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# *Water Resources in Brazil*

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*WATER RESOURCES  
IN BRAZIL*

1998

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## *Introduction*

This document portrays the current state of water resources in Brazil. It also registers the reflexes and progress in the implementation of Agenda 21 Chapter 18 in the country, bearing in mind the VI Meeting of the Commission on Sustainable Development of the UN, which will be held on April 20 - May 1, 1998 in New York.

The work was coordinated by the Secretary of Water Resources of the Ministry of Environment, Water Resources and the Legal Amazon, with the substantial contribution other governmental bodies and agencies involved in water resources issues.

The document highlights the recent progress observed in the legal framework of the water resources sector, in particular with regard to Law No. 9,433/1977, which establishes the National Water Resources Policy and creates the National Water Resources Management System. It provides for improved institutional mechanisms in favor of a wise and shared management of water resources.

# *1. Brazil: general aspects*

## *DEMOGRAPHICS AND ECONOMY*

The Brazilian population in 1995 was 155.8 million inhabitants. In the year 2000, this population will reach 166.7 million inhabitants, and 202.1 million by 2020. In 1991, 75% of the population was concentrated in urban areas.

The economic growth pattern adopted in the last few decades, based on industrial development, led to the growth of a complex and diversified mass consumption urban-industrial economy. This growth pattern, however, was not capable of eliminating poverty, although it contributed to its reduction in the more dynamic moments of its cycle. Exhaustion of this model was accentuated during the eighties, a period marked by fiscal crisis and foreign debt, by the loss of dynamism in productive activities, by high public deficit, recurring inflation and ill fated attempts at stabilization. During that period, social problems in the country took a turn for the worse.

The successful experience of economic stabilization - the Real Plan - begun in 1994, has been having positive effects, especially for the poorest strata of society, resulting in a significant redistribution of income. Furthermore, the profound restructuring process of the Brazilian economy, with its characteristic technological and managerial modernization, open markets, greater competitiveness, and smaller presence of the State in the economy, among others, has been affecting some occupational groups.

Brazil's natural resources have a decisive importance in the economy. The agribusiness sector is responsible for circa 40% of the Brazilian GDP (Gross Domestic Product). The forest sector, 4% of the GDP, the fishing sector 1%. Biological diversity products, especially coffee, soybeans and oranges, account for 31% of Brazilian exports. Vegetal extractivism and fishing employ more than 3 million people. Vegetable biomass - including sugar-cane alcohol, firewood and coal derived from planted and native forests - has a share of 17% of the national energetic matrix, especially in the Northeastern Region. Presently 92% of the electric energy is generated through hydropower dams.

## *PHYSICAL AND ENVIRONMENTAL ASPECTS*

Brazil is a country of continental dimensions with an area greater than 8.5 million sq. km. and its coast is almost 8.500 km long, where most of the Brazilian population is concentrated. The country has a rich biological diversity at three levels: genetic, variety of species and of ecosystems - the product of great climatic and geomorphologic variation.

The landscape of the country shows a large variety of geomorphologic aspects, resulting from passed climate changes, lithologic and structural characteristics and biological factors, which lead to its current geomorphologic regionalization. The territory has a very wide diversified climate.

The country has a vast and dense hydrographic network, where many of its rivers are notable for their extension, width and depth. The plateau rivers, which are predominant due to the nature of the relief, have ruptures of declivity and imbedded valleys, which give them a high potential to generate electric energy. Among the large national rivers, only the Amazon and the Paraguay are predominantly plain rivers and largely used for navigation. The São Francisco and the Paraná are the main plateau rivers. Also very important are lakes, estuaries, coastal lagoons and wetlands. Brazil has the largest wetland of the planet, the Pantanal

Most of the vegetation is to be found within the Neotropical Zone, and for geographical purposes, it may be divided into two territories: the Amazon, and the extra-Amazon.

Brazilian fauna is abundant in species that have a relatively small number of individuals, many of them being endemic. This fact indicates that the fauna is very fragile. According to researchers, in Brazil there are 524 species of mammals, 77 of them primates, 27% of the world total; 1622 bird species; 400 reptile species; of the 3131 species of vertebrates, excluding fish, there are 259 endangered species; more than 3000 species of freshwater fish. It is further estimated that there are at least between 5 and 10 million insect species (the majority not yet described by science).

The country has the most diversified flora of the world, with 50 to 56 thousand described species of higher plants, 20 to 22% of the world total. The group of angiosperms (flowering plants) is the main, and economically most important, group of the land plants. There are close to 250 thousand



angiosperm species in the world, and in Brazil, it is estimated that there are between 40 and 70 thousand species, especially in the Atlantic Forest, Amazon Basin and the Cerrado. The most recent collections of Brazilian flora are deposited in some 70 herbariums around the country.

## *ECOSYSTEMS*

Brazil has defined nine ecosystems, according to ecological conditions reflected by the original dominant vegetation and its geographical position.

The **Amazonian Ecosystem**, dominated by the Rain Forest, represent the Brazilian share of the largest forest of the planet, which is situated in the equatorial humid tropics, where rainfall is far higher than the potential evapotranspiration. The Amazonian Ecosystems occupy a surface area of 4,005,082 sq. km. Waters and native vegetation cover approximately 92% of its area. Animal and vegetable extractivism mainly characterize the use and occupation of land.

The **Cerrado Ecosystem** occupies an area of 1,890,278-sq. km., with varied vegetation. The Cerradão has dense arboreal formation, the Cerrado is made up of relatively low, tortuous trees, interspersed with shrubs. In the Cerrado fields, trees and shrubs are spaced out, and grass is the predominant feature. Agriculture and cattle raising determine the use and occupation of lands.

The **Pantanal Ecosystem** occupies an area of 154,884 sq. km. The native vegetation covers 97% of the area. New technologies are being developed to improve the condition of the native grasslands for cattle raising purposes. The Pantanal depression is an extensive area of water and sediments accumulation, with mainly plain and gently rippled terrain, which is periodically flooded.

The **Ecosystem Caatinga and the Northeast Deciduous Forests** are characterized by a hot, thorny and dry landscape. The temperatures are very high and humidity is low. This ecosystem occupies a surface area of 939,391 sq. km. The Caatinga is classified as Arboreal Caatinga, Shrub-Arboreal Caatinga and Shrub Caatinga. They are made up of small trees and shrubs, highly branched and often very thorny. The sertão (backlands), which dominate the interior constitute the sparsest vegetation of the semi-arid. Use and occupation of lands are essentially agricultural with a short and precarious cycle.

The **Midnorth Ecosystem** is a complex transition ecosystems between the Amazon, Cerrado and Caatinga flora ecosystems. The climate varies from hot tropical sub-humid, characteristic at the border area between the Cerrado and the pre-Amazon, to semi-arid, characteristic of the Caatinga. The dry season varies from 4 to 7 months. The Midnorth Ecosystem have a surface area of 164,205 sq. km. Use and occupation of lands are defined by extractivism, pastures and short and medium cycle agriculture.

The **Seasonal Semidecidual Forests Ecosystem** is complex and with a long history of occupation, where urban-industrial, agricultural and fishing activities mingle. It includes a large strip that goes from the Northeast to the Southeast between the Atlantic Forest, the conifer forests and the Cerrados. The climate which generally characterizes these areas is hot tropical and sub-hot subhumid, with a dry season lasting 4 to 5 months. They occupy 518,834 sq. km. The remaining forested areas represent about 4% of the original natural cover. Mining activity is intense.

The **Conifer Forests Ecosystem (Pinheirais)** coincide with the Brazilian Southern Plateau and in this area there are representatives of tropical, Afro-Brazilian flora and temperate, Austro-Brazilian flora. It is the area of dispersion of the *Araucaria* sp, a specie of high economic and landscape value, practically eradicated in its place of origin. The natural vegetation so called the *Araucaria* Forest, covers today only 10% of its original area. The use and occupation of land is mainly agriculture. The Ecosystem of the Pinheirais occupies an area of 220,363 sq. km.

The **Extreme South Ecosystem** include the south of the Southern Plateau, previously covered by fields and forests, and limited on the eastern side by the Atlantic coastal areas. Climate is mild temperate mesothermal, superhumid without a dry season. They cover an area of 203,875 sq. km. Use and occupation of lands is agriculture and cattle raising. The original vegetation and forests were eradicated; and because of overgrazing, the natural fields have been substantially altered. The infrastructure around the larger urban centers occupies a significant area.

The **Coastal and Atlantic Forest Ecosystem**, the marine currents, the water temperature, the air temperature over the ocean, the orographic effect of the mountain chains, the latitude and altitude lead to variable climatic typologies that, acting on the various geological structures, resulted in a specific morphogenesis, which in its turn made feasible the biological adaptations with

vertical stratification and horizontal compartmentalization. This region is about 415,088 sq. km. This is the densest occupied region of the country, where the main industrial and economic activities are located. The original vegetation covers only about 8% of the total area.

## *THE BRAZILIAN RIVER BASINS*

For general purposes, Brazil is divided into 3 river basins and two river basin complexes. The main river basins are as follows: Amazon, Tocantins, São Francisco. The Plata river basin has 3 Brazilian sub-river basins as follows: Paraná, Upper Paraguay and Uruguay. The remaining rivers that flow to the Atlantic are divided into the following river basin complexes: Atlantic North, Atlantic Northeast, Atlantic East 1, Atlantic East 2, Atlantic Southeast.

The average water production within Brazil - understood as the annual flow that drains to the Plata river and to the Atlantic Ocean- is 168,790 m<sup>3</sup>/s. The flow generated out of the Brazilian territory is estimated at 89,000 m<sup>3</sup>/s. So the total water availability in the country reaches, in average 257,790 m<sup>3</sup>/s.

The water balance data show the great hydrological diversity of the Brazilian territory. In fact, specific surface outflows vary from 48.2 l/s/km<sup>2</sup> in the North Atlantic and 34.2 l/s/km<sup>2</sup> in the Amazon Basin to 2.8 l/s/km<sup>2</sup> in the semi-arid region of the East Atlantic 1 and 4.5 l/s/km<sup>2</sup> in the São Francisco River Basin.

The basic information on these hydrographic water basins is to be found in the table below, in particular the water availability per capita, in m<sup>3</sup>/year/inhabitant, a parameter that permits assessment of water abundance and scarcity in basins. It should be noted that there is an abundance of water in Brazil, if the average value of 36,317 m<sup>3</sup>/year/inhabitant is considered, but there are basins at the threshold of water scarcity such as the Northeast Atlantic river basin complex (5 B).

*Table 1.*  
**BASIC INFORMATION ON BRAZILIAN  
 HYDROGRAPHIC WATER BASINS**

Hydrographic Water Basin	Area (1,000km <sup>2</sup> )	%	Population (1991)	%	Density (inhab/km <sup>2</sup> )	Flow (m <sup>3</sup> /s)	Availability (m <sup>3</sup> /year/inhab)
1 Amazon	3,900	46	6,245,597	4	1.60	120,000	606,379
2 Tocantins	757	9	3,271,674	2	4.32	11,800	113,828
3 S <sup>o</sup> Francisco	634	7	10,958,888	7	17.29	2,850	8,208
4A Upper Paraguay	368	4	1,700,168	1	4.62	1,290	23,946
4B Paran/Æ	877	10	46,622,840	32	53.16	11,000	7,446
4C Uruguay	178	2	3,584,152	2	20.14	4,150	36,543
5A North Atlantic	76	1	3,424,511	2	45.06	3,660	33,730
5B Northeast Atlantic	953	11	25,761,672	18	27.03	5,390	6,603
5C East Atlantic 1	242	3	10,909,302	7	45.08	680	1,967
5D East Atlantic 2	303	4	22,598,203	15	74.56	3,670	5,125
5E Southeast Atlantic	224	3	11,605,507	8	51.81	4,300	11,693
Brazil	8,512	100	146,682,514	100	17.23	168,790	36,317

Source: *Aspectos de sustentabilidade e vulnerabilidade dos recursos hídricos - Benevides, V.F de Sá e; Beekman, Gertjan B. - XI Brazilian Water Resources Symposium, Recife, 1995, adapted by SRH/MMA*

## **POLLUTION AND WATER QUALITY PROBLEMS**

The population concentration in certain regions, towns and metropolitan areas is one of the principal aspects to be considered in the integrated management of water resources, since it implies not only demand for water availability but also for dissolution of urban polluting loads.

Fresh water pollution is aggravating in Brazil, if we consider the increase of urban and industrial polluting loads, inadequate land use practices, erosion, deforestation, inadequate use of agrochemicals and mining. These factors, associated to rainfall distribution and annual amounts, characteristic of equatorial and tropical climates, have led to environmental damage of water resources due to the carrying of solid matter by the drainage network, resulting in silting of water bodies.

The environmental impacts resulting from the pollution of rain waters provoked by the agribusiness centers (specially hog and bird raising) in the south of Brazil and those related to the sugar-alcohol agribusiness in the Northeast and the State of São Paulo are examples of the significant alterations of water resources in Brazil.

In addition, there is the high degree of environmental damage to water resources to be seen in the carboniferous region in the south of the country and in the mining region in the north of the country, where there are no environmentally sustainable technologies for the exploitation and processing of these mineral resources.

Other activities that cause water pollution are thermoelectric power stations and steel mills which still operate with older industrial processes and have not installed equipment to control environmental pollution.

Conflicts of interest with respect to water use, represented by the hydroelectric sector, by industrial complexes, by urban supply needs, irrigation and urban-industrial densification, show the need for interinstitutional coordination to adopt integrated water resources management policies.

## ***GROUNDWATER***

Exploitation of groundwater has been increasing significantly every year. Several urban water supply systems depend on groundwater, exclusively or complementarily. Industries, rural properties, schools, hospitals and other establishments use groundwater.

The available volume of groundwater less than 1000m deep and with good quality for human uses is estimated at 112,000 sq. km. There are around 200,000 wells being exploited, with drilling of about 10,000 wells a year. Circa 61% of the Brazilian population is supplied from subsurface springs, such as shallow wells (6%), springs/sources (12%) and deep wells (43%).

In spite of this significant usage, in the Northeastern Region, where potential use of ground water is 40 times of the total volume currently exploited. In the State of Maranhão, 76.6% of the cities are supplied with groundwater and in the State of Piauí, 84.3% of the cities consume subsurface waters. The metropolitan region of Recife consumes 20% of the total volume provided to the population. In the State of São Paulo 50% of the industries uses groundwater.

## *2. Legal and institutional framework for the environment and water resources in Brazil*

### *THE NATIONAL ENVIRONMENT POLICY*

The National Environment Policy, established through Law No. 6,938, dated August 31, 1981, created the National Environmental System and has as its main objective the preservation, improvement and recovery of environmental quality suitable for life, to ensure conditions for socioeconomic development, national security interests and protection of the dignity of human life.

Among the principles adopted by the aforementioned law, the following may be highlighted: consideration of the environment as public heritage, to be necessarily safeguarded and protected, bearing in mind its collective use; sustainable use of water, as well as other environmental resources; planning and inspection of the use of environmental resources; the control and zoning of potential or effective polluting activities; incentives to study and research on technologies for sustainable use and protection of environmental resources; monitoring of the environmental quality; recovery of degraded areas; protection of areas threatened by degradation; and environmental education at all levels of schooling, including education of the community.

As to the objectives, noteworthy are: harmonization of economic and social development, preserving environmental quality and ecological balance; definition of priority areas for governmental action related to environmental quality and balance, meeting the interests of Federal, State and Local governments; establishment of criteria and standards for environmental quality and of regulations related to the use and management of environmental resources; development of research and technologies for the sustainable use of environmental resources; dissemination of environmental management technologies, environmental data and information; and obligation for polluter and predator to recover or reimburse the damage caused, and on the user, the obligation of contributing for the use of environmental resources for economic purposes.

## ***THE NATIONAL ENVIRONMENT SYSTEM - SISNAMA***

The National Environment System - SISNAMA, is constituted by the bodies and entities of the Federal, State and Local governments and the foundations instituted by the Federal Government, responsible for the protection and improvement of environmental quality.

## ***THE NATIONAL ENVIRONMENT COUNCIL - CONAMA***

The National Environment Council - CONAMA that deals with the National Environment Policy, is the consultative and deliberative body of the National Environment System - SISNAMA. CONAMA is a collegiate body, representative of the various sectors of government and civil society that deal directly or indirectly with the environment. Composition of the Plenary is thus: a representative of each Ministry and the other Secretariats of the Presidency and IBAMA; a representative of each of the State Governments and the Federal District; as well as representatives of the following entities: National Confederation of Industries, of Trade and Agriculture; Brazilian Steel Institute; Brazilian Association of Sanitary Engineering - ABES; Brazilian Foundation for Nature Conservation - FBCN; and the National Association of Counties and the Environment - ANAMMA; and representatives of legally constituted entities for the protection of natural resources and to combat pollution, chosen by the President of the Republic; and representatives of legally constituted civil societies of each geographical region of the country, whose activities are directly linked to the preservation of environmental quality and registered in the National Register of Environmental Entities - CNEA.

CONAMA is further made up of ten permanent Technical Chambers and eight temporary Technical Chambers. Each Technical Chamber is made up of seven advisers, which elect a chairperson and a rapporteur. The temporary Technical Chambers are created by determination of the Plenary for a specific period to fulfill a predetermined objective.

## ***CONSTITUTIONAL PRECEPTS***

The 1988 Federal Constitution establishes that "*the Federal Government has property of lakes, rivers and any currents in lands that belong to it, or that bathe more than one State, or are borders with other countries or extend into foreign*

*territory or come from them, as well as marginal terrain and fluvial beaches". It further establishes as being "property of the States, the surface or ground, flowing, emerging or deposited waters, with the exception, in this case, according to the law, of those resulting from Federal Government works".*

It is the strict competence of the Federal Government to legislate on water. It is the competence of the Federal Government to exploit, directly or through authorization, concession or permission, the energetic use of watercourses, in coordination with the States where the hydropower potentials are located; waterway transport between Brazilian ports and national borders or that transposes the limits of the State or Territory; and define criteria for concession of water usage rights.

It is the common competency of the Federal, State and Local Governments to protect the environment and combat pollution in any of its forms; promote the improvement of conditions and supervise concessions for the rights to exploit water resources in its territories; and legislate at the same time on protection of the land and natural resources, protection of the environment and pollution control, responsibility for damage to the environment and health protection.

For administrative purposes, the Federal Government may coordinate actions within the same geoeconomic and social complex envisaging development and reduction of regional inequalities, through prioritization of economic and social use of waters, mainly in low-income regions, subject to periodical droughts.

## ***THE WATER ACT***

The Water Act, established by Presidential Decree No. 24,643, dated July 10, 1934, is the background for the Brazilian legislation on water. Considered by legal experts to be advanced, especially considering the period in which it was enacted, it is in need of updating, mainly to be adjusted to the Federal Constitution of 1988, to Law No. 9433, dated January 8, 1997; and several of its aspects need regulation.

This Act ensures the free use of any water current or spring for basic life necessities and permits everyone to use any public waters, observing administrative regulations. It prevents deviation of public waters for use in agriculture, industry and hygiene, without the existence of concessions - in



the case of public utilities - and authorization in other cases; in any case, it gives priority to deviation for public supply.

The Water Act establishes that the concession or authorization should be carried out without harm to navigation, except in the cases of use for basic human needs or foreseen in special law.

It also establishes that it is not lawful for anyone to pollute or contaminate waters, which they do not consume, with harm to third parties.

It further highlights that the work towards cleaning of waters shall be carried out at the expense of transgressors who, besides being criminally responsible, if it be the case, will answer for the loss and damage incurred and for fines that may be imposed by administrative regulations. This provision is also seen as a precursor of the "polluter/payer" principle, with respect to use for assimilation and transport of pollutants.

### *THE NATIONAL WATER RESOURCES POLICY*

Federal Law No. 9,433, dated January 8, 1997, establishes the National Water Resources Policy, creates the National Water Resources Management System and regulates paragraph XIX of Article 21 of the Federal Constitution. This Law considers the following principles: water is a public good; water is a limited natural resource, with an economic value; in situations of scarcity the priority use for water is for human and animal consumption; water resources management should always assure the multiple use of waters; the river basin is the territorial unit for implementation of the National Water Resources Policy and actions by the National Water Resources Management System; management of water resources should be decentralized and rely on the participation of the government, users and communities.

It further establishes the following general guidelines: systematic management of water resources, without dissociation of quantity and quality aspects; water resources management suitable to the physical, biotic, demographic, economic, social and cultural diversities of the various regions of the country; integration of water resources management with environmental management; coordination and promotion of water resources planning with the user sectors and with regional, state and national planning; coordination of water resources management with land use management; integration of river basin management with estuarine and coastal zone management.

This Law defines the regimen of granting of water resources usage rights. Its main objective is to ensure the qualitative and quantitative control of water usage, as well as the effective exercise of access to water for all. The following uses of water resources are subject to water right concession: deviation or catchment of water for final consumption, including public supply, or input to the productive process; exploitation of groundwater for final consumption or input to productive process; discharge of treated or untreated sewage and other liquid or sludge waste into water body, with the purpose of its dilution, transportation or final disposal; use for hydropower generation; and other uses that alter the regimen, quantity or quality of water existing in a water body.

The Law further establishes that granting will take effect by an act of the competent authority of the Federal, State or Local Government. The Federal Government may delegate to States and the Federal District competency to grant usage rights for water resources under Federal Government jurisdiction.

Moreover, it determines that the Federal Government coordinate beforehand with the States and the Federal District for the granting of usage rights of water resources in hydrographic water basins with waters under federal and state jurisdiction.

The **National Water Resources Management System**, will coordinate integrated water management; arbitrate the conflicts related to water resources; implement the National Water Resources Policy; plan, regulate and control the use, preservation and recovery of water resources; and establish the water pricing mechanism integrating parties of the National Water Resources Management System are: the National Water Resources Council; the State Water Resources Councils; the River Basin Committees; the federal, states and local authorities whose competencies are related to water resources management; and the Water Agencies.

### ***THE NATIONAL WATER RESOURCES COUNCIL***

The National Water Resources Council - CNRH to be created shortly will be the higher normative and deliberative body with the following mandate: to promote the coordination of water resources planning with national, regional and local planning, as well as user sector planning; deliberate on projects of resource usage; monitor the execution of the National Water Resources Policy; establish criteria for granting of water usage rights water

pricing mechanism. The President of the council is the Minister of Environment, Water Resources and Legal Amazon and its Executive Secretary is under the responsibility of the Secretary of Water Resources.

### ***THE RIVER BASIN COMMITTEES***

The River Basin Committees have as main functions: to promote the debate of issues related to the river basin and coordinate the intersectorial actions; arbitrate, at first instance, the conflicts related to water resources; approve and follow the implementation of the river basin plan; establish the water pricing mechanisms and suggest the amounts to be charged; establish criteria for cost sharing of works for multiple use, of common or collective interest.

The Committees will be made up of: public representatives of Federal, State and Local Governments that use the waters in their jurisdiction, and representatives of civil entities for water resources with proven activity in the basin.

Representation of Federal, State and Local Governments is limited to half the total number of members of each Committee of federal rivers. Each State determines its regulations.

In the basin Committees of border and transboundary rivers, representation from the Federal Government should include the Ministry of External Relations and in those territories that include Indian lands, representatives of the National Indian Foundation - FUNAI and from the Indian communities should be included.

### ***THE WATER AGENCY***

The creation of a Water Agency will depend on authorization from the National Water Resources Council or from the State Water Resources Councils, through a request from one or more River Basin Committees. An River Agency can be established for one or more Committees.

The Water Agencies will be responsible to charge the water use in their jurisdiction and will be the Executive Secretariat of the respective River Basin Committee or Committees. The creation of these Agencies will be conditioned, in each basin, to its financial sustainability.

The main competencies of a Water Agency is: keep an updated balance of the availability of water resources in their area of action; keep a roster of users and carry out, through delegation of the granting authority, charge for water use; prepare studies and assessment of the projects and works to be financed with resources generated by the water charges and submit them to the financing institution responsible for the administration of these resources; monitor the financial administration of the resources received from water charges; make agreements and financing and services contracts to execute its competencies; promote the necessary studies for management of water resources; draft the Water Resources Plan and submit it to the respective River Basin Committee; propose to the respective River Basin Committee the classification of water bodies into use classes, the amounts of the water charge, the plan for application of resources and the sharing of costs for multiple use works.

### ***WATER RESOURCES MANAGEMENT INSTRUMENTS***

The main instruments for water resources management: the Water Resources Plans; the classification of water bodies according to the main water use; granting of water usage rights; water charges; compensation fund for Local Governments; and the Water Resources Information System.

The **Water Resources Plans** aim at providing fundamentals and guidance to the implementation of the National Water Resources Policy and long term management of water resources, with a planning period compatible with the period of implementation of its programs and projects. It should contain the diagnosis of the current situation of water resources, prospective analyses and studies of socioeconomic dynamics, identification of potential conflicts, targets for wise use, projects to be implemented, guidelines and criteria water pricing, among others, as well as measures that envisage the protection of water resources. They will be drafted for river basins, for States and for the country, and will become elements of the National Water Resources Policy, to be regulated.

**Classification of water bodies** aims at: ensuring a water quality compatible with the most demanding uses for which it is intended; reduction of costs of combating water pollution, through continuous preventive measures. The classes of water bodies are defined by environmental legislation.

The objectives of **grants** are to ensure the qualitative and quantitative control of water uses and the effective exercise of access rights to water. The various deviations, captures, castings and uses that alter the regimen are subject to grants. It is applicable to existing water bodies as well as to underground aquifers. Grants for hydroelectric purposes will be subordinated to the National Water Resources Plan, and should respect the class of water body and maintain appropriate conditions for waterway transportation, whenever appropriate. Granting of water resources usage should preserve their multiple uses.

The objectives of **water charges** are: to recognize water as an economic good and to provide the user with an indication of its real worth; encourage the sustainable use of water; assure funds to finance programs and interventions foreseen in water resources plans. The use of water subject to granting will be charged. The amount collected will be primarily invested in the river basin in which it was generated.

The **Water Resources Information System** is a system for collection, processing, storage and recovery of information on water resources as well as the factors that intervene in their management, with data generated by the bodies that integrate the National Water Resources Management System - SINGREH. The basic tenets of its organization are: decentralization of collection and production of data and information; unified coordination of the system; guaranteed access to data and information for the whole society. Its objectives are thus defined: gather, make consistent and disseminate data and information on the qualitative and quantitative situation of water resources in Brazil; permanently update information of availability and supply of water resources throughout the country; provide input for drafting of Water Resources Plans.

## ***STATE LEGISLATION***

It is the strict competence of the Federal Government to legislate on water. The States should approve and setup complementary legislation to assure that the water resources management is adequate to the local features and to enforce the national guidelines. Presently fourteen States has passed the State Water Law.

Coordination between federal and state structures follows these guidelines: a) coordination between the Basin Committee of a river under federal jurisdiction with the State Committees of the same basin will be carried out

on a case by case basis; b) coordination between the Water Agency, and the Basin Agencies foreseen in State legislation, is also to be defined on a case by case basis through negotiation between the Federal Government and the intervening States; and c) coordination between the SINGREH Executive Secretariat and the state management bodies.

The institutional solutions adopted by the States for management of water resources are extremely varied, especially those related to the existence of a specific body or entity for water resources, responsible for granting usage rights of water resources.

### *3. Assessment of Water Resources*

#### *NATIONAL WATER QUALITY AND QUANTITY NETWORK*

In order to increase knowledge of the availability and nature of water resources, Secretary of Water Resources and other interested organizations is undertaking actions to modernize the national hydrometeorological and water quality network. Among others the reason for updating network is to provide information for all segments of the society

This basic network is currently made up of 5,138 stations, 2,234 of which are pluviometric, 1,874 fluviometric and 1,030 other types: sedimentometric, telemetric, water quality, evaporimetric and climatological.

Presently besides the national basic hydrometeorological network, other institutions have setup networks for there specific interest. Presently all these data are included in an national data bank. This data bank is presently being evaluated, in order to be updated in the next future

#### *NATIONAL MONITORING AND ENVIRONMENTAL ASSESSMENT PROGRAM - MONITORE*

The National Monitoring and Environmental Assessment Program - MONITORE is being implemented. Its main objective is to implement a monitoring system that generates and makes permanently available information on the Brazilian environmental situation in priority areas, making it possible to assess both the different government sectoral policies and the land occupation and exploitation process.

The Program, which will not substitute, nor does it intend to, other monitoring programs existing at federal, state and local levels, seeks to integrate and aggregate the various existing initiatives, optimizing resources, avoiding duplication of efforts, improving and complementing the quality of generated information.

The Program is structured into five basic components which make up the Brazilian environmental picture: coastal and marine, continental aquatic, land, atmospheric, and urban environments. To assess the environmental state or

quality, indicators are being selected that will permit a general view of the condition of the analyzed environment.

The methodology to be adopted by the Project is based on the Pressure-State-Response model adopted by the UN Commission on Sustainable Development. This model suggests the use of indicators for human activities that exert pressure on the environment, indicators of the state of the environment and natural resources, and indicators of responses in terms of policies, programs and actions for environmental protection or the sustainable use of natural resources.

### *ENVIRONMENTAL MAKROMONITORING PROJECT*

Another project being executed by the Brazilian Institute of Environment-IBAMA, entitled "Environmental Macromonitoring", was developed to provide technical and operational support to the agency in its action in the four issues considered to be priority for environmental management in the country: atmospheric resources, water resources, energy and environmental licensing.

It is expected that the information contained in future data banks will provide input for environmental licensing, control and supervision processes, besides the granting of usage rights and classification of water bodies. Utilization of this information will permit these processes to be interconnected in a more efficient manner. Once the Project is consolidated, drafting of reports on environmental quality can be processed in an automatic and continuous form; strengthening environmental licensing activities.



## *4. Multiple Uses of Water*

There are various sectors, which use water resources as a basic input for their activities. However, there are governmental efforts to make sectoral criteria and norms consistent with water resources legislation, so as to permit disciplining of these different uses. Among these uses are:

### *SANITATION*

The analysis of the evolution of the levels of coverage of sanitation services in Brazil reveals important improvements in services to the population, especially the urban population (IBGE, 1996). On the other hand, there are still significant deficits that reflect the unequal growth pattern of the country in the last few decades.

It is worth noting, for example, that a country whose urban population has increased 137% in 26 years, going from 26 million in 1970 to 123 million in 1996, has been able to raise, in this time frame, the level of water supply to households connected to the mains networks from 60% to 91.1%. On the other hand, more than 11 million people that live in cities still have no access to water through plumbing.

Currently, the main deficit of the Sanitation Sector is in the area of sanitary sewage, more specifically with respect to sanitary sewage treatment. According to PNAD/96 data, 48.9% of the sewage produced in Brazil is collected in public networks, but only 32% of this amount is treated, that is, 15.6% of the total produced in Brazil is being treated.

Another aspect to be considered is the wastage of water in the public water supply systems. It is estimated that in Brazil this wastage (physical losses plus loss in income) can reach up to 45% of the volume offered to the population, which represents some 4.68 billion m<sup>3</sup> of water produced a year. Adopting a target of 25% of losses, representing 2.08 billion m<sup>3</sup> of water a year, would save around R\$ 1.02 billion a year.

### *AGRICULTURE AND IRRIGATION*

Presently 2,8 million ha are being used with irrigated agriculture, out from 145 million ha of land that can be used for agriculture. The potential for irrigable land is about 49 million ha.

16% of the 1996/1997 crop was harvested from irrigated areas. A major project in the framework of the Brazil in Action Program called "New irrigation Model" envisages to incorporate 490 thousand ha of irrigated land into the present productive areas, in the next four years.

## *HYDROPOWER*

Electric energy is supplied to circa of 92% of households in the country. The 1996 consumption stood at 258 TWh.

The installed generation capacity is 57,640 MW, 53,029 MW (92%) of which from hydroelectric power stations and 4,611 MW (8%) from thermoelectric power stations. The percentage contribution of the hydroelectric power stations for energy generation (97%) is greater than the percentage of the installed potential (92%) because thermoelectric power stations are inoperative for long periods of time, only being activated during dry periods, when reservoirs become dangerously low.

New hydroelectric power stations can be built in several of already inventoried places, making a total of 107,307 MW of installed generating power in the next few decades. The Brazilian hydroelectric potential is around 258,686 MW, of which only 20% is being exploited.

## *WATERWAY TRANSPORT*

Brazil has around 40,000 km of waterways, 26,000 of that are precariously navigable. The main waterways are to be found in the following basins: Amazon (18,300 km), Northeast (3,000 km), Tocantins/Araguaia (3,500 km), São Francisco (4,100 km), East (1,000 km), Tietê/Paraná (4,800 km), Paraguay (2,800 km), Southeast (1,300 km) and Uruguay (1,200 km).

A natural singularity conditioned the development of internal waterway transport in Brazil: the most developed regions have not navigable to the sea ports. This occurs, for example, in the Metropolitan Regions of São Paulo and Belo Horizonte. This situation hindered the development of internal navigation for a long time, and in some ways, contributed to the highway policies that have been prevalent in the last few decades.

On the other hand, in the Amazon Basin, navigation has an essential role. It is ensured naturally by the hydrographic conditions peculiar to the region, where there are some 18,300 km of natural waterways.

1966 Ministry of Transport data show that out of the total 1.2 billion tonnes of cargo transported during that year in Brazil, only 14 million of tonnes (about 1.5% of the total) were transported by river navigation.

The Brazil in Action Program of the Federal Government prioritizes the development of four waterways in 1998/1999, namely: Madeira, Araguaia-Tocantins, São Francisco and Tietê-Paraná. Within the context of the Brazilian Privatization Program, there are new possibilities for participation of the private sector in the development of the Brazilian waterway sector.

### ***INDUSTRIAL USE***

A study made estimated that in 1980 the industrial demand for water was 247 m<sup>3</sup>/s, which represented 23% of the total consumption in Brazil, estimated at 1,065 m<sup>3</sup>/s. New studies estimates a total demand of 1,156 m<sup>3</sup>/s for Brazil and 139 m<sup>3</sup>/s for industry, which demonstrates a significant possible reduction of about 10% in industrial consumption. So presently the industry consumes about 12% of the total energy consumed in the country.

This reduction is, mainly motivated by: i) internalization of environmental requirements for industries that in some way participate in foreign markets with their products or stock control, ii) increase in the cost of water in the metropolitan regions where most of industries are, iii) increase in energy costs to capture, treat and pump water, and iv) introduction of programs to reduce costs, improve operation and internal control of processes with a view to reducing consumption of energy and inputs.

### ***FISHING AND AQUACULTURE***

Commercial fish catch in Brazil is estimated in 700 thousand tonnes/year. Around 220 thousand of these are from fishing in continental waters (IBAMA, 1996). Freshwater fishing has contributed significantly to informal fishing, being the main source of income for many people. It is also from the sale of surplus fish that those who live near the rivers, and who practice subsistence fishing and farming, acquire their consumer goods. In some regions, fish represents

the main source of protein for riverside populations. In the Amazon, for example, 70% of the catch comes from subsistence fishing.

Besides the important commercial species to supply small cities and large urban centers, Brazil has a large diversity of ornamental fish that sustains fishing activities largely geared to the foreign market. It is estimated that there are 1200 species of ornamental fish in the Amazon. IBAMA permits export and trade of 180 of them. The State of Amazonas exports some 12 to 15 million units a year, a number that could well reach 43 million/year under sustainable principles.

Brazil also has favorable conditions for the development of different modalities of aquaculture, that is: large water potential (rivers, lakes, reservoirs), diversity of aquatic species, native or adapted species to local environmental conditions, internal and external market, both, with unsatisfied demand, support infrastructure (research centers and aquaculture stations), appropriate climate and areas.

According to the National Council for Scientific and Technological Development - CNPq (1966), in 1995 the Brazilian fish production from aquaculture was around 40,000 tonnes, thus distributed: North Region (2,000 t), Northeast (6,000 t), Midwest (6,000 t), Southeast (11,000 t) and South (15,000 t). This production is responsible for 10% of the fish production from aquaculture in Latin America and 5% of the total fish production in Brazil.

## *TURISM AND RECREATION*

Tourism and recreational activities are increasing and participating more and more in the basic economy. Presently the private sector is investing in activities such as rural tourism based on the interest of public to visit water falls, swim in lakes and reservoirs. The reservoirs built for hydropower generation has a strong potential for touristic use.

## *5. Programs and Projects*

### *MAIN INITIATIVES OF THE FEDERAL GOVERNMENT*

There are numerous programs and projects, implemented, under implementation or being drafted, in the area of water resources management in Brazil. A large part of these programs is developed under the direct coordination of the interested States. However, in this document, the most important programs and projects developed under the coordination of the Federal Government will be highlighted. These are, in principle, interventions of a more comprehensive nature. Also highlighted will be interventions financed by multilateral technical cooperation organisms.

Many of the actions undertaken by the Water Resources Secretariat, by the Urban Policy Secretariat and other government agencies are directed towards the increase in gross water supply in water bodies, in appropriate quality and quantity. Among the main measures adopted at federal level under the Water Resources Secretariat:

The **PROÁGUA SEMI-ÁRIDO** (Semi-Arid Proágua Program), aims to increase the supply of good quality water for human consumption in the Brazilian semi-arid region. In 1997, the structuring activities of the Program were concluded, as well as funding at some financial organisms. In 1998 negotiations with the World Bank will be concluded, which will allow signing of agreements with State Governments in order to start operationalization of the Program. At the moment, implementation instruments are being consolidated and projects are being prepared to establish eight priority works.

With similar characteristics, but with distinct areas of action, the **PROÁGUA NACIONAL** (National Proágua) Program began to be drafted in 1996, and today is part of the Brazil In Action Programs. Its activities are also in the area of flood prevention and control. During 1997, investments were carried out that should benefit 3 million people in the States of Mato Grosso, Mato Grosso do Sul, Pernambuco and Santa Catarina. At the same time, drainage has been carried out, as well as rectification and canalization of watercourses.

The **Projeto Água Boa** (Good Water Project) seeks to increase the availability of drinking water mainly to meet the needs of the community of the Brazilian Semi-Arid Region. It consists of desalinizing brackish waters of deep wells through the inverse osmosis process.

The **Programa de Conservação e Revitalização dos Recursos Hídricos** (Program for the Conservation and Revitalization of Water Resources), being implemented by the Water Resources Secretariat, aims to contribute to controlling pollution of water resources, and as a result, improve availability of water, in terms of quantity and quality, in various basins in Brazil. The general objective of this Program is to revitalize, wherever necessary, and conserve, wherever it is still possible, water resources as a whole, from the perspective of the hydrological cycle, through management of physical and biotic environment elements, where the hydrographic water basin, specially the capture basin, is the basic planning and work unit.

**Institutional Strengthening:** This program has as main objective to strengthen the Secretary of Water Resources and the State Secretaries of Water Resources. In the framework of this program the Secretary of Water Resources is conducting most of its current activities. It has the direct support of the Inter-American Institute of Agriculture-IICA.

**University Cooperation Network for Water Resources:** This network has as main objective to establish a link between professors and Students of the University, facilitating exchange of knowledge, and contribute for the decentralized water resources management. Presently the 30 Institutions with about 180 projects are linked to the network.

**Municipal Water Resources Management Plans:** aims to support municipalities to prepare their water resources management plans according to the existing federal and state legislation. This program has a strong link with public involvement. Presently 157 municipalities joint the program.

**Basic Studies for Water Resources:** this program aims to make gather and make available methodologies, technologies, data banks, georeferenced charts, software and other tools to support water resources management.

**Upper Paraguay and São Francisco River Basin Management:** the Global Environment Fund-GEF will support these two projects that aims the establishment of a river basin management program. For the Upper Paraguay river basin the management system will be prepared envisaging the involvement of the other countries that shares the Basin with Brazil, and the system for the São Francisco is envisaging the influence of the changes upstream over the coastal zone and marine life.

**Hydrometeorological data processing:** data consistency is particularly important to implement a hydrometeorological and water quality information system. Thus the SRH is concluding the Hydrologic Data System, which will carry out maintenance, operation and processing of hydrometeorological and water quality data gathered. This system is derived from an already existing system called Hydrometeorological Data Microsystem (SDH). As of May 1998, an initial version of the SDH will be available for interested users, with routines for *hydrological calculations and additional statistics*.

**The National Water Quality Program-PRONAQUA** aims the implementation of a water resources management and monitoring model. The program is based on the establishment of reference laboratories all over the country, that could support decision making by local authorities and the river basin committee. The program has also the objective to make available water quality information for the general public, in order to facilitate *public participation in the water management process*.

In the framework of the Urban Policy Secretariat, of the Ministry of Planning and Budget the following programs are in execution, among others:

**PRO-SANEAMENTO (Pro-Sanitation)**- the objective of this program is to increase coverage of the following services: water supply, sewage treatment, urban drainage and urban solid wastes collection and final disposal, as well as *improving the efficiency of the service*. Within this program, the Sanitary Sewerage section is intended to increase the appropriate coverage and/or treatment and final disposal of effluents. The Solid Wastes section is intended to finance projects to increase the coverage of appropriate treatment and final disposal of urban solid wastes. Furthermore, within this program, there is an added incentive in the Sanitary Sewerage section, where the rate of interest is lower than that in other sections of the program.

The **PQA (Water Quality and Water Pollution Control Project)** - aims to provide technical and financial support to the preparation of investment programs for the environmental sanitation of river basins that have a high level of pollution, specially in those areas with high urban density and intense productive dynamics. It is an innovative initiative, marked by simultaneous efforts, seeking solutions that consider: i) physical interventions, designed with a multidisciplinary and systemic perspective, capable of promoting the recovery and protection of environmental quality, and as a consequence, *improving the living conditions of the populations that live in large cities or*

metropolitan regions, according to equations of least cost and greatest environmental benefit; and ii) institutional arrangements, capable for providing sustained management of river basins, including the development of economic environmental and natural resources management instruments.

**PROGEST** (Program to Support Solid Waste Management). This program aims to support the establishment of a nationwide policy for the urban solid wastes sector, geared towards the solution of collection and final disposal problems. Its actions benefit, among others, those counties situated in the areas of source protection, thus contributing to prevention of environmental pollution and, therefore, indirectly, aiding in the conservation of water bodies and in the increase of quality and quantity of water supply.

The **PMSS** - (Project to Modernize the Sanitation Sector)- seeks for the improvement of the National Sanitation by adopting a strategy that consists mainly in inducing the efficiency of public operators, and establishing and inducing the participation of private operators. These actions will basically include the technical assistance of the Federal Government, aiming at the creation of regulatory frameworks, management models and the improvement of the efficiency in provision of services. The regulatory frameworks will establish quality standards for water supply as well as for the quality of effluents discharged in the receiving water bodies. The investment component acts through direct actions for rehabilitation, optimization and expansion of collection and treatment of waste waters.

The **PASS** - (Social Action Program for Sanitation) is directed towards the implementation of projects in water supply and waste water treatment; collection and disposal of solid wastes in the poorest areas in large cities and small and medium sized counties, in order to improve the population's life quality. Through actions in sanitary sewerage and collection and disposal of solid wastes, the program acts directly in the control of water pollution and, indirectly, in the conservation of water bodies.

The **PROSEGE** - (Social Action Program for Sanitation) was conceived and structured to generate double benefits to the most vulnerable segments of the population of large and medium sized urban centers of the country. At the same time that it enabled temporary solutions for critical unemployment problems, especially in construction, executing projects to implement/expand the sanitary sewerage system, it increased the coverage of sanitation services, ensuing favorable effects on the health and living conditions of the targeted



population. The program is developed in order to improve life quality of lower income populations, by investment in basic sanitation, preferably in projects with assured environmental, technical, financial and socioeconomic feasibility.

The **PROSANEAR** Program provides for integrated actions in sanitation, involving, among others, implementation and improvement of the following services: water supply, sanitary sewerage, recycling of solid wastes and microdrainage in degraded urban areas occupied by lower income populations, in cities with more than 50,000 inhabitants. Pollution prevention, and consequent conservation and increase in water supply in the sources of the region, is one of the effects of the program, as sewage and solid wastes are properly disposed.

The **National Program to Combat Water Losses**, has as its main objective to promote the sustainable use of water for public supply, for the benefit of public health, environmental sanitation, and efficiency of services. The program's strategy consists in identifying and implementing measures that revert the identified wasteful situation, based on actions and technological, regulatory, economic and institutional instruments, aiming at an effective saving of water.

## *6. Brazilian Experiences in River Basin Management*

The first approach in river basin management started in 1978 when the Federal Government created the Special Committee for Integrated Studies of River Basins-CFEIBH. In the framework of this Committee, several river Basin Committees has been created. The main problem of these Committees was the fact that they were only consultative. They had no enforcement power. But even than, some of these Committees started initiatives that culminated with important management tools. The creation of some of the new Committees was only possible due to actions that has been taken in the framework of the old existing Committees.

The first two river basin that has been studied was Paraíba do Sul and Rio Doce river basins. The studies have been conducted with support of the French government, in the framework of a technical cooperation project.

The **Rio Doce Project**, begun in May 1989 and was completed in May 1992. It was the first simulation in Brazil of the implementation of a system based on integrated river basin water resources management, as a concrete basis for sustainable development. Based on the basin diagnosis, an initial plan of action was drafted and a system was simulated for charging for water use (quantity, quality), soil use and financing of works by the Basin Agency and Committee system. Further steps will be implemented later, since the priority had to be shifted to other basins where the impact of human activity was more intense.

The **Paraíba do Sul Project** begun in 1992 and was a follow-up of the Doce project. With the experience gained and based upon the user-pays and polluter-pays principles. This project is supposed to implement a river basin management system the addresses the existing conflicts in the basin. The main use of the Paraíba do Sul waters is the supply of Rio de Janeiro. The metropolitan area of Rio takes about 90% of its water for human supply out of the Paraíba river basin. Since 1992, the Paraíba do Sul Project has been putting together an important collection of studies on the basin, and operating permanent field measuring networks. The first technical target for the project was attained in November 1993, with the implementation of Integrated Management Center for the Basin, in Rio de Janeiro. In 1996, after intense

discussions among States and Federal Ministries, a consensus was reached as to the reformulation of the Basin Committee. The former Executive Committee for Integrated Studies of the Paraíba do Sul River Basin-CEEIVAP was extinguished and the Current Committee for Integration of the Paraíba do Sul River Basin, CEIVAP, was created.

Other river Basin Committees has taken actions aiming sustainable river basin management.

The **Executive Committee of Integrated Studies for the São Francisco River Basin** was created during the late seventies. This Committee was composed of federal and state organizations involved in the basin. In the eighties, it promoted several studies such as the São Francisco Management Project, in which the classification of the federal rivers that are part of the basin was proposed. In 1997 the Committee accepted new members as irrigation associations and non-governmental organizations.

Besides the creation of the Committees, the Federal Government welcomes other independent initiatives like the Intermunicipal River Basin Consortiums. These are local initiatives were the local governments and users establishes the priority for the river basin development, under the principle of sustainable development. Some of these experiences will be shown:

The **Intermunicipal Consortium of the Piracicaba and Capivari Rivers**, in the State of São Paulo, constitutes an example of intermunicipal river basin management initiative. The basins of the rivers Piracicaba and Capicavari occupy an area of 14,400 sq. km, partially or totally covering 51 municipalities in the State of São Paulo and 4 municipalities in the State of Minas Gerais with a population of about 3 million inhabitants. It is estimated that 6% of the Brazilian GDP is produced in this region. It is home to the largest petrochemical district in Brazil (Paulínia), a large sugar-alcohol production region and conducts a very modern agriculture. With respect to public water supply, it is estimated that water production in 1997 reached the threshold of circa 14 m<sup>3</sup>/s. In addition to this amount 31 m<sup>3</sup>/s from this basin is diverted to the metropolitan area of São Paulo. In 1989, 12 mayors of the basin met and created this Intermunicipal Consortium, with the objective of fighting for the recovery and protection of sources. This organization, which today has 38 municipalities and 20 private companies, is the best structured water user association in Brazil.

Another example of intermunicipal management of water resources is the **Santa Maria/Jucu Consortium**, in the State of Espírito Santo. It is equally a not-for-profit organization created in 1987, the year in which the State underwent a long drought that led to increased conflict of water use. The Consortium is made up of a) a Council of mayors, the highest decision making level; b) a Fiscal Council composed of a councilperson from each associated municipality in charge of overseeing the association's accounts; c) a Municipal Working Group for each municipality, made up of community leaders, municipal technical personnel or representatives of institutions present in the municipality, associated to areas of interest; and d) a technical body, coordinated by the Executive Secretariat, situated at the Consortium headquarters, responsible for indicating solutions to problems raised by the working groups, as well as to discuss criteria for prioritization and eligibility.

### ***WATER MANAGEMENT EXPERIENCES IN METROPOLITAN REGIONS***

With respect to pollution control programs in metropolitan regions, four stand out, among other programs: the Pró-Guaíba, in the state of Rio Grande do Sul, the Program to Clean the Waters of the Upper Tietê river basin, in the state of São Paulo, the Program to Clean the Guanabara Bay in the state of Rio de Janeiro and the Program Bahia Azul, in the state of Bahia.

The **PRÓ-GUAÍBA** program, executed by the Government of the State of Rio Grande do Sul, through aims to improve the environmental conditions of the Guaíba River Basin. It is the most important out of the of the three hydrographic regions of the State. It covers an area of 85,950 sq. km. and is divided into eight sub-basins and covers 30% of the total area of the State. The PRÓ-GUAÍBA will reach more than 251 municipalities, responsible for the generation of 86% of the GDP of the State of Rio Grande do Sul, where 2/3 of its population live. The general objective of the Program is to create the conditions required for the sound use of natural resources, recovery of environmental quality in urban and rural areas, as well as to carry out sustained environmental management of agricultural, herd, forest and industrial production. The PRÓ-GUAÍBA will take from 15 to 20 years to achieve its goals. This process is being guided by a Master Plan for Control and Administration of the Basin, to support the management strategies established according to the diagnosis presented by the experts responsible for the initial studies. The estimated investment for the intervention for the

whole basin is US\$1 billion. The first module, with conclusion foreseen for July 1998, amounts to US\$ 220.5 million, with financing from the Inter American Development Bank (60% of total costs) and counterpart funds from the State and Local Governments (40%). In the first module, the following projects are being executed: Electronic Infrastructure of PRÓ-GUAÍBA - Systematization of Geoinformation; Training of Human Resources; Communication Plan; Master Plan for Control and Administration of the Guaíba Hydrographic Water Basin; Environmental Monitoring Network; Plan of Action for the Control of Industrial Pollution in the Guaíba Basin; Collection and Treatment of Domestic Sewage in Cachoeirinha, Gravataí and Porto Alegre; Master Plan for Solid Wastes for the Metropolitan Region of Porto Alegre; Solid Wastes System in Porto Alegre; System for Soil Management and Control of Contamination through Agrochemicals; System of Parks and Natural Reserves; Studies for the Consolidation of the System of Parks and Reserves; Environmental Education.

**The Program to Clean the Upper Tietê River Basin** is the first stage of the Industrial Cleaning Program, developed by State Environmental Agency of the State of São Paulo-CETESB. It goes back to the beginning of the nineties, when CETESB carried out the diagnosis of the pollution sources of the Upper Tietê river. At that time it was estimated that the rivers of the basin received an organic load of approximately 1,100 tonnes BOD/day and 5 tonnes/day of inorganic load, reflecting pollution by metals, cyanide and fluoride. Industries were responsible for the emission of inorganic load, as well as one third of the organic load, the remaining organic load was domestic sewage generated by 34 municipalities of the Metropolitan Region of São Paulo. The program, to be concluded by December 1998, amounts to US\$ 900 million, 50% of which is financed by the IDB and 50% by the Brazilian Government. At the beginning of the program, 1,250 companies were selected, which together emitted 369 tonnes BOD/day and an inorganic load of 4.7 t/day. In August 1995, the first stage of the Industrial Cleaning Program was considered finished, when 1,168 industries met the legal emission standards, there being a reduction of inorganic load of 3.5 t/day, as well as reduction of 219 t BOD/day in industrial polluting emissions. Industrial pollution control activities have continued, and in June 1997, it was verified that 97.6% of industries had implemented control plans and obtained a favorable assessment in their compliance with legal emission standards. About 1.8% had implemented treatment systems which were being tested (did not meet emission standards), while only 0.6% of companies were not yet implementing control plans. Furthermore, a reduction of the inorganic load of industrial origin was verified, from the industries included in

the first stage of the Industrial Cleaning Program.

The **Program to Clean the Guanabara Bay** was established by the Government of the State of Rio de Janeiro, with the financial support of IDB and the Japanese Overseas Economic Cooperation Fund (OECE), with the main objective of meeting basic needs of the areas of basic sanitation, water supply, collection and final disposal of solid wastes, drainage and environmental monitoring. The basic philosophy of the Program is to start a process to recover the environment of the region. The Program is constituted by a group of multidisciplinary actions including works, goods and services covering the following components a) Sanitation; b) Macrodrainage; c) Solid Wastes; d) Complementary Environmental Programs; and e) Digital Mapping. The total cost foreseen for the Program is US\$ 933 million, of which US\$ 350 million were financed by the IDB, and US\$ 237 million by the Japanese OECE, and US\$ 306 million as national counterpart. With its implementation, a significant recovery of commercial fishing is expected, as well as improvement of the quality of the beaches in the interior of the Bay, reduction of the interruption of the socioeconomic activities resulting from floods, reduction in the occurrence of waterborne diseases and reduction of the silting process of the river channels and the bottom of the Bay. It will lead to, among other benefits, the collection and treatment of 6.9 m<sup>3</sup>/s of sanitary effluents, with the building of five new sewage treatment stations and placement of 1,200 km of collecting networks, as well as 6.8 km of land and oceanic outflows, 28 elevating stations and 139,000 household connections. Water supply in the Baixada Fluminense will be improved with the construction of 10 reservoirs, 452 km of distribution networks, 16 km of water mains and 45,900 household connections, as well as the acquisition of 525,000 hydrometers. Besides this, there will be improved collection and final disposal services in seven municipalities, for 700 t/day of garbage, through the establishment of recycling and composting centers, acquisition of collection vehicles and equipment, besides the control and treatment of greases through the recovery of existing sanitary landfills. Moreover, attenuation of the effects of floods is foreseen, through drainage works and rectification of watercourses. With respect to associated environmental programs, noteworthy is the recovery and improvement of the environmental quality of the Metropolitan Region of Rio de Janeiro, through several projects of industrial pollution control, environmental quality monitoring, environmental education program and capacity building of the involved institutions, reducing the polluting load generated by industries by 90% (organic load), 97% (toxic load) and 70% (oil and grease from oil terminals and

gas stations).

The **Bahia Azul Program** directly benefits the city of Salvador, Bahia and eleven municipalities that surround it, along the Todos os Santos Bay. There are five components involved, namely: a) water supply; b) sanitary sewerage; c) solid wastes; d) institutional development; and e) environmental education. It involves engineering projects and institutional coordination in the above mentioned areas and will bring benefits that will reach more than 2 million inhabitants. Among these benefits are: jobs and income generation; increase of tax collection; improved sanitary conditions; reduction in the number of waterborne diseases; improvement in the living conditions of the population, as well as the environmental benefits such as: environmental recovery water bodies, including urban beaches and rivers; collection and appropriate disposal of solid wastes; institutional strengthening of the state environmental agency; expansion of the waste water treatment station for reducing organic load of sewage; complementation of the Camurugipe interceptor; among others. The program involves, for the period 1996/2000, funds to the amount of US\$ 600 million, financed by the World Bank, the Inter American Development Bank and the Overseas Economic Cooperation Fund. The national counterpart is ensured by resources from the Government of the State of Bahia, the Caixa Econômica Federal, and through three other programs (some already mentioned above); The Environmental Sanitation Program of the Todos os Santos Bay; the Program to Modernize the Sanitation Sector; and the Metropolitan Program for Solid Wastes.

## *7. Social Participation*

Although there are strengthened legal instruments and governmental bodies to coordinate water resources management, its not enough to solve the problems that occur in this area today in Brazil. Society, as it seeks alternatives to solve its own issues, exerts a fundamental role in water resources management, sharing with the government, the same objective: ensure the availability of water at all levels of consumption for present and future generations. Law 9.433/97, the "Water Law", enshrined the concept of citizen involvement in the work of water resources management as a necessity, bearing in mind the continental dimensions of Brazil and the characteristics of the sector, which make any centralized or plain governmental initiative to deal with water, impossible. Brazilian social movements have been responsible for a large share of the progress achieved, both in managing waters, and in other initiatives for environmental conservation and protection, although they still lack a greater coordination and the recognition of several factors which contribute to increase the efficiency and scope of these movements. To provide visibility to these actions in favor of water, the Water Resources Secretariat supported the Citizenship Movement for Water, launched on the 1996 World Water Day (March 22). With the objective of inviting citizens to act in the preservation and recovery of water resources, the Movement is organized in a decentralized manner, through the Reference Centers established in Brazilian States and Municipalities. What differentiates the Citizenship Movement for Water from others already created throughout Brazil is that, in spite of being conceived by a government body, it does not establish norms or rules for those who integrate it. Each person in his space and in a voluntary manner, defines what is the best way to solve the water problems of his locality, seeking partnerships and mobilizing other citizens to work together to protect the waters. In these two years of its existence, the Movement has also created a National Reference Center, housed at the Water Resources Secretariat, responsible for distributing the Movement publications to all installed Centers, as well as for dissemination and participation in the actions carried out throughout the country. Another six state entities have already stated their interest in becoming the headquarters of the Movement. For 1998, it is foreseen that there will be more than 16 Municipal Reference Centers and more that 50 altogether in Brazil.



## 8. *International Cooperation*

In the wider context of international cooperation, Brazil is executing, with bilateral and multilateral partners, a large number of initiatives, designing and implementing various projects.

From the bilateral point of view, the more relevant actions in the area of water resources are carried out with the collaboration of Germany, France and Japan, involving on the Brazilian side not only the Federal, but also State and Local Governments.

Among the bilateral projects currently underway are: Irrigation Jafba II; Cleaning of the Tietê Basin; Salvador and Surroundings Sanitation Program; Paraná Environmental Sanitation; Rio de Janeiro Water Resources Plan; Management of Hydrographic Water Basins; Environmental Planning and Management of the Pirapama River Basin; Paraná Water Resources Plan; Santa Catarina Water Supply; Basic Sanitation in Pernambuco.

Generally speaking, the initiatives are processed through cooperation agencies of the aforementioned sources, the basic objective being technical cooperation. There are, however, some problems in this external collaboration area. In certain cases, changes in the Brazilian institutional scenario have led to a negative impact in project development. On the other hand, there have been shortcomings in monitoring tasks of some these external sources, jeopardizing project progress. The balance, however, has been positive, and Brazil is interested in expanding external cooperation with traditional and non-traditional partners.

The multilateral aspect of external cooperation is significant if we consider large scale institutions such as financing institutions like IDB and the World Bank. Both these banks have a large loan portfolios with Brazil in the area of water resources. GEF also has collaborated in this context, funding small projects - "small grants" have up to 30 thousand dollars and will support two major projects, starting in July 1998. IICA, OAS and UNDP also develop initiatives with reimbursable funds.

Among the projects financed by IDB and the World Bank are: Cleaning of the Tietê River; Cleaning of the Guanabara Bay; Microdrainage, Stage II; Modernization of Sanitation Companies; Water Quality Control - Federal

Government; Water Quality Control - São Paulo; Basic Sanitation of Fortaleza; Sanitation of the Todos os Santos Bay; Cleaning of Coastal Ecosystems - Espírito Santo.

The volume of funds involved in these multilateral projects amount to loans of US\$ 3.6 billion, bilateral loans amount to US\$ 1 billion, making a total of US\$ 4.7 billion of external funding and US\$ 3.6 billion in national counterpart funds for sanitation and water resources - a total of US\$ 8.3 billion.

In general, Brazil has had a positive experience with the negotiation of these resources, although sometimes the requirements tend to be exaggerated, especially those of an environmental nature. An important gap, which must be more suitably filled, specially in larger scale projects, is the need to increase actions of technical capacity building to better implement these initiatives. On the Brazilian side, however, there is need to improve internal bureaucratic procedures.

### *THE TREATY OF THE RIVER DEL PLATA*

The Treaty of the River del Plata entered into force in the seventies and worked for several years as a political interconnection among the countries of the Southern Cone (Argentina, Brazil, Bolivia, Paraguay and Uruguay). It was the first step in transforming the boundaries into "cooperation borders". The progress in the regional integration process that resulted in the MERCOSUL, as well as the solution of pending disputes lessened the essentially political nature of the Treaty and transformed it into an instrument of technical cooperation for the transnational management of water resources. Its main objectives are: the wise use of water resources, regional development with preservation of flora and fauna, physical, fluvial and terrestrial integration, as well as promotion of greater knowledge of the basin, its resources and potential.

To implement these objectives a system has been institutionalized throughout the years made up of three main bodies; the Intergovernmental Coordinating Committee of the Plata Basin (CIC), the Financial Fund for the Development of the Plata Basin (FONPLATA) and the Intergovernmental Committee of the Paraguay-Paraná Waterway (CIH). To provide greater efficiency and practicality to priority activities, the CIC developed a Program of Concrete Actions (PAC) in 1987. It includes 10 projects, distributed among the

following areas: exchange of hydrological data, quality control of Basin waters, soil conservation, navigation and river and land transportation, and border cooperation. Several groups of technical counterparts were created to deal with PAC issues.

Among the results obtained in the area of monitoring, assessment and use of the water resources of the Plata Basin, most noteworthy are the programs for information on water quality and hydrological warning. These work basically through the exchange of data collected by the Parties. Brazil has the most sophisticated monitoring system for the Basin, with data and information updated on a daily basis and made available on the Internet. Negotiations are at an advanced stage and the program has IDB funding.

With respect to the physical integration, there are intense debates and ongoing studies on the feasibility of a large waterway that will connect the main economic regions of the involved countries (Argentina, Uruguay, Paraguay, Bolivia and Brazil). This project would be carried out to connect the basins of the Tietê, Paraná, Paraguay, Uruguay and Plata Rivers. The objective of the Project is to ensure reliable and safe navigation, since the waterway in itself is already a reality. It is not, therefore the question of building something new, but rather, of making it more efficient and environmentally sound. It is worth mentioning that there is special concern in measuring the environmental impacts of the undertaking, specially in the Pantanal Region, in order to design mitigating actions. Furthermore, it is expected that the waterway may harmonize navigation rules among the different countries and permit the multimodal interconnection of means of transport.

### ***THE AMAZON COOPERATION TREATY***

The Amazon Cooperation Treaty (TCA) was signed in 1978 by Brazil, Colombia, Ecuador, Guyana, Peru, Surinam and Venezuela, having entered into force for Brazil in 1980. Its highest decision making body is the Amazon Cooperation Council, and it has as an auxiliary body, a Pro Tempore Secretariat, currently in Caracas. Recently it was decided to turn it into a Permanent Secretariat, with headquarters in Brasilia.

The Treaty, a veritable seed of ecological awareness, emerged as a response of the region's countries to a series of necessities resulting from the characteristic peculiarities of the Amazon region. In all these countries, the Amazonian portion of the territory was understood as an isolated area: the obstacles

imposed by the jungle to communications and transportation made the integrated economic development with other regions very difficult. The unfavorable physiographic features imposed severe hardships on the peoples of the forest, condemning them to primitive economic activities and to miserable living conditions within the richest environment of the planet.

The basic scope of the TCA may be thus defined: to promote the harmonic development of the Amazon, in order to allow an equitable distribution of the benefits of this development among the Parties, improving the quality of living of its peoples and achieving the full incorporation of their Amazon territories to the respective domestic economies.

The TCA constitutes, in this scenario, a wide framework agreement, which establishes general parameters, at the same time that it permits the signatory countries considerable flexibility in actions. It should be stressed that under the Treaty, decisions must be unanimous and there is complete equality among the members.

Financing of projects under the TCA comes mainly from the European Union (which finances projects such as the "Planning and Management of Protected Areas of the Amazon Region"), UNDP (which, with GEF funds, underwrites the ecological-economic zoning of the Amazon), the World Bank, and on a lesser scale, the IDB ("Project to Support the Amazon Zoning"), OAS, Governments and other sources.

The TCA has come to be highly innovative in many of its articles, providing for issues that only recently have been included in the international agenda. In its 28 articles, it establishes various instruments that permit the efficient transboundary management of the potential existing in the Amazonian rivers.

### ***OTHER AGREEMENTS***

The Amazon and Plata countries offer a wide range of examples of bilateral transboundary management of water resources. Among these are: a) Fisheries Agreement between Brazil and Argentina; b) Agreement on Fisheries and Preservation of Living Resources between Brazil and Uruguay; c) Agreement between the Government of Brazil and the Government of Paraguay on Conservation of the Aquatic Fauna of the Bordering Rivers; d) Amazonian Cooperation Agreement between the Government of the Federative Republic

of Brazil and the Government of the Republic of Colombia; e) Cooperation Agreement between the Government of Brazil and the Government of Uruguay for the Use of Natural Resources and Development of the Quaraí River Basin; and f) Treaty for the Use of Shared Natural Resources of the Bordering Stretches of the Uruguay River and its tributary, the Pepiri-Guaçu River, between Brazil and Argentina.