

# PUBLIC POLICIES AND ENVIRONMENTAL PROTECTION: ANALYSIS OF ENVIRONMENTAL LEGISLATION APPLICABLE TO A RIVER BASIN IN SOUTHEAST BRAZIL

**Fernando Henrique Machado<sup>1</sup>**

Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP)  
Instituto de Ciência e Tecnologia (ICTS)  
Graduation Program in Environmental Sciences (PGCA)

**Felipe Hashimoto Fengler<sup>2</sup>**

Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP)  
Instituto de Ciência e Tecnologia (ICTS)  
Graduation Program in Environmental Sciences (PGCA)

**Gerson Araujo de Medeiros<sup>3</sup>**

Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP)  
Instituto de Ciência e Tecnologia (ICTS)  
Graduation Program in Environmental Sciences (PGCA)

## ABSTRACT

The Jundiaí-Mirim River Basin (BH-JM) is the most important source of public water supply in Jundiaí (SP). In the last decades, the accentuated economic and population growth has caused countless externalities, such as environmental degradation. For this reason, studies related to environmental public policies represent important analytical instruments for management purposes in order to evaluate the effectiveness of environmental protection by the State. Thus, this study aimed to identify and discuss public environmental policies (of a legal nature) related to the Jundiaí-Mirim River Basin (BH-JM). For this purpose, a bibliographical and documentary research was used, along with a historical-descriptive approach, in order to analyze the state and municipal environmental legislation. We identified 14 public regulatory applicable to BH-JM: 9 municipal (8 Laws and 1 Resolution)

<sup>1</sup> Doctor in Environmental Sciences by Science and Technology Institute of Universidade Estadual Paulista Júlio de Mesquita Filho (ICTS/UNESP). Master in Environment and Water Resources by Universidade Federal de Itajubá (UNIFED). Specialist in Environmental Technology by the Environmental and Sanitary Engineering Department of Universidade Federal de Minas Gerais (DESA/UFMG). Bachelor in Administration/Environmental Management by Escola Superior em Meio Ambiente (ESMA). ORCID: <https://orcid.org/0000-0002-9717-4765> / e-mail: fernandomb@hotmail.com

<sup>2</sup> Doctor in Environmental Sciences by Science and Technology Institute of Universidade Estadual Paulista Júlio de Mesquita Filho (ICTS/UNESP). Master in Tropical and Subtropical Agriculture by Instituto Agronômico (IAC). Bachelor in Environmental Engineering by ICTS/UNESP. ORCID: <https://orcid.org/0000-0002-7982-2300> / e-mail: felipe\_fengler@hotmail.com

<sup>3</sup> Post-Doctor by University of Alberta (UALBERTA). Doctor and Master in Agricultural Engineering by Universidade Estadual de Campinas (UNICAMP). Professor at Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP) ORCID: <https://orcid.org/0000-0002-9122-3909> / e-mail: gerson@sorocaba.unesp.br

ones, and 5 state (1 Law, 3 Decrees, and 1 Resolution) ones. The analysis showed that Jundiaí has a broad legal framework; nevertheless, there was limited legal effectiveness in its implementation when the established requirements are compared with existing environmental studies. For this reason, the need for more government intervention and community participation was noticed, in order to ensure effective compliance with the established laws. Furthermore, management guidelines were proposed in to subsidize better management of the river basin.

**Keywords:** Anthropogenic Pressure; Environmental Legislation; Jundiaí-Mirim; PCJ River Basins.

*POLÍTICAS PÚBLICAS E PROTEÇÃO AMBIENTAL: ANÁLISE DAS MEDIDAS LEGAIS APLICÁVEIS A UMA BACIA HIDROGRÁFICA PAULISTA*

*RESUMO*

*A bacia hidrográfica do rio Jundiaí-Mirim (BH-JM) é o principal manancial de abastecimento público de Jundiaí-SP. Nas últimas décadas o acentuado crescimento econômico e populacional ocasionou inúmeras externalidades, sobretudo àquelas relacionadas à degradação ambiental. À vista disso, políticas públicas ambientais, materializadas por meio de atos normativos, representam importantes instrumentos de análise a fim de avaliar a efetividade da tutela ambiental pelo Estado. Nessa perspectiva, este estudo visou identificar e discutir as políticas públicas ambientais de natureza legal relacionadas à BH-JM. Para este fim, utilizou-se de pesquisa bibliográfica e documental, em que foi empregada uma abordagem histórico-descritiva na análise do aparato legislativo ambiental estadual e municipal. Identificaram-se 14 medidas legais em vigor aplicáveis à BH-JM, sendo: 9 normas municipais (8 Leis e 1 Resolução); e 5 estaduais (1 Lei; 3 Decretos; e 1 Resolução). A análise realizada constatou que Jundiaí apresenta um arcabouço jurídico abrangente; contudo, notou-se uma baixa efetividade jurídica na sua implementação quando os requisitos estabelecidos são confrontados com os diagnósticos ambientais existentes. Destarte, observou-se a necessidade de uma maior intervenção do Estado e participação da coletividade visando o efetivo cumprimento das normas estabelecidas. Ademais, diretrizes de gestão a fim de subsidiar um melhor manejo da bacia foram propostas.*

**Palavras-chave:** *Bacias PCJ; Jundiaí-Mirim; Legislação Ambiental; Pressão Antrópica.*

## FOREWORD

The municipality of Jundiáí (SP) has shown a strong economic and population growth in the last decades. Among the indicators of this growth, the municipal *per capita* GDP of R\$ 94 thousand year<sup>-1</sup> (SEADE, 2014) and the average annual growth rate (1.07% p.y.) stand out (SEADE, 2016) – whose results proved to be higher than those of the State (i.e., R\$ 44 thousand year<sup>-1</sup> and 0.85% p.y., respectively). In Brazil, economic and population growth without proper planning shows numerous externalities, especially those related to environmental degradation, thus requiring concrete public administration actions regarding environmental protection (MELLO; SATHLER, 2015; MEDEIROS et al., 2017). From this perspective, studies related to environmental public policies are important analysis tools, since they provide the necessary governmental regulation to improve environmental quality (REVESZ; STAVINS, 2007; SPADOTTO; BARREIRO; MEDEIROS, 2017).

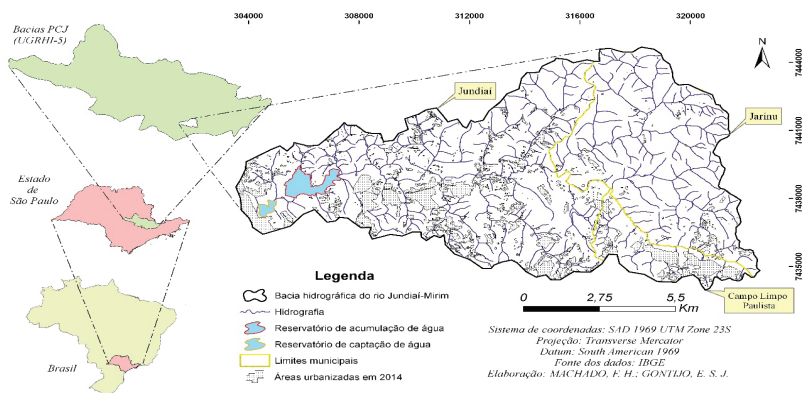
According to Souza (2006), the study of public policy emerges from the need to understand the reasons and circumstances where governments decide on and direct their actions. In drafting public policies, rulers actualize and execute their purposes by means of plans, programs and projects (i.e., put the government into action), thus resulting in eventual benefits to those they govern. Souza (2006) summed up the main elements of public policies, including what the government intends to do and what it actually does; it gets multiple formal and informal players involved; it does not stop at creating laws and rules; it bases itself on goals and is essentially long-term – despite resulting in short-term benefits.

In this way, we can see the theoretical-conceptual scope of public policies, as well as the countless elements that can make them up. This study focused on discussing public policies actualized through normative acts – although, as preliminarily stressed, they are not limited to this aspect alone. In view of this, the research problem emerged from the need for a greater reflection on the gaps, limitations and reach of public environmental policies aimed at the environmental protection of watersheds. Given that their territorial coverage can get more than one municipality involved, even with the existence of legal requirements, an efficient jurisdictional protection of these areas clashes with the diffuse interests of the various social players involved.

In this context, this study aimed at identifying and discussing the environmental protection public policies of a legal nature applicable to the Jundiaí-Mirim River Basin (BH-JM), as well as to analyze the effectiveness of their application by the State when protecting this environmental asset. For this purpose, we searched for normative acts in the state (São Paulo) and municipal (Jundiaí) legal database. Thus, we first introduce the area under study, as well as the research method adopted and the respective research criteria; subsequently, the results and discussions related to the normative acts identified are presented; and finally the main conclusions regarding the results are provided.

## 1 STUDY SUBJECT MATTER

BH-JM (Figure 1) represents the main source of public water supply for Jundiaí; it is responsible for supplying 95% of the water to the municipality (COBRAPE, 2016), whose population is estimated at 414,810 inhabitants (IBGE, 2018). BH-JM has a 118 km<sup>2</sup> drainage area, and its boundaries include Jundiaí (SP) (55%), Jarinu (SP) (36.6%) and Campo Limpo Paulista (SP) (8.4%) (FENGLER et al., 2015b). In the last decades, BH-JM has experienced an intense process of urbanization, increase in land price, and also agricultural and mining activities (FREITAS et al., 2013; FENGLER et al., 2015b). As a reflection of this land use and occupation, an overexploitation of water resources above their natural capacity has been noticed (MACHADO et al., 2018), together with degradation in the water quality of the watershed tributaries and reservoirs (BEGHELLI et al., 2015; DE-CARLI et al., 2018; MACHADO et al., 2018), suppression of forest remains (FENGLER et al., 2015b), and overwash and breaching (FENGLER et al., 2015a; MEDEIROS et al., 2016; SILVA; MEDEIROS, 2017).



**Figure 1** Location of the Jundiáí-Mirim River Basin (BH-JM).

Source: the author.

## 2 RESEARCH METHOD

The methodological development took place through a bibliographical and documentary research, where a historical-descriptive approach to the environmental legislative framework applicable to BH-JM was used. This approach is based on the description of the object under analysis and the consequent establishment of relations with other attributes (GIL, 2008). The documentary research was carried out by consulting normative acts (in effect) regarding protectionist measures for BH-JM; the bibliographical research, in its turn, aimed at identifying literature in order to subsidize the discussions.

It should be stressed that part of the literature consulted consisted of environmental diagnoses of BH-JM that have been conducted about two decades ago by a multidisciplinary team linked to Instituto Agrônomo (IAC) and Science and Sorocaba Technology Institute of Universidade Estadual Paulista (ICTS-UNESP).

In the legislative level, the legal databases of legal provisions presented in Table 1 were consulted, without temporal restriction; the keywords used in the search were Jundiáí-Mirim; Jundiáí Mirim; Jundiáí Mirim; and Jundiáí-Mirim River watershed. During the search, due to the fact that the

municipality has a neighborhood of the same name, all the hits pointing to that information were excluded.

**Table 1** Database queried during the survey of the legislative-environmental apparatus of BH-JM

Database	Sub-database	Filters used	Source
Legislative Assembly of the State of São Paulo (ALESP)	Legislation Database of the State of São Paulo	<ul style="list-style-type: none"> <li>• Statutory Laws</li> <li>• Complementary Laws</li> <li>• Constitutional Amendment</li> <li>• ALESP Resolutions</li> <li>• Resolutions</li> <li>• Executive Branch Decrees</li> <li>• Legislative Branch Decrees</li> <li>• Decree-Laws</li> <li>• Complementary Decree-Laws</li> <li>• ALESP Acts and Rulings</li> </ul>	ALESP ([s.d.])
Jundiaí City Hall (PMJ)	Urban and Environment Planning Management Unit	<ul style="list-style-type: none"> <li>• Environmental Laws</li> <li>• Regulatory Acts</li> </ul>	PMJ (2016?-a)
	Department for Licensing of Works and Installations (DELOI)	<ul style="list-style-type: none"> <li>• Legislation</li> </ul>	PMJ (2016?-b)
Jundiaí Town Council (PMJ)	OpenLegis – Open Legislative Management System	<ul style="list-style-type: none"> <li>• Legal Norms</li> <li>• Legislative Act</li> <li>• Executive Branch Decree</li> <li>• Legislative Branch Decree</li> <li>• Fundamental Law Amendment</li> <li>• Law</li> <li>• Complementary Law</li> <li>• Ordinance</li> <li>• Resolution</li> </ul>	CMJ ([s.d.])
Jundiaí Water Supply and Sewage Agency (DAE Jundiaí)	Legislation	<ul style="list-style-type: none"> <li>• Municipal Legislation</li> <li>• State Legislation</li> <li>• DAE Ordinance</li> <li>• Technical Standards</li> </ul>	DAE (2017a)

**Source:** the author.

### 3 HITS

Based on the criteria laid down, it was possible to identify 14 existing legal measures applicable directly or indirectly to BH-JM, 9 of which are municipal regulations (of which: 8 Laws and 1 Resolution) and 5 state regulations (of which: 1 Law; 3 Decrees; and 1 Resolution). The public policies (legal measures) identified related to the protection of BH-JM, as well as their respective purposes, are presented in Table 2:

**Table 2** Legal measures of environmental protection related to BH-JM

Public policies (legal measures)	Main purposes	Source
Municipal Act No. 2,405 from 10 June, 1980 (Law of protection to watersheds – updated until Law 7,503 of 2010)	<ul style="list-style-type: none"> <li>• Ruled on the use of the soil aiming at the protection of the water collection points of Jundiáí</li> <li>• It established BH-JM as an environmental protection area from the catchment dam down to the town limits, including all tributaries of the Jundiáí-Mirim river</li> <li>• It established that urbanization projects or any economic activity in BH-JM must be approved by the competent municipal bodies, including DAE S.A. Jundiáí;</li> <li>• Priority use of BHJM waters for public supply</li> <li>• It prohibited fishing, water sports and other activities that could impair the water quality of the public supply reservoirs located in BH-JM;</li> <li>• It prohibited enterprises that have a liquid effluent that could affect the quality of the waters protected by Law</li> <li>• It restricted the Watershed Protection Law to the expansion of previously existing ventures</li> </ul>	Jundiáí (1980)
State Law n. 4,095 from June 12, 1984 (updated until Law No. 12,290 from March 2, 2006)	<ul style="list-style-type: none"> <li>• It declared the urban and rural region of Jundiáí as Environmental Protection Area (APA), including the entire drainage area of BH-JM;</li> <li>• It restricted activities and earthworks that can cause accelerated loss of soil.</li> </ul>	São Paulo (1984)
State Decree No. 24,839 from March 6, 1986	<ul style="list-style-type: none"> <li>• It included the Jundiáí-Mirim River and its tributaries as Class 1 waterways.</li> </ul>	São Paulo (1986)
Organic law of the municipality of Jundiáí, from April 5, 1990 (updated until December 22, 2015)	<ul style="list-style-type: none"> <li>• It established BH-JM as an environmental protection area;</li> <li>• It prohibited the release of industrial and organic waste in BH-JM.</li> </ul>	Jundiáí (2015b)

Municipal Act No. 3,522 from 6 April, 1990	<ul style="list-style-type: none"> <li>• It prohibited the release of any polluting substance from economic activities in the waters of BH-JM;</li> <li>• It establishes pecuniary sanctions against violators.</li> </ul>	Jundiaí (1990)
Municipal Act No. 5,032 from 8 September, 1997	<ul style="list-style-type: none"> <li>• It authorized DAE Jundiaí to supply untreated water from the Jundiaí-Mirim River to companies that use this resource in their production processes.</li> </ul>	Jundiaí (1997)
State Decree No. 43,284 from 3 July, 1998	<ul style="list-style-type: none"> <li>• It established the Water Conservation Zone in order to quantitatively and qualitatively protect the water resources of APA Jundiaí and, specifically, BH-JM.</li> </ul>	São Paulo (1998)
Municipal Act No. 5,221 from 31 December, 1998	<ul style="list-style-type: none"> <li>• It authorized DAE to sell public areas for the implementation of recreational equipment and urbanization in the vicinity of the Jundiaí detention dam.</li> </ul>	Jundiaí (1998b)te></EndNote>
Municipal Decree No. 18,148/2001	<ul style="list-style-type: none"> <li>• He stressed the need for strict observance of state and federal standards at the municipal level in the delimitation of areas of environmental preservation along the watercourses, lagoons, springs and reservoirs.</li> </ul>	Jundiaí (2001)
Municipal Act No. 8,203 from 28 April, 2014	<ul style="list-style-type: none"> <li>• It included financial investments for works to complement the Jundiaí-Mirim river dam in the Municipal Multi-Annual Plan.</li> </ul>	Jundiaí (2014a)
Joint State Resolution SMA/SSRH No. 001, June 5, 2014	<ul style="list-style-type: none"> <li>• It has assigned financial resources to BH-JM (and other basins) for the recovery of its riparian forests and for the replanting of vegetation.</li> </ul>	São Paulo (2014b)
Municipal Act No. 8,607 from 16 March, 2016	<ul style="list-style-type: none"> <li>• It created the program “Nascentes de Jundiaí” for the conservation, recovery and protection of springs;</li> <li>• It authorized the executive branch to provide financial and/or technical support to rural landowners who join the program.</li> </ul>	Jundiaí (2016a)
Municipal Act No. 8,673 from 15 June, 2016	<ul style="list-style-type: none"> <li>• It instituted Jundiaí-Mirim River Day as one of the commemorative environmental dates of the municipality.</li> </ul>	Jundiaí (2016b)
Municipal Act No. 8,683 from 7 July, 2016	<ul style="list-style-type: none"> <li>• It established the Jundiaí Municipality Master Plan;</li> <li>• It created the Environmental Protection and Recovery Zone of the Jundiaí-Mirim and Capivari and Ribeirão Cachoambu River Basins.</li> </ul>	Jundiaí (2016c)

**Source:** search results.



## 4 DISCUSSIONS

### 4.1 General municipal laws related to the protection of the environment and water resources

In the analysis of the Fundamental Law of the Municipality of Jundiaí (JUNDIAÍ, 2015b), it was possible to find protectionist legal measures directly related to BH-JM and other water sources of the city, such as the Moisés and Caxambu streams (declared as environmental protection areas). Likewise, in Chapter IV (on the Environment) of this Law, it is emphasized that the springs located in the territory of the municipality must be protected by the Public Power, together with the remarkable landscapes they are found in; one notices, thus, that protectionist requirements were included in the greater municipality superseding Law very recently. However, even though this had been provided for since the Forest Code of 1965, the protection of these areas proved to be ineffective, especially in relation to springs, since the survey carried out by the local public authority indicated that, of the 1,4 thousand springs of the municipality, 390 (28%) were degraded and 456 (33%) deserved state of attention (OLIVEIRA, 2016).

In its turn, Municipal Decree 18,148/2001 (Jundiaí, 2001) addresses the municipality's commitment to the state and federal regulations regarding the creation of environmental protection areas located along the banks of water courses, lakes, springs and reservoirs. Therefore, it does not include any new regulations, but reinforces the commitment of the municipality of strictly complying with the provisions laid down by these regulations that are external to the municipality. This Decree also reinforced the need for environmental licensing when state and federal legal provisions cannot be met in these areas.

Based on the studies of Freitas et al. (2013), it is possible to determine that this Decree has little legal effectiveness, as those authors found that 55% of the permanent preservation areas (PPAs) of BH-JM did not meet requirements in the federal legislation at the time. Fengler et al. (2015b) also verified that, in the period from 1972 to 2013, the urbanized area increased by 592%, a fact that shows anthropic pressure as the main causing factor of disturbance of these areas. However, a decline in this growth rate was noticed when we compared the periods from 1972 to 2001 (48.1 ha year<sup>-1</sup>) and 2001 to 2013 (29.7 ha year<sup>-1</sup>). This

event contributed to reduce the growth rate of this disturbance of the BH-JM forest fragments, since in the period from 2001 to 2013 some basin streams, such as Caxambu, showed a percentage increase in their forest cover area (*ibid.*).

Municipal Law 2,405/1980 (JUNDIAÍ, 1980), also known as the Watershed Protection Act, prohibited the deployment of solid waste treatment systems in BH-JM, and determined that all solid waste generated in the basin should be removed from the protected areas. In addition, it laid down that buildings not connected to the public sewage system should have septic tanks. However, studies conducted at BH-JM have noticed the presence diffuse household waste in their protection areas and roadsides, as shown by, Fengler et al. (2015a), Medeiros et al. (2016) and Silva e Medeiros (2017). This scenario shows the need for specific approaches to BH-JM resident and transient population regarding solid waste disposal, for instance, by means of programs and initiatives related to environmental education. In addition, despite the presence of septic tanks in BH-JM rural area, evidence of sewage discharge in the streams of this basin, even in the more urbanized parts, was reported by Beghelli et al. (2015) and De-Carli et al. (2018).

The Watershed Protection Law (JUNDIAÍ, 1980) also defined the power of bodies linked to the Municipality of Jundiaí in the analysis of aspects related to developments and economic enterprises in BH-JM; now, the analysis of the basin water protection was under the direct jurisdiction of the Jundiaí Water Supply and Sewage Agency (DAE Jundiaí). Thus, all environmental licensing processes for economic activities in protection areas laid down by this Law must first go through the Municipal and DAE bodies before being evaluated by other public agencies.

In this regard, and in compliance with the subordination to state and federal agencies, the Municipality of Jundiaí (PMJ) and DAE were made responsible for supervising and applying sanctions related to protected areas in the following aspects (JUNDIAÍ, 1980, art. 5.1):

- I – pipeline pass-through conditions;
- II – conditions for collection, shipment and disposal of sewage and waste;
- III – conditions and quantitative limits of harmful products that may be stored without posing risks to the quality of water resources;
- IV – the use of pesticides and fertilizers and agricultural and cattle raising activities, which should be limited to forms that do not contribute to the deterioration of water resources;

V – requirements to be met by existing plants or plants under construction and a relocation plan for those that cannot remain in the area;

VI – expansion and increase in the production scale of industrial establishments;

VII – earthworks;

VIII – deforestation;

IX – use of water bodies;

X – soil paving and waterproofing;

XI – land use;

XII – other activities that may interfere with the quality of water bodies.

Given the legal requirements listed above, there is a basic (and broad) legal framework related to environmental protection, and specifically to Jundiaí water resources. Also noteworthy is the commitment made by the municipality to comply with environmental legal requirements, as well as the powers given to PMJ and DAE at the municipal level for environmental protection in matters related to the supervision and application of sanctions to those responsible for causing environmental degradation. However, although this new jurisdictional criterion was created in the 1980s, the environmental diagnoses provided show a lack of engagement by the resident and transient population of the basin, exemplified by litter scattered in protection areas, urban expansion, suppression of riparian forests and discharge of domestic effluents in BH-JM tributaries.

## **4.2 Legislation related to the Jundiaí Environmental Protection Area (APA Jundiaí) and protectionist measures concerning BH-JM**

The creation and management of an APA denotes specific actions by the state and municipal management bodies, since it an APA is a sustainable use unit that already displays a certain level of anthropic occupation constituted by public and private properties (BRASIL, 2000). Fundamentally, with a view to the sustainability of the use of natural resources, competent management bodies should lay down standards limiting or prohibiting in APAs (BRASIL, 1981, art. 9º):

The deployment and operation of potentially polluting plants capable of affecting watersheds;

The execution of earthworks and the opening of canals, when these initiatives import in a sensitive alteration of local ecological conditions;

The exercise of activities capable of speeding up erosion of the lands and/or a marked

silting up of water bodies;

The exercise of activities that threaten to extinguish endangered species of the regional biota in the protected area.

Based on those assumptions, APA Jundiaí was established by means of State Law 4,095/1984 (SÃO PAULO, 1984), which explicitly marked down the entire drainage area of BH-JM as an environmental protection area. However, at first, this Law described only the portion of land located within the Jundiaí town limits as an APA; this wording was only changed 22 years later, by means of Law 12,290/2006 (SÃO PAULO, 2006), when the portions of BH- JM lands located in Jarinu and Campo Limpo Paulista were also included in the APA. Thus, it is possible to articulate and integrate inter-municipal governance among these counties in order to avoid and/or prevent activities that degrade the basin environment.

In this context, the surveys carried out by Fengler et al. (2015b), Medeiros et al. (2016), Silva e Medeiros (2017) and De-Carli et al. (2018) stand out; these identified inadequate agricultural management practices in the headwaters of BH-JM, notably in the territorial portion of Jarinu. Without proper soil management, these activities increase the erosion processes and the corresponding overwash to the tributaries of this basin. However, these impacts are more significant to Jundiaí, since they are strategic areas for the production of natural water for the municipality. So, there is need for a more effective and articulated inter-municipal governance, and it is necessary to draft the legal requirements for the basin in order to meet the specificities and requirements of both municipalities.

After State Law 4,095/1984 (SÃO PAULO, 1984), State Decree 24,839/1986 (SÃO PAULO, 1986) was enacted, which classified Jundiaí-Mirim River and all its tributaries as Class 1 waterways<sup>4</sup>. It is thus an important management tool for the monitoring BH-JM water quality based on the principle of limits, as it laid down classification standards for that water body. Specifically, one can also notice a legislative progress regarding the preservation of BH-JM waters, since this type of classification, at the national level was established only years later, with CONAMA Resolution 357/05 (BRASIL, 2005).

However, according to observations by Beghelli et al. (2015), De-Carli et al. (2018) and Machado et al. (2018), the quality of the water assessed in

<sup>4</sup> According to State Decree 8.468/1976 (SÃO PAULO, 1976, art. 7, inc. 1), Class 1 waters are those “intended for supplying homes without prior treatment or with a simple disinfection”. This Decree also established Classes 2, 3 and 4, Class 4 amounting to waters for less demanding uses and/or requiring an advanced treatment for human consumption.

both the tributaries and the main river bed of BH-JM has not met Class 1 requirements due to farming activities and discharge of domestic effluents. This shows the limitations faced by the management bodies that, despite the legal realization of public policies, indicates a difficulty in maintaining an environmental agenda for a river basin. Likewise, territorial extension and diffuse sources of pollution along an area of over 10,000 ha such as that of BH-JM also impose limits on the monitoring and implementation of these policies.

State Decree 43,284/1998 (SÃO PAULO, 1998) aimed at regulating State Law 4,095/1984 (SÃO PAULO, 1984). This regulation reinforced the initial purposes of the creation of APA Jundiaí, mainly regarding the protection of water resources; a water conservation zone was then established, which included the whole extension of BH-JM. At the same time, actions to avoid erosion processes were also laid down, either by means of specific plans for farming land management or by a requirement of environmental licensing for urban development projects within BH-JM.

In the 1990s, faced with problems related to pollution caused by plants located near Jundiaí-Mirim River, Municipal Law 3,522/1990 (JUNDIAÍ, 1990) was enacted in order to ban any discharge of polluting substances from economic activities into water courses. Thus, we can see that, at the time, BH-JM already showed problems related to the industrial expansion of the municipality. The importance given to this matter also stands out, as Bill 4,949/1989 (JUNDIAÍ, 1989) was recommended by the Committees of the Legislative House with jurisdiction on the matter and unanimously approved by the Jundiaí City Council (*ibid.*), thus showing a concern with the protection of the basin.

In 2004 the System for Protection of Japi Range Areas was established by means of Complementary Municipal Law 417/2004 (JUNDIAÍ, 2004), which restricted any new occupation of the Japi Range Biological Reserve, and also laid down strict standards for occupancy of the Reserve buffer areas. Fanelli e Santos Junior (2013) say that, thanks to the restriction on occupation of the Japi Range region, which takes up about a third of the Jundiaí territory, there was a large occupation of the other areas of the municipality, culminating also in the processes of conurbation between the adjacent municipalities of Várzea Paulista and Campo Limpo Paulista.

In addition, Municipal Law 417/2004 (*ibid.*) proved to be an effective instrument for the environmental protection of natural heritage. Accordingly, Fengler et al. (2012) pointed out that the relative importance

of the forest area in the Japi Range buffer zone went from 46.60% in 1989 to 69.71% in 2010. Likewise, the authors stressed that, in the meantime, there was an increase in areas with natural regeneration, as opposed to areas with agrosilvopastoral and reforestation activities. Thus, these data show that this region was favored by changes in soil cover during the assessed period, despite the strong anthropogenic pressure caused by the urban expansion in its surroundings.

In this regard, this problem can be better understood when we analyze the division of Jundiá into macro zones, where we can see the extent and dispersion of the Zone of Urban Structuring and Qualification of the municipality and its respective fragments in the Environmental and Water Protection and Rural Development Zone. On the other hand, one can see a smaller occurrence of this structuring zone within the protection limits of Japi Range, given the greater restrictions in place due to it being an Full Protection Unit (BRASIL, 2000). Therefore, the establishment of protected areas in regions of intense growth and population density creates a problem; this fact also highlights the need for municipal management concrete actions for drafting and enacting public policies to control and direct the urban fabric, especially in areas of water production within the scope of Sustainable Use Units.

### **4.3 Municipal law to authorize the sale of water from the Jundiá-Mirim River**

Law 5.032/1997 (JUNDIAÍ, 1997) authorized DAE to supply raw water to companies that use water resources as input to their production processes, against charging of a fee. This supply was conditioned to *ad referendum* authorization by the City Hall for new companies or for those that aim at increasing the supply already granted them (*ibid.*). In view of this, the importance of the BH-JM water resources to the municipality's economy becomes evident. However, based on the principles of democratic management and equitable access to natural resources, this authorization should also involve other social players interested in this decision-making process, such as non-governmental organizations and educational and research institutions.

In this context, Coates et al. (2012) stress in a reflective way the reciprocity involved in economic growth based on an increase of industrial water use, where, while economic forces put pressure on water resources,

the availability and state of this resource also influence and/or limit economic activities. Likewise, the political-economic bias involved in the process of providing this resource should be taken into account. This stems from the fact that eventual permits for consumption of BH-JM water by the aforementioned entities can be assessed without taking into account strictly technical-environmental criteria, as well as criteria based on the predominant uses of this resource, especially in situations of water shortage<sup>5</sup>, which are common in the region.

#### 4.4 Municipal law on the disposal of public areas

Municipal Law 5.221/1998 (JUNDIAÍ, 1998b) reclassified public areas located around the Jundiaí detention dam, in Jardim Florestal neighborhood, and authorized DAE to dispose of them. Among other factors, the purpose was to allow the company to lay down spaces and establishments subject to compliance with specific standards and criteria, such as those aimed at cultural and environmental preservation (e.g., historical monuments, water protection and areas with a scenic value).

The aforementioned Law laid down some requirements to be met by the seller, among which the following stand out (JUNDIAÍ, 1998b):

- Implementation of permanent preservation areas;
- Implantation of woods;
- Reallocation of sewage interceptors; and
- Minimum use of waterproofed areas.

However, because it is an urban project located in an area of relevant environmental interest (JUNDIAÍ, 1980; 2015a; 2016c), a filing was made requiring the seller to prepare an Environmental Impact Study (EIS) and its respective Environmental Impact Report (EIR), as recommended in CONAMA Resolution 01/86 (BRASIL, 1986)<sup>6</sup>, as well as in accordance with the Municipal Fundamental Law (JUNDIAÍ, 2015b)<sup>7</sup>. However, the

5 From this perspective, the São Paulo Public Prosecutor's Office (MPSP) investigation to look into the amount of raw water provided by DAE to a soft drink plant in the municipality must be stressed; it was found out that the company supplied the minimum annual volume of 2,5 thousand m<sup>3</sup>, or about 80 L s<sup>-1</sup> (MPSP, 2014). This corresponds to 20% of the mean Jundiaí-Mirim River flow reported by DAE (i.e., 400 L s<sup>-1</sup>) (DAE, 2016).

6 CONAMA Resolution 01/1986 laid down the requirement to prepare an EIS/EIR in several situations and, for the case at hand: "Urban projects over 100 ha or in areas considered of relevant environmental interest, at the discretion of the Special Environment Department (SEMA) and state or municipal agencies" (BRASIL, 1986, art. 2º, inc. XV).

7 The Jundiaí Fundamental Law rules that "regarding public services provided by the Municipality and in their granting, licensing and renewal, they and their environmental impact must be assessed" (JUNDIAÍ, 2015b, art. 166).



Legislative Assembly rejected this filing, as can be seen in Amendment 1 of Bill 7,441/98 (JUNDIAÍ, 1998a); this shows, therefore, a possible easing in the project implementation process.

Thus, although the environmental studies presented attest to the environmental feasibility of the proposed interventions, as well as the social benefits of implementing recreational equipment in the area (JUNDIAÍ, 1998a), the small benefit to the ecosystem provided to the area in terms of effective protection of water resources, fauna and flora should be emphasized. Figure 2 (A, B, C and D) shows images of the area under discussion, where it is possible to see the scant presence of local native forest specimens, as well as the absence of riparian shrubbery restoration, which measures would reduce the borderline impacts on the municipality water reservoir.



**Figure 2** Images of the City Park (500,000 m<sup>2</sup>) located on the left bank (along the Jundiaí-Itatiba direction) of km 66 of João Cereser Highway, in Jundiaí (SP).

**Source:** Public photographic collection of the Jundiaí Municipality (PMJ, 2005-2009).

Thus, from the analysis of the above-mentioned images, we can see that an area was created whose landscaping was modeled on European gardens, as opposed to the creation of an area whose forms should reflect – for



ecosystem reasons – the local biome. Nevertheless, it should be considered that the creation of a park in this area has contributed to a decrease in real estate speculation, as well as to the prevention of illegal occupations – such as those that took place along the banks of the São Paulo State capital supply reservoirs (FONTANA et al., 2014).

#### **4.5 Municipal Law for Investments in the Jundiáí-Mirim River Dam**

Municipal Law 8,203/2014 (JUNDIAÍ, 2014a) included financial investments for complementary works for the Jundiáí-Mirim River dam in the 2014 -2017 Municipal Multi-Annual Plan. The justification stated in this Law was the preservation of the environmental area and the protection of springs. However, the planned investments of 4 million (JUNDIAÍ, 2014a) were directed to dam raising works of accumulation and expropriation of properties located in the vicinity (JUNDIAÍ, 2014b). Data from the Ministry of Planning also indicate that, between 2007 and 2010, through the Growth Acceleration Program (PAC), there was a contribution of almost R\$ 18.7 million (at the completed stage) of funds for complementing the Jundiáí Dam (BRASIL, 2017).

Thus, there is a clear concern of the municipality and its management bodies in expanding the town water storage capacity without, however, making clear efforts toward natural production of water in BH-JM. In this regard, we can also consider that, although there is an increase in water storage usable area that can be reduced over time if direct interventions in the basin are also not performed. Along those lines, the problems related to erosive processes in BH-JM (MORAES, 2003; FREITAS et al., 2013; MEDEIROS et al., 2016; MORAES, 2016; SILVA; MEDEIROS, 2017; DE-CARLI et al., 2018; MACHADO et al., 2018) must be stressed, which intensify overwash into the Jundiáí storage and collection reservoir.

These erosive processes also cause direct and high costs for the maintenance the water storage capacity in reservoirs (LIU; WALLING; HE, 2017). In 2008, DAE invested approximately R\$ 1.5 million in works to dredge the storage reservoir, leading to the removal of over 100 thousand m<sup>3</sup> of accumulated debris (DAE, 2008). In 2017, the company allocated about R\$ 4.5 million for works to dredge the reservoir (DAE, 2017c). Also from the economic point of view, another factor to be observed is the excessive contribution of nutrients, which are responsible for the uncontrolled proliferation of aquatic macrophytes in supply reservoirs

(BEGHELLI et al., 2015). This situation has already been recorded in Jundiá reservoirs, where studies have pointed out the need to remove 80% of the macrophytes present in the accumulation reservoir (DAE, 2017c), at a cost close to R\$ 1.1 million (DAE, 2017d).

Similarly, the investments foreseen by the DAE for the period from 2017 to 2018 stand out. In this interval, a series of investments in works and services for the supply system of Jundiá were reported, amounting to 25 million (ARES-PCJ, 2017). However, it was found that, from the 67 investment items listed, not one is directly related to actions geared at decreasing the erosion processes or to the preservation and/or conservation of areas strategic to the natural production of water in BH-JM or to actions directed at the efficient use of water.

#### **4.6 Incentive Programs to Recover Watershed Areas**

In 2014, through State Decree 60,521/2014, the São Paulo State Government instituted the “Program of Incentives for the Restoration of Riparian Forests and the Restoration of Vegetation along the Watershed Forming Basins – Riparian Forest Program – with the objective of increasing the protection and conservation of resources and biodiversity [...]” (SÃO PAULO, 2014a, art. 1º). Subsequently, this Decree was regulated by São Paulo State Environment Department (SMA) Joint Resolution 001/14 (SÃO PAULO, 2014b), at which time the initial priority areas for the Program intervention were established.

Among other basins, Riparian Forest Program selected the Jundiá River basin and BH-JM as initial areas for intervention, focusing on environmental recovery actions along the banks of water courses and springs in the region of headwaters (SÃO PAULO, 2014b). However, the initial area of intervention provided for in the Program for these areas was only 700 hectares (ha) wide; this amounts to 3.9% of the total area benefited by the Program in the State (i.e., 18,077 ha) (SÃO PAULO, 2014b) and only 0.6% of the total area of the Jundiá River basin (i.e., 111,403 ha) (CBH-PCJ, 2016).

At the municipal level, the first legal proposal aimed at creating an environmental program for the protection of springs took place in early 2016, through Bill 12.008/2016 (JUNDIAÍ, 2016d). This proposal was based on the importance of protecting water sources and water courses in the municipality, as well as in view of the decrease in water production

in BH-JM due to the degradation of important areas for water production (*ibid.*). Therefore, it can be seen that the municipal administration understood the environmental problems in BH-JM, as well as that there was a need for creating more effective legal measures to remedy or solve them.

As a result of the discussion on this matter, Municipal Law 8,607/2016 (JUNDIAÍ, 2016a) was enacted, at which time the “Jundiá Springs Program” was established, whose main purpose was to lay down actions for the recovery, conservation and protection of water resources in the municipality. Thus, an important instrument for the protection of water resources was created at the municipal level, and major concepts were established, among which the following stand out (JUNDIAÍ, 2016a):

- The selection of priority areas for protection based on technical and legal criteria;
- The inclusion of the concept of environmental and ecosystem services as a way to achieve the sustainability of water resources;
- Registration and on-site financial and/or technical support to the participants of the Program in order to meet the previously-established goals, with the possibility of partnerships with governmental entities, the private sector and the civil society.

Since the enactment of the aforementioned Law (JUNDIAÍ, 2016a), we can already notice some initiatives being put in effect in BH-JM, in the Roseira Stream sub-basin region. These initiatives are being developed from partnerships between the municipal administration and DAE with the international organization The Nature Conservancy (TNC), two municipal beverage companies and a construction company – the latter, as a result of an Environmental Recovery Commitment (TCRA 7,2881/16) signed as a counterpart to the deployment of a high-level land development project in the municipality (PREFEITURA REFORMA..., 2017; SÁ, 2016; SÃO PAULO, 2017).

Thus, we can see that Municipal Law 8,607/2016 (JUNDIAÍ, 2016a) brought benefits to BH-JM, and also provided funding for the business sector. Nevertheless, it should be noted that these same companies are/will be beneficial owners of the ecosystem services originating from the

protection of the springs, especially with regard to water supply. It should also be taken into account that the industrial and urban growth of the city puts direct pressure on water resources, thus requiring direct counterparts from that sector – especially from those that use BH-JM water in their processes.

#### 4.7 Municipal Law to Create the Jundiá-Mirim River Day

The recent Municipal Law 8,673/2016 (JUNDIAÍ, 2016b) established June 3 as the Jundiá-Mirim River Day. This way, an important environmental education instrument was created for BH-JM, which is directly part of the municipal environmental agenda. Among other developments, this enactment was due to Jundiá being a signatory of the State Government GreenBlue Municipality Program (PMVA, or *Programa Município VerdeAzul*), which, among other requirements, lays down pedagogical guidelines to be followed in environmental education efforts (SÃO PAULO, 2016). This premise can be explicitly observed in Art. 2 of Municipal Law 7,381/2009 (JUNDIAÍ, 2009), which establishes the Jundiá environmental commemorative date calendar; there, it is stated that:

[...] environmental themes will be addressed via inclusion in curricula, in activities carried out in schools of the municipal public network, being part of their contents, objectives and teaching guidelines for all subjects; they must also be extensive to the society as a whole, thus favoring the development of healthy habits and attitudes of environmental conservation and respect for Nature, in the drafting of projects and educational activities, campaigns, community efforts and other forms of adequate dissemination and communication (JUNDIAÍ, 2009, art. 2).

However, it should be noted that the inclusion of Jundiá-Mirim River Day as an environmental commemorative date took place only in 2016 (JUNDIAÍ, 2016b). On the other hand, there were already nine other environmental commemorative dates established in the municipality since 2009 (JUNDIAÍ, 2009). Thus, we can see that the proposed inclusion of Jundiá-Mirim River in the municipal environmental calendar took place in an immediatist context of a water shortage crisis experienced in the Piracicaba, Capivari and Jundiá River basins (PCJ basins) at the time (CBH-PCJ, 2015). In this sense, based on the analysis of Bill 11,819/2015 (JUNDIAÍ, 2015c), from which Municipal Law 8,673/2016 (JUNDIAÍ, 2016b) was derived, it can be seen that it was based on the importance of raising the Jundiá population awareness regarding the preservation of

natural resources and, specifically, the BH-JM water resources, which was treated as the municipality's largest asset.

## 4.8 Territorial Planning Master Plan

### 4.8.1 Jundiá Master Plan

The Master Plan is a basic and mandatory territorial ordering tool for cities and towns with more than 20 thousand inhabitants (BRASIL, 1988) and, unless otherwise stated, should be reviewed every 10 years (BRASIL, 2001). In Jundiá, we found that territorial ordering legislative matters go back to the mid-1950s. In this context, Municipal Law 503/1956 (JUNDIAÍ, 1956) stands out, which laid down, at the time, a deliberative commission for the municipality Master Plan. Since then, there have been several updates, with the most recent Jundiá Master Plan (PDJ) having been enacted by means of Law 8,683/2016 (JUNDIAÍ, 2016c).

PDJ was designed to make its guidelines compatible with the Integrated Urban Development Plan of the Jundiá Urban Agglomeration (AUJ) (Jundiá, 2016c). Thus, in the political arena, this fact contributed directly to the management of BH-JM, since its limits cover another two municipalities belonging to AUJ, where an integrated planning is essential. PDJ also stands out in matters related to water protection, since its planning include detailed mappings of the hydrographic network, springs and forest remnants, and it also lays down the design of areas for water resupplying of the municipality (*ibid.*). This fact reflects an important and innovative guideline for the definition of priority areas for intervention, which directly contribute to the maintenance and/or increase of natural local water production.

Regarding zoning, PDJ instituted 3 large macro-zones for the municipality, among which the Environmental, Water and Rural Development Protection Macro-Zone stands out. It also included the Environmental Protection and Recovery Zone of the Jundiá-Mirim and Capivari and Ribeirão Cachoambu River Basins as a subarea, whose proposals were based on (JUNDIAÍ, 2016c, art. 37):

- Inspection and control to contain illegal urban occupation;
- Fostering of rural development in an environmental, economic and social sustainable way, and encouraging of agroecology and family farming;
- Conservation, preservation and recovery of fragments of native vegetation and permanent preservation areas, thus allowing for the configuration of ecological corridors;
- Guarantee of low-density occupation, with economic activities in keeping with water production.

For the special environmental protection zones, 80% for areas over two hectares was defined as the minimum permeability rate, together with a restriction of built areas above 7 meters tall (Jundiaí, 2016c). Thus, we can see the creation of measures geared at avoiding verticalization and the expansion of waterproofed areas, which are direct consequences of an increase in population density. However, it should be noted that, although restrictive land use and occupation criteria are established for the BH-JM region, there is evident anthropogenic pressure in the basin already consolidated by peri-urban occupations. Therefore, it should be pointed out that, in the legal system, a norm cannot retroact, as recommended by the principle of nonretroactivity. Thus, incentive programs to increase permeable areas for properties already consolidated in the basin should be considered in order to decrease existing impacts and also those in place before the Law.

Also within the scope of BH-JM, it should be noted that PDJ considered the areas adjacent to the catchment and accumulation reservoirs as a Special Environmental Protection Zone, an area that should extend, at least due to protectionist/ecosystemic issues, throughout the entire main channel of the Jundiaí-Mirim River. However, it should be considered that such areas already show themselves as having a certain degree of occupation; thus, the deployment of zones like this would require huge financial resources for expropriation and implementation of environmental restoration measures. Nevertheless, measures such as this should be considered in the long term for the protection of the basin water resources.

#### *4.8.2 Jarinu Master Plan and its implications for BH-JM*

The establishment of common legal requirements for spatial planning between municipalities included in the basin is of fundamental importance, namely between Jundiaí and Jarinu (where part of BH-JM headwaters are located). However, Jarinu is trying to deploy an urban development project, the environmental licensing process of which has already been approved (CETESB, 2017). This medium-high-level project includes the deployment of residential and commercial lots in a 387-hectare area, and will house about 10,000 inhabitants over a 40-year term (DFREIRE, 2015).

According to the zoning established by the Jarinu Master Plan, which proves the project compatibility (DFREIRE, 2015), the project

deployment area is located in the Municipal Qualification Macro-Zone of the municipality, which is characterized by being an area:

[...] made up of areas endowed with public and community infrastructure, services and utilities and with a higher construction and population density, which require urbanization qualification and **are able to being in private real estate investments** (Jarinu, 2009, art. 41, grifo nosso).

In view of this zoning laid down by the Jarinu Master Plan (JARINU, 2009) and in light of the current DPJ (JUNDIAÍ, 2016c), we can see that this subdivision may directly jeopardize the BH-JM water production, as well as help bring in new developments to its vicinities. Likewise, we can see that the Master Plans of the two municipalities have divergent proposals, since PDJ aims at containing urban expansion and rural development in this region, whereas the Jarinu Master Plan aims at attracting private real estate investments, even though it also determines areas of special environmental interest in its vicinities.

These facts also highlight the diffuse interests of each municipality in the elaboration of their respective territorial planning, since the Jundiaí region, which already underwent a strong demographic and economic development, is now directing protectionist efforts toward municipal water safety; on the other hand, Jarinu is attempting to expand its economy by bringing in new ventures. This fact also reflects a change in the economic matrix of Jarinu, with a decline of the rural sector importance in recent years, while the service sector is growing in the opposite direction (SEADE, 2014).

It is also worth noting that Jarinu does not present problems related to public water supply; its watersheds, located along the Maracanã River basin, are in good condition and do not show significant sources of pollution (SABESP, 2012). Therefore, theoretically, it becomes clear that water is not a priority issue for the municipality; in Jundiaí, on the other hand, the need for greater inter-municipal articulation is evidenced, since it is in the north and east portion; a large part of the Jarinu territory is included in BH-JM, where the sub-basins provide the greater water contributions throughout the year are located, thanks to the higher rates of subsurface side-stream and recharge of the aquifer of these regions (MORAES, 2016).



## CONCLUSION

The survey of the legal-environmental framework showed that Jundiá presents a comprehensive and advanced environmental protection legislation, which includes legal requirements of spatial planning that go back to the 1950s. Likewise, the municipality has a specific legislation for the protection of water resources dating back to the 1980s, which has already undergone several updates and is still in effect. However, after nearly four decades of its enactment, the environmental diagnoses carried out indicate a negative variation in the water quality of BH-JM, as well as its overexploitation. Likewise, land use and occupation is often incompatible with what is legally required – as in the case of the analyzed APP areas. Thus, the inefficiency of the State, represented at the municipal level by PMJ and DAE, to protect this environmental asset is notorious, since the degradation of the basin has been clear and constant over time.

In addition, although the survey of the legal-environmental framework related to BH-JM has identified actual protectionist legal instruments, it must also be considered that a better implementation of inter-municipal management of the basin is also fundamental, since 45% of its area is located outside the Jundiá town limits (areas that were included only in 2006 by Law, after 22 years of the creation of APA Jundiá, thus harming the discussions about this issue). For this situation, the need for legal measures that could favor the environmental discussing among the municipalities is clear, such as the Council for the Development of the Jundiá Urban Agglomeration (CDAUJ) and the APA Jundiá Administrative Council. Such actions become vital to meet the diffuse interests existing in each municipality belonging to BH-JM.

We also found out that the Japi Range Biological Reserve has a better protective legal framework and, on the other hand, BH-JM has a less restrictive legislation; this fact has caused a greater anthropic pressure on this basin, comparatively speaking. This situation is further aggravated by the diverse interests, social players, impacts, and complexity of relationships present in a basin, thus making the effective application of the legal framework into a challenge to be faced. The need to rethink the future of the municipality with regard to water security then becomes clear, together with the need to have the community understand the importance of BH-JM and so demand the effective implementation of existing requirements from the government. In addition, society must realize its duty of defending this



asset, since the management of a basin should not be based only on the creation and enforcement of laws and rules by the State.

Finally, in view of the results observed, the following management guidelines for BH-JM are summarily recommended: (i) the adoption of incentive programs for the creation of Private Natural Heritage Reserves (RPPNs) and acquisition and/or expropriation of lands in order to protect strategic areas of water production, as well as to contain real estate speculation; (ii) the establishment of guidelines for integrated management with the other municipalities in the AUJ and with the state government; (iii) a greater incentive to monetary payments for environmental and/or ecosystem services to rural producers in BH-JM; (iv) incentive to public participation of the various social players in the decision-making processes for the deployment of protectionist measures in BH-JM; and (v) the creation by PMJ of working groups articulated to act with EAD in order to constantly inspect illegal land uses.

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