest portions of financing were destined for works (39%), services (28%) and studies (21%), leaving 12% for projects, research and others.

For investments in the BAT water catchment areas, 99 projects were indicated with a total amount of R\$ 65,915,726.59, that is, only 34% of the total amount contracted. Of these 99 projects, 45 were

canceled without any execution; 19 were concluded; four were under analysis; 11 were not started; and 20 were under execution (eight of them have been dormant for five years).

No investments were made in the smaller sub-basin areas (Alto Cotia, Guaió, Cabuçu and Tanque Grande), with investments concentrated on those most relevant APRMs (Alto Tietê Cabeceiras, Billings, Guarapiranga and Alto Juquery).

Regarding the effectiveness of results for the environmental protection of the BAT's water catchment areas, Pollachi (2019) observed in more detail the 19 projects circumscribed to these areas recorded as completed, which amounted to an investment of R\$ 4,623,256.83, equivalent to 2.4% of

the total amount approved for funding by FEHIDRO from the indications of the CBH-AT. Twelve projects were found in which the results were of null effectiveness or difficult to prove. In another four, effectiveness had yet to be proven. Finally, only three projects had proven to be effective, with positive results for environmental protection through the implementation of:

- (i) a management plan for the Nascentes de Paranapiacaba Municipal Park, in Santo André;
- (ii) an environmental education program still active in Embu das Artes; and
- (iii) a Development and Environmental Protection Plan, which served as a basis for the elaboration of the specific law for the Alto Tietê Cabeceiras APRM.

Therefore, the application of FEHIDRO resulted in a tiny degree of effectiveness for the environmental protection of the BAT's water catchment areas, as only three projects - 1.3% of those financed - produced demonstrably positive effects through the application of R\$ 873,540.00, corresponding to 0.4% of the total investment of the CBH-AT with FEHIDRO from 2007 to 2018.

A part of this result can be credited to the performance of the FEHIDRO management and operation process, established in the scope of the SIGRH, whose causes - previously identified - were found by Pollachi (2019):

- (i) high percentage of cancellations, in quantity and value;
- (ii) inconclusive contracts for several years;
- (iii) expressive reduction of amounts claimed;

(iv) predominance of the State segment over the others;

(v) pulverization of resources; and

(vi) only two contracts concluded in six years.

On the other hand, the obligation of Law No. 12.183/2005 that privileges investments in water catchment areas shows itself as a positive initiative to reverse this trend, since, from 2015 to 2018, about 60% of the resources from the COB financed 32 projects in water catchment areas with over R\$ 51 million, almost four times the amount applied in these areas from 2007 to 2015.

4. Final considerations: the role of FEHIDRO in the transition towards integrated and adaptive management

The governance of water resources in line with IWRM introduced charging for the use of water resources as an instrument to encourage water conservation and protection, contributing to advances in different planning scales in the state of São Paulo: regional and local. The perspective of an integrated management made it possible to create mechanisms such as FEHIDRO, providing financial support to the SIGRH management and making feasible the execution of projects that benefit the management, recovery and protection of waters throughout the São Paulo State. On the other hand, the low availability of water in a large part of the Brazilian Southeastern impacts the regularization of water supplies and causes internal and external tensions in the hydrographic basins and respective Basin Committees of the São Paulo Macrometropolis.

The water resources policy approved by the CBH-AT presupposes the use of a financial instrument, such as the FEHIDRO fed by the COB, as a tensioning vector on the socio-technical system, favoring the directing of resources towards the protection and recuperation of waters and water catchment areas. This arrangement contributes to an adaptive process that makes it possible, for instance, to increase water availability for water supply by improving the quality of surface water in critical basins in the state of São Paulo.

However, despite the fact that the BAT is in the first position in COB revenues in the state of São Paulo, this amount is not large enough to meet a more significant part of the investment needs foreseen in its PBH or to mitigate the degradation caused by urban occupation in the water catchment areas. There is an indirect incentive to adaptive resilience in the charging for the use of water resources: the reduction of water waste. This, however, does not arouse the user's interest, since the reference value charged per volume of water collected or extracted is small - R\$ 0.01/m³ (one cent of real per cubic meter) without updated based on inflation, and, in general, is incorporated in the price of products or services.

In this way, the application of FEHIDRO needs to find again its principle of economic instrument and vector of induction to the rational use and improvement of water quality, that is, primarily towards a transition in the perspective of recovery and preservation of the watersheds for public supply. Despite its limitations in scale, FEHIDRO has the potential to play a role as a source of encouragement to enable the integrated management of water resources in different scales of governance (multilevel), favoring the implementation of projects,

programmes and regional (consortia or regions) and local plans. There are examples of possibilities on a regional or local scale, such as the training of managers and technicians, the definition of priority areas for environmental recovery, the preparation of studies and analyses, the mapping and monitoring of raw water and watercourses, the implementation of decentralized measures in pilot projects with some potential to generate regional benefits. Favoring the continuous and gradual improvement of development patterns and management models, moving towards medium and long-term structural actions, especially in the protection and recovery of water producing areas.

This whole process would be more lasting and consolidated through the systematic use of governance practices that favour effective social participation in a democratic and decentralized environment, bringing about changes in the culture and systems of territorial planning and water management, necessary conditions for a socio-technical transition towards integrated and adaptive management.

The low level of effectiveness verified through the research in the application of FEHIDRO in the water catchment areas of the BAT is partly due to critical characteristics of the process, such as the lack of transparency in the cancellations, conclusion and results of the projects. In an integrated and multilevel perspective, the CBH-AT should consolidate its institutional role as a collaborative space for dialogue, conflict mediation and the construction of agreements between civil society and government entities on water resources and their integration with public policies, expanding the channels for participation and dialogue with stakeholders.

In this context, the BAT's link with neighbouring basins, suppliers of water for its subsistence, expresses inseparable preponderance of governance not only metropolitan, but also macrometropolitan when it comes to water resources. This position as a major importer of water reinforces the role of BAT in the articulation of effective actions to recover the quality of its waters, preserve its water catchment areas, reduce waste and promote equitable distribution, converging efforts towards the sustainable use of waters within the SPM.

For the transition of the water resources management instituted and practiced in the Alto Tietê Basin and, by extension, throughout the São Paulo State, it will be necessary to modify its control paradigms with the "realization that it faces increasing uncertainties from climate change and rapidly changing socioeconomic conditions." (Pahl-Wostl, 2007, p. 567). Increased uncertainties indicate the necessary transformation in water resources management to manage risks through new approaches and the integration of all actors. In this environment, techno bureaucratic solutions that disregard the human dimension will no longer be sufficient to meet the challenges of water governance.

Finally, considering the theoretical framework of socio-technical transitions, water governance in the Alto Tietê Basin may represent a niche for the experimentation of practices favorable to the transition to IWRM systems. Thus, towards greater resilience in the face of risks and uncertainties associated with climate change, as well as problems and vulnerabilities that result from gaps in integrated management and conflicts in the multiple uses of water.

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