



*Facilitating Negotiations Over Land And Water Conflicts In Latin- American Peri-Urban Upstream Catchment: Combining Agent-Based Modelling With Role Playing Game*  
**PROJECT NEGOWAT.**

## **Land and water management in the Metropolitan Region of Sao Paulo: Presentation of the geographic and institutional context.**

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# Land and water management in the Metropolitan Region of Sao Paulo: Presentation of the geographic and institutional context

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***Abstract** —The most populated and industrialized region of Latin America, the Metropolitan Region of São Paulo host 18 millions people in 39 municipalities. The urban water services are managed in a centralized way by a state firm which provides for a domestic demand of 63 m<sup>3</sup>/s of which 50 % is imported from a neighbouring catchment. Half of the water comes from the periurban catchments of the agglomeration which are submitted to a rapid subnormal urbanization with inadequate sanitation arrangement that directly impact the quality of the water. The tensions are likely to increase with the increasing population and difficulties for the sanitation authorities to keep pace with the urbanization processes. Land management is under the responsibility of the municipalities but a specific land legislation to control urbanization in the catchment defined in the 70's did not permit to control urbanization. The implementation since 1995 of an integrated water management policy has permitted to implement multi-stakeholder platforms for water management called catchment committee, to better articulate land management and water management, as well as to facilitate the participation of civil society in the process.*

## 1 - Introduction

The intention of this paper is to present the geographical and legislation context of land and water management in the periurban catchment of the Metropolitan Region of Sao Paulo in Brazil. The first part presents the Metropolitan Region itself, and its organization for water supply and sanitation. The second part introduces the evolution of the relevant legislation and presents the main features of the legal instruments. The last part rapidly describes the two sub catchments studied.

## 2 - Water management in Sao Paulo metropolitan catchment : main issues

### 2.1 - The expanding metropolis

The most populated and industrialised region of Latin America, the Metropolitan Region of Sao Paulo (RMSP) hosts some 18 millions inhabitants living in 39 adjacent cities. It is the economical capital of Brazil and produces nearly 18 % of the gross domestic product of Brazil (FUSP, 2001). It represents an area of 8 050km<sup>2</sup> of which 1 500 km<sup>2</sup> are urbanised (Braga, 2000). The Sao Paulo city itself hosts 10 millions people on its 900 km<sup>2</sup>. The agglomeration is situated in South-Eastern region of Brazil, on a plateau whose altitude varies between 750 and 900 m (figure 1). The average yearly precipitation varies between 1400 and 1700 mm with two distinct seasons: a dry and “cold” winter (less than 60 mm in June/July) and hot and rainy summer (260 mm between January/February). Three main geomorphologic sets structure the landscape of the region: (a) the alluvial flood plain, or wetlands areas, badly drained during rainy seasons; (b) the hilly areas, that used to be covered by the Atlantic tropical forest; (c) The high step hills and mounts of the South and the East of the catchment that combine severe slopes and poor soils. The two latter sets are characterised by their dense net of springs

and streams which supply the flow of the Tietê River and its main tributaries (Pinheiros, Tamanduatei). The natural river flows follow a dual season pattern with a low flow in september-october.

The city of Sao Paulo was founded in the sedimentary basin of the plateau, but it is now expanding on the surrounding crystalline hills. The natural water system have been highly modified by urbanization: It includes a reversion of the natural flow of the Pinheiros River, now only implemented in case of flood emergency, the urbanization of the flooding plains, the rectification of the watercourse of the major rivers and the development of 9 reservoirs.



**Figure 1 : Localization of the Metropolitan Region of Sao Paulo, in the Sao Paulo State.**

The city had a humble beginning. It was founded in 1554 as a small Indian mission and remains a poor colonial city during 400 centuries although it was located on a transport route between the coast and the inland regions. The city started to grow in the late 19<sup>th</sup> century with the opening of the first railroad to Santos in 1867 and the development of coffee plantations in the surrounding regions that attracted migrants. Migration accounted for 80% of the population growth of the city of Sao Paulo. In 1890, Sao Paulo was already the main economic centre in Brazil. The development of two reservoirs for hydroelectricity (Billings and Guarapiranga) in the beginning of the 20<sup>th</sup> century made the area even more attractive for industry and the city continued to grow to reach a population of 1.3 million in 1940. During 1967-1973, known as the time of the economic miracle, the developing automobile industry and increasing foreign investments attracted immigrants from the hinterland. In the 80's, it was estimated that 56 % of the population of the metropolitan area had not been born in the municipality where they lived (SEADE, 1992). The grow rate of the population in the MRSP that reached 7 % between 1960-1980, has now slowed down to 1,4 % (FUSP, 2001). But it is unequally spread over the region; the city centre is growing less, or even losing population while the periphery areas are continuing to grow at an average of rate up 3 to 5 %.

## **2.2 - A centralized water supply system**

Most of the MRSP is included in the Alto-Tietê Catchment (Figure 2) at the head of the river Tietê river basin, which is part of the Rio Parana basin. Most of the water consumed in the area comes from superficial resources: groundwater is estimated to account only 13 % of the water supply. (Porto, 2003). On an average of 103,9 l/s of available superficial water in the catchment, 43,3 m<sup>3</sup>/s are captured for the domestic, industrial and agricultural demand which is estimated of 80,2 m<sup>3</sup>/s. Some 61,1 m<sup>3</sup>/s are diverted for domestic supply (FUSP, 2000), which necessitates various inter-basin water transfer. Thus, the Piracicaba-Jundiaí catchment situated at the north is contributing with 33 m<sup>3</sup>/s to nearly 50 % of the water demand of the MRSP through a transfer via the Cantareira

system. (SIGRH, 2004). Water production within the Alto-Tietê catchment mainly takes place in the Guarapiranga catchment (connected to the Billing reservoir) in the Southern part of the city which provides for 14,3 m<sup>3</sup>/s and the Cabeceiras-Alto-Tietê System in the East (10,6 m<sup>3</sup>/s).

The water supply organisation is managed by a State owned firm named SABESP- Companhia de Saneamento Basico do Estado de São Paulo - that provides for 28 municipalities of the area, either directly or by selling to municipal distribution firm treated water. Four municipalities manage isolated water systems, and a couple of them complement the central system. The isolated systems generate 5.2 m<sup>3</sup>/s (Porto, 2003). The SABESP water production very centralized is composed by 6 main interconnected production systems, with nine reservoirs, various tunnels and treatment plants that permit to supply water to 90 % of the urban homes. The coverage of drinking water distribution is high in the regular urban areas but precarious in the periphery.

The water uses includes domestic consumption, industrial uses, irrigation for horticultural food supply for the city as well as a developing tourism and environmental demand. Information on water uses and demand remains insufficient. 2,2 % of the water distributed by SABESP in the RMSP, 8,4 % by the commercial sector (Porto, 2003). It is estimated that 20 % of the water consumed in the RMSP (groundwater included) is used by industries and 3 % by the agriculture sector (FUSP, 2001).

### **2.3 - The degradation of the water resources quality**

Water resources quality is being monitored in 33 spots by a state institution, CETESB - Companhia de Tecnologia de Saneamento Ambiental or Company of Technology for Environmental Sanitation. In these spots, forty three indicators are measured every two weeks and aggregated in water quality indexes. Globally, water quality is low in all the catchment area, except in the Cabeceiras-Tietê sub-catchment (Porto, 2003). The degradation results from two processes: non point source pollution from surface run-off and discharge of non-treated domestic effluents.

The sanitation system of most of the municipalities of the agglomeration is managed by SABESP. It relies on a centralized system made of 6 effluent treatment stations. The collect of domestic effluents remains insufficient, in spite of a recent investment effort. In 2000 it was estimated that 65 % of the effluents are collected but 32 % are treated (Porto, 2003). The sanitation plan of SABESP plans to increase the connection number to 93 % in 2020, which will leave still 1,3 millions people unconnected. Polluting industries, controlled by CETESB are compelled to have their own treatment facilities or to be connected to the sanitation system, when possible.

The domestic connection is particularly low in the periurban area of the agglomeration, affected by the rapid development of sub-normal settlements. In the context of high social inequalities of Brazil and poor housing policies, low income population had often had no other options than to settle in the margin of the city, preferentially in the spring catchment areas whose land value has been depreciated by the legislation that aimed to protect them (Bellenzani, 2000; Marcondes, 1999a). It is estimated that nearly a million people had settled in the protected area of the municipality of São Paulo, in very precarious socio-economical conditions. These illegal settlements are lacking basic infrastructures such as water supply or sanitation networks. In 1996, It was estimated that if 86 % of the homes of the municipality were connected to a proper sanitation system, 20 % only of all collected sewage were actually treated (Prette, 2000). The urban centers in the periurban areas are particularly deficient and they are responsible for the production of important organic pollution. In the Guarapiranga catchment, with only 12 % of the homes connected to a sanitation network in 1996, domestic effluents generated some 245 kg/day of phosphorus during the dry season 1995 (Porto, 2003). The important effort in sanitation investment of the last 5 years, which permitted to connect to sanitation network of 50 % of the homes in the Guarapiranga catchment, did not permit to compensate for the urbanization rate and to control pollution in the main drinking water reservoirs, especially during the low flow period. Thus, pollution level remains high in most of the strategic reservoirs, such as the Taçubepa reservoir in the Cabeceiras-Tietê catchment, which has been facing an significant increase of Total P and DBO since 1997 (Porto, 2003).

The expansion of the city is also resulting by the increase of impervious surface with increase water run-off, leading to peaks flow in rivers and sewage systems and sub-sequent inundations. Inundations remain a severe problem, and a huge investment effort is being made to reorganise the drainage plan of Sao Paulo and build retention areas.

## 2.4 - A growing competition for water

In spite of the decrease of the demographic growth rate (Prette, 2000), the supply system is reaching its limits: Rationing, which was eliminated during the 90's thanks to an important investment effort, was reintroduced during the dry year of 2001 and 2003. Projection estimates the demand in 2010 between 69,8 and the 78,6 m<sup>3</sup>/s. The production capacity of the Alto-Tietê system can only be increased of 15 m<sup>3</sup>/s, securing a production of 70,6 m<sup>3</sup>/s (Porto 2003). Projections point out that water offer will only exceed demand by 2,5 % in 2010, even with a good control of the distribution losses. Other measures include incentives to reuse water and treated water, especially in the industrial and public sector (public park irrigation, street cleaning etc).

The situation is even more difficult in the long term (Porto, 2003). To face this challenge, new importations of water are being discussed. These resources will necessary transit trough two of the production catchment: the Guarapiranga or the Cabeceiras Tietê watershed. The latter one, with a surface of 1690 km<sup>2</sup> over 9 municipalities is one of the last periurban catchment where increasing water production remains possible. It is thus planned to collect a supplementary 5 m<sup>3</sup>/s for São Paulo water supply in a close future thanks to the development of two new dams. Limiting the degradation of the quality of the resources is also strategic in order to avoid contamination of good quality water that could be transferred in these catchments.

## 3 - The institutional context of land and water management in the periurban catchment of São Paulo

Brazil is a Federal Republic, independent from Portugal since 1822 made of 26 states and 1 federal district. The states are relatively independent and have for example their own judicial system. The states are divided in municipalities. In the field of water and environmental management, the different jurisdiction is divided as followed (table 1).

**Table 1: The different administrative jurisdiction level**

Level of government	Jurisdiction
Federal	Use of interstate water resources
	Management of regional and natural resources
Federal and state	Protection of the environment and natural resources
	Agriculture
	Sanitation
	Hydroelectricity
State	Residual power which are not assigned to federal or municipal level
Municipal level	Land use

The management of land and water in the periurban area is controlled by different legislations defined during the last 50 years (table 2)

### 3.1 - Toward the implementation of integrated water management in the Metropolitan Region of Sao Paulo

#### a) 1930 – 1970: Specific laws to control industrial pollutions

The city of Sao Paulo has faced water shortage since the 19<sup>th</sup> century as the development of the water supply system has always been unable to pace with the high rates of population increase in the area (SABESP, 2000). In this context, water legislation has focused on the protection of the resources, especially of the spring areas, since its first definition.

Land expropriation was promoted from the end of the nineteenth century to the 30's, when the State or water production firms bought land. This approach soon proved to be too expensive with São Paulo's growth, with the subsequent rise of land prices as well as the extension of catchment areas to be protected. A Water Law (Lei das Águas) was enacted in 1934, defining water resources as public property and disconnecting land and water rights. The decades between the 30's and the 70's are characterized by a high growth rate of the city, 4 to 5 % per year (Prette, 2000). This growth rate

allowed the population to almost double during the 50's, and was accompanied by a rapid industrial development and integration of the margins of the main rivers (Tietê and Pinheiros) within the urban network. This urbanization soon started to jeopardize the catchment areas in its South-Southwest axis. The water policy promoted before the 60's tried to control the pollution by a series of specific laws, most of them oriented toward industrial pollution (Marcondes, 1999a). At the same time, the increased energy demand due to the industrialization and urbanization processes lead to the establishment of a strong hydroelectric complex that dominated the water management system in the region, in a centralized and technocratic way. The territorial and population expansion of the metropolitan area, however, was followed by an increase in the domestic water demand and thus by the establishment of a water producing industrial complex that competed for water resources more and more openly with the hydroelectric complex (Prette, 2000).

The urbanization process was characterized by the development of irregular settlements and shantytowns in the water spring catchment areas, with inadequate sanitation and solid waste infrastructure. This land occupation pattern, described "disorganized occupation of land", was consolidated in the protected area of the basin during the 70's, leading to a rapid degradation of the water quality when the water resources were already insufficient to meet the population needs. In 1973, it was estimated that 43% of the inhabitants lacked access to water and only 28% of the houses were connected to sewage collecting network (Uemura, 2000). It became apparent that it was necessary to provide an integrated treatment of the problems caused by urbanization processes (Bellenzani, 2000).

*b) 1970's: implementation of land control legislation to protect the periurban spring catchment areas*

It led to the establishment in 1971 of the Metropolitan Plan of Integrated Development with the following objectives: (1) to reorient the direction of the city growth to the East/West axis, and (2) to preserve the upstream spring catchment by the development of a green open space system in the surroundings of the city. With this objective, different tools were implemented, including a State law of protection of spring catchment areas, to control land use and occupation in an exclusive sanitation vision of the protected area (Marcondes, 1999b). The law (law n°898/75 and 1.172/76, and its enforcement decree n°9.714/77), named *Legislação de Proteção dos Mananciais* (LPM), meant to protect the whole southern part of the metropolitan area of São Paulo, summing up about 54% of its area (Governo do Estado/sma, 1997).

Characterised by its centralized and authoritarian features adapted to with the political context of its definition (Marcondes, 1999b), this law proved at the time to be an important step in terms of management of the metropolitan territory. Three specific tools were particularly important and were supposed to interact in a combined and compatible form: 1) the zoning, that defines different categories of land use and occupation; 2) the licensing for the development of "industrial" activities or land divisions for the diverse economic activities compatible with the objectives of catchment preservation; 3) the monitoring and control to guaranty the respect of the legislation.

Zoning defined two categories of protection. In the first one, the occupation was strictly restricted. In the second one, three different zones were defined, based on the authorization of decreasing occupation densities, depending on the proximity of water superficial resources: (i) class A were urban areas where the population density was limited to 50 inhabitants/hectares; (ii) class B, situated in the immediate surroundings of urban zones, was destined to urban expansion. The population density was limited to 34 inhabitants/ha; (iii) class C were areas considered not to be adequate for urbanization. Class C, which occupied most of the protected area, had more severe restrictions and a population density not to overcome 24 inhabitants/ha and be close to rural density.

These measures failed however to significantly contain the urbanisation processes, reorient city growth, and protect the remains of the forest. Various factors were blamed for this failure, such as the economic crisis of the 1980s and its social consequences on the Brazilian population, the implementation of opposing sectorial policies for transportation and housing, the insufficient control and monitoring, the lack of financial mechanisms at regional scale, and the lack of social and financial programs to accompany the restriction of land use, the devaluation of the land due the restriction of legislation that facilitated the development of a land market for small income housing (Bellenzani, 2000; Marcondes, 1999a).

**Table 2 : Evolution of the legislation relative to land and water management in the MRSP**

Date	Level	Object	Nature	Comments
Before 1877	Municipal	Water supply	Water supply organisation through "chafarizes" (public fountains)	
1877	Municipal	Water supply	The Companhia Cantareira de Agua e Esgotos (CCAIE) is created	The water supply is transferred to CCAIE that closes the fountains
XIX -1930	State	Water quality	The state buys catchment areas	Creation of natural reserves (Atibaia Natural Reserve)
1934 <i>Codigo das Aguas</i>	Federal	Management of water resources		Defines social rights on water
1930 -1970	State Federal	Water quality	Various specific pollution control laws oriented toward industry	
1962	State	Water Management	The DAEE is in charge of implementation of the water code in the Sao Paulo State	
1973	Municipal	Municipal planning	Creation of Sao Paulo Metropolitan Region	
1975 PMDI	Municipal	Municipal Planning	The Metropolitan Plan of Integrated Development defines lines to : reorient city growth on a West/East vector line, promote an integrated system of open spaces to protect water resources, establish water policy that prioritise water supply and recreation	Command and control law that did not succeed to control urbanisation processes in the upstream catchment
1976	State	Upstream catchment protection	Delimits protected areas (spring sources areas or <i>areas de mananciais</i> )	54 % of the metropolitan territory is included in the area. Two types of land use is delimited, by a 30 hab/ha (human density)
1988 Federal Constitution	Federal		Establish a specific system for water resources management different from environmental management. Water is defined as a public commodity.	
1989 State Constitution	State	Water Management	Establish the state policy for water resources management	
1990	Federal	Water quality	Norms for potable water for human consumption	The only existing norm
1990 <i>Guarapiranga Program</i>	Municipal	Water quality	Restoration of water quality in the Guarapiranga catchment by intervention of re-urbanisations in shanty-town	
1993 <i>Deliberation of water resources council</i>	State	Water Management	Establish the Catchment Committee (organisation, function etc) Establish FEHIDRO (financial body for catchment management)	Sao Paulo is one of the first state of Brazil to experiment water management at catchment level
1997 <i>Water Law</i> n°9433/97)	Federal	Management of water resources	Institution of the National Policy of Water Resources	In implementation phase
1997 <i>Spring Area Law</i> n°9866/1997	National	Upstream catchment protection	Establish new norms for upstream catchment protection	In implementation phase
2000	Federal	Management of water resources	Establish the National Agency of Water (ANA)	Executive agency, in charge of the implementation of the new system



*c) 1990 – 2000: The implementation of participative and territorial management of water*

The 90's were characterized by the emergence of a new paradigm concerning water management (Integrated Water Resources Management) in the world that was developed and defined during the World Water Conferences of Dublin (1992), Paris (1998) and The Hague (2000). At the same time, new claims over water and land emerged in the MRSP, from new type of stakeholders, embedded in the civil society and resident of the metropolitan areas. The democratization processes of Brazil and a better political recognition of the poorest segments of the society facilitated the emergence of these new claims, expressed by different environmental, religious, local or political organizations. This led to a shift in the conflicts over water use in the protected areas, which appears then to be more related to social tensions than to sectorial competition, as during the previous decade.

The 80's were characterized by a progressive consolidation of the sanitation industrial complex, using water resources for diluting effluents, that tended to take a major role in the conflict with the two other corporations (the hydro-electric sector and water producers firm). This type of conflict culminated in the 80's with the dispute over the reversion of the Pinheiros river (Braga, 2000). This corporatist view of water management was linked with the domination of the implementation of technical sectorial solutions. The water producing firm, SABESP, faced more and more openly difficulties to service the growing demand on potable water and at same time collect and treat each time growing flows of effluents. In this context, a change in the water policy system was necessary.

The Guarapiranga Program (*Programa Guarapiranga*), implemented with the support of International Development Bank with the objectives of rehabilitation and control of the quality of water in the Guarapiranga reservoir anticipated the important changes that were to occur in the Brazilian water management system a couple of years afterwards. Innovative from an environmental and urbanistic point of view (Bellenzani, 2000; Marcondes, 1999a), it promoted also intersectorial cooperation and articulation, and a new form of integrated intervention at municipal level (versus regional planning) (Porto, 1999). However, priority was given to structural activities over participative, capacity building and support of economical activities. The results were actually mitigated: it allowed testing some tools that were to be included in the adapted spring area laws "*lei de mananciais*", such as the concept intervention unit. It reinforced effective sectorial cooperation and promoted the mobilization of institutions for the discussion and review of laws, guidelines and tools implemented in the context of the catchment management policy adopted by the Guarapiranga/Cotia sub-catchment committee (Gondolo, 1996) but did not succeed to significantly reduce water pollution in the catchment because of the continuous population growth in its surroundings.

Environmental and water issues were explicitly considered in the Federal Constitution of 1988 and the social, political and sectorial evolution led to the definition and implementation of a new model of water management. The new water policy combines a federal regulation (Federal Water Law Federal law N° 9433/97) that creates the National Water Resources Policy, and state regulations, to account for the management of water resources at state level. The federal legislation relies on the following principles: water is a public commodity, a limited natural resource with economic value, priority is given to the use of water for human and animal consumption, there are multiple uses of water, the hydrological watershed is the water management unit and water management should be decentralized and participative. The institutional landscape combines administrative structures, operational bodies, and specific tools integrated in specific legislations at Federal and State levels (table 3). Two different types of operational organizations have been defined and implemented at both levels: consultative, deliberative and normative bodies and organization with an executive function in charge of the implementation of the tools and plans proposed by the consultative bodies.

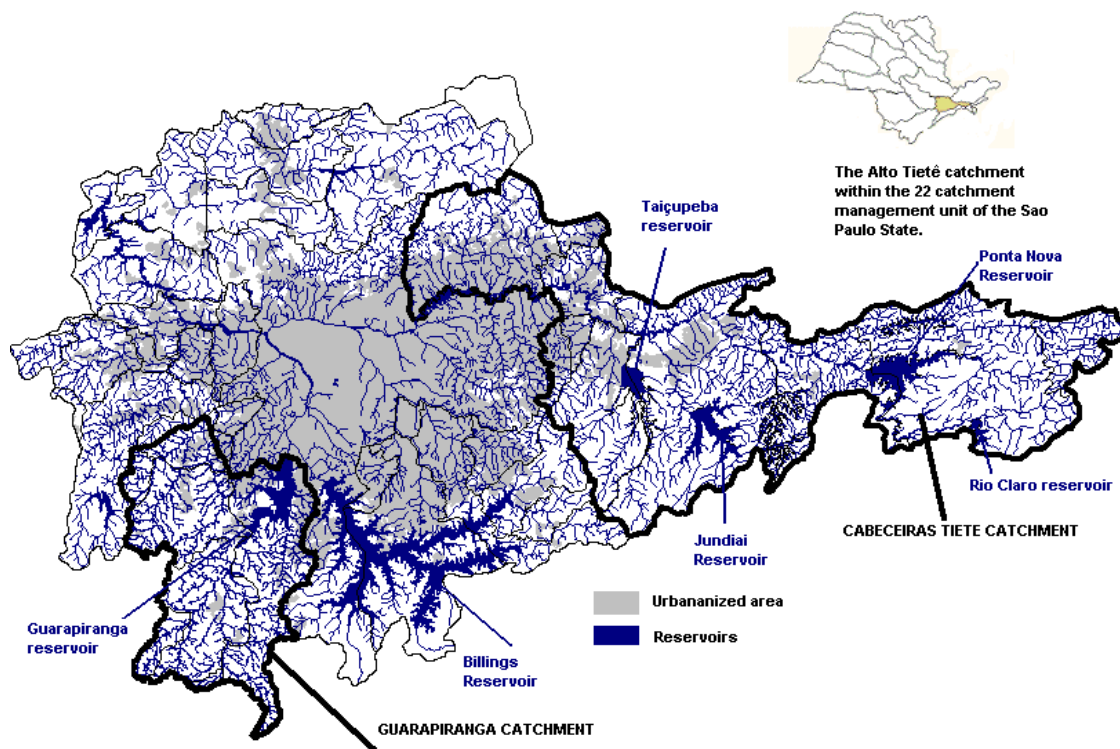
In the Sao Paulo state, the State Policy of Water Resources (Law n° 7.663/91) defines the functions and roles of the new institutions, the Catchment Committee and the Basin Agency Catchment. The Committee is formed by organizations of the civil society, municipal and state public entities, organized in a tripartite representation system. The Committee is a coordinating, consultative, normative and deliberative body responsible for the decision implementation at sub catchment level (Neder, 2000). The Basin Agency is an executive and technical institution in charge of assistance in decision-making, technical studies and implementation of the tools and plans proposed by the Catchment Committee. A special funding agency, the FEHIDRO (State Fund for Water Resources)



was also implemented to support the management process. It receives contribution from the hydroelectricity sector and at medium term the license fees previsted by law but not yet implemented.

The legislation was also completed by a specific law to protect the spring areas (*Revised Lei dos Mananciais*, nº9866/1987), adapted from the former law (*Lei dos Mananciais*) of 1975 by the adapted *Lei dos mananciais* or law for the protection and recuperation of catchment areas (LPRM). Law nº9,866/97. This legislation defines another level of management unit (the area for protection and recuperation of spring catchment – or APRM - *Área de Proteção e Recuperação de Mananciais*) made of one of various sub-catchment, and integrated in the watershed unit. It also promotes the development of specific planning (Development and Environmental Protection Plan. – PDPA) to be integrated in the Catchment plan and specific tools to each APRM (norms, financial tools etc).

The Sao Paulo state has been divided into 22 management unit or catchments (figure 2), each one with its own catchment bodies. The Alto-Tietê catchment, with 35 municipalities and 5985 km<sup>2</sup> include nearly 74 % of the MRSP. Due to its complexity, this catchment has been divided into 5 sub-catchment (Cotia-Guarapiranga, Billings-Tamanduatei, Cabeiceras-Tietê, Pinheiros-Pirapora, Juqueri-Cantareira) each one with their own sub-catchment committees, composed by one third of representatives of government authorities and agency (DAEE, Cetesb, Sabesp etc), by one third of representatives of municipalities, and by one third of representatives of the organized local civil society – local universities, local corporation and syndicate, local environmental NGO etc.



**Figure 2 : The Alto Tietê catchment and two subcatchments**

Watercourses are classified following a water quality norm defined in the CONAMA resolution 20 of 18/06/86, and the Water Law nº 9433/97. This norm defines 4 classes of water, depending of their main uses. The classes define the quality norm to maintain in the related watercourses, and thus the allowed pollution discharge.

**Table 3 : The different institutions with their role in relation with water management**

State structure	role
Institutions on federal level	Ministry of Environment • Planning, co-ordination, supervision and control in environmental management, with the help of several agencies under its control
	ANA (Agência Nacional das Águas) • The executive branch of the Ministry of Environment for water management, founded in 2000.
	National Agency of water • Responsible for implementing the waterboards, especially at for federal waterboards and provides them technical advices.
	CONAMA • a consultative and deliberative body of the Ministry of Environment, in the field of environmental policies, with representatives from civil society, industrial sectors and other concerned federal and decentralised governmental agencies
	• advises, proposes and studies governmental environmental policy.
	IBAMA (Brazilian institute for the environment and renewable resources) • Created in 1989, the main executive agency to enforce federal environmental laws in the field of environmental policy like forestry, fishing, oil industry and <u>in environmental waste water standards</u> in relation with water management
São Paulo State	Secretary of the hydrological resources Secretaria de Recursos Hídricos • Created in 1995, involved with the implementation of the new system of water management, with a special focus on the integration of the water management, environmental policy, the monitoring of the functioning of a new water management system as well as the integration of technological and scientific knowledge in water management, and
	SABESP • State company in charge of the potable water supply and sewage treatment in the state of São Paulo. The company is operating in 368 municipalities in the state and operates eight water treatment systems in the Sao Paulo metropolitan area.
	CETESB State agency for environmental protection. • Created in 1968, responsible for the development, implementation and monitoring of environmental regulations , monitoring the quality of water and the treatment of water., as well as the diffusion en environmental technologies.
	DAEE state department of Water and Electric energy. • Created in 1951, it used to be the authority in charge of water management at State Level and controlled the hydroelectric systems.
	• His role have been reviewed with the implementation of the new water legislation: It still responsible for the operation management of some reservoirs systems (such as the Production System of Alto Tietê) and administrates licences, planning and the cadastre in relation with water management. Provide technical advices to support the water board
	Catchment Committee Or waterboards • Implemented in 1991, the discussion /negotiation platform to manage water resources.
	• composed by one third of state government authorities, one third by representatives of municipalities, and one third by representatives of organizations of the civil society –NGO, coporation – universities etc
	Catchment Agency • Executive agency in charge of execution of the decision made by the water boards
	FEHIDRO • Financial bodies, receiving contribution by the hydroelectricity sector and in the future the contribution for water licences
	Municipality • Responsible for definition, implementation and monitoring of planning and zoning,; They issue building permit and other development licences.

### 3.2 - New arrangement for the management of land

Land management is under the responsibility of the municipalities but the institutional arrangements governing land management has also been facing transformation during the last decade. On one hand, the municipality of Sao Paulo is promoting a decentralised and participative management to improve the capacity of municipal planning and management, which proved inadequate during the last decade. Five sub-municipal authorities have been created as well a participative procedure for budget planning.

Moreover, a federal legislation, the "City Statute" *Estatuto da Cidade* (Law nº 10257/2001), recently adopted, has been designed as "guidelines" to correct and invert the actual urbanization mechanisms that territorial segregation and expansion of illegal settlements. This legislation, that recommends the use of incentives rather of normative tools, promotes for new urban management practices ranging from participatory planning at municipal level to the extension of regularisation of illegal settlement taking account the specific context of each case (Rolnik, 2001). Thus, it legitimates various on going experiences in the Alto-Tietê catchment of re-urbanization projects aiming to mitigate the impact of existing precarious settlement on environmental resources while facilitating the implementation of monitoring processes to control further inadequate urbanization. It also provides legislative solutions for land titles in these areas. However, various specialists are questioning the implementation of this law and the adaptation of the different tools to the specific context of each municipality. Moreover, while the law underlines the necessity of coordination between municipalities in metropolitan area, it does not provide any tools or indication to facilitate and induce this process.

There is no real integrated regional policy related to metropolitan management and co-ordination in the Metropolitan Region of Sao Paulo. There is no real management or coordination at Metropolitan Level, even if a state firm, The Emplasa - Empresa Paulista de Planejamento Metropolitano or Firm for metropolitan planning - is in charge of elaborating plans and studies to subsidise decision making related to metropolitan management. Actually, there is no real integrated regional policy and co-ordination at metropolitan level. The management relies on the juxtaposition of various sectorial policies (transportation housing health, security) at the best defined at metropolitan level (such as the transportation policy), and most of the case at municipal level. The water management model, that combines a regional objectives, a delocalised and participative implementation is even proposed for a metropolitan management policy (Refinetti Martins, 2003).

### 3.3 - Articulation between land and water management

The new legislations have tried to promote a better integration between land and water management, trough the combination and integration of various tools summarized in the following table.

**Table 4: The different relevant scale for the different instrument of land and water management**

	Metropolitan level	Local	Micro local level
Water management	Catchment planning (by Alto-Tietê catchment committee)	Sub catchment planning (by sub catchment committee)	
Land management		Spring catchment protection instruments at sub catchment level (planning etc) [ <i>lei de Mananciais</i> ]	Communities represented in the sub catchment committee and participative planning process at municipal level
	<i>Not really operational.</i>	Municipal territorial and budget planning	

At local level, that is sub-catchment level, both land and water legislation now relies on the same principles and on the same tools kit: water resources are managed at catchment level, with a decentralized and participative approach aiming to establish of a catchment plan articulating activities and maximizing the use of financial resources. Concretely, the apparatus developed for the protection of spring water, such as the delimitation of specific land management unit (the APRM) is to be integrated in the system developed at catchment level. Environmental and urban guidelines and norms of regional interest are established for each APRM, taking into account the specificities and

environmental functions of the different Areas of Intervention (land management units) and respecting the municipal competencies. This includes a specification of the destination of the areas, with norms and pattern for the licensing of its activities and functions. Municipal legislation on land use occupation and development are supposed to incorporate the established guidelines and parameters in their local regulation.

The planning of this specific land management unit is part of a Development and Environmental Protection Plan (*PDPA or Plano de Desenvolvimento e Proteção Ambiental*), which is to be elaborated by the Catchment Committee and implemented by the Basin Agency. This plan will include guidelines, objectives, programs and proposals for each APRM, forming the Catchment Plan (*Planos de Bacias Hidrográficas*), to be integrated into a Water Resources State Plan submitted to the approval of the state government. This latter plan has to follow the federal guidelines of the Systems of Environment, Water Resources and Regional Development. The implementation of the Catchment Plan will be permitted through the allocation of funding, resulting of the integration of the Plan in the various financial and budgeting tools of the State and Municipalities (Pluri-annual Plans, budgeting guidelines, Annual Budget). Its assessment and monitoring should be done by the State or delegated to the municipality, but a formal agreement to be defined between them should establish the limits of their respective involvement

Other tools are aiming at facilitating the coordination between municipalities, such as the financial compensation between municipalities: The objective of this tool is to orient financial transfer between economically developed municipalities with high demand in potable water toward municipalities specialised in water production and pollution control, which is incompatible with a high economical and industrial development pattern. As with other financial tools previsted by the law such as sectorial incentives for compatible activities with environmental protection, this mechanism is far to be yet operational.

Local communities are supposed to be involved in both the development of catchment plan and municipal planning through their representation in the discussion bodies at catchment or municipal bodies.

### **3.4 - Other relevant legislations**

Other relevant legislations include: (1) The obligation to implement a previous environmental study and its related report of environmental impact to develop any activities responsible “for alteration of physical, chemical, biological properties of the environment, that may impact the health, safety, well being of the population, social and economic activities, aesthetical / sanitary conditions, or the quality of environmental resources (Resolution CONAMA 1, 23/01/1986) (2) The Law 4771/1509/65 or Forest code (“*Codigo Florestal*”) that establishes the obligation to preserve forest around water courses. The size of the forested corridor depends on size of the watercourses (3) The sewage connections must follows rules defined in the Health Code. A pattern for potable water quality norm has also to be followed.

## **4 - Presentation of the Guarapiranga and Cabeiceras-Tietê catchment**

### **4.1 - The Guarapiranga catchment**

The sub-catchment Cotia-Guarapiranga with a superficy of 905 km<sup>2</sup> covers seven different municipalities. The catchment includes the Guarapiranga reservoir, 26 km<sup>2</sup> with a direct catchment of 643 km<sup>2</sup> that provides for 15 % of the domestic water supply of the MRSP. With 3.8 millions people (4275 inhabitants/km<sup>2</sup>) this is the most densely populated catchment and one of the most severely affected by urbanization.

The reservoir was constructed in 1906, for the generation of hydropower. At the end of the 30's the region developed as a luxurious satellite town and was now as the Sao Paulo beach. A low intensity urbanization took place during the 40's and the 50's with the development of job opportunities in industrial sector in the neighbouring Santo Amaro area. The first low income district of 2500 home was build in the 40's, but this increased in the 70's. Urbanization represents now 15 % of total land uses of the catchment and the first third part of the reservoir can qualified of urban. The reservoir is facing high organic pollution rates since the 70's

#### 4.2 - The Cabeceiras-Tietê catchment.

The biggest sub-catchment area of the Alto-Tietê catchment, this 1694 km<sup>2</sup> watershed covers 9 municipalities and hosts 1,8 millions people (1101 inhabitants/km<sup>2</sup>) and the springs of the Tietê river. The catchment provide for 10 % of domestic water supply of the MRSP thanks to two connected system : the Rio Claro system and the Alto-Tietê production System or SPAT – Sistema Produtor do Alto Tietê – The Spat is made of 3 reservoirs that were initially build for flood control purpose. Two other reservoirs are in being finalized to increase water production. Water quality in this reservoir is still preserved if compared to other catchment area, but ultimately urbanization has been increasing in the surrounding of the Taçubepa reservoir where water is being pumped to be treated and the quality of the reservoir is steadily decreasing. With some 8000 ha irrigated, agriculture remains important in this catchment. Actually, this is the only catchment where agriculture is being represented in the committee

#### List of acronyms

ANA	Agencia Nacional das Aguas « National Agency of Water »
APRM	Área de Proteção e Recuperação de Mananciais “Área of protection and recuperation of springs”
CETESB	Companhia de Tecnologia de Saneamento Ambiental “Company of Technologies of Environmental Sanitation”
CONAMA	Conselho Nacional do Meio Ambiente “National Council of Environment”
DAEE	Departamento de Águas e Energia Elétrica. “Department of Water and Electricity”
EMPLASA	Empresa Paulista de Planejamento Metropolitano « Sao Paulo Firm for Metropolitan Planning”
FEHIDRO	Fundo Estadual de Recursos Hídricos “State fund for water resources”
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis “Brazilian Institute of Environment and Renewable Natural Resources”
PDPA	Plano de Desenvolvimento e Proteção Ambiental “Development and Environmental Protection Plan”
SABESP	Companhia de Saneamento Básico do Estado de São Paulo “Company for the Basic Sanitation of São Paulo State”
SPAT	Sistema Produtor do Alto Tietê “Production system of the Alto-Tietê catchment”

#### References

- Bellenzani, M.L.R., 2000. A APA Municipal do Capivari-Monos como uma estratégia de proteção aos mananciais da Região Metropolitana de São Paulo. Mestrado Thesis, Universidade de São Paulo, São Paulo, 204 pp.
- Braga, B.P.F., Jr, 2000. The management of urban water conflicts in the Metropolitan Region of Sao Paulo. Water International, 25(2): 208-213.
- FUSP, 2000. Plano da bacia hidrográfica do Alto Tietê. Plano 0., FUSP, São Paulo.
- Gondolo, G.C.F., 1996. Bacia do Guarapiranga, região metropolitana de São Paulo. De saíões de um sistema complexo à gestão ambiental. Mestrado Thesis, USP, São Paulo, 176 p. pp.
- Governo do Estado/sma, 1997.
- Marcondes, M.J.A., 1999a. Cidade e natureza : proteção dos mananciais e exclusão social. Studio Nobel, Editora da USP, FAPESP, São Paulo, 236 pp.

- Marcondes, M.J.d.A., 1999b. Cidade e natureza : proteção dos mananciais e exclusão social. Studio Nobel : Editora da USP: FAPESP, São Paulo, 236 p. pp.
- Neder, R.T., 2000. Avaliação da capacidade governativa de comitê de bacia hidrográfica metropolitana : um caso exemplar em São Paulo. Programa Políticas Públicas. USP/ESALQ, Piracicaba, Brasil, 140 p. pp.
- Porto, M., 1999. Sustaining urban water supplies : the Metropolitan Region of Sao Paulo, Brazil. Keynote Lecture, Urban Stability Through Integrated water related issues management : 9th Stockholm water symposium, Stockholm, pp. 107-112.
- Porto, M., 2003. Recursos hídricos e saneamento na Região Metropolitana de São Paulo : um desafio à tamanho da cidade. Serie Agua Brasil N°3, Banco Mundial, Brasília, DF, Brasil.
- Prette, M.E.d., 2000. Apropriação de recursos hídricos e conflitos sociais: a gestão das areas de proteção aos mananciais da Região Metropolitana de São Paulo. PhD thesis Thesis, Universidade de São Paulo, São Paulo, 192 pp.
- Refinetti Martins, M.L., 2003. Sao Paulo, alem do Plano Diretor. Estudos Avançados, 17(47): 167-186.
- Rolnik, R., 2001. Estatuto da Cidade. Instrumento para as cidades que sonham crescer com justiça e beleza. In: N. Saule Junior, Rolnik, Raquel (Editor), Estatuto da Cidade : novas perspectivas para reformas urbanas. Caderno Polis n°4, Sao Paulo, pp. 64 p.
- SABESP, 2000. Águas de São Paulo : Passado e presente, Ligação : Saneamento, Meio Ambiente e Desenvolvimento sustentável, São Paulo.
- Uemura, M.M., 2000. Programa de saneamento ambiental da Bacia de Guarapiranga. Alternativa para a proteção dos manancias ? Tese de Mestrado Thesis, PUC, Campinas, SP, Brasil.