



# The challenges of multi-stakeholder management in the watersheds of São Paulo

*Pedro Jacobi*

Dr Pedro Jacobi is senior professor at the School of Education and the Programme of Environmental Sciences at the University of São Paulo, Brazil.

Address: Rua Cayowáa 1082, apt. 61, 05018-001 São Paulo, Brazil; e-mail: prjacobi@terra.com.br

**SUMMARY:** *This paper reviews the serious social, economic and environmental problems in the watersheds on whose freshwater Greater São Paulo's enterprises and 18 million inhabitants depend. These problems include the growing concentration of illegal settlements in the watersheds and the fact that environmental legislation in the 1970s actually increased the problem. A large and growing proportion of the low-income population has come to live in the watersheds, in settlements with poor living conditions and high levels of violence. This paper describes the new measures taken during the 1990s to address watershed protection and the social and economic problems of those who live there; also, the way in which these measures are structured to bring together the efforts of the state government, the municipal authorities and civil society.*

## I. INTRODUCTION

ENVIRONMENTAL PROBLEMS WITHIN Brazil's metropolitan centres have grown rapidly in the last 50 years. Inadequacies in addressing these problems have had significant consequences, including large increases in the number and scale of floods, difficulties in the management of solid wastes, environmental damage arising from inadequate waste management and high levels of air pollution. Much of this is related to uncontrolled urban expansion. Until around 1950, the physical expansion of Brazilian metropolises generally avoided those areas that presented greater problems for occupation (high slopes, fragile soils and soils liable to erosion); they were more distant from the centre, and pressure for occupation was less intense. However, the constant expansion of new urban developments in the periphery (which has been more intense in the last 30 years) has brought about two simultaneous movements: intensified interventions in the drainage network, with rectification works and the channelling of rivers; and a boom in land sub-division and plot development in the periphery.

The rules and regulations governing the occupation and use of land for urban development reflect the interests of the upper and upper-middle classes. Most plots developed in city peripheries are illegal and do not meet the established planning standards. They are also officially excluded from access to public infrastructure and services. The expansion of metropolitan areas has brought with it increasing environmental deterioration, and is marked by the inadequacy or even total absence of public policies to address these problems. Public administrations are slow to identify and

address these problems and slow to implement measures to manage land use and guarantee improvements in the quality of life.

The environmental problems arise mainly from the precariousness of services and the failure of the public authorities. But these problems also reflect neglect on the part of the residents themselves, even in the neighbourhoods that lack infrastructure, as people dispose of their solid wastes on sidewalks and in streams, ditches and public places. With the precarious nature of their homes and neighbourhoods, residents of poor areas frequently do not act cooperatively to address the problems, or do not organize themselves to reduce their impact. This highlights the contradiction between urban environmental problems and existing social practices: those among the population who are well serviced are not necessarily aware of the problems, and those who are badly serviced have very little means of solving the problems generated by environmental degradation. The degradation of water sources from careless dumping of household wastes, or air pollution by automobiles can also be seen as examples of individual interests taking precedence over the quality of life for the city as a whole.

The urbanization dynamic associated with the expansion of the suburban areas has produced a segregated and highly degraded urban environment, with serious effects for the quality of life of its population. Areas ill-suited to occupation, such as steep slopes, marshes and watershed protection areas, are developed – and often with poor quality dwellings and inadequate or no urban services. As large numbers of households lack connections to sewer systems, there are problems with sewage being dumped on land sites, with illegal connections to surface water drains and with direct dumping into the rivers. Cities are affected by an increase in critical flooding points. The disposal of solid wastes has become highly problematic in most cities because of the lack of space for disposal. Precarious dwelling conditions in *favelas* (slums) and peripheral plots contribute to the deficit of urban infrastructure, and their location in critical areas often increases environmental degradation.<sup>(1)</sup>

The inadequacy of public policies and the lack of legislation regarding land use, which could help control irregular physical growth, create an “illegal city” that occupies the empty spaces of the city, mainly in areas of less value, including areas within watersheds. It is mostly low-income groups that daily face the risk of floods, the collapse of slopes, soil and water pollution resulting from the illegal disposal of industrial toxic wastes, accidents with hazardous loads, leaks at petrol stations, and dangerous co-existence with mining and quarrying facilities that contribute to high levels of air pollution and noise (including from explosions). The close relationship between urban risks and the problems of land use and occupation is obvious and, among the determinants of environmental conditions in cities, it is particularly difficult to address, and calls for greater competence on the part of local authorities.

## II. METROPOLITAN URBANIZATION, SPATIAL SEGREGATION AND WATERSHED DEGRADATION

THE SÃO PAULO Metropolitan Region consists of São Paulo city (with around 10 million inhabitants) and 38 surrounding municipalities (with around 8 million inhabitants), making it one of the world’s largest cities. It is currently undergoing a process of transition from an industrial economy

1. Jacobi, Pedro (2001), “The metropolitan region of São Paulo – problems, potentials and conflicts”, in DISP 147-4/2001, ORL Institute, Zürich.

<b>Table 1:</b>		<b>Population of São Paulo city and metropolitan region</b>	
Year	Population of the metropolitan region	Population of the city	
1960	4,791,245	3,666,701	
1970	8,139,730	5,924,615	
1980	12,588,725	8,493,226	
1991	15,444,941	9,646,185	
1996	16,583,234	9,834,436	
2000	17,834,664	10,434,252	

SOURCE: FIBGE, Demographic Census 1960–2000.

to one based on services. Much of the metropolitan pattern of urbanization involves processes of expansion, transformation and modernization of the intra-urban spaces that provide a poor quality of life to significant parts of the population. Much of this has been driven by the difficulty faced by low-income groups in getting access to housing in safe, adequate locations. Increasingly, the metropolitan region is becoming a dual space, with increasing social and environmental differences between a formal city where public investment is concentrated and an informal city that is excluded from most such investments.

Urban expansion has led to a concentration of the low-income population in peripheral areas, much of it in watersheds that are meant to be protected by the Watershed Protection Law of 1976. This law was created to protect São Paulo's water resources by controlling metropolitan urban development along the north–south axis and by planning the forms of land use allowed in the watersheds. It defined areas of watershed protection, corresponding to 54 per cent of the metropolitan region, and established standards of land occupation and use for these areas. The metropolitan area lies almost entirely within the physical limits of the Alto Tietê watershed; in fact, all municipalities in São Paulo Metropolitan Region are included within it, either in whole or in part. Of the 39 municipalities, 17 have more than half their territory in the watershed. However, the law did not prevent disorderly urban expansion in these protected areas. Indeed, it contributed to the consolidation of precarious urban settlements there that lacked provision for water, sanitation, drainage and solid waste collection and other infrastructure, thus contributing to the degradation of water resources.

During the 1960s and 1970s, the metropolitan region's population grew rapidly by more than 4.4 per cent per annum. During this period, the metropolis used to receive around 4 million new inhabitants each decade (Table 1).

Over the last two decades, there has been a significant slowing down in population growth rates in the metropolitan region. During the 1990s, the population growth rate of 1.6 per cent per annum was close to the rate of natural increase, so there was no net in-migration. This reduction in growth rate is associated with a reduction in the region's attractiveness to new investment and to a steep fall in fertility, and this, associated with changes in family structure, has resulted in a reduction in the average family size and in the average number of persons per dwelling.

Despite declining growth rates, invasions and the illegal sub-division of land in watershed areas continued, leading to a growing number of *favelas*. Mechanisms to protect these areas have been difficult to implement, and the situation is made worse by the intense conflicts over the occupation and use of land and the illegal sub-division of land. This endangers the watersheds that ensure water supplies for the metropolis, especially those where there is already intense occupation and where the quality of water is compromised, as in the Billings and Guarapiranga reservoirs; also, where the threat of urban growth is imminent, as in the areas surrounding the reservoirs that belong to the watersheds of Alto Tietê (Cabeceiras) and Cantareira.

The situation has also contributed to high levels of social vulnerability in these areas and to some of the worst indicators of public security. Violence continues to be one of the most important social problems in the region, and the main causes of the high homicide rate are drug-trafficking, insufficient police presence and the high concentration of low-income population. In São Paulo, the richest 10 per cent of the population have 30 per cent of total income, while the poorest 50 per cent have only one-quarter.

### III. URBAN ENVIRONMENTAL LEGISLATION AND WATER PROVISION IN THE METROPOLITAN REGION

THE 1976 ENVIRONMENTAL protection legislation for watershed areas in the metropolitan region (54 per cent of the territory) imposed great restrictions on the use and occupation of land. This not only generated a chaotic process of land occupation but also caused a drop in land prices. These areas, in turn, became attractive to people excluded from the formal market – more than 1 million inhabitants at present – for the purposes of illegal sub-division. Only in 1997 was legislation approved by the Legislative Assembly of São Paulo State that aimed to make watershed protection and preservation compatible with environmental protection. It also sought to promote the use and occupation of land and the socioeconomic development of protected areas through the establishment of general guidelines for protection and recovery, which must be regulated in all the watershed areas. The new watershed protection legislation improves on previous legislation in that it considers water management more broadly and integrates within it the issue of land management. Furthermore, it allows the characteristics of each watershed to be taken into account during the planning process, which necessarily involves the participation of the different stakeholders. It does not propose the creation of rigid zoning but, rather, proposes a concept of areas of intervention that guides the implementation of public policies in a dynamic manner, aimed at each of the watershed protection areas and at the effective protection and recovery of watersheds. However, it is difficult to measure the success of these new management approaches and their capacity to change the spatial configuration of watersheds in terms of reducing residential and other urban developments there.

The most significant new element of this 1997 legislation is the guiding principle of supporting community management to resolve conflicts of interest rather than simply prohibiting the occupation of watershed areas. Municipalities and civil society are included through watershed committees. The bill has three basic principles: management by watershed (rather than by administrative boundaries), the co-management of water resources,

and a charge for water usage (*cobranza del agua*). This makes it possible for residents in irregularly occupied areas to be provided with infrastructure. Responsibility for the control of the protected area rests with the state government due to the broad application of the watershed protection legislation. However, final responsibility rests with each municipality as it must regulate the use and occupation of land in accordance with both sets of legislation. If the area is not regulated, the municipality may neither collect taxes nor provide any kind of urban infrastructure. The revised legislation proposes a tripartite management for the legalization of the area, involving the state government, civil society and the mayors of the municipalities, which brings all the sectors together with the aim of overcoming the problems of illegal occupation.

Approximately 1.3 million people live in areas covered by the watershed protection legislation, 1.1 million of them in the areas surrounding the Guarapiranga and Billings dams to the south of São Paulo city.<sup>(2)</sup> These areas around the dams total 1,226 square kilometres and this calls for a complex process of control. The growth in population in these areas in the last two decades is related to the low cost of land and proximity to a vast industrial park.

The existing sewage system reached approximately 45 per cent of the metropolitan population in 1995, but it excludes most of the *favelas*. The high-density occupation has meant that much of the land has become impermeable, limiting the extent to which rains can recharge the water tables that feed the reservoirs during the dry seasons. There has been a gradual deterioration in water quality in the tributaries and watercourses of the dam, including the points of collection of raw water, which has resulted in an increase in eutrophication and in algae growth.

In 1999, there were more than 270,000 sub-standard dwellings within the metropolitan region of São Paulo, most of them in São Paulo city (municipality) where, in 1993, around 1.9 million people, or 19.8 per cent of the population, lived in 1,800 registered *favelas*. Most of this *favela* population is concentrated in the periphery of the municipality. The São Paulo city council estimates that 2.8 million people within the city live in sub-standard accommodation in their municipality – in *favelas*, *cortiços* (slum tenements) and self-constructed houses on illegal plots – that is, 28 per cent of the city's population.<sup>(3)</sup> Illegal sub-divisions cover approximately 500 square kilometres, where around 1.5 million inhabitants live in precarious environments and with inadequate infrastructure and services.

#### IV. BASIC SANITATION AND SOCIAL VULNERABILITY IN THE SÃO PAULO METROPOLITAN REGION

THE NEW WATER management policy introduced in the 1990s established the “watershed” as a planning and management unit. The metropolitan region is supplied by three major water-producing systems: the Cantareira system, the Guarapiranga/Billings system and the Alto Tietê system. The Alto Tietê management system is sub-divided into five sub-watersheds – Guarapiranga, Billings, Cantareira, Pinheiros-Pirapora and Cabeceiras-Tietê. Approximately 50 per cent of the water consumed in the metropolitan region is imported from the Piracicaba River watershed through the Cantareira system. The quality of the water generated in these systems depends, among other factors, on urban expansion processes which, when uncontrolled, have negative impacts. In highly urbanized watersheds, there

2. Data provided by the Ministry of Environment.

3. Secretaria Municipal de Planejamento (2001), *Plano Diretor do Município de São Paulo*, São Paulo.

is an inevitable connection between the management of the metropolitan territory and the management of water resources. The control exercised by the former interferes with the operation of the latter. The situation is serious in that 95 per cent of the water collected in the watershed of the São Paulo Metropolitan Region itself (Alto Tietê watershed) is not in totally protected areas, and control over the watersheds of the water-producing systems depends on land use and occupation policies as well as on adequate management processes that exercise efficient control.<sup>(4)</sup>

However, the region is considered one of low water availability, as it supplies the largest city in Brazil. For an adequate supply, it depends on water imported from other watersheds – such as the Piracicaba River’s, which supplies the Cantareira system. Water scarcity in the São Paulo Metropolitan Region, associated with increasing and uncontrolled urban expansion in the water-producing systems, necessitates broad and integrated actions to ensure water of a quality and quantity adequate for public provision.

The municipality of São Paulo has more than half the metropolitan area’s population, and 36 per cent of its territory is in an area of watershed protection – 547 of its total 1,509 square kilometres. This is being illegally occupied, mainly in the areas surrounding the dams and their reservoirs. The illegal occupation of watershed protection areas began in the 1980s in the sub-watersheds of the Billings and Guarapiranga dams. At present, 1.8 million inhabitants – approximately 10 per cent of the metropolitan population – live in sub-watersheds of strategic importance to the metropolitan region, the majority (1.6 million) in the Billings and Guarapiranga sub-watersheds. Here, population growth is well above the metropolitan average – in excess of 3 per cent a year. Most of this growth constitutes low-income residents, and it is estimated that around 20 per cent live in *favelas*. The sections below describe the socio-environmental characteristics of each of the watershed areas, highlighting the main demographic and socio-spatial dynamics relating to the metropolitan region, and the interfaces between poverty, social vulnerability and water resource management and conservation.<sup>(5)</sup>

**a. Guarapiranga watershed**

The Guarapiranga watershed is one of the metropolitan region’s main sources of water supply. It contributes some 12.1 cubic metres per second, representing around 20.8 per cent of the total flow available to the region. It covers an area of 640 square kilometres within the municipality of São Paulo and six other municipalities. Its reservoir<sup>(6)</sup> supplies some 3 million inhabitants.

It is estimated that 40 per cent of the Guarapiranga watershed has irregular urban developments.<sup>(7)</sup> Around 80 per cent of the watershed population is concentrated in 27 per cent of the territory, with densities of up to 500 inhabitants per hectare, and there are 180 *favelas*. In spite of the 1970s watershed protection legislation, the occupation of the dam’s surroundings was intense, and the restrictive measures had the opposite effect to that intended. Taking the region’s large undeveloped areas out of the formal land market meant that a stock of cheap land was available for illegal occupation and sub-division. In 1991, the area had 1,009,400 inhabitants, 56 per cent of whom were in São Paulo city; by 2000, it had 1,324,590 inhabitants, 60 per cent of whom were in São Paulo city. Projections suggest continued rapid growth, with 1,618,000 people likely to live in the watershed by 2010.

4. Jacobi, Pedro (2003), “Gestão compartilhada de recursos hídricos na região metropolitana de São Paulo – desafios da inovação nas políticas públicas”, mimeo.

5. Jacobi, Pedro, Fernando Monteiro and Ricardo Novaes (2002), “Gestão integrada da água e serviços e pobreza na região metropolitana de São Paulo”, mimeo.

6. The reservoir was constructed in 1907 to guarantee power production in the Parnaíba power plant. By the middle of the 1920s, its waters were used for public provision.

7. PDPA: Plano de Desenvolvimento e Proteção Ambiental.



8. In Cardia, Nancy and Suely Schiffer (2002), "Violência e desigualdade social", in *Ciência e Cultura: Temas e Tendências* Vol 54, No 1, pages 25-31. One minimum wage consists of about US\$ 80 a month, and even three minimum wages is barely enough to get by.

9. See reference 8.

10. Data obtained from *Índice de Vulnerabilidade Juvenil* – Fundação SEADE (Fundação Sistema Estadual de Dados) [www.seade.gov.br](http://www.seade.gov.br) also FUSP (Fundação Universidade de São Paulo) and FEHIDRO (2001), "Plano da bacia do Alto Tietê", São Paulo.

11. See reference 8.

12. See reference 10, FUSP (2001).

13. See reference 10, FUSP (2001).

The population here is among the poorest in the metropolitan region; in 2000, those São Paulo districts belonging to the Guarapiranga watershed had among the region's lowest average incomes. In the southern zone, half the population have family heads with no wages or income below the poverty line (considered here to be less than three minimum wages or the equivalent of US\$ 250 a month).<sup>(8)</sup> In the peripheral areas, there is a noticeable increase in informal labour and in the number of *bicos* (casual labourers); also, higher concentrations of children and adolescents.<sup>(9)</sup> The region's population suffers from low levels of education and high levels of violence and social vulnerability. In 1999, four districts, with 8.4 per cent of the population, had 854 homicides, which represented 12.9 per cent of all homicides in that municipality.<sup>(10)</sup> Some municipal districts within the region of Guarapiranga have among the worst indicators of social exclusion – violence, illiteracy and unequal income distribution.

The factors that contribute to the population's instability are made worse by the disagreements between the state and civil society. On the one hand, the public authorities are unable to provide basic infrastructure and services; on the other, the inhabitants are not able to get their land occupation regularized. This impasse, apart from generating tensions and stresses on both sides, increases people's instability. They cannot establish more durable links with their settlement, do not feel part of a community, and consider the neighbourhood just as "a place to live in". This contributes to the lack of social cohesion. The region also has an above average number of inhabitants per household, which contributes to family conflict and stress. Areas with higher densities per household have more homicides.<sup>(11)</sup> In addition to poverty and low levels of education, criminality and drug-trafficking also contribute to violence in the region.

At the same time, uncontrolled urban occupation and lack of investment in basic sanitation have significant environmental impacts, compromising existing natural resources. The main problem is pollution of the reservoir water, especially due to uncollected domestic sewage and diffuse non-point sources. Indiscriminate forest and land clearance has led to soil erosion and silt-laden run-off, and expanding urbanized areas increase the impermeable area.

## b. Billings watershed

The Billings watershed covers an area of 582.8 square kilometres in the southeast of the metropolitan region. Urban occupation here is similar to that in Guarapiranga, with *favelas* and illegal sub-divisions in areas where occupation is not permitted. São Paulo city continues to grow to the north of the watershed, and high-level plots near the dam coexist with *favelas* and low-income plots, most of them clandestine and irregular.

This watershed contributes 4.5 cubic metres of water per second to public provision in the region.<sup>(12)</sup> The area's population reached 765,891 inhabitants in 2000, nearly 70 per cent of whom reside in the municipality of São Paulo in the districts of Grajaú, Pedreira and Parelheiros. The average annual population growth rate during the inter-census period (1991–2001) was 5.9 per cent, four times the average for the metropolitan region.<sup>(13)</sup>

The region has large numbers of low-income inhabitants whose conditions are made worse by the intense conflicts related to invasions, and the establishment of *favelas* and illegal sub-divisions. This contributes to social vulnerability, and the region has some of the worst indicators of public safety. In addition to precarious dwelling conditions, large numbers of

<b>Table 2: Mortality rate from homicides (deaths per 100,000 inhabitants)</b>			
District/municipality	1990	1995	2000
Diadema	116.1	112.0	108.8
Ribeirão Pires	25.8	31.2	30.7
Rio Grande da Serra	41.9	46.3	35.8
Santo André	28.9	45.9	54.6
S.B. do Campo	53.6	45.7	60.8
Grajaú	-	-	86.2
Parelheiros	-	-	106.4
Pedreira	-	-	47.1
São Paulo	-	50.8	57.5

SOURCE: Fundação SEADE (2000) and Programa de Aprimoramento das Info. de Mortalidade (Mortality Information Enhancement Programme) in São Paulo Municipality/PRO-AIM.

people lack adequate infrastructure and urban services, particularly with regard to basic sanitation, and they also face environmental degradation from indiscriminate deforestation and water pollution. Around 16 per cent of the population reside in *favelas*, most of them in areas allocated to infrastructure or that are unsuitable for occupation, on public lands and on the margins of dams and tributaries.<sup>(14)</sup>

One-third of the region’s family heads have incomes below two minimum wages, while another third have incomes between two and five minimum wages. The population has better average educational indicators than in Guarapiranga, but in the poorest districts, approximately 62 per cent of the population has not finished primary education, compared to an average of 48 per cent in the city of São Paulo.

Violence continues to be one of the major social problems in the region. As shown in Table 2, the mortality rate from homicide is very high in São Paulo – 57.5 per 100,000 inhabitants. In some districts, it is nearly twice as high. The main causes are drug-trafficking, insufficient police presence and high concentrations of low-income people.

More than 10 per cent of the population of the peripheral area are between 15 and 19, and the risk of homicide for this age group is particularly high; the probability of a young person being murdered is four times higher in neighbourhoods in the periphery than in central city neighbourhoods. There is also a higher risk of involvement in crime for young people in these peripheral areas.

The problems related to violence and social exclusion in the Billings watershed region are more evident in the “urban” part, in the southern zone of the municipality of São Paulo and in the industrial belt – including the municipalities that make up the “ABC region”.<sup>(15)</sup> For the people residing here, there is an urgent need for policies of social and economic inclusion to combat violence, articulated with policies of environmental protection. However, a great part of the watershed where fewer people live suffered little or no alteration or deterioration.

The process of uncontrolled urban expansion is compromising water

14. See reference 10, FUSP (2001).

15. Santo André, São Bernardo do Campo, São Caetano, Diadema, Mauá, Ribeirão Pires, Rio Grande da Serra.



quality. The growing impermeable area increases erosion and worsens flooding. With regard to sanitation, the lack of sewers may contribute to the pollution of the water table and compromise the quality of tributaries of the reservoir.

### c. Alto Tietê water-producing system

The Alto Tietê water-producing system is located at the source of the Alto Tietê watershed, and covers a total area of 1,046.2 square kilometres. It includes three existing reservoirs and two further ones under construction, the drainage area of the Rio Claro water-producing system, and a complex water network formed by the tributaries of the Tietê River. It was developed in 1990 to supplement freshwater provision to the metropolitan region since, at the time, the production of 44.2 cubic metres per second, obtained mainly from the Cantareira (24.2 cubic metres per second) and Guarapiranga (9.5 cubic metres per second) systems, was insufficient to meet the 50 cubic metres per second required in the metropolis. The system includes works that need to be undertaken before 2010, which will involve the construction of two dams and connecting structures in the watershed. Once completed, this will increase the flow of the Alto Tietê water-producing system from 10 to 15 cubic metres per second, thus increasing the production of drinking water for the whole metropolis to 68.4 cubic metres per second.

There is little urban occupation in this watershed (2 per cent of the territory) and most of the land under use is farmed – particularly fruit and vegetables and the intensive breeding of pigs and poultry. This rural universe in transition is already connected, through the expansion of the city, with the neighbourhoods in the eastern periphery of São Paulo and its bordering municipalities, most of whose populations suffer from unsatisfied needs. Social indicators in these neighbourhoods, together with the municipality of Guarulhos, show high levels of social exclusion and high rates of violence, in contrast to the municipalities in the upper part of the watershed, which still show characteristic aspects of rural poverty, such as small agricultural properties based on subsistence and low productivity. The Alto Tietê water-producing system is critical to meeting the metropolitan region's expanding requirements for water, and this requires the development and implementation of a broad protection plan for its watershed.

Several municipalities that, until recently, were considered rural and made up the so-called "green belt of São Paulo" have suffered changes in their social indicators that reflect the expansion of the metropolitan area and of poverty into their territories. The increase in the number of homicides is one indicator of this trend in the neighbourhoods of the eastern edge of São Paulo. Here, as well as in the municipalities more distant from the metropolitan dynamic, more than half of all family heads have a monthly income below two minimum wages. In the eastern periphery of the capital, as well as in the rural and more distant municipalities of the metropolitan region, nearly 40 per cent of family heads have less than three years schooling.<sup>(16)</sup>

### d. Cantareira watershed

The Cantareira watershed is located in the north of the metropolitan region, and several neighbourhoods in the north of São Paulo city are part of it – including some areas of extreme poverty. The watershed and its sub-

16. Mapa da Inclusão/Exclusão Social da Cidade de São Paulo, 1996, EDUC/PUC, São Paulo.

systems are responsible for around 55 per cent of the metropolitan water production, which means that protection is especially critical for this region. The area has a heterogeneous population in terms of socioeconomic indicators, and includes localities with a dense pattern of occupation and pockets of extreme poverty with poor quality of life indicators and well-above-average homicide rates. In several municipalities, approximately 50 per cent of family heads have an average monthly income below two minimum wages, and 32 per cent are illiterate or partially illiterate.

**e. Water and sanitation: costs and socio-environmental threats**

Water quality in these watersheds is deteriorating as a result of irregular land occupation, illegal land transactions, the dumping of sewage, the destruction of forests, and silting and waste-dumping. In the metropolitan region, virtually all houses are served by the public water network, but only 81 per cent are served by the sewage system, with the lowest levels of connection being in the peripheral neighbourhoods.

By the end of the 1980s, technical, political and financial factors had contributed to considerable delays in expanding the system. The consequences of this deficit have been serious. Where the network is insufficient to collect sewage, this results in dumping on land sites, illegal connection to the network of rainwater drains and direct dumping into rivers and streams. Domestic sewage is responsible for two-thirds of the pollution in waterways.

Floods are another significant environmental problem. Uncontrolled land occupation and development, which lead to increasingly impermeable areas and a lack of green areas, create a permanent increase in the speed and volume of runoff. The consequence of this is a high number of flood points, and there are around 400 in the municipality of São Paulo alone, located mostly in the periphery of the city.

The capacity of the metropolitan region's two major dams has been reduced by silting. The Billings dam, which accounts for 5 per cent of the region's water provision, has already lost 50 per cent of its natural production capacity in little more than 60 years and 15 per cent of its storage capacity as a result of silting caused by illegal occupations. The reservoir also receives around 1,000 tonnes of untreated sewage a day, dumped by residents and from illegal mining and trade activities.<sup>(17)</sup>

More than 65 per cent of the population in the areas surrounding the Guarapiranga dam reside in precarious settlements and *favelas*.<sup>(18)</sup> These areas have become the main option for families with the lowest incomes, with the purchase price of a small plot starting at US\$ 2,000. There is also a growing number of land invasions here. The pressure for land for dwellings makes it almost impossible to control such occupations, despite the consequent increased degradation of the reservoir. To this must be added the impact of the industrial pollution that contravenes regulations, and the difficulties that the authorities have had in implementing environmental protection laws. The fines associated with these laws are so low that they create little incentive to reduce pollution.

Because of the rapid deterioration in the quality of water resources, in December 1992 the state government signed the Guarapiranga programme to recover and protect this watershed area. The intention was first, to mitigate the negative consequences of the occupation and use of land, and second, to define and gradually operate mechanisms for reorganizing exist-

17. Porto, Mônica (2002), "Water demand, water supply and integrated sanitation, São Paulo", IBRD/World Bank, Washington DC.

18. Data contained in Programa Guarapiranga, 1994, Prefeitura de São Paulo.

ing urban settlements. The programme's objective is to guarantee the quality of the watershed's water through corrective measures that aim to reduce the effects of degradation and through actions focused on maintaining and guaranteeing environmental quality standards.

## V. QUALITATIVE CHANGES IN THE MANAGEMENT OF WATER PROVISION IN THE REGION; THE ROLE OF NEW INSTITUTIONAL ENGINEERING

IN GREATER SÃO Paulo, the policy adopted to address the serious problems of water quality and quantity involved the land management of watershed areas characterized by urban occupation and poverty. In the absence of a more integrated system of urban/metropolitan development, jurisdiction over the use and occupation of land was to be articulated with each municipality's related legislation.

The Alto Tietê watershed consumes much more water than it produces. Approximately half of the water used for public provision (31 cubic metres of the 63.1 cubic metres per second) is imported. Total losses are estimated at approximately 31.5 per cent; 2.6 cubic metres per second are used for irrigation purposes and part of the industrial requirements are met. The watershed occupies just 2.7 per cent of the territory of the state of São Paulo but it contains almost half its total population. It has a very complex hydraulic and hydrological regime by virtue of the transformations caused by intense urbanization. Apart from being used for human, industrial and agricultural purposes, the Tietê River also serves to dilute and break down industrial wastes and domestic sewage, and acts as a repository for a large quantity of solid wastes.

The Alto Tietê watershed committee was created by State Law 7663/91 and set up in December 1994. The committee is formed by representatives of the state, of the 36 municipalities in the watershed and of civil society entities. The plenary of the committee comprises 48 members, 16 from each group. As of 1997, five sub-committees were created. The duties of the committee include: the creation of management mechanisms for the operation of the committee itself; plans and programmes; the promotion of studies and debates; the allocation of financial resources to carry out actions; and annual and multi-annual programmes of application for financial resources for services and works of interest.

The main concern of the plan developed by the committee is land management. The participatory character of management is emphasized, to the extent that the plan is meant to serve as a guide to the discussions needed in Brazil's most complex watershed. The objectives established by the plan relate to the management of the quantity and quality of water, the protection of surface and underground water, the preservation and the rational use of water, the recovery and preservation of the quality of water-courses of the watershed, and the development of efficient systems of drainage and flood control.

The plan defines the need for an integrated vision and is based on four principles:

- integration of the water resource management system with the system of land management for controlling the use and occupation of land;
- integration of the management of the urban systems, including water resources, dwellings and transportation;
- management of water resources, representing all water users, and aiming

- at the control and rationalization of water demand; and
- integrated operation of all the governmental and private sectors that act in the management of the system, to guarantee the effective implementation of preventive and corrective actions.

The fact that many problems have become worse over the years and that many have become critical increases the difficulties in establishing priorities for action. The challenges of this new system, based on a democratic and decentralized management, are very complex and not easily solved in the short term.

It is evident that the problems associated with the management of water resources in the Alto Tietê watershed largely exceed the capacity of the water institutions to solve them, especially the problems from the process of uncontrolled growth of this huge city. The social and regional complexity of the watershed encouraged the search for solutions that may respond more directly to local concerns. The creation of sub-committees was intended to help decentralize management and enable closer proximity to the problems, but it also generated more segmentation in the process. The dynamics of the sub-committees also vary, reflecting their differing capacities for organization and mobilization. The watershed committee reflects a reality where each of the municipalities has its own particular problems, which makes it difficult to get cooperation. The problems faced by the Alto Tietê watershed committee relate to the living conditions of the region's 18 million inhabitants. The absence of a metropolitan-wide policy that seeks solutions significantly limits the committee's capacity.

In spite of the limitations, the committee has become one of the few instances in Brazil of discussion at the metropolitan level. By involving people from different institutions and localities around the same group of problems, it extends the possibilities for articulation. It has contributed increasingly to greater awareness among different sectors of society regarding the need for qualified and consistent participation by its members. However, the lengthy delay in getting the system for the collection of wastewater constructed and operational, and the watershed agency institutionalized, is a concern for many stakeholders. At the same time, this delayed start has been an important period of learning for stakeholders.

## **VI. CONCLUSIONS**

THE DEGRADATION OF water quality in the watersheds in and around São Paulo is related to socioeconomic issues. These include the survival strategies of low-income populations, who occupy clandestine plots and *favelas*, as well as the environmental degradation caused by industrial activity. The lack of attention by government to poorer groups' housing needs and the inadequacies in public authorities' environmental regulations worsen the situation.

In the São Paulo Metropolitan Region, during the last few decades, a complex situation of socio-spatial segregation has developed, characterized by the multiplication of pockets of poverty and violence that are not easily addressed. These represent a situation of social exclusion and vulnerability directly related to problems of environmental degradation. This makes urgent the need for public policies that make social inclusion compatible with environmental management.

The new legislation emphasizes the decentralized management of watersheds or sub-watersheds, the recognition of diversity in the areas to be

protected or recovered (and, thus, the need for particular actions in each area), and community participation in the management and preservation of water resources. The new instruments extend the possibilities of proposing and taking action to government and to civil society. The innovation is in the capacity of legislation relating to the watersheds or sub-watersheds to be a structural component of public intervention in the protection of the water resources, and to be of regional interest for public provision. In recognition of the degradation produced by the previous legislation, the new law provides possibilities for reclassifying areas that were illegally occupied and consolidated while, at the same time, encouraging well-managed future occupations.

The new watershed law presents a new framing of the issue of watershed protection, by recognizing the prime importance of a management system, by extending the protection instruments proposed and by opening the possibility of developing widespread agreement among stakeholders for the actions that are needed. Thus, the watershed committee represents the construction of new institutional spaces for the relationships between experts and citizens, between technicians and users, between the public and private sectors. The dynamic of the committee facilitates transparency and permeability in the relationships between the community, entrepreneurs and NGOs. It incorporates the main stakeholders into the process and creates a formal channel for citizen participation. It appears as a space of articulation, negotiation and debate, and allows for the expression and defence of a wide range of interests. The committee reduces the risk that the public structure will be appropriated by pressing immediate concerns and vested interests, and extends the possibility of practice guided by socio-technical negotiation. Thus, territorial interests and technical needs are articulated in a process open to negotiation.

Improvements in access to information and social participation have promoted changes in attitude that favour the development of a collective environmental conscience, an important step towards the consolidation of citizenship. The major challenge for participation is to strengthen active citizenship, to search for and request information, to ensure that such information is provided and to follow up the control of environmental damage in accordance with collective interests. The population must break with existing patterns of dependence and protection, and become more involved and demand more. There is the challenge of overcoming excessive compartmentalization of public policies, and guaranteeing the integration of water management within other sectors, following the recommendation of Agenda 21.

