

**UNITED NATIONS  
ECONOMIC COMMISSION  
FOR LATIN AMERICA  
AND THE CARIBBEAN - ECLAC**



Distr.  
GENERAL  
LC/G.1917  
28 August 1996  
ENGLISH  
ORIGINAL: SPANISH

---

**PROGRESS ACHIEVED BY THE LATIN AMERICAN AND CARIBBEAN COUNTRIES  
IN THE IMPLEMENTATION OF THE RECOMMENDATIONS MADE IN  
CHAPTER 18 OF AGENDA 21 ON INTEGRATED  
WATER RESOURCES MANAGEMENT**



## CONTENTS

	<u>Page</u>
Abstract .....	1
INTRODUCTION .....	3
I.  ARGENTINA .....	5
A.  INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT .....	5
1.  The national government .....	5
2.  The provincial states .....	7
3.  Integrated water resources management and river basin management .....	8
B.  PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS .....	8
C.  DRINKING WATER SUPPLY AND SANITATION .....	10
D.  WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT .....	11
II.  BRAZIL .....	13
A.  INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT .....	13
1.  The existing administrative and institutional structure .....	15
2.  Efforts made towards fulfilling Agenda 21 .....	15
B.  WATER RESOURCES ASSESSMENT .....	16
C.  PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS .....	16
D.  DRINKING WATER SUPPLY AND SANITATION .....	17
E.  WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT .....	17

III.	COLOMBIA .....	19
	A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT .....	19
	B. WATER RESOURCES ASSESSMENT .....	20
	C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS .....	20
	D. DRINKING WATER SUPPLY AND SANITATION .....	21
	E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT .....	22
IV.	CHILE .....	25
	A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT .....	25
	B. WATER RESOURCES ASSESSMENT .....	27
	C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS .....	27
	D. DRINKING WATER SUPPLY AND SANITATION .....	28
	E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT .....	29
	F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES .....	30
V.	MEXICO .....	33
	A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT .....	33
	B. WATER RESOURCES ASSESSMENT .....	34
	C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS .....	34
	D. DRINKING WATER SUPPLY AND SANITATION .....	36
	E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT .....	36
	F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES .....	37
VI.	VENEZUELA .....	39
	A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT .....	39
	B. WATER RESOURCES ASSESSMENT .....	41
	C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS .....	42
	D. DRINKING WATER SUPPLY AND SANITATION .....	43
	E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT .....	45
	F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES .....	46

VII. OTHER COUNTRIES .....	47
A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT .....	47
B. WATER RESOURCES ASSESSMENT .....	49
C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS .....	50
D. DRINKING WATER SUPPLY AND SANITATION .....	51
E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT .....	54
F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES .....	55
CONCLUSIONS .....	57
BIBLIOGRAPHY .....	59
Annex - LATIN AMERICA AND THE CARIBBEAN: STATISTICS ON THE USE OF WATER RESOURCES .....	61



### **Abstract**

The purpose of this paper is to present information on the progress achieved by Latin American and Caribbean countries in the implementation, within the context of their water policies, of the recommendations made in chapter 18 of Agenda 21. This report, the second prepared for this purpose, is complementary to a previous report, entitled **Agenda 21 and integrated water resources management in Latin America and the Caribbean** (ECLAC, LC/G.1830, 7 September 1994).

The bulk of this report consists of case studies on six countries: Argentina, Brazil, Colombia, Chile, Mexico and Venezuela. Although the situation in these countries is not the same as in all the other countries of the region, their experiences are representative of the efforts being made by governments to improve the management of their water resources in the light of Agenda 21. Brief overviews are provided of the progress made in five other countries —Costa Rica, Cuba, Guatemala, Peru and Saint Lucia— based on the papers presented at the regional meeting.

In general, it may be said that the agencies responsible for water resources management are definitely interested in adopting a set of standards aimed at ensuring sustainable and integrated management, as envisaged in Agenda 21. Most of the countries, however, do not have a clear idea of the procedures to be followed in policy making, institutional coordination, adoption of suitable planning mechanisms and project execution.



## INTRODUCTION

Over the last few years, there has been a marked trend in the Latin American and Caribbean countries towards decentralization of responsibilities in the area of water management and application of some of the basic water resources management principles enunciated at the United Nations Water Conference and the **Mar del Plata Action Plan** (United Nations, 1977). In the last two years, water management policies in many countries —and hence the institutional structure in this area— have begun to show the influence of Agenda 21, adopted at the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, particularly chapter 18 on **Protection of the quality and supply of freshwater resources: application of integrated approaches to the development, management and use of water resources** (United Nations, 1992).

Environmental problems have made it difficult to incorporate into public policy the concept of sustainable and integrated management of water resources. In many countries of the region, the constant deterioration of water quality is considered the greatest problem that has to be addressed in connection with the management of this resource (PAHO, 1990). In general, the struggle against pollution is the area in which the region has the least water management experience. However, new water laws are being developed to regulate pollution and discharges. In Mexico, for example, in order to meet the standards established in the environmental agreements signed in the context of the North American Free Trade Agreement, a system for levying tariffs for discharges has been introduced under the National Water Act of 1992 (ECLAC, 1994). In other countries, such as Argentina and Chile, measures have recently been taken to strengthen the institutions responsible for supervising water quality. For most governments, it is obvious that policies and strategies are needed to monitor pollution, set up data bases on pollutants and water quality, develop effective technology for combatting pollution and treating waste discharges, further develop institutions and establish appropriate funding mechanisms.

At the same time, concern regarding the repercussions of economic development on the natural environment, along with increasing awareness of the close interrelationship between poverty (especially in rural areas) and environmental deterioration, have put environmental management at the forefront of political debate. In this debate, the management of water resources is sometimes viewed as just one more element within the institutional mechanisms required for environmental management. This has led many to argue that the “unique” nature of water and the major role it plays in sustainability of environmental systems has been ignored. Mention is often made of recent reforms in Colombia as an example of a case in which, in the process of drawing up modern environmental legislation, responsibilities for managing water resources were divided and placed under the jurisdiction of three different ministries. In Argentina, emphasis has also been placed on the creation of institutional policies and mechanisms for environmental management, but the official administrative body responsible for water management has been lowered in rank and remains assigned to a different ministry (ECLAC, 1994a).

In several countries, such as Argentina, Brazil, Colombia, Cuba, Chile and Venezuela, public institutions have been reorganized and specialized agencies have been created to take charge of environmental policies. In still others —of which Venezuela is the main example—, these institutions carry out important executive responsibilities, although in many cases, their duties are limited to drawing up policies which are then executed by other, older regulatory agencies, as in Chile and Cuba, for example.

In this report, an effort is made to examine the progress made by the countries of the region in implementing the recommendations set forth in chapter 18, as well as the problems that still remain. In general, it may be said that there is a definite willingness among the agencies responsible for water management in these countries to establish a general framework of regulations for the sustainable and integrated management of water resources, as requested in Agenda 21. Most of the countries still do not have a clear idea of how they will go about accomplishing this, inasmuch as it will involve policy making, institutional coordination and finding suitable planning and project execution mechanisms.

Consequently, as pointed out in this report, much remains to be done in addressing the problems posed by the agreement set forth in chapter 18. One of the main problems is that serious shortcomings still exist, four years after the end of the International Drinking Water Supply and Sanitation Decade, in regard to efficient water supply and environmental sanitation services. This significant and growing social need, which has been intensified with the reappearance in 1991 of cholera in the region, has led policy makers to give highest priority to the expansion of water supply to homes. This has diverted attention from other aspects of integrated water management and from a more in-depth examination of the environmental impact of regulatory decisions relating to water resources.

## I. ARGENTINA

### A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

#### 1. The national government

The Secretariat of Natural Resources and Human Environment (SRNAH), which was set up in 1992 as a unit of the Office of the President of the Republic of Argentina, is responsible for coordinating environmental programmes at the national level. SRNAH had limitations from its inception, as a result of the low level of budgetary resources allocated to it and because of the composition of its staff, which consisted predominantly of administrative personnel. Thus, the technical capabilities and efficiency of the agency were limited. Moreover, only a small percentage of its professional staff had received academic training in areas specifically related to the environment.

One of the main activities carried out by SRNAH is the creation of a programme for the development of environmental institutions, in order to address several issues raised in Agenda 21. Specifically, the programme is aimed at promoting more efficient environmental management in Argentina through the strengthening of legal regulations and institutions at the national and provincial levels and, indirectly, at the local level.

In this regard, the programme is geared towards supporting the development of national environmental policies; working for adjustments in environmental legislation on the basis of the elements agreed on in the Federal Environmental Pact; strengthening the technical capabilities of SRNAH and supporting the institutional development of the main bodies responsible for environmental matters at the national and provincial levels; promoting environmental education, and setting up, in selected provinces, high-priority experimental programmes for the prevention and control of environmental deterioration.

The SRNAH programme seeks the establishment of a national environmental system which, with the participation of members of the Federal Council on Housing and the Environment, other levels of government and representatives of the nongovernmental sector, will contribute to defining the role of the different agencies responsible for environmental management. In designing the programme, it was found that the environmental legislation of the country was very dispersed, permitting the provinces to establish their own standards for water resources and environmental management. This, added to the fact that there is no federal law on the environment, has led to ambiguity in the application of environmental policies.

As regards environmental legislation, the programme includes an analytical review of existing legislation, the development of drafts of complementary legislation and an analysis of legislation and jurisprudence in the field of environmental and natural resource management. This analysis has revealed the existence of gaps, overlapping and contradictions that need to be corrected. The goal is to make a

compendium that will provide full information on the national and provincial levels, for widespread distribution in a format that will allow for regular updates to be made.

Institutional strengthening, for its part, is geared both towards SRNAH and the provincial environmental management agencies. In this regard, an analysis is being conducted of the organizational structure of SRNAH, with a view to making it more functional, efficient and effective. The reorganization will entail:

- a review of the existing structures and a description of the proposed national environmental system;
- the number and distribution of staff;
- the scope of responsibilities of internal bodies, the need for equipment, etc., and
- the development of technical and administrative procedures.

In the case of environmental education, action is being taken to disseminate information on environmental issues and problems through the formal educational system, as well as through informal means such as television and the written press. It is also worth mentioning that in those provinces in which more progress has been made towards dealing with environmental issues, a number of different systems and actions have been adopted, both formally and informally, in the educational system.

Technical assistance to the provinces has begun in Buenos Aires, Cordoba, Mendoza and Misiones. These programmes will follow a process similar to that of SRNAH, i.e., on the basis of an institutional analysis, the agencies will be reorganized in order to enable them better to fulfill their functions. In these provinces, three experimental programmes will be carried out in the area of the prevention and control of environmental deterioration: control of environmental deterioration, development of institutional structures for river basin management, and industrial pollution control programmes.

The National Directorate of Water Resources (DNRH) a unit of the new Undersecretariat of Water Resources (SRH) created by the Ministry of Economic Affairs, Works and Public Services in 1994, has undertaken the development of a master or regulatory plan. As a beginning to this activity, a number of meetings were held with officials of all the provinces, with a view to reaching agreements on the stages proposed for the plan. The idea is for this plan to be included in the five-year plan presented by the national government in early 1995. The master plan is contained in a report which includes a compilation and analysis of the most recent and reliable information on the availability of and demand for water nationwide, with a view to establishing a balance between them. This in turn should contribute towards a national development model in which there is harmony between the social and the economic spheres, through the adoption of appropriate decisions by governments at the different levels of jurisdiction. The drawing up of the plan, requires consensus among the different levels of jurisdiction, which must be explicit at each stage of the plan, and mechanisms for implementing and evaluating the different stages will be provided for. To emphasize the importance of consensus, a Coordinated System of Water Planning has been established. This will make it possible to establish a pattern for relations between the institutions, with a view to facilitating the development of a national water plan. To this end, a charter is being drawn up for the System, in order to create interest among the different provincial authorities and the municipal government of the City of Buenos Aires. At the national level representatives of the bodies directly involved in water resources management will participate. Each province and the Federal Capital would appoint a representative. It is felt that the private sector should also be represented in the system by nongovernmental organizations and other institutions such as industrial associations, universities, scientific societies, professional associations, research institutes among others.

Since so many people will be participating in the system, it is felt that there should be a technical committee made up of seven members, at the most, which would analyze proposals and needs of the members of the system and carry out specific tasks proposed at the plenary meetings. There would also be an Executive Secretariat which would carry out operational decisions for the system, organize and carry out activities and convene plenary meetings.

The directors of DNRH argue that the operation of this system would bring the following benefits:

- the planning it would carry out will, without exceptions, bring together the sum of know-how, ideas, experiences, etc., of the participants and will have the necessary consensus and political support;
- budgetary resources will be allocated in a transparent and reasonable fashion;
- better terms will be obtained for external financing for selected projects, and
- internal management of project funds will be more efficient.

## 2. The provincial states

The Constitution stipulates that the provinces have full jurisdiction over their water resources and their environmental systems. When resources or environmental problems cross provincial boundaries, the provinces concerned must reach an agreement, with the participation of the federal government.

The water sector is better organized at the provincial level than at the national level. It is true that the more developed provinces have taken a predominantly sectoral approach to water management, but actions are currently underway to attain a level of organization that will allow for integrated management of water resources. This is the case in Corrientes, Jujuy, Mendoza, Salta and San Juan, which have begun a process of institutional coordination. At these levels, which are very enthusiastic and have investment capacity, priority is being given to providing support for technical and institutional development.

In the provinces, the various governments, and occasionally municipal governments, have administrative units that are in charge of environmental matters. In some of the provinces, the environmental bodies have made more progress in their development than at the federal level, inasmuch as some of the provinces have entered into interprovincial agreements on environmental legislation with a view to establishing similar regional policies. This is the case of the provinces of La Rioja, San Juan, Mendoza and San Luis (the agreement on environmental legislation of Nuevo Cuyo).

Although several provincial governments, in line with public interest, have assigned priority to environmental considerations, the policies that have been drawn up are not explicitly linked to economic, educational and social policies. At the same time, while many provinces have appointed authorities to apply the existing legislation, the agencies they lead are faced with serious constraints on staff, training and technical development, and this makes it difficult to achieve the goals proposed. There is a lack of administrative capability to translate broad policies into regulations and procedures that will allow for their implementation.

### 3. Integrated water resources management and river basin management

Argentina does not have a history of solid experience with integrated water resource management; in most cases, the water resource has been managed under a strictly sectoral approach. Some experience has been gained in river basins, with different water authorities and other parties concerned forming "basin committees", for the purpose of implementing integrated water management and monitoring both quantity and quality. Although most of these committees have not made significant progress in terms of the integrated management of the resources, because they have not had the necessary financial resources and have been dependent both administratively and financially on the different provinces and national agencies that make up the committees, many of them have played an important role as technical agencies providing management support.

Despite the adverse context in which these initiatives have been carried out, there are positive experiences, such as those in the River Plate Basin in conjunction with the other riparian States, and the regional corporation for the Bermejo River, the interprovincial technical commission for the Colorado River, the Lago San Roque Basin committee, and others. In almost every case, progress has been made towards the development of agreements and joint plans among the parties involved in the basin and, in some cases, towards implementing some major investments in order to solve different problems; however, integrated management of the water resource has not yet been achieved. The establishment of this type of joint action to create basin committees or authorities should be considerably easier under the decentralization process that has been put underway in the country.

In 1995, for example, a new attempt was made towards achieving integrated management of the River Plate Basin, with the creation of "the River Plate research and environmental management network". This is a regional project designed to set up a system of communications, information and cooperation among institutions of the region that are involved in assessment, research, technological development, administration, management and utilization of the water resources of the River Plate. This initiative was preceded by a number of efforts, beginning with the first and second international workshops on regional approaches to the development and management of reservoirs in the River Plate Basin. A technical coordinating committee was set up in August 1994, and the participating agencies are seeking funding from the Inter-American Development Bank (IDB). The objective is to conduct a short-term study of the feasibility of designing and setting up a network.

## B. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

Until 1994, Argentina had not established an environmental policy or a policy on natural resources management, and it still does not have an overall environmental law. This is not due to any inability to produce new laws, but rather to the fact that in the current federal system, the provinces are somewhat skeptical about the benefits of a national law. The main argument is that it would be difficult to establish rules at the national level that would take into account the diversity of circumstances in the different regions of the country.

The National Constitution of the Argentine Republic, adopted in August 1994, makes explicit reference to environmental issues. It stipulates that all inhabitants have the right to a healthy environment, in order to ensure that production activities meet present needs without jeopardizing future generations.

The law provides that anyone causing damage to the environment will be required to pay some kind of compensation. The text also states that the authorities are to protect the right to the rational utilization of natural resources, to the preservation of the natural and cultural heritage and biological diversity, and to environmental information and education. In this regard, the basic rules for providing this protection are to be drawn up by the federal government; these rules are then to be supplemented by the provincial governments.

Along the same lines, any citizen has the right to appeal before a judge against actions of third parties that have a negative effect on the environment. This constitutional principle takes precedence over provincial environmental laws, such as the Mendoza law, which states that such actions are to be channelled through the state attorney general.

Environmental policy objectives must be consistent with the constitution of the country, which provides that the provincial governments own the rights to water and other natural resources. This means that the provinces are directly responsible for preserving the quality of the environment in their jurisdictions. Consequently, in order for a national law to be truly national in scope, it must be supported by the provincial governments.

This type of distribution of ownership over natural resources and the environmental responsibility it entails can have both positive and negative implications. On the one hand, having so many different institutions involved has given rise to many conflicts and has led to great disparities in the way resources are managed in the country. On the other hand, the distribution facilitates decentralization, and those provinces that have a greater awareness of the importance of the environment and of conservation of natural resources have been able to act quickly.

One element that must be considered is the constant proliferation of all kinds of draft legislation, at both the national and the provincial levels. In July 1995, for example, an effort was made to establish a National Integrated Water Resources Management System. The idea was to rationalize the use of resources so as to ensure sustainable, planned and integrated management. The proposal provided for the creation of a basin committee for each surface basin in the country; these bodies would have legal standing as public corporations, and would represent the highest authority as regards the regulation and supervision of surface and underground water resources in each basin. It is evident, without going into an in-depth analysis, that this proposal would have the effect of centralizing authority, and that from its inception, it would pose jurisdictional problems for the provincial and municipal governments. Its implementation would have entailed a great deal of compromise, at a high cost, so that it would never get off the ground.

Another draft law proposes the establishment of a legal and institutional framework for monitoring pollution and preserving water resources. The idea is to make preservation and pollution control of surface and underground water resources obligatory. The draft proposes an absolute ban on the discharge of effluents containing pollutants in amounts exceeding the maximum allowed. It also proposes authorizing dumping in receptacles, for which projects on purification plants would be drawn up and adopted, and provides sanctions aimed at controlling pollution.

These are only two examples of the many draft laws that have been introduced at the federal level and in the provinces to address the issues of water resources management and quality of the environment. In this respect, the programme set up by the Secretariat of Natural Resources and Human Environment,

which provides for drawing up a national compendium of all legislation currently in force will be most useful in helping to avoid a multiplicity of laws that only creates confusion and uncertainty.

The Federal Council on Housing and the Environment, made up of the provincial environmental agencies and the federal Secretariat of Natural Resources and Human Environment, was recently established. The objective of this Council has been, first of all, to produce the Federal Agreement on the Environment. This agreement was adopted in mid-1993 for the purpose of promoting environmental policies at the national level, establishing a framework for agreements between the federal government and the provincial governments, and facilitating and improving the efficiency of environmental protection in keeping with the principles set forth in Agenda 21. Although the agreement signed to date is more a statement of desires than a guide for future action, the fact that it was signed is an important step towards the development of a consistent environmental policy containing agreed programmes in specific areas.

A national hazardous waste law has also been enacted to control emissions, especially of industrial origin, that threaten human health or the environment. This marks the beginning of a considerable number of court cases, and has led to the beginning of treatment of effluents from major factories in the Buenos Aires metropolitan area. Nevertheless, much remains to be done before the existing regulations can be properly enforced.

The Secretariat of Natural Resources and Human Environment is taking measures to clean up the most seriously affected rivers of Buenos Aires; for example, US\$ 150 million have been allocated for the clean-up programme in the Matanza-Riachuelo River. In addition, the Secretariat has just signed a loan agreement that would provide over US\$ 30 million, mainly to fund the institutionalization of environmental management, with special attention being given to industrial pollution and river basin management.

### C. DRINKING WATER SUPPLY AND SANITATION

It may be said that, with a few exceptions, no significant progress has been made in this area in Argentina in the last fifteen years. In the few cases in which coverage has been expanded, this has usually been done at the expense of the existing systems. The low level of provision with sewerage and of the treatment of sewage represent a great risk, especially since the appearance of cholera and other gastrointestinal diseases that continue to affect the country. In the provinces, medium and long-term plans to develop this sector have been set up in only a few cases, and there is no financial policy to help solve the problem. To a large extent, this is due to the inefficiency of the now dismantled Federal Council on Drinking Water and Sanitation.

The inefficiency of the bodies responsible for providing drinking water and sewer services has created a favourable atmosphere for the current trend towards privatization through the granting of concessions. Concessions are usually granted for 30 years, and stipulating that the concessionaire must meet basic standards pertaining to water quality, pressure, quality of effluents before discharge, goals for meeting demand among others. Although it would not be wise to jump to conclusions, the privatization of *Aguas Argentinas*, which covers the Federal Capital and 13 districts of Buenos Aires province, has brought significant improvements compared with the previous public management. Major investments have been made, the census of users has been updated, and water tariffs have dropped. Previous

experience in Argentina shows that the use of cooperatives to manage drinking water and sanitation services has been very efficient in rural areas.

The Under Secretariat of Water Resources (SRH) handles a substantial amount of funds from multinational sources provided to promote the expansion of drinking water systems. Thus, in early 1995, a programme was set up to supply drinking water to every town with a population of more than 15,000 that had deficits in coverage or did not have adequate systems for drinking water supply. The idea is to reach a high level of coverage during this new stage of expansion of the drinking water systems.

#### D. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT

In Argentina, the provincial governments are responsible for irrigation, and its management is very varied. Each province has its own traditional system for irrigation as well as, responsible institutions. Thus, in some cases, the organization is highly centralized, while in others the programme is carried out by autarkic bodies, private corporations or State corporations. User participation in these undertakings ranges from direct participation in water management, as in Mendoza and San Juan, to mere users, as has been the case in the past with the water services of Salta and Jujuy. In provinces where irrigation is not a significant use, no special institutions have been created for this purpose.

Recently, the provincial governments have taken charge of all irrigation districts. Parallel to this, with the process of State reorganization, steps have been taken to transfer management of irrigation systems to the users. Such action has often been promoted by farmer organizations, as is the case in the province of Salta.



## II. BRAZIL

In Brazil, responsibility for water resources management is shared by the Federal Government and the states. Under the existing Brazilian constitution, enacted in 1988, water resources are public property, and are under the control of the State or the states. The Federal Government is responsible for operating (either directly or by means of concessions) electric power services and plants and the use of watercourses for power generation, jointly with the states that have hydroelectric potential. The State also manages navigable watercourses that cross state boundaries, and undertakes disaster prevention programmes, particularly for floods and droughts. The Federal Government is also responsible for creating a water resources management system at the national level and drawing up criteria for the granting of water rights. It also draws up and implements socioeconomic development plans, inasmuch as it alone is responsible for water legislation, although this mandate can be delegated.

Under article 43 of the national constitution, the Federal Government is empowered to create development zones in low-income regions subject to droughts, where water use priorities must be consistent with economic and social concerns. In these regions, the Federal Government must promote the recovery of arid lands, cooperating with small- and medium-scale land owners to establish sources of water and carry out small-scale irrigation projects.

### A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

The Federal Government and the state governments are in the process of discussing proposals for legislation to be drawn up on the basis of the constitutional principles mentioned above. Some states have already developed their own legislation. Seven already have a state water resources law, while several others will soon be enacting theirs. Of the 27 states which make up the Federative Republic of Brazil, 13 have constitutional provisions governing the management of water resources, 9 have a supplementary law on the matter, and one state has enacted a state law on the matter, although it is not covered by its constitution.

The proposed law on a national water resources policy, which was introduced in the National Congress in 1991, provides for the creation of a national water resources management system and the allocation of funds for this purpose. The fundamental merit of this draft is that it lays the foundation for the formulation of a national water resources policy, with a view to ensuring the integrated and harmonious use of such resources and promoting the development and well-being of Brazilian society.

The policy tools specifically mentioned include the granting of water use rights, levying tariffs on water use, recovering the costs of multiple-purpose projects and establishing areas of protection for

springs and water sources use for human consumption. In addition, the proposal specifies that anyone discharging effluents will be required to meet pollution control standards.

This draft envisages the creation of the National Water Resources Management System (SINGREH), in order to provide adequate management and execution of a national water resources plan. The guidelines proposed for water resource management are as follows:

- consider regional diversity;
- integrate proposals at the three levels of government;
- promote decentralization of programmes by delegating to the states many of the powers of the Federal Government;
- promote technical, institutional and financial cooperation among users, and
- encourage the participation of local communities.

The National Water Resources Management System would have national committees made up from regional committees, formed by state representatives and representatives of ministries and the secretaries of the Presidency concerned with water resources. Basin committees would also be set up under the system. Finally, there would be an executive secretariat, responsible for drawing up general guidelines to support the development of the national water plan and promote actions aimed at executing this plan.

The basin committees, which would be given an important role, would include representatives of the public bodies concerned with water resources, either in regard to their use or to their protection. Local governments, as well as, users and any future sub-basin committees or user associations would also participate.

Response to the proposal has been varied; among others, including:

- opposition to the further strengthening of the traditional predominance of the energy sector;
- calls for increased decentralization of water resources management;
- concern at the fact that several states are developing their own management systems, which could complicate the future establishment of a national system, and
- fear at the prospect that the proposed system might be too authoritarian and might hinder the more democratic and decentralized schemes adopted in some states.

In the light of these reactions, the proposal has gone through some changes, including the following:

- propose general guidelines for levying water tariffs, which would only be implemented in agreement with the states;
- establish principles for regulating water use, allowing concessions for multiple uses, setting definite time limits (renewable) and penalties for non-use (to discourage financial speculation with concessions), and
- drawing up a general institutional design within which river basin agencies would be created independently and in accordance with a specific law.

### 1. The existing administrative and institutional structure

The existence of many levels for water resources management, including the Federal Government and the different states, as well as the different ownership systems —federal and state— makes management extremely complex.

The Secretariat of Water Resources (SRH) was created in January 1995, as part of the Ministry of Environmental Affairs, Water Resources and the Legal Amazon Region. It is responsible for planning and monitoring activities related to water resources in the Federal Government. Rights over state rivers are administered by agencies in the respective states.

One of the main reasons for the creation of the Secretariat of Water Resources was to unify federal government action relating to the management of water resources. As a first priority, the SRH is trying to decentralize activities to the state and regional level, as well as at the river basin level, as envisaged in chapter 18 of Agenda 21.

The government's objective is to promote the efficient and equitable use of water resources. Several obstacles stand in the way of achieving this objective, namely: the lack of an adequate system for granting water rights, the lack of administrative controls to prevent disputes and the inadequacy of existing information. The work of drawing up an official register of all farmers using water for irrigation, which began in 1985, has been interrupted several times, and is still not completed.

The sharp reductions in staff and in budgetary resources that occurred during the previous administration have seriously weakened the agencies in charge of water resource management. At the present time, these difficulties are being solved by the Federal Government, which is using national financial resources and accepting cooperation from international agencies. One important point is that since 1989, under federal laws 7990 and 8001, the hydroelectric power companies are required to pay water use rights; these revenues are then distributed among states and local governments to compensate for the expense caused by the flooding of the areas where the dams were built. Some of the funds generated are also earmarked for surveillance systems and water management.

### 2. Efforts made towards fulfilling Agenda 21

Brazil is taking administrative and legal steps to ensure the integrated development and management of its water resources. As mentioned above, legislation has been proposed to establish a national policy on water resources management, set up a national management system and to ensure that financial resources are allocated for this purpose.

Although there is still no national water management plan, many of the Brazilian states already have their own plans, which will be integrated into the national plan once it is drawn up. In some states, the control and management of water quality does not coincide with the criteria for the allocation of water quantity.

Most of the states have public systems or bodies responsible for water resources management and for environmental matters. There are also some examples of integrated development or multi-use management. In the cases of the Doce, Paraná and Paraíba del Sur Rivers, and of the basins of the Alto Paraguay and of the Piracicaba, Capivari and Jundiá Rivers, significant progress has been made.

However, aside from these examples, there are many other basins and water resource complexes where problems exist that have not yet been adequately resolved.

In order to enhance the efficiency of existing water management at the national level, a well-organized and operational national information system is needed that will make it possible to evaluate programmes and projects. In addition, it is necessary to recover costs implement this both legally and administratively. An official register for water and discharge rights is also needed.

## B. WATER RESOURCES ASSESSMENT

Brazil has a hydrometric network which operates at the national level, consisting of a number of stations where basic water resource parameters are measured. This system, which is operated by national or regional and state institutions, generally includes the following:

- a basic hydrometric network, made up of flow metering stations;
- a basic climatology/rain gauge network;
- a special network of flood warning and prevention stations;
- a network for the measurement of basic water quality parameters, and
- a sediment measurement network.

The system currently in operation is made up of 3,450 flow metering stations, 8,200 rain gauge stations, 450 water quality stations, 370 sediment measurement stations and 900 weather stations. In accordance with generally accepted criteria, the existing network is satisfactory in the southern/southeastern region; in the northeast, however, and especially in the north, much still remains to be done to expand the network. Moreover, data collection needs to be improved at the local level and in the more densely populated regions. Thus, additional efforts must still be made to bring the system up to standard.

## C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

The Federal Government and the state and local governments are jointly responsible for environmental protection, public health, pollution control, poverty reduction and social integration. The state and Federal governments also share responsibilities relating to registration, follow up and monitoring of water rights. Under the Constitution, a national law must be enacted to set out the rules on cooperation among the different levels of government.

The three levels of government may legislate on pollution control, resource conservation and environmental protection. The federal level is responsible for enacting basic legislation, and the state governments enact complementary laws. In the absence of federal legislation, the states are fully competent to manage water use in accordance with their particular needs. Within state waters belong to the state concerned, as does groundwater; interstate waters and those that serve as a boundary between Brazil and other countries or that cross into or originate in foreign territory fall under federal authority, as do waters stored in federal reservoirs.

The Secretariat of Water Resources has the following duties in regard to the protection of water resources:

- planning, coordination, supervision and monitoring of activities relating to the environment and water resources;
- formulation and implementation of a national policy on the environment and water resources;
- preservation, conservation and rational use of renewable natural resources;
- implementation of international agreements pertaining to the environment, and
- creation of an integrated policy for the Legal Amazon region.

#### D. DRINKING WATER SUPPLY AND SANITATION

According to data for 1991, 81 % of urban dwellings are supplied with water and in 64 % of these, sewage is disposed either to a public system or in septic tanks. However, 80 % of the sewage does not receive any kind of treatment.

Local governments are responsible for providing drinking water supply and sanitation services, which they administer directly or by means of concessions. The Federal Government, however, still participates in setting drinking water supply and environmental sanitation policies. The objective of the Sanitation Sector Modernization Project is to conduct an up-to-date assessment of basic services and draw up a strategy for meeting needs in the sector.

#### E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT

In Brazil, irrigation plays a major role in food production. Most of the public irrigation projects are located in the northeastern region of Brazil, which is the region with the greatest social and economic needs. Many of its problems arise from the shortage of water. Substantial financial resources have been earmarked for the implementation of these irrigation projects, which not only help reduce the exodus from rural areas to the big cities, but also help promote food production by providing for more efficient water use.

The local communities have taken part in the projects through the basin committees and the public hearings that are required by the Brazilian environmental laws. Despite signs of a change in attitudes on this issue, the public agencies, in general, still are not opening the way for effective public participation in project implementation.



### III. COLOMBIA

Of the countries studied, Colombia is that which is carrying out the most far-reaching changes in legal and administrative structures governing environmental issues in general and water resources in particular. It is also implementing changes in public services, including drinking water supply, basic sanitation, and electric power services. From a traditional state structure organized according to sectors of socioeconomic activity, it has moved to an organization based on environmental and economic development objectives, characterized by strong decentralization of authority and a strengthening of regional organizations. Nevertheless, there is some uncertainty as to what will be the definitive design of the reformed organization. The legal and institutional guidelines are clear, but decisions are still pending on the procedures to be followed in order to implement the design and organization of the new bodies. The prevailing view, however, is that the direction of change is positive and desirable.

#### A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

The main change was the enactment of the Political Constitution of 1991, which establishes that all citizens have the right to enjoy a healthy environment, and stipulates that the State has the following duties:

- to protect the natural resources of the nation and the diversity and integrity of the environment, and to preserve areas of special ecological interest;
- to plan the management and development of natural resources, and to guarantee their sustainable development and their conservation, restoration or replacement;
- to prevent and control factors that degrade the environment;
- to organize, direct and regulate environmental sanitation, which is a public service provided by the State, in line with principles of efficiency, universality and solidarity, and
- to cooperate with other nations in protecting ecosystems located in frontier areas.

The general principles set forth in the new Constitution and in Colombia's environmental law are based on the universal principles and principles of sustainable development included in the Rio Declaration on Environment and Development adopted in June 1992. The first article of the law establishes as objectives the maintenance of biodiversity, respect for human rights and special protection for wetlands, springs and areas of aquifer recharge. Priority is given to human use of the water resource above all other uses, and it is stated that lack of scientific knowledge to make a reliable assessment of certain types of environmental impact may not be used as an excuse for postponing the implementation of effective measures to prevent environmental degradation.

The Ministry of Environmental Affairs and the National Environment System are organized as follows: Ministry of Environmental Affairs, regional autonomous corporations, and districts or municipal governments. It should be noted that the regional autonomous corporations are assigned an important role. The Ministry of Environmental Affairs is the agency responsible for setting guidelines for the management of the environment and renewable natural resources, and is charged with fostering a relationship of respect and harmony between man and nature and designing policies and regulations aimed at the recovery, conservation, protection, development, management, and utilization of the country's renewable natural resources and environment, in order to ensure sustainable development. The Ministry of Environmental Affairs is to carry out those duties, in the area of protection of the environment and renewable natural resources, that were previously carried out by the National Institute of Renewable Natural Resources and the Environment, the Ministries of Agriculture, Health, Mines and Energy and the National Planning Department.

Along with these changes in the legal and administrative superstructure of the country, a number of changes have been made in connection with the decentralization of administrative responsibilities, the regionalization of decision making, the recovery of costs and in the self-financing of most activities.

## B. WATER RESOURCES ASSESSMENT

The environment law provides for the creation and modification of a number of institutes which had provided scientific and technological support. This entails making changes in several existing institutions; for example, the Colombian Institute of Hydrology, Meteorology and Land Development (HIMAT) has been renamed as the National Land Development Institute (INAT), and oversight of water and weather-related activities has been transferred to the new Institute of Water, Weather and Environmental Studies (IDEAM). This institute has been charged with conducting the basic research on natural resources that was formerly carried out by the National Institute for Renewable Natural Resources and the Environment, which is slated to disappear, with its other activities being delegated to the regional autonomous corporations.

Four other institutes have been created to work respectively on coastal maritime research, study of biological resources, problems of the Amazon region and environment systems of the Pacific region.

## C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

The Ministry of Environmental Affairs has all the necessary authority to set quality and emission standards; to levy tariffs for water use and utilization of renewable natural resources, and to administer the National Environment Fund (FONAM) and the Environment Fund for the Amazon Region.

The environmental law provides for the regional autonomous corporations to be set up as public corporations, serving regions which, because of their particular nature, constitute a single ecosystem or a geopolitical, biogeographical or hydrogeographical unit. These corporations enjoy administrative and financial independence, and have their own equity capital and legal standing. Their sources of funding are, among others: fees and fines; water use tariffs; the environmental percentage of property taxes and

transfers from the electric power sector. The regional autonomous corporations are responsible, within their sphere of jurisdiction, for managing the environment and the renewable natural resources so as to promote sustainable development, in accordance with the general principles of the environmental law. The river basin criterion is only one of many for determining the physical jurisdiction of the regional autonomous corporations.

The law establishes the requirement to obtain an environmental license in order to construct works, to establish industries or to engage in any activity that might be harmful to the environment. Projects for irrigation, drainage, land recovery, flood prevention and the regulation of watercourses to ensure proper management and utilization of river basins remains under the jurisdiction of the departments of local government, which must coordinate their actions with the National Land Development System and the regional autonomous corporation in whose jurisdiction the department is located.

Another important point is the responsibility of the State for promoting the inclusion of environmental costs and the use of economic measures to prevent, correct and restore environmentally deteriorated areas and to ensure the conservation of renewable natural resources.

#### D. DRINKING WATER SUPPLY AND SANITATION

During the 1980s, the coverage of drinking water supply and sanitation services began to lag. Up until then, the sector had been receiving financing from an urban development fund, but this was not sufficient to meet all needs.

Between 1988 and 1989, the sectoral adjustment plan for drinking water supply was established with the specific goal of expanding the coverage of drinking water supply and sewerage services. A US\$ 150 million loan was obtained from the World Bank, and to this were added US\$ 300 million from the system's own resources and from government contributions. In 1989, by Act No. 57, the National Development Finance Office (FINDETER) was set up to enhance the capacity of the municipalities to provide drinking water and sanitation services. This Office began its activities in 1991, establishing ten regional offices in charge of implementing the structural adjustment plan, which was designed to meet needs for physical works and institutional development. FINDETER now serves 600 of the more than 1 000 municipalities in the country.

Decentralization is being implemented in agreement with the sectoral adjustment plan, and responsibility for drinking water supply is being transferred to the municipalities. As a result, there are many instances of successful experiments with privatization and administrative decentralization of water supplies. One example is that of the city of Barranquilla, where the public corporation that had been providing the service went bankrupt because of its constant and rising financial deficits. A mixed corporation has now been set up, with the private sector holding 13% of the shares; this firm is now financially independent and even generates profits.

The Ministry of Economic Development was reorganized in 1992 to incorporate, at the vice-ministry level, of the drinking water and basic sanitation services sector. This was a response to the need of the sector for a new institutional framework that would be more consistent with the ongoing process of decentralization, and to establish adequate standards and information and follow-up procedures. The Higher Council for Urban Development, Social Housing and Drinking Water was set up as an

autonomous advisory and coordinating body to the vice-ministry and the Drinking Water and Basic Sanitation Regulatory Commission was created.

The main duties and powers of the Regulatory Commission are: i) to draft laws to be submitted for consideration by the Government and to recommend the adoption of such regulatory decrees as may be necessary; ii) to regulate free competition and abuse of power by service providers; iii) to set the tariff schedule; iv) to set efficiency criteria; v) to design indicators and models for evaluating the financial, technical and administrative management of utilities and to request evaluation as deemed necessary for the performance of their duties; vi) to set quality standards to be met by utilities; vii) to order the splitting up, merging or liquidation of these companies in certain circumstances; viii) to determine when the works constructed by utilities and the installation and operation of their equipment must meet official technical standards, to promote competition or prevent harm to third parties, and to request the ministry concerned to draw up these standards, if necessary; ix) to adopt such measures as may be necessary to enforce compliance with drinking water quality standards established by the Ministry of Health; x) to settle disputes that may arise between companies; xi) to promote competition between companies and regulate monopolies in this area when competition is not feasible, and xii) to establish criteria and standards for protecting user rights in respect of billing, marketing and related matters.

The social action strategies developed in the National Development and Investment Plan for the period 1995-1998, and known as the *Salto Social*, include targets for improving living conditions, giving priority to the poor, investing in social programmes and overcoming extreme poverty. One of the main strategies is to expand the coverage of drinking water supply and sanitation services.

The investment plan includes a programme for drinking water supply and sanitation which is divided into two subprogrammes. Under the first, local governments will be responsible for managing the services. An effort will be made to attain regional coverage at average levels of 90% for drinking water and 77% for sewerage by 1998, with a view to providing drinking water for 6.8 million additional users, and sewerage for 6.7 million additional users. The quality of water supplies will be improved for all users, the weaknesses of the systems will be reduced and promote sustainable water management with citizen participation.

The second subprogramme entails the creation of a tariff system that will realistically reflect the cost of services and focus subsidies on the poorest sectors of the population; the development of criteria for evaluating the utilities and monitoring their management plans; technical assistance for service providers in order to help them modernize their operations; the drawing up of rules regarding relations with the private sector, and the preparation of a strategic plan to guide their long-term development.

## E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT

The Land Improvement Act was passed in January 1992, and in December of that same year, the Colombian Institute of Hydrology, Meteorology and Land Development (HIMAT) was reorganized, in accordance with the Environment Law. The central idea of the authorities was to privatize, insofar as possible, the irrigation districts that had previously been run by the State, with a view to enabling the sector to become financially independent.

The purpose of this law is to regulate the construction of land improvement projects, so as to achieve irrigation management, drainage or flood protection, and thus improve agricultural productivity and ensure the protection and conservation of river basins. In the future, the managers of land improvement projects will be responsible for obtaining concessions to the necessary surface and groundwater rights. The managers of each irrigation district will be responsible for granting use rights within its area of jurisdiction.

The duties of the technical secretariat of the Higher Council for Land Improvement will be carried out by the National Land Improvement Institute (INAT). The Council's duties include: selecting projects; establishing requirements for projects; defining the forms, terms and related matters of payment, and setting standards and technical and economic criteria for tariffs collected to cover operating and maintenance costs. Likewise, it determines the way in which investment costs will be recovered and ascertains the socioeconomic situation of users who apply for subsidies. The subsidies are granted by reducing or waiving the recovery of the investment costs.

The criteria for project selection include factors such as the interest of the community where the project is to be carried out, the social returns expected from the project, its location with respect to export ports, and the density of small- and medium-scale owners.

Parallel to this, a National Land Improvement Fund (FONAT) was set up, to fund studies, design and construction of irrigation, drainage and flood prevention projects. To apply for benefits under this law, the users in a land improvement district must organize an association that will manage the district.

Every agency in charge of executing works in a land improvement district is entitled to full or partial reimbursement of the investments made. A subsidy amounting to 50% of investment recovery quotas has been set up for small farmers with limited payment capacity.



#### IV. CHILE

Chile was one of the first countries in the region to apply the rules of the market and allow the private sector to manage water resources. The 1981 Water Code sets out the definitions and concepts that govern the ownership and use of water. Under this code, water is a public good and the right to its use is granted to individuals. Water rights are considered private property which, according to the Civil Code, may be sold or mortgaged separately from the land on which the water is located. Water use rights are real and entail ownership rights. An owner is entitled to use the water, to obtain benefits from it and to dispose of it. After the initial concession, the State no longer has authority over how it is assigned, and leaves future distribution of user rights up to market forces. This is tantamount to saying that water receives the same treatment as any other tradable good.

The creation of a water market allows for certain savings to be made at the administrative level, given the fact that it provides for decentralized operations. The role of the private sector in Chile goes beyond the sale of rights, and also includes the management of water use and its assignment to different users, through institutions known as control boards (*juntas de vigilancia*). The role of the public sector, on the whole, is limited to supervising and regulating the actions of the private sector, through regulatory agencies and subsidy programmes. Consideration is currently being given to the creation of an autonomous decentralized system, governed by private law, which would allow for management of the externalities involved in water use. Such a system would entail the creation of a system of river basin commissions.

##### A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

A number of ministries exercise direct responsibility for water resources, but the Ministry of Public Works, to which the Department of Water Resources (DGA) and other institutions belong, plays the most significant role in setting water policy.

The Department of Water Resources is in charge of coordinating and monitoring the management of surface and underground waters. Its main duties are to create and update a registry of all water rights; to plan, monitor and supervise waters in natural river beds, and to exercise oversight of user organizations. Up to now, this has been the agency through which the water law has been applied.

In addition to these duties, which are assigned to it under the law currently in force, the Department of Water Resources is preparing to draft a broader national water policy, and has made considerable progress towards defining the objectives of such a policy. These objectives will be: to ratify, as a basic legal principle, the concept that water resources are a national asset for public use; to prevent pollution and other processes of degradation; to guarantee legal security for users and encourage them to organize associations, and, finally, to include environmental considerations in user rights, in order to

require holders of rights to comply with standards aimed at ensuring the conservation and restoration of the quality of the resource.

Draft legislation has been introduced to amend the Water Code, which has been in force for over ten years. The proposed amendments are aimed, first of all, at restoring the principle that water is a national asset for public use, in order to justify establishing and enforcing certain guidelines in this regard. Since existing legislation allows the granting of unlimited water resources free of charge, with the only requirement that certain administrative procedures be fulfilled, the new proposal provides for limits to be set on the concession of new water use rights by requiring applicants to justify the need for the water requested and to give assurances that it will be properly used.

Standards are also being developed for integrated river basin management and for improving user organizations. The problems currently affecting the river basins, as well as the users, are erosion and silting; droughts and the implications for irrigation; periodic flooding, the damage of which is usually compounded by human activity, and the pollution of virtually all water bodies. To correct this situation, the proposal envisages the creation of an integrated river basin management system. This system would be based on the European experience, but would be adapted to Chilean circumstances. Standards would be established based on the specific characteristics of the different regions, since a very broad law would not take into account the great diversity of environmental systems in Chile, which range from the desert in the north to the cold rainy regions of the south.

Finally, the proposal includes considerations on the impact on third parties of water resource transactions, particularly as regards externalities. Another important feature of the proposal is that it empowers the Department of Water Resources to act in cases of the use of groundwater where externalities involve harm to third parties or pollution of groundwater.

The Department of Water Resources is carrying out a number of integrated water resources management programmes at the basin level, in conjunction with the Department of Irrigation of the Ministry of Public Works. In this regard, an integrated river basin management programme is being proposed within the public sector, with the participation of several state agencies, including the Ministry of Public Works, the Ministry of Agriculture, the Ministry of Planning and Cooperation, the National Environment Commission and others.

The objective being pursued with this action is to establish an institutional infrastructure that will promote the integrated and rational management of natural resources, improve water management systems, and protect and preserve water resources in the urban and agricultural sectors. A pilot study is currently underway in the basin of the Bío-Bío River, with support from the World Bank.

This integrated management effort is intended to address problems such as the improper use of renewable natural resources, conflicts among users, the loss of plant cover, the increase in pollution, erosion and silting; the lack of infrastructure for resource management, and the lack of coordination among the agencies involved in activities within the basins. It should be noted, however, that the proposals and studies on watersheds do not explicitly include the drinking water supply and sanitation sector.

## B. WATER RESOURCES ASSESSMENT

The National Hydrology Service network is made up of approximately 1 600 measurement stations that monitor river flows, sediment movement, water quality, snow accumulation in the mountains, lakes, groundwater levels, glacier balances and a number of meteorological parameters that have implications for water resources.

The National Water Data Bank of the Department of Water Resources collects the information obtained in the field and other information required for the preparation of hydrometric and meteorological statistics, and data on sedimentation and on water quality. The data collected serve as the basis for various regional and national studies which provide a comprehensive view of the country's water resources, as is the case with the study of the water balance in Chile, the national hydrogeological map and many others.

The Water Resources Information Centre is being set up under an agreement with the Pontifical Catholic University of Chile. It will systematize all files, records and inventories.

## C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

According to recent studies, the most serious problems encountered in connection with water resources management in Chile are pollution in the more densely populated areas and shortages in the far north and south of the country. Almost all sewage from the urban and industrial areas is discharged, untreated, directly into the rivers or the sea.

Recently, after more than a year of discussions in the National Congress, the Basic Law on the Environment was passed. This law is both operational, in that it creates tools, and institutional, in that it establishes a management structure. It expresses the central principles of Chile's environmental policy and creates management tools, establishes an institutional structure, i.e., the National Environment Commission, which is presided over by the Minister Secretary-General of the Office of the President and is made up of the Ministers of the Economy, of Development and Reconstruction, of Mining, of Housing and Urban Development, of Transport and Telecommunications, and of Planning and Cooperation, as well as 13 regional commissions.

The main environmental management tool set up under the law is the Environmental Impact Assessment System. Among the projects that must be submitted for this assessment are those pertaining to waterworks, reservoirs or spillways, dams and drainage works, dredging works, levees and any other significant alteration of a water body or a natural watercourse. Environmental impact studies are to be submitted to the National Commission or to the Regional Commission concerned. The Commission then generates mechanisms to ensure the informed participation of the organized community in the process of conducting these studies.

The law establishes procedures for setting environmental quality and emissions standards, standards for project design, and for the presentation of and compliance with water resource management plans, including maintenance of watercourses. It also introduces the general concept of "liability for harm to

the environment." The first environmental quality and emissions standards for water are currently being drawn up, and it is hoped that national emissions standards will enter into force in 1996, and that the environmental quality standards will be ready in 1997. Finally, an Environmental Protection Fund is created for the purpose of funding, either totally or partially, the preservation of nature and conservation of the environmental heritage.

The Ministry of National Defence, through the Department of the Maritime Territory and the Merchant Marine of the Chilean Navy, is responsible for surveillance of coastal and ocean waters and regulating the discharge of sewage from industry, mining activities and local governments into navigable rivers, lakes and the sea.

#### D. DRINKING WATER SUPPLY AND SANITATION

During the early 1970s, sanitation services were provided by many different agencies that had similar duties, were not financially independent and had no global plans or criteria to enable them to develop the sector. In view of this situation, in 1977 the National Sanitation Works Service (SENDOS) was created to merge the entities in the sector into a single institution. SENDOS was created as a State corporation, and was linked to the State through the Ministry of Public Works. It had a national directorate and 11 regional directorates, one in each administrative division of the country. At the same time, in the Metropolitan Region and the Fifth Region independent companies were established, i.e., the Metropolitan Sanitation Works Corporation (EMOS) and the Valparaíso Region Sanitation Works Corporation (ESVAL); they were under the jurisdiction of SENDOS.

In late 1989, it was decided to redefine the role of the State in this sector, relieving it of duties strictly related to providing services, and emphasizing its subsidiary, regulatory role. As a result, an institutional transformation was carried out, according to the following guidelines:

- separation of regulatory functions from production and commercial operations, with each type of function being entrusted to a separate institution; the Office of the Superintendent of Sanitation Services and the regional public corporations were created;
- application of common legislation to public and private corporations operating in the sector;
- establishment of a regulatory framework for the purpose of regulating natural monopolies;
- establishment of a tariff system as an incentive to improve the efficiency of the corporations and provide suitable signs to users and providers of the service, and establishment of a direct subsidy for low-income users.

A legal framework was thus set up to give the sector stability and enable the corporations to obtain the resources they need in order to be able to operate efficiently, generate adequate profits and attract resources from the private sector for development of the services.

Under the General Sanitation Services Act and the relevant regulations, drinking water supply and sanitation services are provided through concessions. Different concessions are granted for supply and treatment of drinking water, distribution of drinking water, elimination of sewage and treatment of sewage. The concessions are granted for an indefinite period, and are transferable. They are granted by decrees issued by the Ministry of Public Works, subject to a report being submitted previously to the Office of the Superintendent of Sanitation Works.

The drinking water supply and sanitation companies offer their services within a given area to both the rural and urban population, in accordance with the terms of their concessions. In rural areas, the regional companies provide the service in collaboration with the drinking water supply committees or cooperatives. The 13 regional companies are incorporated in accordance with the regulations of the Production Development Corporation (CORFO), a State-controlled corporation. The two largest regional companies, EMOS and ESVAL, have some private stockholders (a minority) and their shares are traded on the stock exchange. Some private companies provide services in selected areas, such as the eastern section of Santiago, the city of Valdivia and in a number of tourist centres. Private participation is on the rise and consideration is being given to further increasing it. The Government recently sent to the National Congress a draft law that provides for the possibility of privatizing the sanitation companies. The reasons for this include the need to improve the management of these companies, but principally because the deficiencies in coverage of drinking water supply, sewer services and especially, sewage treatment, make it necessary to invest resources in amounts that cannot be met by the public sector. The project proposes that the State should retain at least 35% of the shares in each regional corporation and sell the rest to the private sector. The transfer of shares would be supplemented by improvements in the regulatory framework, in order to safeguard the interests of users and provide incentives to companies to operate more efficiently.

The Office of the Superintendent of Sanitation Services (SSS) is also responsible for monitoring liquid industrial wastes through Act No. 3133, of 1916. In 1992, draft regulations were drawn up to update the law and adapt it to present circumstances in Chile. Technical standards were also prepared to regulate the discharge of industrial waste into watercourses and sewer systems. SSS drew up a national register of discharges of liquid industrial wastes, which identifies more than 2,500 sources of discharges.

## E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT

In the area north of latitude 32° S, basin runoff is usually insufficient to water all the lands classified as irrigation lands; hence, reservoirs and regulation mechanisms are required, as well as modern, highly efficient irrigation methods. In the central valley, between the Aconcagua and Itata Rivers, there are periods of extreme water shortage. This is an area of high population density and much economic activity, and may be described as a region that has a typically mediterranean climate, with damp cold winters and dry hot summers. Irrigation is needed and most of the water is used for this purpose, but there is also a substantial demand for water for urban and industrial uses.

At present, as a result of both private and State activity, the country has an irrigated area of 1.8 million hectares; however, on 700,000 hectares of this area, the water supply is uncertain. Approximately 75% of agricultural production, equivalent to 7% of the gross domestic product, comes from irrigated areas.

The Department of Irrigation is responsible for studying, designing, building, maintaining, repairing and operating the irrigation works built with public funds that have not been transferred to users.

The National Irrigation Commission, which is part of the Ministry of Economic Affairs, Development and Reconstruction, is responsible for planning, studying and evaluating integrated irrigation projects, supervising the different public and private agencies that operate irrigation projects, and entering

into agreements with individuals or companies for the purpose of carrying out studies and irrigation projects. The Council of the National Irrigation Commission is made up of the Ministry of Economic Affairs, Development and Reconstruction, which presides over it, and the Ministries of Public Works, of Agriculture, of Finance and Planning and of Cooperation.

The Commission is also responsible for applying Act No. 18450, of October 30, 1985, which sets standards for promoting private investment in irrigation and drainage works. Under this law, the State may reimburse up to 75% of the cost of private investment in construction and repair of irrigation and drainage works and in mechanical irrigation equipment, provided that they are intended to expand the irrigation zone, improve the water supply on irrigated areas where there is a shortage, or prepare farm land that does not have adequate drainage. Act No. 19326, of August 29, 1994, amended the previous one and extended its duration. Under the current regulations, financing may also be provided for studies, investment for improving efficiency in the use of irrigation water and the operation of irrigation works, expenses involved in organizing water communities, and drainage works. In special cases, to be determined by the Commission, funding may be provided for irrigation-related works, such as those aimed at solving water problems in the livestock sectors and problems related to rural development.

This law was well received by farmers, and gave rise to considerable demand. Consequently, as applications were received and projects were chosen —through public competitions similar to tenders— the percentage of financing established in the law was substantially reduced, public resources were channelled to priority areas and, in general, the law was applied more efficiently.

The Chilean Water Code stipulates that irrigation users should create associations or other types of organizations to assume responsibility for water management in matters pertaining to construction, operation, conservation and other aspects. These private institutions, known as water communities, canal-user associations and surveillance boards, act with complete independence; for more than a century, they have played an active role in the administration of water resources and the development of irrigation and drainage infrastructure. The Canal Users Confederation of Chile, which brings together the institutions at the national level, plays an important role in Chilean society and has traditionally enjoyed great respect.

Finally, it should be noted that consideration is being given to the possibility of including irrigation works among the public works entrusted by concession to the private sector; as is already the case drinking water supply services, ports and roads.

## F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

It has been predicted that global warming will raise the snow line, and be directly responsible for enlarging the area of catchment basins. This has obvious implications for flood control. In the central region of Chile, for example, it is predicted that the temperature will rise by 3° C by the end of 2030. This will raise the snow line by about 500 metres, thus doubling the area of the river basins. These changes would make it necessary to change the existing infrastructure and construct new works to protect the Andean foothills.

The premature snowmelts that could be caused by global warming will increase the volume of flow of rivers during winter and spring in the watersheds of the central region of the country and in some parts

of the north. In summer, on the other hand, the volume of flow will decrease by about 20%, resulting in an equivalent reduction in the irrigation capacity of the rivers, with negative effects on agriculture.

The greenhouse effect will create a higher rate of evapotranspiration and a decrease in the share of rainfall that contributes to runoff. The 3° C increase in temperature would reduce water yield by between 10% and 15% - under the same rainfall conditions —in rainy areas and the reduction would be much greater in the arid and semiarid regions. It is expected that in the central region of the country, the seasonal differences in runoff will increase and the summer dry spells and winter floods will be exacerbated.

The increase in the average level of the ocean of between 20 and 30 centimeters that is expected by the end of the next century will cause problems in some lowlands, and could affect the salinity in wells, aquifers and coastal springs, as well as coastal protection works and rates of silting. To this must be added the impact of the changes in rainfall, which are still hard to predict.

The Chilean Meteorology Office has suggested that data systems should be strengthened in order to make it possible to predict the impacts of these phenomena on water resources, detect hydrological changes and improve the definition of parameters for models of processes.



## V. MEXICO

Mexico has had a centralized water management structure for many years. Far from being an obstacle to present decentralization efforts, this situation has greatly facilitated them. This is because the persons in charge of the water sector are fully persuaded of the need for these changes and of the advantages they offer. Indeed, they are the very people who have promoted the delegation of management functions and have laid the foundations for the creation of the new legal structure.

### A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

In 1926, the National Irrigation Commission was created in Mexico, which in 1946 became the Ministry of Water Resources. Subsequently, in 1976, it was merged with the Ministry of Agriculture to become the Ministry of Agriculture and Water Resources (SARH). However, since water is not only used in the agricultural sector, in 1989 the National Water Commission (CNA) was created as an independent agency under SARH. Finally, in December 1994, the Ministry of the Environment, Natural Resources and Fisheries (SEMARNAP) was created, and the National Water Commission was kept separate from it. This structure reflects the philosophy that water should be viewed as a natural resource in its own right, separately from the sectors of the economy that use it.

The activities of the National Water Commission are carried out within a broad legal framework, which includes the National Water Act, adopted in December 1992 as the law regulating article 27 of the Constitution, and the regulations adopted in January 1994; the Federal Rights Act, adopted in 1982; the Federal Revenues Act (in force year-by-year); the Act on Contributing to the Improvement of Irrigation Infrastructure Public Works, enacted in 1991; the state laws on drinking water supply and sanitation, enacted between 1969 and 1994 in the 32 federative entities, including the Federal District; the National Assets Act, adopted in 1982; the General Act on Ecological Balance and Environmental Protection, passed in 1987, and the Treaty on Division of International Waters between the United Mexican States and the United States of America, signed on 3 February 1944.

In 1972, the commission for the National Water Plan was set up to formulate a plan and study and propose programmes that would allow for balanced development and more efficient management of water resources in the regions. This commission completed its first text in 1975; it subsequently carried out other studies and updated the plan, and a new edition was published in 1981.

For the period between 1995 and 2000, the Office of the Assistant Director General for Planning of the National Water Commission (CNA) has drawn up a water programme based on the 1981 update of the National Water Plan (which is more in line with changes in demand for water among the different economic sectors) and on more recent assessments of the availability of surface and underground water;

the urgent need for sustainable development has also been borne in mind. The water programme for the period 1995-2000 includes four main programmes and a number of smaller, supplementary ones. These main programmes are aimed at solving problems pertaining to the use of water in agriculture, drinking water, sewerage and sanitation, the hydrologic system and water management. The first two are aimed at developing water resources to ensure their efficient use so as to contribute to the country's development, bearing in mind the need for balance between economic, social and environmental objectives. The water management programme provides for important actions such as updating of the public registry of water rights, granting concessions and permits for water use and for federal zones, collecting payment of water use rights, verifying —by means of measurement— that payments for concessions and permits are collected, regulating the status of water users among others.

## B. WATER RESOURCES ASSESSMENT

The National Water Commission's hydrology system programme envisages two types of actions, namely those of a structural nature, which are geared towards maintaining, rehabilitating and expanding the infrastructure for the regulation and utilization of water for different uses, and those of a nonstructural nature, which are geared towards obtaining detailed information on the hydrological system, in both quantitative and qualitative terms. The subprogrammes envisaged under the nonstructural actions include modernization of water management and support for planning and administration of the resource. In this regard, there are plans for modernizing and expanding the monitoring and data bank networks (in the fields of meteorology, climatology, hydrometry, geohydrology and surface and groundwater quality), as well as the laboratories. Data on availability of water resources will be kept current, and the demand for water in different economic sectors will be assessed, with a view to establishing regional status reports.

In order to facilitate assessment of the availability of water resources and to conduct other types of studies, the country has been divided into 37 water regions, which in turn have been divided into 72 subregions which include 314 river basins.

Under the hydrology system programme, the hydrometric studies will improve as more measurements are made as a result of the expansion of networks. At present, there is a network of 1,320 stations; of these, 1,023 are managed by the National Water Commission and the rest are managed by the Federal Electricity Company (CFE) and the International Boundaries and Water Resources Commission.

## C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

Water pollution caused by discharges of waste water from domestic and industrial sources, drainage of farm lands, leaching of soils, water weeds and marine intrusion in aquifers is a factor that seriously limits water use in most sectors. Consideration is being given to the possibility of setting up special programmes to mitigate and control pollution. In particular, a legal framework has been developed with a view to implementing controls, especially through the regulations of the General Ecological Balance and Environmental Protection Act and the relevant water quality standards, along with the provisions of the

National Water Act and its regulations and the Federal Rights Act, which envisages penalties for discharging waste waters that do not meet standards.

The Federal Water Rights Act, adopted in 1982, sets the amounts to be charged for irrigation services in the districts as well as for the exploitation and use of national waters. In 1986, a change was made with a view to enabling water management services to be financially independent, improve the efficiency of water use and distribute costs among users proportionally to the benefits they obtain from the resources. A further chapter relating to water was added, first it deals with tariffs to be paid by users of water supplied from works built and operated by the federation, and second deals with tariffs for use of water resources belonging to the nation. These rights vary according to the availability of water, with higher rates being charged where water is scarce. The country was divided into four regions, based on water availability.

Finally, another chapter that was added to this law refers to rights to use property that is in the public domain, such as waterbodies used to receive waste water discharges. Sanctions are envisaged for individuals or companies that permanently, sporadically or occasionally discharge waste waters at concentration levels higher than those allowed under the rules in force for rivers, watersheds, streams, reservoirs, sea water or other bodies or streams of water, as well as for anyone who discharges waste waters on the land or allow them to infiltrate land that is public property.

In part this law operates on an annual basis, so that each year some of the articles are amended, particularly those referring to tariffs and rights. The basic purpose is to determine how much the different users should pay for the use of water. Rights to services are established on the basis of the total cost of the service, including finance charges. The amount, the form, the place and the time of payment of rights are established on a case-by-case basis.

Each of the CNA programmes includes actions aimed at attenuating and controlling pollution, especially in the subprogrammes on Clean Water and Sanitation on the Border, which are part of the Drinking Water Supply, Sewer and Sanitation programme. All of these seek not only to reduce pollution, but also to improve public health.

Beginning in 1974, the national water quality monitoring system began operation. Of the 793 stations in current operations, 390 cover 196 rivers and 7 streams; 230 allow for surveillance of wells, springs and natural wells; 74 cover for 42 reservoirs; 49 monitor drainage ditches and channels in irrigation districts; 25 cover 12 coastal zones and 5 estuaries, and 23 monitor 22 lakes and lagoons. The hydrology system also includes a subprogramme on pollution control that is aimed especially at controlling waste water discharges of domestic, industrial and agricultural origin in the 15 most polluted river basins of the country, i.e., the basins of the Pánuco, Lerma, Balsas, San Juan, Blanco, Papaloapan, Culiacán, Bajo Río Bravo, Yaqui, Mayo, Fuete, Coatzacoalcos, Conchos, Coahuayana rivers and the closed basin of the Valley of Mexico. Priority is also given to monitoring pollution caused by land sources in the Gulf of California and the Mexican Caribbean, as these are very fragile systems.

There are other priority problems that also need to be dealt with in each of the 314 river basins in the country. These include groundwater pollution due to saltwater intrusion, the concentration of salts as a result of over exploitation, and urban, industrial and agricultural pollution, as in the case of the aquifers of San Quintín and Maneadero, in the northern part of Baja California; Santo Domingo and La Paz, in southern Baja California; Caborca, Hermosillo and Guaymas, in Sonora; Guadiana Valley, in Durango; the Aguascalientes Valley; the lake region of Durango and Coahuila; the Valley of San Luis de Potosí;

El Mezquital, in Hidalgo; the Valley of León, Celaya and Salamanca, in Guanajuato, and Mérida, in Yucatán, among others.

Efforts are also being made to monitor the main waste water discharges, especially those of domestic and industrial origin, and to promote the installation of treatment plants and/or change water use patterns, to prevent pollution at the source. The goal for the year 2000 will be to ensure compliance with discharge standards in the regions mentioned above, which have priority, and to ensure that ecologically sound practices are applied in the rest of the country, as a preventive measure.

#### D. DRINKING WATER SUPPLY AND SANITATION

It is estimated that in 1995, of the total population of Mexico (91.6 million), 15.1 million did not have drinking water and 30.2 million did not have sewer service.

It has been proposed as a goal to raise the coverage of drinking water supply and sewer service to 87.5% and 76.3%, respectively, during the period between 1995 and 2000. This means that 10.3 million people would receive the benefit of drinking water supply and 14.3 million sewerage. This in turn would represent an 8.3% increase in net demand for water, in volume served.

It is estimated that 13,170 Hm<sup>2</sup> of water are channelled to drinking water supplies and that 5,270 Hm<sup>2</sup> are wasted because of the poor condition of the systems. It is estimated that 6,300 Hm<sup>2</sup> of waste water are generated, and this in turn generates organic matter equivalent to 1.8 million tons per year, of which 1.22 million are collected in the sewer systems and only 15% are properly treated.

In order to improve the drinking water, sewer and sanitation services, the National Water Commission, in collaboration with state and local governments, is taking steps to promote the creation of autonomous agencies, independent of the municipalities, to operate the drinking water, sewer and sanitation systems, in accordance with state laws. In addition, in the major urban centres, there is interest in involving the private sector in the provision of these services through concessions. To this end, the necessary amendments have been made in the existing legal framework. As regards sanitation, the design, construction and operation of integrated systems for the treatment of waste waters in medium-sized cities is being promoted, by means of joint investment or concession arrangements with the private sector, which will make it possible to increase installed capacity.

#### E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT

Given the physical and climatic features of Mexico, most of the country does not have the necessary conditions for rainfed agriculture. In the irrigation subsector, where the harvested area in 1993 was 5,027 million hectares (28.8% of the total harvested area), the value of production represented 56.5% of the total value of agricultural production.

Over the last eight years, the harvested area in regions with an irrigation infrastructure has fallen by close to half a million hectares, partly because producers who were not competitive dropped out of the market. Recent studies conducted by the Graduate School of Agricultural Sciences showed that in

several irrigation districts, the users had transferred their irrigation rights and had leased their lands out because they could not live on the proceeds of their crops. This has led to a drop in the demand for water in this sector.

In 1994, the National Water Commission estimated that the demand for water for the agricultural sector was in the order of 61,135 Hm<sup>2</sup>, of which 41,052 Hm<sup>2</sup> were from surface sources, and 20,083 Hm<sup>2</sup> were from underground waters. It is estimated that on the basis of a rehabilitation of irrigation works and a moderate increase in the area with infrastructure, the demand for water will only increase by 3% by the year 2000.

In general, the sector is faced with serious problems: 92% of the area is irrigated by the gravity method, which leads to substantial waste. In the irrigation districts, the average conveyance efficiency is only 64% and the efficiency of application is even lower. This means that, less than 40% of the piped water is actually used in any district. Not all the "lost" water is wasted, however, since part of it helps restore the aquifers and part of it is used downstream. It is estimated that around 335,000 hectares with irrigation infrastructure are affected by salinity or sodicity; other areas are affected by erosion.

In order to improve water management in the agricultural sector, the National Water Commission is carrying out a number of programmes, some of them structural and others non-structural. Among the latter, the transfer of the operation, conservation and management of irrigation districts to user organizations is of key importance. Between 1989 and June 1995, 80.3% of the total area of the irrigation districts (2,584 million hectares) were transferred; this represents 43 complete districts and part of 15 others. These lands were turned over to 329 irrigation user associations. In addition, seven limited liability companies of public interest, grouping 98 user associations covering an area of 705,592 hectares, were established. These companies have fully taken over the operation of their districts, including the operation and maintenance of the major canal, drainage and road systems. Campaigns have also been conducted to improve the management of irrigation waters and reduce problems of flooding, salinization of soils and erosion.

Among the actions of a structural nature, the following are considered to be the most important: continuation and completion of several major and minor irrigation projects currently in the design or construction stage; rehabilitation of irrigation and drainage infrastructure in several irrigation districts; setting up of a farm development programme, with a view to helping users in the districts to rehabilitate the interfarm infrastructure; construction of farm drainage systems; rehabilitation of saline lands, and modernization of irrigation methods. Other important programmes, on efficient water and energy use and the full use of the irrigation infrastructure, are aimed at restoring the productivity of abandoned irrigation areas.

## F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

In view of the fact that so much of the country is subject to meteorological phenomena that often cause disasters (either floods —usually caused by hurricanes on the coast of the Gulf of Mexico and the Pacific— or droughts), the National Water Commission has set up a national programme to ensure the security of the irrigation infrastructure and preserve its safety and ensure its continued operation. For this purpose, data are supplied daily by 600 weather stations and 200 hydrometry stations; this data is used to forecast and issue warnings about impending disasters. Since this network is still quite small, plans are

being made for its expansion and to improve prevention systems. Regional monitoring guidelines have also been drawn up to provide instructions for dealing with a severe hydrometeorological event.

The National Water Commission, with the direct support of the National Institute of Water Technology (INTA), has conducted several studies on climate change, and it also has programmes designed to study changes in microclimate caused by the drying up or filling of reservoirs and, in particular, by deforestation. Some of these studies attempt to establish a relationship between changes in annual precipitation and runoff rates and changes in temperature and environmental humidity. Studies have been conducted for several years in certain regions, such as the Lerma River and Chapala Lake.

## VI. VENEZUELA

In Venezuela, environmental management, including water management, has as its legal basis in the National Constitution, which provides the framework for the Forestry Act relating to Soils and Waters (1965), which governs the utilization of water resources and stipulates that the protection of river basins, streams and conservation areas is a matter of public interest. The Forestry Act relating to Soils and Waters, along with the Basic Law on the Environment (1976), the Law on the Central Public Administration (1976) and the Law on Land Use Planning (1983), and the recent Criminal Law on the Environment (1992), are the legal instruments that govern the environmental management of the country's water resources.

The Basic Law on Land Use Planning (1983) provides for the preparation and adoption of the so-called "sectoral plans for the development of natural resources", which include plans for the development of water resources; this initiative, however, has not materialized. The law also establishes that certain areas are to be placed under special management for purposes directly concerned with water resources. The rationale underlying the protection of waters and basins or the areas in which they are located is different in each case. In addition, the law regulates water use in each area, depending on the purposes for which they were created.

In 1993, with a view to implementing the recommendations set forth in chapter 18 of Agenda 21, the Ministry of the Environment and Renewable Natural Resources (MARNR) set up a task force made up of the general directors of sectors concerned with the management of water resources. This group developed some proposals for action aimed at implementing some of the suggestions contained in Agenda 21.

### A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

The Ministry of the Environment and Renewable Natural Resources exercises administrative authority for the management of Venezuela's water resources. This Ministry, created in 1976, is charged with ensuring that the country achieves sustainable development and a better quality of life through the conservation of the natural heritage, environmental protection, land use planning, increased awareness of environmental issues and more active citizen participation. The Ministry is responsible for regulating, planning, policy making and implementation of programmes relating to environmental management, surveillance and control.

MARNR is responsible, at the national level, for protecting the environment as a whole and for water resources in particular, including management, use, regulation and other related matters. The *Empresa C.A. Hidrológica Venezolana (HIDROVEN)*, which supplies drinking water and sanitation

services, as well as its regional companies and the Institute for the Monitoring and Conservation of Lake Maracaibo operate under the aegis of the Ministry of the Environment and Renewable Natural Resources. These institutions, along with the local governments and the ministries of Agriculture and Livestock (MAC), of Health and Social Welfare (MSAS), of Energy and Mines, and of Transport and Communications, are responsible for the administration of water resources at the national and municipal levels.

Over the last five years, the financial resources of the Ministry of the Environment and Renewable Natural Resources have been reduced. The Ministry has undertaken a process of restructuring to cope with these restrictions and still meet new needs, both in the nature and in the quality of environmental services; this is a task that requires participation, decentralization and improved efficiency.

The Ministry, as the highest water authority in Venezuela, has not been well organized for the task of managing water resources. Consideration is therefore being given to the possibility of setting up an independent water service (*Servicio autónomo de agua*) to carry out activities considered to be complementary, such as data collection, research and planning, as well as the conservation and management of water and all related resources. This service would have as its purpose to manage water resources, generate data and conduct research on water, land and vegetation, based on the concept of the river basin as the planning and management unit. It would have the following specific objectives:

- to administrate the integrated use and development of water resources, through the granting of concessions, and to coordinate with the competent agencies the creation of other water resources management mechanisms. It would process, monitor and evaluate the concessions, and draw up policies for ensuring the adequate development of this source of financing;
- to enforce a conservationist approach to management of river basins, in order to ensure that the quantity and quality of water meets the needs of all sectors of the country;
- to generate, systematize and interpret, for different purposes, basic data on hydrology, hydrogeology, meteorology, climatology, soils and biodiversity, and to process the data gathered by other agencies, with a view to meeting the country's needs in these areas.

The Ministry of the Environment and Renewable Natural Resources is also responsible for the management of groundwater, and to this end, regulates their use and conservation and of their ecological environment. It may restrict or prohibit the exploitation of aquifers when they have been overexploited or are likely to become polluted. Projects are currently being considered which would regulate the development of groundwater, water resources and river basins. A preliminary water law is also under consideration. All the pertinent legal instruments assign a leading role to the Ministry for the management of water resources; these instruments will also provide the basis for the independent water service. The proposed rules on groundwater regulate the exploration, exploitation, management and use of such waters. Potential use will depend on the quality of the water and its use will be based on plans that assign priority to supplying the population and the low-water-use industries located in population centres.

The regulations on water resources and river basins propose the creation of a national water planning system that would incorporate the regional plans. Some of the actions envisaged are: preparation of a national inventory of resources; preparation and updating of the national and the regional plans; granting of concessions, assignments and authorizations for water development; surveillance and monitoring activities; preparation of studies, projects and standards, and development and promotion activities. The creation of a national planning council for the rational development of water resources has

also been proposed; it would serve as an advisory body to support the implementation of the national plan and the regional plans.

One of the objectives of the regulations is to obtain funds for programmes geared towards conservation and management of water resources and river basins, with the participation of water users, basin residents, and the states, municipalities and other agencies.

The concessions for the use of water can include the operation of the necessary infrastructure for intake, transportation and distribution. Holders of concessions or licences for water development are required to take part in conservation efforts in the river basin, and may be required to propose improvements relating to environmental monitoring, river basin research and surveys and water quality.

The draft water law includes provisions to ensure efficient management, such as decentralization, water quality and tariffs for discharges. In addition, it pursues the following objectives:

- to maintain the existing ownership regime, except that groundwater is declared to be in the public domain;
- to eliminate use rights over public waters, recognizing acquired rights where effectively used;
- to establish the competence of the State to manage water resources independently of who owns or develops them;
- to establish administrative sanctions for those who use water resources irrationally or pollute them;
- to regulate tariffs and fees for discharges that cause pollution;
- to set up a national water resources planning system and mechanisms for promoting decentralization, and
- to create an efficient system for drinking water supply and sanitation services.

## B. WATER RESOURCES ASSESSMENT

The Regulation on water resources and river basins envisages, among other measures, the preparation of a national inventory of surface and groundwater, quality monitoring, and the supervision and control of the use of the resource.

The Ministry of the Environment and Renewable Natural Resources has put underway a project to improve the national hydrometeorological forecasting system (VENEHMET), with funding from the United States Export-Import Bank (EXIMBANK). The general objective is to modernize hydrometeorological forecasting in order to issue timely warnings of floods, droughts and other adverse weather conditions. One of the innovative aspects of this programme is that it provides for the participation of all the agencies involved in water and weather activities, which will be coordinated by the National Meteorology and Hydrology Commission, to avoid duplication of efforts, ensure optimum use of resources and assure that the needs of the different sectors are met.

To obtain accurate information quickly, automatic teleobservation systems will be set up (stations for climatology, hydrometry, water quality, synoptic, agriculture and air quality), as well as a network of weather radar stations; GPS high-altitude climatology systems; lightning detection systems and surface

observatories in airports. An integrated forecasting system such as this will not only save lives but will provide the information to manage and protect water resources, determine their environmental impact and rationalize farming.

### C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

Among the main problems related with water resources faced by Venezuela are: the relative scarcity of water north of the Orinoco River, the progressive reduction in the useful life of reservoirs, the uncontrolled use of water in certain areas, the over exploitation of aquifers, the pollution of waters by untreated effluents, the improper use of land in upper river basins, the lack of protection of wetlands and other aquatic ecosystems, and the indiscriminate occupation of flood plains.

In the Eighth Plan of the Nation (1990-1995), the Government of Venezuela established standards for environmental protection, regional development and territorial security that are aimed at strengthening institutional mechanisms so as to prevent and reduce damage to the environment and promote regional development without degradation of natural resources in the regions. In this regard, the following strategies have been defined:

- legally require that industries causing a high level of pollution install physical and/or chemical monitoring devices;
- to impose pollution fees;
- to build, at the expense of the public sector, waste treatment plants,;
- to strengthen educational, communication and artistic activities aimed at increasing awareness of environmental issues and creating a conservation-minded culture.

In addition to the prevailing concern for conservation and environmental management, the creation of the special management areas (ABRAE), along with the corresponding regulations on their use, arises from the need to set aside certain areas outside the general legal framework for use envisaged for the rest of the country, basically under the civil law, for the purpose of placing them under protective restrictions, as envisaged in the relevant declarations. At present, there are thirteen national water reserves, totalling 1.7 million hectares; six critical areas for priority treatment, covering 3.6 million hectares; 38 river basin protection zones, with a total area of 11.7 million hectares, and two zones for the construction of dams and reservoirs, covering 7,000 hectares. All together, these areas account for 8.66% of the national territory and 25.71% of the protected natural spaces in the country.

In order to manage the wetlands established by governmental decree as special management areas, the law has mandated the drawing up of a legal instrument to establish zones, regulate use and activities and set up programmes for the management of resources and maintenance of the environment, in order to guarantee sustainable development.

The Ministry of the Environment and Renewable Natural Resources is presently implementing the project on river basin conservation and management, funded by the Inter-American Development Bank (IDB), the purpose of which is to contribute to the rational management of the renewable natural resources in the basins of the Yaracuy, Tocuyo and Boconó Rivers. This will improve living conditions among the rural populations in these areas. This project represents the first stage of the Ministry's

national river basin conservation programme. To ensure continuity, the project includes the preparation of feasibility studies and the design of the next stage, which will cover from three to six basins. The specific objectives of the project are:

- to reduce erosion, which affects crop and livestock production in the zones covered by the project, and promote sustainable development of renewable natural resources;
- to prolong the useful life of the existing water and road infrastructure;
- to reduce local deforestation processes, and
- to reduce the risks of flooding and the resulting damage to the affected populations, especially in the urban areas.

The regulation of the basic environmental law, related to environmental impact studies and which has been in force since 1992, is applicable to water projects and to activities that have the potential to pollute water. The Ministry of the Environment and Renewable Natural Resources is focusing on the application of this regulation, which represents one of the most useful tools for planning and preventive monitoring of activities that have the potential to degrade the environment. In addition, environmental hearings have begun to become useful follow-up mechanisms for monitoring compliance with existing rules.

In respect of water quality, activities have focused on the drawing up of technical standards for establishing permitted quality levels in all bodies of water. The Basic Environmental Act provides the legal framework, while the technical standards, of sublegal rank, refer to water pollution. The main objectives of these standards are:

- to regulate discharges by the private sector, bearing in mind the specific characteristics of the bodies of water and the quality desired, which are to be determined in terms of the uses that will be given them;
- to enable public corporations that are in the process of privatization to continue operating under clear rules, until such time as they are able to take the necessary steps to adjust to the new environmental standards;
- to put underway quality plans for the water bodies, which take account of specific conditions and which specify in detail the steps to be taken in order to achieve the objectives, and
- to establish an overall system of quality control for discharges.

Although these regulations envisage sanctions for discharging polluting effluents and establish quality standards, they do not provide for compensation to be paid for damage done to water quality; such a measure is envisaged in the proposed water law.

#### D. DRINKING WATER SUPPLY AND SANITATION

Until 1991, the National Sanitary Works Institute (INOS) provided water supply and sewer services for a large proportion of the Venezuelan population. INOS focused on the construction of large-scale works, and assigned lower priority to rehabilitation, operation, maintenance and marketing of services. In addition, its inflexible centralized organizational structure led to a sharp decline in services and increased dependency on transfers of resources from the central government. In 1989, in response to concerns of a political, financial, economic and social nature, a process of administrative decentralization and

restructuring of services was begun, and steps were taken to allow private sector participation in areas that had traditionally been reserved for central government.

In 1991, HIDROVEN and ten regional corporations began operations. HIDROVEN, following the policies of the Ministry of the Environment and Renewable Natural Resources, has as its mission to draw up guidelines to be followed by the regional water corporations and other agencies responsible for such services. In addition, it coordinates, supervises and monitors the work of these corporations, under agreements between the regional corporations and municipalities and other local bodies. In the states of Amazonas, Bolívar and Delta Amacuro, services have been managed by the *Corporación Venezolana de Guayana* (CVG).

The regional water corporations, constituted as limited companies, are not only responsible for providing all water services, but they have also promoted the creation of operating companies involving the participation of municipal and regional governments, which will eventually take over the services. During the transition stage, the corporations will receive funds from the national government in order to cover their operating and maintenance costs, until such time as the necessary rate increases go into effect. The companies have the following duties: i) operation, maintenance and rehabilitation of service systems, ii) billing and collection of tariffs for services provided; iii) meeting the costs of the operation and management of the systems; iv) promoting the creation of local operating companies, and v) carrying out necessary new works or expansion of existing infrastructure.

No significant progress has yet been made with regard to the participation of the private sector, nor have the different water corporations become financially independent. Basically, this is due, to the economic and political instability of the country, which has prevented a realistic adjustment of utility rates. However, some small progress has been made towards ensuring the financial independence of the water companies, especially in the setting of tariffs and their collection; these amounts, however, do not even cover the operating and maintenance costs, although an adjustment is being assessed.

As there are still a number of issues, both internal and external in nature, that have hindered proper water management, in late 1994, HIDROVEN began to make adjustments for the drinking water and sanitation sector, with a view to achieving levels of coverage that would be financially sustainable and thus make it possible to offer both efficient service and reasonable rates. To this end, three basic strategies were outlined, namely: to work further on decentralizing the service, to redirect financial resources, and to improve the institutional capability of the companies in the sector.

The premises on which these strategies are based are:

i) The national government will stop intervening in the provision of services, and its role will be to regulate, monitor and offer technical assistance to the sector. The municipalities will be responsible for providing services, preferably through operating companies, depending on the population served, the demand and the financial viability of each region or locality;

ii) The tariffs to be charged must cover the operating costs of the companies and the investment requirements of the service;

iii) A general regulatory framework will be established for the sector which will clearly outline the spheres of competence of the different levels of political and regional authority, create a national

regulatory agency, establish mechanisms for evaluating the performance of the sector and propose ways to encourage private initiative, and

iv) The municipalities will participate in joint financing investments in the sector, with a view to maximizing their sources of income and exercising their capacity to levy taxes.

The Ministry of Health and Social Welfare (MSAS) is responsible for applying health policy. Among other things, it is in charge of designing programmes and coordinating, supervising, directing and regulating water supply and sewer services in all rural communities.

## E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT

The lands with the greatest production potential are in areas most intensely urbanized. In these areas, there is little or no rainfall for between four and six months a year, making irrigation a necessity. Many public and private irrigation works have been developed, especially in the Andean valleys, where intensive use is made of highly advanced microirrigation technology, and in the semiarid regions, especially in the Quibor Valley and the state of Lara.

The Ministry of Agriculture and Livestock (MAC) is responsible for setting irrigation policy in coordination with the Ministry of the Environment and Renewable Natural Resources. This Ministry is responsible for the supervision, monitoring and maintenance of irrigation works, a duty it carries out through the General Directorate for Sanitation and Irrigation.

At present, a total area of approximately 450,000 hectares is under irrigation throughout the country; however, the physical infrastructure has the capacity to irrigate approximately 1.7 million hectares. There are certain institutional limitations, however, which cause the physical infrastructure of the public systems to be underutilized and deteriorated; users are not well organized, and production and productivity are low. All this often makes it difficult to ensure optimum use of water and to reassign in line with real priorities.

As an exception to this situation, the successful private irrigation systems should be noted, particularly in the upper valleys of the Andean region, where farmers have organized into irrigation committees or boards of irrigation users. This has enabled the Ministry of Agriculture and Livestock to transfer to the user associations all matters pertaining to the management, operation and maintenance of the systems. In fact, one of the most controversial issues in the process of drafting the water law has to do with determining the criteria that should be applied to the use of water for private irrigation.

Irrigation users are in the process of becoming organized, and are being encouraged to do so by the regional water corporations. Also, it is hoped that through the concessions programme, users will take an active part in providing services and protecting the resources they use. The National River Basin Conservation Programme, begun by the Ministry of the Environment and Renewable Natural Resources with support from the Inter-American Development Bank, is aimed at promoting sustainable development based on the rational use of renewable natural resources, as a way of improving social and economic conditions among the small-scale farmers living in the river basins involved. It is hoped that farmers and communities will play an active role in this process of technological change.

## F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

Despite the significance of climate change to the development of the country, Venezuela has so far conducted very few studies on this problem. The international workshop on variability and climate change in Venezuela and the Caribbean, held in Mérida in 1990, produced the first scenarios on climate change (rainfall and temperature) in Venezuela, and there was general discussion of the potential impact that changes in temperature and rainfall might have on agriculture (corn production was taken as an example) and on the water resources of the country.

A preliminary assessment has been made of the impact of global climate change on the hydrological characteristics of three river basins (Catatumbo, Machango and Maticora Rivers) located in western Venezuela. This study was included in the General Report on the Potential Impacts of Global Climate Change on Agriculture, Terrestrial Ecosystems and the Water Resources of Venezuela, prepared by the "Pan Earth" project for the Ministry of the Environment and Renewable Natural Resources in 1991. Researchers in the tropical climate unit of the Inter-American Centre for Environmental and Territorial Development and Research (UNECT-CIDIAT) and of the University of the Andes are working on a project evaluating the potential effects of climate change on erosion in the Motatán River basin, in the state of Trujillo.

## VII. OTHER COUNTRIES

Other countries are in situations similar to those of the countries discussed in the case studies. Despite the progress that has been made in the area of environmental legislation, and specifically in the conservation and rational use of water resources, the existing regulations often seem to be more like a statement of principles than a set of practical provisions that can be put into operation. Nevertheless, some countries do seem to have a clear frame of reference for the management of their water resources. Up to recently, however, the existence of many different agencies have been involved in this area, has led to conflicts of competence which hinder efforts to achieve integrated development of the water resource.

### A. INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT

Most Latin American and Caribbean countries do not have real experience with the integrated management of water resources; in most cases, the resource has been managed on a strictly sectoral basis. There are a few experiences with river basin management, including the creation of committees made up of the different water authorities and other concerned parties, which have as a goal the integrated management of the quantity and quality of water in the basin. Most of these entities have not made significant progress towards achieving truly integrated management, because of the lack of financial resources and their dependency—in administrative and financial terms—on the different government agencies they are under. Nevertheless, some of them have provided significant technical support to management.

In Cuba, water resources management is centralized under the National Water Resources Institute (INRH), which is responsible for directing, executing and monitoring state policy on all matters pertaining to water resources. The main components of the national environmental strategy, as regards integrated management, protection and use of water resources, are: i) to organize and provide for the integrated management of water resources and to maintain the relevant infrastructure; ii) to ensure a stable supply of drinking water and sanitation services for urban and rural communities, and iii) to improve the legal framework for the management and protection of water resources.

Recently, the National Water Resources Institute has conducted comprehensive geographic studies of the main river basins of the country, i.e., Toa-Duaba, Agabama, Cauto and Cuyaguateje. An investment programme is being designed in order to ensure sustainable development based on comprehensive up-to-date planning and organization of water and land resources. This programme, which is organized regionally, is aimed at grouping river basins, with a view to balancing current water needs with the future population, agriculture, industry and stock raising, as well as, ensuring protection and conservation of the resources. In the study demand management will be assessed in terms of efficient water use, costs and benefits, and use indicators will be developed for the different industrial activities

legal framework will be improved in order to allow for more efficient water use and better protection of the water resource. The National Water Resources Institute is designing systems for measuring and monitoring water use. A programme has been set up to install water metres; its implementation will depend on community participation in the different local and regional governments and in non-governmental organizations. The participation of certain sectors of the population, especially women and the young, will be particularly important.

Recently, in **Costa Rica**, a number of structural changes have been made aimed at directly promoting water resource management. Since 1994, the political constitution has stipulated that everyone has the right to live in a healthy and ecologically balanced environment, to denounce any act that endangers the ecological balance, and to seek reparation for any damage caused. The State has the obligation to guarantee, protect and preserve these rights.

Another recent legislative advance in regard to environmental matters, specifically the conservation and rational use of water, was the enactment in 1995 of the basic environmental law, No. 7554. This regulatory instrument stipulates that water is in the public domain, and that its conservation and sustainable use are of social interest. It also establishes that, in order to achieve conservation and sustainable water use, every effort must be made to protect, conserve and, insofar as possible, restore water ecosystems and those elements that play a part in the water cycle; to protect the ecosystems that make it possible to regulate the hydrological regime, and to maintain the water balance, by protecting individual components in a river basin.

In **Guatemala**, public management of water is carried out by many centralized, decentralized, autonomous, regional and special institutions. Some, like the National Electrification Institute (INDE), pursue sectoral objectives; others, like the municipalities, cover specific areas, and some have special purposes such as the National Environment Commission (CONAMA), which monitors water pollution, and the Ministry of Public Health and Social Welfare, which ensures that water for human use is potable. All these agencies together, however, have not been able to organize the use of water resources, meet the demand, protect water resources or forecast future needs. They have not coordinated their work, whether by planning, execution, evaluation or in any other way.

Except for the Lake Amatitlán and Lake Atitlán Authority, not a single organization in the country has addressed water management at the level of the river basin, political-administrative or hydrological regions. The State has promoted pilot projects in certain river basins, and the user associations established in some public irrigation districts have recently undertaken the operation, maintenance and conservation of works, as well as the management of the water resource in their areas. There are many neighbourhood committees in villages and towns which have submitted requests for drinking water services to government agencies and/or nongovernmental organizations. However, there is no public or private culture of integrated and coordinated management of the water resource.

In 1992, the Secretariat of Water Resources was set up under the Presidency of the Republic. Its duties are to coordinate sectoral and specific planning processes with the national planning process, and to coordinate conservation activities by promoting shared objectives, principles, strategies and actions. This Secretariat will be responsible for water management at the national level, once the general law on the matter is enacted.

In **Saint Lucia**, there is still no legal framework for global management of water use. Each sector has its own framework and its own legal regulations. These include the Water and Sewerage Authority

(WASA) and the Forestry Division and the Lands and Waters Unit of the Ministry of Agriculture. Although work has begun on the drafting of a law that would create a water resources management department, there is still no unified approach to the issue.

In **Peru**, the Ministry of Agriculture (MINAG) has drafted a law which is still under discussion by the Congress of the Republic. This draft provides for the development, preservation and conservation of surface and groundwater in the national territory. It would also assign a real value to water resources, and rationalize their management, development and conservation on the part of all users and sectors concerned, in order to prevent deterioration and improper use of water.

Since water resources belong to the nation, anyone —individuals or companies— may use and develop them, provided they obtain the rights to such use. Water rights are considered a real right which entitles the holder to exclusive use or to develop the resource concerned for any purpose, in according with the laws currently in force. Under the rules on real rights set forth in the Civil Code of Peru, water rights may be transferred, transmitted, pledged as collateral or mortgaged separately from the land on which the water is located or the activity for which it is used.

The distribution of waters in natural springs and water works is the responsibility of water user organizations (which will be called in future basin user boards) and canal commissions (previously called irrigation user commissions). In addition to distribution, these groups are also responsible for making appraisals and conducting hydrological studies on the care of river banks and of river basins in general.

Measures will be taken to prohibit alterations in the quality of surface and underground waters, in order to protect human health, as well as the fauna and the flora. To this end, the environmental authority is to establish water quality standards for certain uses in certain places.

Administrative jurisdiction over the waters is to be exercised by the following authorities, listed in order of rank: the National Water Council, the River Basin Directorate, the Sub-Directorate for River Basin Management and the Public Registry of Water Rights. The National Water Council, will have among its responsibilities the final decision on matters concerning the granting, use and modification of water rights. This Council is independent of the Ministry of Agriculture, and is made up of six directors appointed by supreme decree; one of their most important duties is the appointment of river basin directors.

## B. WATER RESOURCES ASSESSMENT

The National Programme on the Environment and Development of **Cuba** includes within its objectives: to improve water resources appraisal techniques and services, and to provide efficient and practical means for water collection and storage and for the preparation and dissemination among users of information on the quantity and quality of available water. Water quality is monitored by means of the water quality network, which is made up of 1,800 stations distributed throughout the country; 34% of these monitor surface waters and 66% monitor groundwater.

In **Guatemala**, the national network of water stations is operated by the National Institute of Seismology, Volcanology, Meteorology and Hydrology (INSIVUMEH), which operates weather and hydrometric stations. In addition, other bodies, such as the National Electrification Institute (INDE), the

Electric Power Company, the Ministry of Agriculture, Livestock and Food, the Military Geographic Institute, Guatemalan Railways (FEGUA), certain municipalities and several individuals keep specific records on these processes. Of the 226 hydrometric stations that have been set up, only 93 are in operation. Of the 255 weather stations, only 160 are in operation. In several hydrometric stations sediment samples are taken which has allowed the physical and chemical properties of 26 rivers in the country to be determined. These measurements complement those made in the agricultural sector. A greater number of measurements have been made in rivers such as the Villalobos and the María Linda. Data on water quality are not standardized and are not available on a general basis nationwide.

Not only has the number of stations been reduced, but there has also been a significant reduction in the services provided by the stations. Data are not available on an ongoing basis, but only sporadically and at fairly long intervals, and the specialized staff has almost disappeared.

In **Saint Lucia**, all the agencies that are concerned with water resources are responsible for monitoring water quantity and quality. The Ministry of Agriculture, through its Forestry Division, and the Water and Sewerage Authority (WASA) jointly monitor water quantity, working in coordination in order to avoid overlapping of duties. Unfortunately, this service does not cover the entire island, but WASA intends to monitor all watercourses with a view to collaborating in the drawing up of strategic plans for the future. WASA is setting up a special division on strategic planning in order to improve management of the water balance. The Caribbean Environmental Health Institute is playing an important role in quality control in respect of watercourses and coastal waters. It also provides similar services to other countries belonging to the Organization of Eastern Caribbean States (OECS).

In **Peru**, the National Institute of Natural Resources (INRENA), sponsored by UNESCO, is conducting river basin studies, with a view to preparing regional water balances. The University of Piura and the National Meteorology and Hydrology Service (SENAMHI) are participating in this effort. In addition, an appraisal of the use of water resources by different productive activities in Peru is being undertaken, with support from the United Nations Development Programme (UNDP), in the context of efforts to promote the sustainable use of water resources.

### C. PROTECTION OF WATER RESOURCES, WATER QUALITY AND AQUATIC ECOSYSTEMS

Many countries have taken innovative approaches in evaluating water quality, but less so in the evaluation of supply. However, although some countries have greatly improved the technology used for assessing supply, they have done very little to assess demand. Demand assessment is the basis, in particular, to establish the origin, magnitude and nature of potentially harmful discharges.

In **Peru**, it has been found that a significant percentage of the natural resources of the country show signs of pollution, sometimes at critical levels of environmental deterioration. Natural disasters and other less obvious forms of deterioration, once identified, are practically irreversible. Desertification, deforestation, deterioration of soils, urbanization of farm lands, depletion of water sources and of flora and fauna are some of the environmental problems faced in Peru. There is a new awareness of the need to protect the environment and improve the living standards of the population, as well as, to respect the rights of future generations. In the absence of a nationwide study of the quality of water used for different uses, the National Institute of Natural Resources (INRENA) is conducting an inventory of water quality,

which will soon be published. One of the important results of this inventory is that it has led to the creation of a new classification system for water use and the identification of the main causes and the extent of pollution throughout the country. There are still few controls and little monitoring of the quality of water for human use. Only the major cities, where approximately 62% of the urban population live, carry out regular surveillance of water quality. Little is being done in this regard in the rest of the cities of the country.

Chapter XII of the basic environmental law of **Costa Rica** stipulates that water is in the public domain, and that its preservation and sustainable use is, therefore, in the public interest. Articles 51 and 52 provide that in order to ensure conservation and sustainable use, as well as the operation and management of drinking water systems, it is essential, on the one hand, insofar as possible, to restore water ecosystems and the elements that play a part in the hydrological cycle; and, on the other, to protect the ecosystems that make it possible to regulate and maintain balance in the water system, protecting each component of the river basin. The article is, however, more a statement of principles than a set of practical provisions, but it does provide a clear frame of reference for the water management, particularly for the supply of drinking water.

In **Saint Lucia**, the pollution of watercourses could cause damage to the quality of coastal waters. The Ministry of Health exercises overall responsibility for dealing with this problem, but when a watercourse is the source of a drinking water supply, the responsibility is exercised jointly by the Ministry of Health and the Water and Sewerage Authority (WASA). When there is deterioration in a river basin, responsibility is shared between the Ministry of Agriculture and WASA.

In **Cuba**, action is being taken to improve protection against pollution and to preserve water quality. A river basin approach is taken to water resources management, which includes systematic monitoring of water quality, treating water for human consumption, and ensuring adequate disposal and/or recycling of liquid waste, with special emphasis being placed on monitoring the level of pathogens in raw water (sources) and sewerage, in the interest of protecting public health.

The objective is to design, on the basis of general and regional schemes for integrated utilization of water and land resources, a system of larger regions involving the organization and management of river basins. The idea is to prepare strategies for an ecologically rational organization of freshwater systems and their interrelations with coastal water systems, bearing in mind the fishery and farming activities involved and the need to maintain biological diversity. At the same time, efficient pollution prevention and control programmes will continue to be implemented, environmental impact will be assessed and improved standards will be developed for both specific and nonspecific pollution sources, taking account of the future social and economic development of the country.

#### D. DRINKING WATER SUPPLY AND SANITATION

During the 1980s and the early 1990s, basic sanitation services were seriously affected by the economic recession experienced by most countries in the region. Recently, however, there have been some change for the better, and improvements have been made in drinking water and sanitation services, with special emphasis on making them financially independent. In several countries, the revitalization of the sector has been accompanied by the transfer of services, in most cases by means of concessions, to the private sector.

In **Costa Rica**, for example, the Costa Rican Water Supply and Sanitation Institute (A y A) has been reorganized. Many levels of management have been eliminated, and the structure has been streamlined in order to improve efficiency. Productivity goals have been adopted with a view to expediting and improving the quality of customer services. The studies carried out in preparation for the reorganization made it possible to identify those areas of operation that might be taken over by the private sector. This reorganization represents a first stage in preparation for the adoption of new means for the management and operation of drinking water supply services. As the sphere of operation of the Water Supply and Sanitation Institute is more clearly defined, it will be possible to identify the policy and regulatory functions that should remain under state supervision.

A part of the process of reform of the public sector in Costa Rica, has involved changes in the public drinking water supply and sanitation services. In order to achieve this a draft law, entitled the Creation of an Institute to Regulate Water and Sanitation Services and Regulation of Operating Companies, has been drawn up. This Institute would be responsible for setting standards, planning and monitoring, making policy and drawing up guidelines for public drinking water and sanitation services.

Under this law, the service operators could be public, mixed or private companies or companies and institutions—such as cooperatives and associations specifically related to water management— created by special legislation.

In **Saint Lucia**, the Water and Sewerage Authority (WASA) is in charge of drinking water supply. It is also responsible for ensuring the conservation, the expansion, distribution and proper use of such resources, including the preservation and protection of river basins and the treatment and elimination of sewerage and other effluents. In the future, WASA will be expected meet all its operating costs. All consumers will, therefore, be metered and will pay a tariff based on the amount consumed. WASA has recently been the subject of studies by consultants. One of the options, which the consultants were asked to investigate, was privatization. In their preliminary report, the consultants did not recommend privatization, but they did point out the lack of a regulatory framework. For sewerage, WASA recently changed the sewer tariff system, which is now based on the estimated annual rental value of the property to one based on the volume of water used.

The new Constitution of **Peru** establishes that the municipalities are responsible for providing public services. The public sector, which has been considered inefficient, is reorganizing and rationalizing its services, and, at the same time, creating the conditions to allow for the private operation of utilities. A series of measures have been taken and legal instruments have been issued to change the institutional environment and adjustments have had to be made to ensure an adequate organization. The main initiatives and legal steps that have been taken in connection with drinking water supply and sanitation services are listed below:

- Legislative Decree No. 674, of September 1991, promoting private investment in State enterprises.
- Legislative Decree No. 627, of November 1991, promoting private investment in sanitation services, leaving the granting of permits to the municipalities.
- Decree Law No. 25491, of May 1992, providing for the merger of the Ministry of Housing and Construction and the Ministry of Transport and Communications, and the transfer of the Drinking Water and Sewer Service of Lima (SEDAPAL) to the Ministry of the Presidency, thus separating it from the rest of the sector, which still remains under the Ministry of Housing, Construction, Transport and Communications.

should contribute towards the conservation of water resources and mitigate the current trend towards degradation. It is also hoped that by the year 2000, at least 50% of the urban population will have sewer services and that the remainder will have environmentally sound disposal systems.

Steps are being taken to modernize the operation and maintenance of water supply and sanitation systems through centralized operations, efficient measurement of consumption, uninterrupted operation and systematic planning for the application of conservation and rehabilitation technologies. To complete the reorganization of the sector, funding mechanisms will be improved and technical and administrative procedures will be implemented that will ensure greater efficiency in the utilization and operation of the main water supply and sanitation systems in the country. These measures will help reduce the current tendency to grant increasing amounts of budgetary resources for subsidies.

In **Guatemala**, the problems of the drinking water supply system may be viewed from the standpoint of three basic parameters: the current deficit in coverage in the urban and rural sectors (56% and 44% respectively, in 1995); the high population growth rate (nearly 3% per year), and the anticipated increase in per capita consumption over the medium term. The problems faced in sewerage services are even more serious, inasmuch as there is a 56.5% deficit in sewerage coverage nationwide; this is further aggravated by the fact that in the rural areas, although the number of latrines available is considerable, most of them are not in use. In this regard, it is especially important (in order to avoid serious pollution of rivers and other water bodies) to implement a large-scale programme to ensure proper elimination and treatment of sewerage. It should be noted that some steps have been taken in this direction in Guatemala City. Thanks to technical assistance received from the Government of Japan, a system is being implemented, by stages, that will provide proper sanitation services to the metropolitan area, which is the main focus of pollution of water for domestic and industrial uses in the country.

#### E. WATER FOR SUSTAINABLE FOOD PRODUCTION AND RURAL DEVELOPMENT

In almost all the Latin American and Caribbean countries, the largest percentage of total water use is taken up by agriculture. In many countries, except for a few Caribbean islands, agriculture accounts for more than 80% of total water use.

In **Cuba**, where there has been a considerable increase in the area under irrigation, official policy is aimed at ensuring proper operation and maintenance of the existing irrigation systems and improving the efficiency and productivity of water use in agriculture. To this end, steps have been taken to develop and improve irrigation technologies that will make it possible to improve the efficiency, productivity and utilization of water through the implementation of integrated regional systems, which will respond to the problems of drainage and salinity, with an emphasis on irrigated areas. At the same time, appropriate and ecologically sound aquaculture technologies are being introduced, and efforts are being made to ensure the sustainable development of fisheries. The goal is to achieve sustainable aquaculture practices.

In order to ensure the sustainable development of agriculture in **Peru**, the Ministry of Agriculture has developed guidelines for the sector which include natural resources management. In essence, these standards are: appointment and strengthening of water and river basin authorities responsible for water management and for the collection of water use tariffs, in coordination with user boards and irrigator commissions, and the implementation of programmes in the following priority areas: up-to-date

- The basic law of the Ministry of the Presidency, of June 1992, providing for the National Drinking Water and Sewer Service (SENAPA) to be transferred to the Ministry of the Presidency.
- Decree Law No. 25738, of September 1992, stipulating that all sanitation services are to be carried out by the Ministry of the Presidency, and providing for the transfer of the General Directorate for Basic Sanitation, the Executive Unit of the National Drinking Water and Sanitation Programme and the Rates Commission (CORTAPA).
- Decree Law No. 25965, of December 1992, creating the Office of the National Superintendent of Sanitation Services as the agency in charge of proposing standards for sanitation services, monitoring and developing these services and assessing the performance of the entities providing the services. Parallel to this, Decree Law No. 25973 providing for the dissolution and liquidation of the National Drinking Water Supply and Sewer Service (SENAPA).

The Office of the National Superintendent of Sanitation Services is a decentralized agency of the Ministry of the Presidency which operates autonomously—in economic, technical, financial and administrative terms and is responsible for supervising sanitation services to ensure that they are provided under the best possible conditions. The operators of services are local agencies under the municipal governments. The Executive Directorate for the National Drinking Water and Sewer Programme's Special Project is an agency of the Ministry of the Presidency, set up as a temporary body to carry out the improvement programme for the basic sanitation sector.

The general law on Sanitary Services provides for private sector participation in the operation of sanitary services, as a way to solve the serious problems the country faces in this area. It may be assumed that the private sector will only invest in locations where they can be assured of a reasonable return; the State will then be able to concentrate on the low-income areas that the private sector will not be interested in. The private sector will be able to increase its investment in providing services to the extent that its own economic situation can be improved.

At present, the deficiencies of the sanitation infrastructure are so overwhelming that it will be difficult for the companies to provide the necessary funds. State support may be required in channelling potential technical and financial cooperation to this end, and in determining national priorities for the sector.

In Cuba, drinking water supply services are well developed, but 17% of the urban population and 22.2% of the rural population still do not have access to them. The supply of these services is somewhat irregular, pressure in the distribution systems is low, and they are not adequately maintained. The urban areas have sewer systems; in the rural areas, sanitation services consist of sanitary latrines, and in the less populated rural areas, unsanitary latrines. Only 21.6% of waste waters are treated, and the remainder are discharged directly into rivers and streams or into coastal waters.

Government policy is aimed at providing coverage for the entire population, improving services in the cities and extending coverage in rural areas. To this end, it is taking steps to improve operating efficiency and to better integrate the water supply and the management and elimination of liquid and solid waste. Financing for the sector needs to be rationalized, and investments must be selected more carefully.

The specific goal is that by the year 2000, 95% of the urban population should have water in their homes, and clear guidelines for use should be established for the big cities. Improving the levels of supply

technology for water management for irrigation, rehabilitation and maintenance of irrigation and drainage infrastructure, recovery of degraded lands, use of groundwater and treated sewage waters, and investment in small- and medium-scale irrigation works.

#### F. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

Despite the understandable concern in many Caribbean countries about the potential effect of global warming on sea levels, few countries have reported any systematic action on their part to assess the local repercussions of climate change. Some interesting studies have been conducted in **Peru** on long-term forecasting of the effect of the El Niño current on the weather, with a view to adjusting cropping systems. This is an example of what could be done by the countries in the region, but it is the only example.

In **Cuba**, there is an interest research on climate change, and to this end, steps are being taken to improve the process of collecting, confirming and maintaining hydrology and water quality data. Deterministic and stochastic hydrological models are being developed in order to assess and forecast the influence of climate change on the water system, with a distinction being made between the anthropic and the climatic effects.



## CONCLUSIONS

### TOWARDS SUSTAINABLE MANAGEMENT OF WATER RESOURCES

This study shows that progress has been made towards achieving sustainable and integrated management of water resources in Latin America and the Caribbean, although much still remains to be done to fulfill the agreements set forth in chapter 18 of Agenda 21. However, it is obvious that those countries whose water resource management institutions are better organized are able to respond more rapidly and more effectively to the management problems mentioned in Agenda 21 and to emergency situations such as the cholera epidemic in Costa Rica and Chile and the water-related natural disasters, as in Cuba. When water resources management is weak or responsibilities are scattered, response to emergency situations and to ongoing problems will often involve a great deal of effort, but the activities will be overlapping and ineffective, with no continuity or guarantee of success. Similarly, when the water sector is better organized, as in Mexico, changes in policy can be introduced more rapidly and effectively.

The years between the United Nations Water Conference, held in Mar del Plata in 1977, and the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, may be divided, as far as Latin America and the Caribbean are concerned, into three distinct periods. The first, from 1977 to 1982, was characterized by unprecedented economic growth. However, this period was followed, from 1982 to 1990, by the most serious economic recession since the 1930s. From 1990 onwards, most of the countries of the region began another period of growth and have recovered, to a large extent, from the recession of the 1980s. In many countries, the recovery almost coincided with the holding of the United Nations Conference on Environment and Development; in some it started somewhat earlier, and in others, economic recovery still is not fully consolidated.

Both the boom of the 1970s and the recession of the 1980s diverted interest from the situation of the public sector, and this was reflected in a lack of innovation in matters pertaining to water resources. Indirectly, however, both periods have had repercussions on the administration of water resources. The boom of the late 1970s marked the culmination of the growth of economic activity on the part of the public sector, which began to draw back during the periods of recession and subsequent recovery. Studies have been carried out that clearly show the results, in most countries of the region, of the change in the role played by the State in the economy. One such result is that central government retained the responsibility for granting licences and monitoring the activities of third parties, but gave up the actual operation of water-related production activities. This change paved the way for the adoption of new standards and monitoring mechanisms in regard to the environment, as may be noted, for example, in Colombia and Chile.

The analysis presented in this study shows that there were considerable differences among the countries as regards the adoption of new regulations. However, the change in the role played by the State

in water resources management is a widespread phenomenon, and has led to significant differences with respect to the water management policies that had been in force for over 50 years.

The different country reports show a change in the approach to water resources management. Emphasis is being placed on decentralization and on the participation of the private sector. This has opened the way to the adoption of institutional mechanisms based on the concept of integrated management of river basins through the transfer of responsibilities for exploitation of the resources from central government to local governments, to autonomous public corporations or to the private sector.

In several Latin American and Caribbean countries, such as Brazil, Colombia, Chile, Mexico and Venezuela, water resources are managed by an institution entrusted with the management of river basins. More and more, this is being viewed as the best way to absorb the environmental costs involved in the development and utilization of water resources. However, there is still a strong emphasis on studying the physical components of water systems, or on activities and investments in the sector. More remains to be done with respect to the organizational component of water resources management, which is undoubtedly the most important aspect of this approach.

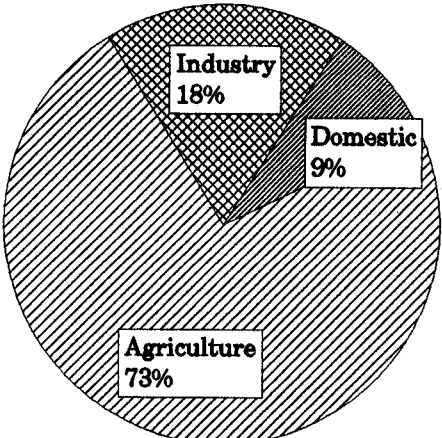
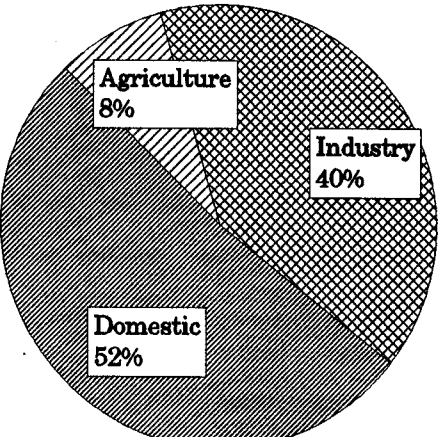
It is evident from this report that much remains to be done in responding to the problems mentioned in chapter 18. One of the main problems is that serious shortcomings still exist (four years after the end of the International Drinking Water Supply and Sanitation Decade) in regard to the efficiency of water supply and environmental sanitation services. This significant and growing social need, which has been intensified by the reappearance of cholera in 1991, has created a serious obstacle that has prevented policy makers, as well as the public at large, from assigning high priority to other aspects of integrated water resources management and from undertaking a more in-depth examination of the environmental impact of regulatory decisions relating to water resources.


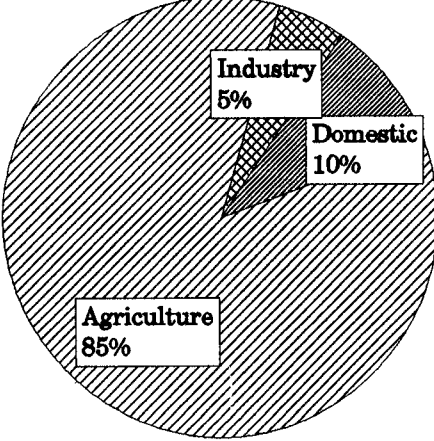
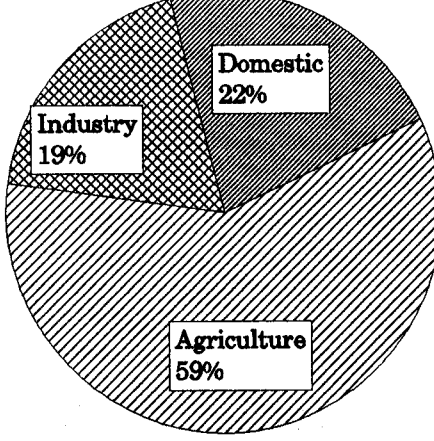
## BIBLIOGRAPHY

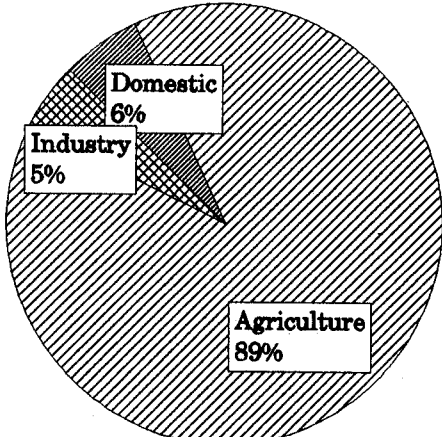
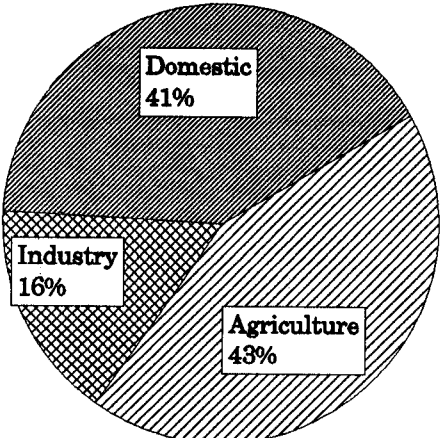
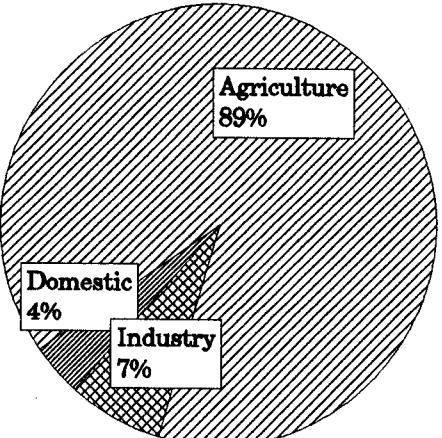
- Bandes R., Tomás A. (cons.) (1995), "Informe sobre Venezuela", Natural Resources and Energy Unit, Environment and Development Division, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).
- Calixte, John, St. Lucia report on the status of integrated water management with special reference to protection of freshwater quality and water supply, Castries.
- Chile, Department of Water, Ministry of Public Works (1995), Conferencia Internacional sobre el Agua y el Medio Ambiente, Informe de la Dirección General de Aguas, Santiago, Chile, December.
- Colombia (1995), "La Ley N° 142/94 que se refiere al régimen de servicios públicos domiciliarios de la República de Colombia", Regulación de agua potable y saneamiento, Comisión de Regulación de Agua Potable y Saneamiento Básico, No. 1, March.
- Cuba (1995), Decreto N° 199 del Comité Ejecutivo del Consejo de Ministros, Contravenciones de las regulaciones para la protección y el uso racional de los recursos hidráulicos, Havana, 10 April.
- \_\_\_\_\_ (1993a), Decreto Ley N° 138 de las Aguas Terrestres, Gaceta Oficial de la República de Cuba, Havana, 2 July.
- \_\_\_\_\_ (1993b), "Protección de las aguas terrestres", Programa Nacional de Medio Ambiente y Desarrollo, National Commission on the Protection of the Environment and the Sound Use of Natural Resources (COMARNA)/CECM, Havana.
- ECLAC (Economic Commission for Latin America and the Caribbean) (1994), Agenda 21 and integrated water resources management in Latin America (LC/G.1830), Santiago, Chile.
- Flores Mayela and Rodolfo Lizano (1995), Informe en torno a los avances en Costa Rica, Costa Rican Water Supply and Sanitation Institute (A y A), San Jose, December.
- Guatemala, Secretariat of Water Resources, Office of the President of the Republic (1995), Estrategia de desarrollo 1996-2000. Sector hídrico, August, unpublished.
- Llop, Armando Arturo (cons.) (1995), "Informe sobre Argentina", Natural Resources and Energy Unit, Environment and Development Division, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

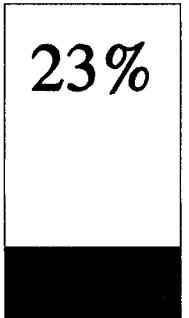
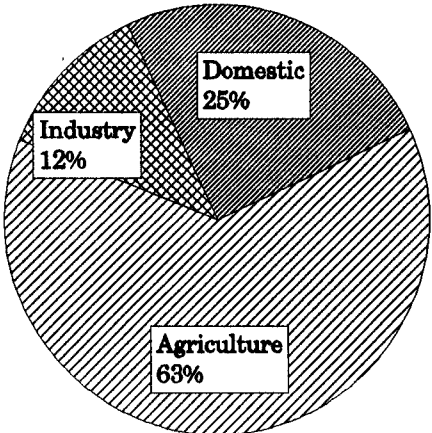
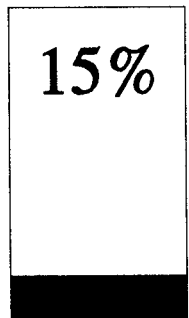
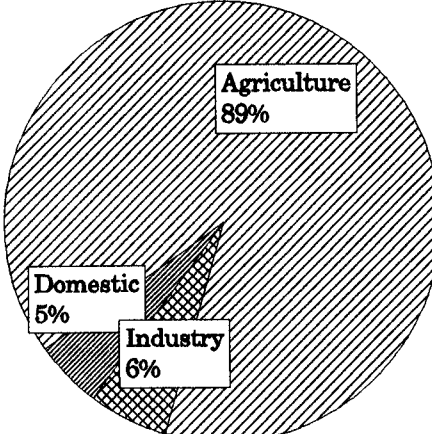
- \_\_\_\_\_ (1994), "Informe sobre Chile", Natural Resources and Energy Unit, Environment and Development Division, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).
- Palacios Vélez, Enrique (cons.) (1995), "Informe sobre México", Natural Resources and Energy Unit, Environment and Development Division, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).
- Peru, Progresos y limitaciones en el cumplimiento del Programa 21 en la gestión integral de los recursos hídricos para el sector saneamiento, Lima.
- Peru, Superintendencia Nacional de Servicios de Saneamiento (1994), Superintendencia Nacional de Servicios de Saneamiento, Lima.
- Saldarriaga Sanín, Jaime (cons.) (1995), "Informe sobre Colombia", Natural Resources and Energy Unit, Environment and Development Division, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).
- Sánchez Sosa, Ricardo (1995), Informe de país: Cuba, Ministerio de Ciencia, Tecnología y Medio Ambiente, Havana, December.
- Silva Kettelhut, Julio Thadeu (cons.) (1995), "Informe sobre Brasil", Natural Resources and Energy Unit, Environment and Development Division, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).
- United Nations (1992), "Protection of the quality and supply of freshwater resources: application of integrated approaches to the development, management and use of water resources", Report of the United Nations Conference on Environment and Development (A/CONF.151/26/Rev.1(vol.2)), chapter 18, New York.
- \_\_\_\_\_ (1977), "Plan de acción de Mar del Plata", Report of the United Nations Water Conference (E/CONF.70/29), New York. United Nations publication, Sales No. E.77.II.A.12.
- Ventura Napa, Miguel (1995), Gestión integral de los recursos hídricos, Ministry of Agriculture/ National Institute of Natural Resources (INRENA), Lima, 12 December.
- WHO/PAHO (World Health Organization/Pan American Health Organization) (1990), Situation of the Water Supply and Sanitation Sector at the End of the Decade, Region of the Americas, Washington, D.C., April.

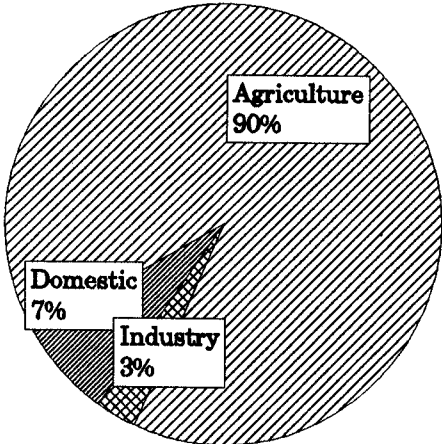
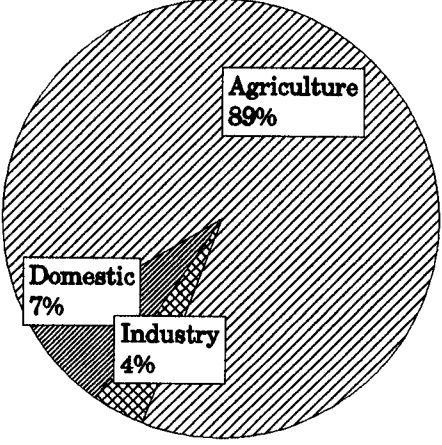
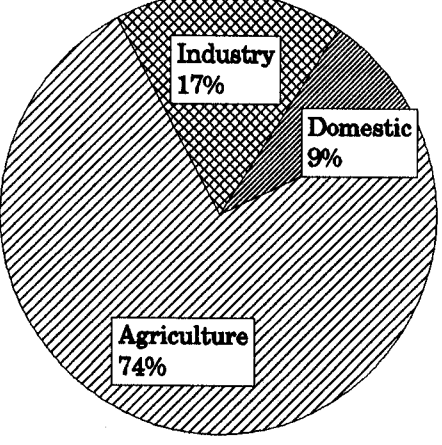
**Table 1**  
**Latin America and the Caribbean:**  
**statistics on the use of water resources**

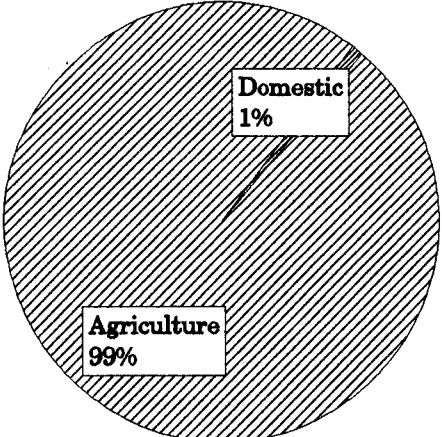
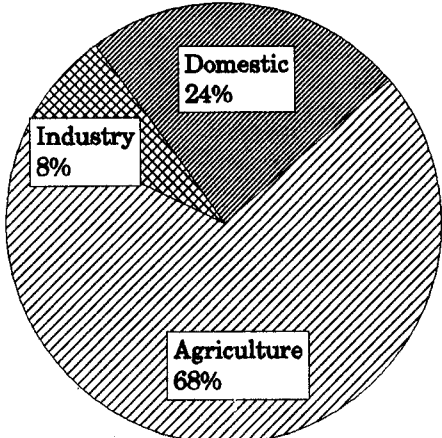
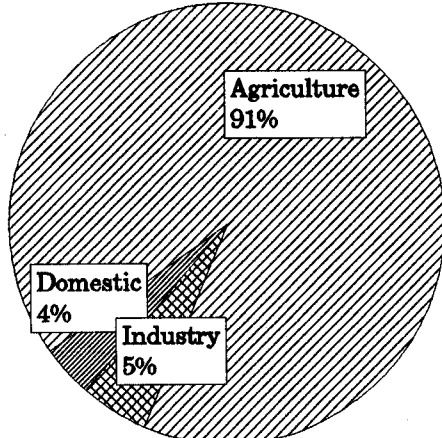
Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Argentina</p> <p>Water withdrawals as a percentage of water resources</p> <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 2em; font-weight: bold;">3%</div>	 <p>Agriculture 73%</p> <p>Industry 18%</p> <p>Domestic 9%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 1 280</li> <li>• 1993 ..... 1 700</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 609 MW</li> <li>• 1993 (installed) ..... 6 991 MW</li> <li>• potential ..... 46 787 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 73 %</li> <li>• rural water (1992) ..... 17 %</li> <li>• urban sanitation (1992) ... 100 %</li> <li>• rural sanitation (1992) ... 29 %</li> </ul>
<p>Bahamas</p>	<p>Not available</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... ..</li> <li>• 1993 ..... ..</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... ..</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 97 %</li> <li>• rural water (1992) ..... 98 %</li> <li>• urban sanitation (1992) ... 98 %</li> <li>• rural sanitation (1992) ... 100 %</li> </ul>
<p>Barbados</p> <p>Water withdrawals as a percentage of water resources</p> <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 2em; font-weight: bold;">31%</div>	 <p>Agriculture 8%</p> <p>Industry 40%</p> <p>Domestic 52%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... ..</li> <li>• 1993 ..... ..</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... ..</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 100 %</li> <li>• rural water (1992) ..... 100 %</li> <li>• urban sanitation (1992) ... 100 %</li> <li>• rural sanitation (1992) ... 100 %</li> </ul>

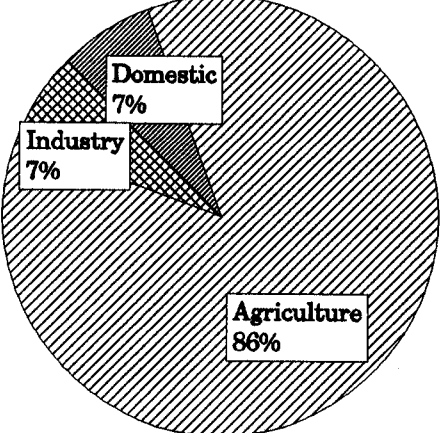
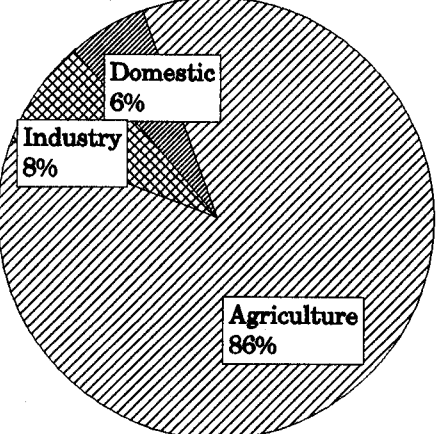
Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Belize</p> <p>Water withdrawals as a percentage of water resources</p> <p><math>\approx 0\%</math></p>	 <p>Agriculture 90%</p> <p>Domestic 10%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 1</li> <li>• 1993 ..... 2</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... ..</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 95 %</li> <li>• rural water (1992) ..... 53 %</li> <li>• urban sanitation (1992) .... 76 %</li> <li>• rural sanitation (1992) .... 22 %</li> </ul>
<p>Bolivia</p> <p>Water withdrawals as a percentage of water resources</p> <p><math>\approx 0\%</math></p>	 <p>Agriculture 85%</p> <p>Industry 5%</p> <p>Domestic 10%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 80</li> <li>• 1993 ..... 175</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 172 MW</li> <li>• 1993 (installed) ..... 345 MW</li> <li>• potential ..... 39 857 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 82 %</li> <li>• rural water (1992) ..... 21 %</li> <li>• urban sanitation (1992) .... 64 %</li> <li>• rural sanitation (1992) .... 18 %</li> </ul>
<p>Brazil</p> <p>Water withdrawals as a percentage of water resources</p> <p>1%</p>	 <p>Agriculture 59%</p> <p>Industry 19%</p> <p>Domestic 22%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 796</li> <li>• 1993 ..... 2 800</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 8 828 MW</li> <li>• 1993 (installed) ..... 48 600 MW</li> <li>• potential ..... 213 152 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 99 %</li> <li>• rural water (1992) ..... 68 %</li> <li>• urban sanitation (1992) .... 83 %</li> <li>• rural sanitation (1992) .... 35 %</li> </ul>

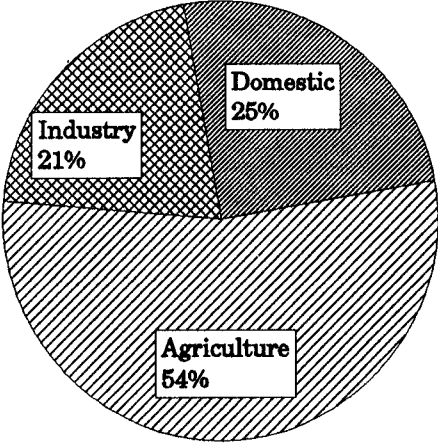
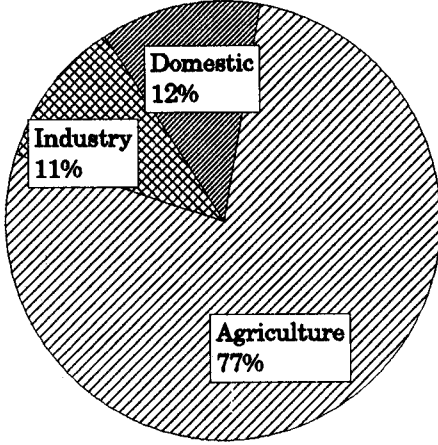
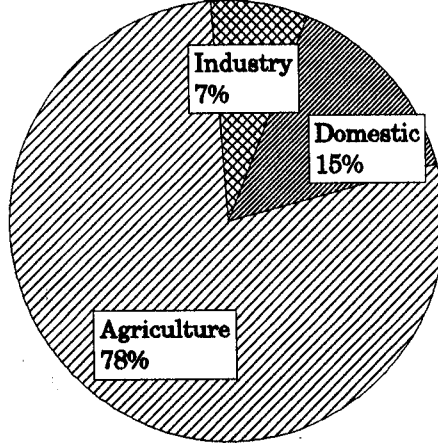
Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Chile</p> <p>Water withdrawals as a percentage of water resources</p> <p><b>4%</b></p>	 <p>Domestic 6%</p> <p>Industry 5%</p> <p>Agriculture 89%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 1 180</li> <li>• 1993 ..... 1 265</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 1 067 MW</li> <li>• 1993 (installed) ..... 3 071 MW</li> <li>• potential ..... 21 874 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1993) ..... 98 %</li> <li>• rural water (1993) ..... 40 %</li> <li>• urban sanitation (1993) ..... 86 %</li> <li>• rural sanitation (1992) ..... 6 %</li> </ul>
<p>Colombia</p> <p>Water withdrawals as a percentage of water resources</p> <p><b>≈0%</b></p>	 <p>Domestic 41%</p> <p>Industry 16%</p> <p>Agriculture 43%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 250</li> <li>• 1993 ..... 530</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 1 796 MW</li> <li>• 1993 (installed) ..... 7 733 MW</li> <li>• potential ..... 120 000 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 90 %</li> <li>• rural water (1992) ..... 90 %</li> <li>• urban sanitation (1992) ..... 70 %</li> <li>• rural sanitation (1992) ..... 27 %</li> </ul>
<p>Costa Rica</p> <p>Water withdrawals as a percentage of water resources</p> <p><b>1%</b></p>	 <p>Agriculture 89%</p> <p>Domestic 4%</p> <p>Industry 7%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 26</li> <li>• 1993 ..... 120</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 182 MW</li> <li>• 1993 (installed) ..... 790 MW</li> <li>• potential ..... 8 230 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1990) ..... 100 %</li> <li>• rural water (1990) ..... 84 %</li> <li>• urban sanitation (1990) ..... 99 %</li> <li>• rural sanitation (1990) ..... 99 %</li> </ul>

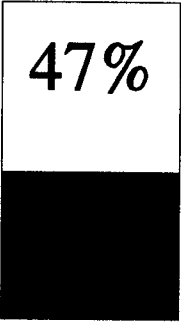
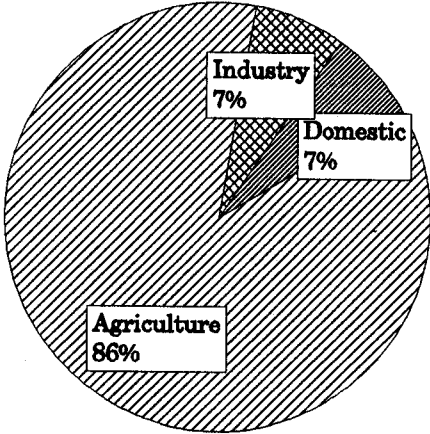
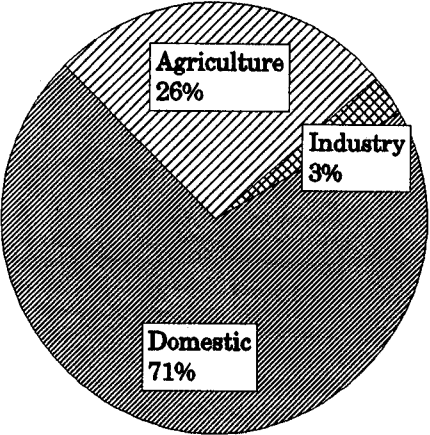
Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Cuba</p> <p>Water withdrawals as a percentage of water resources</p> <p><b>23%</b></p> 		<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 450</li> <li>• 1993 ..... 910</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 44 MW</li> <li>• 1993 (installed) ..... 49 MW</li> <li>• potential ..... 49 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1993) ..... 64 %</li> <li>• rural water (1993) ..... 73 %</li> <li>• urban sanitation (1993) ..... 67 %</li> <li>• rural sanitation (1993) ..... 52 %</li> </ul>
<p>Dominica</p>	<p>Not available</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... ..</li> <li>• 1993 ..... ..</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 1 MW</li> <li>• 1993 (installed) ..... 3 MW</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water ..... ..</li> <li>• rural water ..... ..</li> <li>• urban sanitation ..... ..</li> <li>• rural sanitation ..... ..</li> </ul>
<p>Dominican Republic</p> <p>Water withdrawals as a percentage of water resources</p> <p><b>15%</b></p> 		<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 125</li> <li>• 1993 ..... 230</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 16 MW</li> <li>• 1993 (installed) ..... 207 MW</li> <li>• potential ..... 2 012 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 75 %</li> <li>• rural water (1992) ..... 40 %</li> <li>• urban sanitation (1992) ..... 75 %</li> <li>• rural sanitation (1992) ..... 38 %</li> </ul>

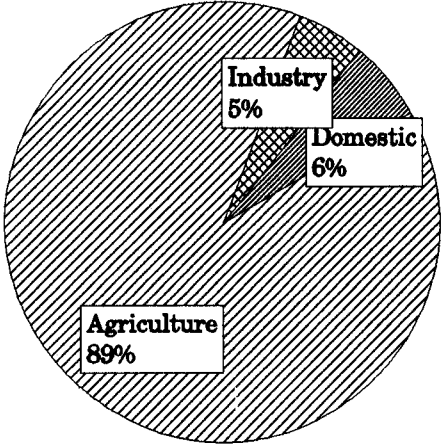
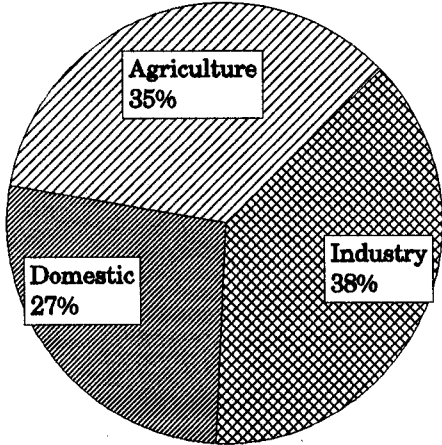
Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Ecuador</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">2%</p>	 <p>Agriculture 90%</p> <p>Domestic 7%</p> <p>Industry 3%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 470</li> <li>• 1993 ..... 556</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 106 MW</li> <li>• 1993 (installed) ..... 1 471 MW</li> <li>• potential ..... 69 953 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 79 %</li> <li>• rural water (1992) ..... 45 %</li> <li>• urban sanitation (1992) ..... 69 %</li> <li>• rural sanitation (1992) ..... 35 %</li> </ul>
<p>El Salvador</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">5%</p>	 <p>Agriculture 89%</p> <p>Domestic 7%</p> <p>Industry 4%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 20</li> <li>• 1993 ..... 120</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 108 MW</li> <li>• 1993 (installed) ..... 405 MW</li> <li>• potential ..... 1 850 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 95 %</li> <li>• rural water (1992) ..... 16 %</li> <li>• urban sanitation (1992) ..... 91 %</li> <li>• rural sanitation (1992) ..... 53 %</li> </ul>
<p>Guatemala</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">1%</p>	 <p>Industry 17%</p> <p>Domestic 9%</p> <p>Agriculture 74%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 56</li> <li>• 1993 ..... 125</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 96 MW</li> <li>• 1993 (installed) ..... 438 MW</li> <li>• potential ..... 9 642 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 84 %</li> <li>• rural water (1992) ..... 51 %</li> <li>• urban sanitation (1992) ..... 82 %</li> <li>• rural sanitation (1992) ..... 64 %</li> </ul>

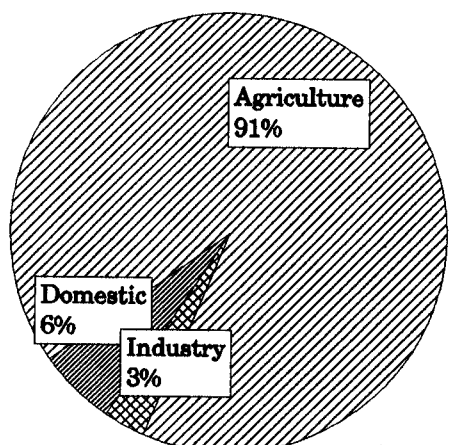
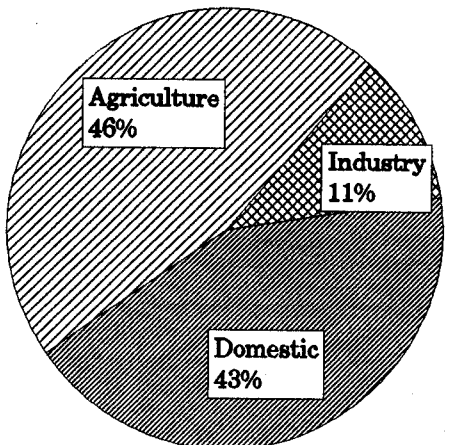
Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Guyana</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">1%</p>	 <p>Agriculture 99%</p> <p>Domestic 1%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 115</li> <li>• 1993 ..... 130</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... 2 MW</li> <li>• potential ..... 4 484 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 100 %</li> <li>• rural water (1992) ..... 75 %</li> <li>• urban sanitation (1992) ... 87 %</li> <li>• rural sanitation (1992) ... 30 %</li> </ul>
<p>Haiti</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">≈0%</p>	 <p>Industry 8%</p> <p>Domestic 24%</p> <p>Agriculture 68%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 60</li> <li>• 1993 ..... 75</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... 70 MW</li> <li>• potential ..... 90 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 55 %</li> <li>• rural water (1992) ..... 34 %</li> <li>• urban sanitation (1992) .... 43 %</li> <li>• rural sanitation (1992) .... 16 %</li> </ul>
<p>Honduras</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">2%</p>	 <p>Agriculture 91%</p> <p>Domestic 4%</p> <p>Industry 5%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 70</li> <li>• 1993 ..... 74</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 30 MW</li> <li>• 1993 (installed) ..... 130 MW</li> <li>• potential ..... 2 800 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 90 %</li> <li>• rural water (1992) ..... 54 %</li> <li>• urban sanitation (1992) .... 91 %</li> <li>• rural sanitation (1992) .... 45 %</li> </ul>

Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Jamaica</p> <p>Water withdrawals as a percentage of water resources</p> <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 2em; font-weight: bold;">4%</div>	 <p>A pie chart showing the distribution of water withdrawals in Jamaica in 1987. The largest slice is Agriculture at 86%, followed by Domestic and Industry, both at 7%.</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 24</li> <li>• 1993 ..... 35</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 21 MW</li> <li>• 1993 (installed) ..... 20 MW</li> <li>• potential ..... 24 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 92 %</li> <li>• rural water (1992) ..... 48 %</li> <li>• urban sanitation (1992) ..... 89 %</li> <li>• rural sanitation (1992) ..... 59 %</li> </ul>
<p>Martinique</p>	<p style="text-align: center;">Not available</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 1</li> <li>• 1993 ..... 4</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... ..</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water ..... ..</li> <li>• rural water ..... ..</li> <li>• urban sanitation ..... ..</li> <li>• rural sanitation ..... ..</li> </ul>
<p>Mexico</p> <p>Water withdrawals as a percentage of water resources</p> <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 2em; font-weight: bold;">15%</div>	 <p>A pie chart showing the distribution of water withdrawals in Mexico in 1987. The largest slice is Agriculture at 86%, followed by Industry at 8% and Domestic at 6%.</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 3 583</li> <li>• 1993 ..... 6 100</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 3 326 MW</li> <li>• 1993 (installed) ..... 8 079 MW</li> <li>• potential ..... 64 806 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 90 %</li> <li>• rural water (1992) ..... 66 %</li> <li>• urban sanitation (1992) ..... 81 %</li> <li>• rural sanitation (1992) ..... 29 %</li> </ul>

Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Nicaragua</p> <p>Water withdrawals as a percentage of water resources</p> <p>1%</p>	 <p>Agriculture 54%</p> <p>Domestic 25%</p> <p>Industry 21%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 40</li> <li>• 1993 ..... 88</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 57 MW</li> <li>• 1993 (installed) ..... 106 MW</li> <li>• potential ..... 5 155 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 74 %</li> <li>• rural water (1992) ..... 30 %</li> <li>• urban sanitation (1990) .... 30 %</li> <li>• rural sanitation (1990) .... 15 %</li> </ul>
<p>Panama</p> <p>Water withdrawals as a percentage of water resources</p> <p>1%</p>	 <p>Agriculture 77%</p> <p>Domestic 12%</p> <p>Industry 11%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 20</li> <li>• 1993 ..... 32</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 62 MW</li> <li>• 1993 (installed) ..... 551 MW</li> <li>• potential ..... 7 146 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1988) ..... 100 %</li> <li>• rural water (1988) ..... 66 %</li> <li>• urban sanitation (1988) ... 100 %</li> <li>• rural sanitation (1988) ... 68 %</li> </ul>
<p>Paraguay</p> <p>Water withdrawals as a percentage of water resources</p> <p>≈0%</p>	 <p>Agriculture 78%</p> <p>Domestic 15%</p> <p>Industry 7%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 40</li> <li>• 1993 ..... 67</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 45 MW</li> <li>• 1993 (installed) ..... 6 490 MW</li> <li>• potential ..... 17 000 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1990) ..... 61 %</li> <li>• rural water (1992) ..... 17 %</li> <li>• urban sanitation (1990) .... 31 %</li> <li>• rural sanitation (1992) .... 60 %</li> </ul>

Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Peru</p> <p>Water withdrawals as a percentage of water resources</p> <p><b>47%</b></p> 	 <p>Agriculture 86%</p> <p>Industry 7%</p> <p>Domestic 7%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 1 106</li> <li>• 1993 ..... 1 280</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 923 MW</li> <li>• 1993 (installed) ..... 2 457 MW</li> <li>• potential ..... 75 381 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1994) ..... 76 %</li> <li>• rural water (1994) ..... 25 %</li> <li>• urban sanitation (1994) .... 62 %</li> <li>• rural sanitation (1994) .... 16 %</li> </ul>
<p>Puerto Rico</p>	 <p>Agriculture 26%</p> <p>Industry 3%</p> <p>Domestic 71%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 39</li> <li>• 1993 ..... 39</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 95 MW</li> <li>• 1993 (installed) ..... 85 MW</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water ..... ..</li> <li>• rural water ..... ..</li> <li>• urban sanitation ..... ..</li> <li>• rural sanitation ..... ..</li> </ul>
<p>Saint Lucia</p>	<p>Not available</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 1</li> <li>• 1993 ..... 1</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... ..</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water ..... ..</li> <li>• rural water ..... ..</li> <li>• urban sanitation ..... ..</li> <li>• rural sanitation ..... ..</li> </ul>

Country	Estimated sectoral water withdrawals (1987)	Water sector profile
Saint Vincent and the Grenadines	Not available	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 1</li> <li>• 1993 ..... 1</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 2 MW</li> <li>• 1993 (installed) ..... 6 MW</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water ..... ..</li> <li>• rural water ..... ..</li> <li>• urban sanitation ..... ..</li> <li>• rural sanitation ..... ..</li> </ul>
Suriname  Water withdrawals as a percentage of water resources  <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 2em;">≈0%</div>	 <p>A pie chart showing the distribution of water withdrawals in Suriname. The largest slice is Agriculture at 89%, followed by Domestic at 6% and Industry at 5%.</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 28</li> <li>• 1993 ..... 60</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 180 MW</li> <li>• 1993 (installed) ..... 290 MW</li> <li>• potential ..... 2 420 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 78 %</li> <li>• rural water (1992) ..... 54 %</li> <li>• urban sanitation (1992) ..... 63 %</li> <li>• rural sanitation (1992) ..... 34 %</li> </ul>
Trinidad and Tobago  Water withdrawals as a percentage of water resources  <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 2em;">3%</div>	 <p>A pie chart showing the distribution of water withdrawals in Trinidad and Tobago. The largest slice is Industry at 38%, followed by Agriculture at 35% and Domestic at 27%.</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 15</li> <li>• 1993 ..... 22</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... ..</li> <li>• 1993 (installed) ..... ..</li> <li>• potential ..... ..</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 83 %</li> <li>• rural water (1992) ..... 80 %</li> <li>• urban sanitation (1992) ..... 60 %</li> <li>• rural sanitation (1992) ..... 50 %</li> </ul>

Country	Estimated sectoral water withdrawals (1987)	Water sector profile
<p>Uruguay</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">1%</p>	 <p>Agriculture 91%</p> <p>Domestic 6%</p> <p>Industry 3%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 52</li> <li>• 1993 ..... 140</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 236 MW</li> <li>• 1993 (installed) ..... 1 353 MW</li> <li>• potential ..... 2 682 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 93 %</li> <li>• rural water (1988) ..... 5 %</li> <li>• urban sanitation (1992) ... 92 %</li> <li>• rural sanitation (1988) ... 65 %</li> </ul>
<p>Venezuela</p> <p>Water withdrawals as a percentage of water resources</p> <p style="font-size: 2em; text-align: center;">≈0%</p>	 <p>Agriculture 46%</p> <p>Domestic 43%</p> <p>Industry 11%</p>	<p>Area under irrigation (1 000 ha):</p> <ul style="list-style-type: none"> <li>• 1970 ..... 182</li> <li>• 1993 ..... 190</li> </ul> <p>Hydroelectric capacity:</p> <ul style="list-style-type: none"> <li>• 1970 (installed) ..... 908 MW</li> <li>• 1993 (installed) ..... 10 675 MW</li> <li>• potential ..... 83 477 MW</li> </ul> <p>Drinking water supply and sanitation coverage:</p> <ul style="list-style-type: none"> <li>• urban water (1992) ..... 68 %</li> <li>• rural water (1992) ..... 67 %</li> <li>• urban sanitation (1992) .... 55 %</li> <li>• rural sanitation (1992) .... 59 %</li> </ul>

Source

*Water withdrawals as a percentage of water resources:* World Resources Institute in collaboration with the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP), *World resources 1994-95*, Oxford University Press, 1994, ISBN 0-19-521044-1 (Argentina in 1976; Belize, Bolivia, Colombia, Dominican Republic, Ecuador, Haiti, Paraguay and Suriname in 1987; Brazil in 1990; Chile, Cuba, El Salvador, Jamaica, Mexico, Nicaragua, Panama and Trinidad and Tobago in 1975; Costa Rica, Guatemala and Venezuela in 1970; Guyana and Honduras in 1992; and Uruguay in 1965); S.N. Kulshreshtha, *World water resources and regional vulnerability: impact of future changes*, RR-93-10, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, June 1993, ISBN 3-7045-0120-4 (Barbados in 1990); and Ministry of Agriculture, National Institute of Natural Resources (INRENA), Directorate General of Waters and Soils (DGAS), *Assessment of water resources and their use by different productive sectors in Peru*, Lima, Peru, June 1995 (Peru in 1992).

*Estimated sectoral water withdrawals:* World Resources Institute in collaboration with the United Nations Environment Programme (UNEP) and the United Nations Development Programme

(UNDP), *World resources 1994-95*, Oxford University Press, 1994, ISBN 0-19-521044-1 (all countries with the exception of Barbados, Cuba, Peru and Puerto Rico); S.N. Kulshreshtha, *World water resources and regional vulnerability: impact of future changes*, RR-93-10, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, June 1993, ISBN 3-7045-0120-4 (Barbados in 1990); Ricardo Sánchez Sosa, *Informe de país: Cuba. Reunión del Grupo de Expertos sobre la implementación del Programa 21 en la gestión integral de los recursos hídricos en América Latina y el Caribe (CEPAL/PNUMA). Santiago de Chile, 12 a 14 de diciembre de 1995*, Ministerio de Ciencia, Tecnología y Medio Ambiente, Havana, December 1995 (Cuba, agriculture includes only the use of water for irrigation and industry includes industrial water use (9 per cent) and "other" uses of water (3 per cent)); Ministry of Agriculture, National Institute of Natural Resources (INRENA), Directorate General of Waters and Soils (DGAS), *Assessment of water resources and their use by different productive sectors in Peru*, Lima, Peru, June 1995 (Peru in 1992); and Wayne B. Solley, Robert R. Pierce and Howard A. Perlman (1993), *Estimated use of water in the United States in 1990*, U.S. Geological Survey Circular 1081, United States Government Printing Office, 1993 (Puerto Rico in 1990).

*Irrigation*: Food and Agriculture Organization of the United Nations (FAO), *1986 FAO production yearbook. Vol. 40*, FAO Statistics Series Nº 76, Rome, 1987, ISBN 92-5-002566-1 (all countries with the exception of Venezuela in 1970); Banco de Datos de Estadísticas Anuales (BADEANU) (Venezuela in 1970); and Food and Agriculture Organization of the United Nations (FAO), *FAO yearbook. Production. Vol. 48. 1994*, FAO Statistics Series Nº 125, Rome, 1995, ISBN 92-5-003679-5 (all countries in 1993).

*Hydroelectric installed capacity*: United Nations, Department of Economic and Social Affairs, Statistical Office, *World energy supplies 1950-1974*, ST/ESA/STAT/SER.J/19, New York, 1976, United Nations Publication Sales Nº E.76.XVII.5 (all countries in 1970); and United Nations, Department for Economic and Social Information and Policy Analysis, Statistical Division, *1993 energy statistics yearbook*, ST/ESA/STAT/SER.J/37, New York, 1995, United Nations Publication Sales Nº E/F.95.XVII.9, ISBN 92-1-061161-6 (all countries in 1993).

*Estimates of economically exploitable hydroelectric potential*: United Nations/Economic Commission for Latin America and the Caribbean (UN/ECLAC), *Statistical yearbook for Latin America and the Caribbean. 1994 edition*, LC/G.1853-P, Santiago, Chile, February 1995, United Nations Publication Sales Nº E/S.95.II.G.1, ISBN 92-1-021034-4 (all countries with the exception of Cuba, Guyana, Haiti, Jamaica and Suriname; technically exploitable potential with a plant factor of 0.5; estimates by countries using the OLADE methodology and for 1984; Argentina, Costa Rica and Uruguay - refers only to assessed installable potential, does not include the estimated potential); and Latin American Energy Organization (OLADE), *Energy statistics of Latin America and the Caribbean*, Quito, June 1995, ISBN 9978-70-072-2 (Cuba, Guyana, Haiti, Jamaica and Suriname; hydropower potential in 1994).

*Drinking water supply and sanitation coverage*: Organización Panamericana de la Salud (OPS), Oficina Regional de la Organización Mundial de la Salud (OMS), *Las condiciones de salud en las Américas. Edición de 1994. Volumen I*, Publicación Científica Nº 549, Washington, D.C., 1994, ISBN 92 75 31549 3 (coverage in 1992); Per Engebak and Hans D. Spruijt, "Central America's inter-agency collaboration in WES programmes", *WATERfront*, Issue 1, February 1992 (Costa Rica in 1990 and sanitation in Nicaragua in 1990); Ricardo Sánchez Sosa, *Informe de país: Cuba. Reunión del Grupo de Expertos sobre la implementación del Programa 21 en la gestión integral de los recursos hídricos en América Latina y el Caribe (CEPAL/PNUMA). Santiago de Chile, 12 a 14 de diciembre de*

1995, Ministerio de Ciencia, Tecnología y Medio Ambiente, Havana, December 1995 (Cuba in 1993, appropriate service); World Resources Institute in collaboration with the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP), *World resources 1994-95*, Oxford University Press, 1994, ISBN 0-19-521044-1 (Panama in 1988, urban areas in Paraguay in 1990 and rural areas in Uruguay in 1988); Ministerio de Obras Públicas, Dirección General de Aguas, *Conferencia Internacional sobre el Agua y el Medio Ambiente (Capítulo 18 de la Agenda 21). Informe de la Dirección General de Aguas. Chile*, December 1995, Chile (drinking water supply in urban and rural areas and sewerage in urban areas Chile in 1993); and Ministry of Agriculture, National Institute of Natural Resources (INRENA), Directorate General of Waters and Soils (DGAS), *Assessment of water resources and their use by different productive sectors in Peru*, Lima, Peru, June 1995 (Peru in 1994, preliminary figures).

#### Note

Caution should be used when comparing different countries because many estimates are based on differing sources, dates and definitions.

Definitions of drinking water supply and sanitation coverage may vary from country to country.

Totals may not add because of rounding.

... - zero, data not available or less than 0.5 of the unit specified.