Water Resources in Latin America and the Caribbean: Issues and Options

Orlando San Martin

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Executive Summary

Water resources contribution to growth and development

The first chapter of this paper shows how important the contribution of water resources is to sustainable development in Latin America and the Caribbean (LAC). The bottom line, and pressing challenge for water resources in the new millennium, is to be able to actively contribute to the region's sustainable development. In this context, water is not only an environmental asset, but also a key economic resource. When properly managed, water resources are powerful tools for development. This simple and important principle ought to guide the financing efforts in the water resource sector in LAC, by governments, international development banks and other financial institutions.

Challenges for development and water management

Water resources and all activities depending on water face a diverse set of problems and challenges in the region. Being a finite (limited) resource, water and freshwater ecosystems are under pressure by different users and increasing demands to satisfy different sector needs and aspirations, and therefore, need to be protected.

For presentation purposes, the paper groups the problems and challenges facing water resources in LAC into the following categories:

- Social challenges
- Economic challenges
- Financial challenges
- Environmental challenges
- Institutional challenges

Each one of these challenges is presented and discussed in the paper.

Social challenges can be summarized by the current needs to: (i) increase piped water coverage rates, especially among low income socio-economic groups and in specific areas where coverage is low; (ii) improve health conditions of the population, especially reducing morbidity rates for water-borne diseases; and (iii) mitigate the risks of natural hazards.

Economic challenges in water resources are mainly related to the issue of water allocation among competing uses. Economic challenges can be grouped into three, closely related, categories: (i) economic valuation of water resources; (ii) efficient allocation among competing uses; and (iii) integrated approaches to water management.

Financial challenges within the water resources sector are divided into two main categories: (i) raising funds for Operation and Maintenance; and (ii) raising funds for new investments.

Environmental challenges for water resources in LAC are grouped in three main areas: (i) pollution control; (ii) integrated management; and (iii) eco-systemic approaches to resource management.

Institutional challenges are grouped under the following categories: (i) water law reforms; (ii) institutional innovation; and (iii) stakeholder participation.

Root causes of problems

It is emphasized that at the root of the immediate water resources problems and their consequences in LAC, there are four main causes:

- lack of understanding of the uniqueness or integral character of the water resource and its low degree of substitution;
- heterogeneity in terms of quantity, quality and availability of the resource;
- insufficient consideration of the economic value of the resource; and, aggravating this situation
- the low levels of awareness about water resource problems among the general public, which in turn results in a lack of political commitment among decision makers to take action on these matters.

Current responses

Nevertheless, several efforts and responses are taking place to tackle water resource problems in the region. The main approaches and instruments being used for water resource development and management are grouped into four categories, as follows:

- reforming the water sector, which includes other water-related sectors, e.g. irrigated agriculture, energy, tourism, etc. These reforms include, but are not limited to, promoting

private sector participation, economic valuation of water goods and services, and cost recovery;

- integrated approaches to water resource management;
- watershed-based planning and management; and
- international cooperation in international river basins.

In practice, the main problems being faced within the water resources sector are complex, and originate in a mixture of different challenges, demanding therefore an "approach-mix" for their successful solution.

It is posed that the following key principles should guide water related financing interventions in LAC:

- consistency with development objectives;
- consistency in the use and timing of instruments;
- incentive-based promotion of changes; and
- coordination and collaboration among related institutions.

The financial interventions in water resources should not lose sight of the *root* causes of the immediate problems and their consequences and should structure their contributions accordingly. Understandably, much effort has been devoted in the past to overcoming some of the most severe problems facing the water resources sector. It is posed that concentrating efforts solely on the immediate problems and their consequences and not on their roots is not sufficient to solve them. On the other hand, governments cannot concentrate only on the root causes ignoring the urging needs of those suffering the consequences. Therefore, a two-tier approach should be sought: attacking root causes while avoiding and reducing the negative impacts of the consequences, as has been proposed, among others, by the Inter-American Development Bank's (IDB) strategy on integrated water resources management.

Promoting Development and Improving Living Conditions: the Role of Water Resources

Water is a key element for social and economic development. Water is an "across-the-board" economic good with a great variety of uses. Water is used as both: (i) a final consumption good, i.e. potable water; and (ii) an intermediate good, i.e. an input for productive consumptive uses, such as industry and agriculture or non-consumptive uses such as recreation, navigation and the generation of hydropower. This chapter presents an overview of the main contributions of water to economic and social development in LAC, as summarized in Figure 1.1.

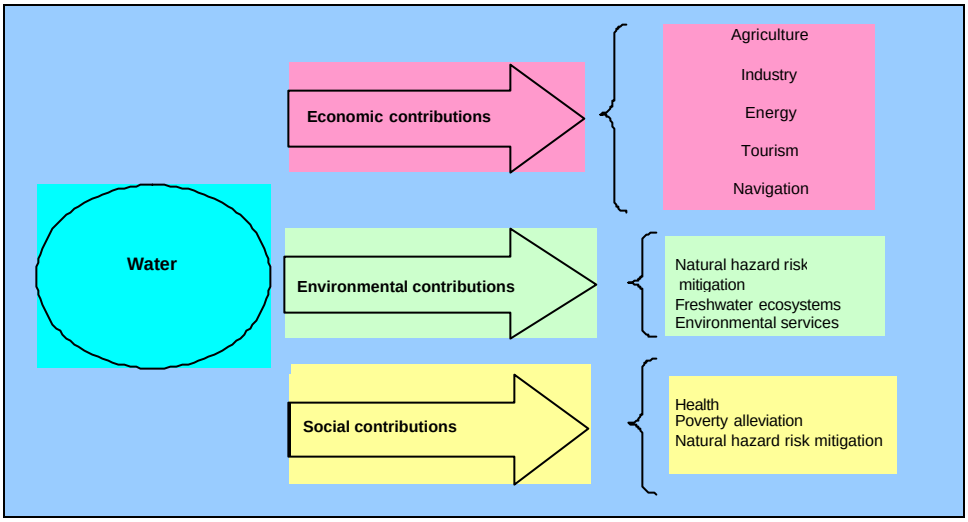

Figure 1.1 Water contributions to Sustainable Development

Economic contributions of water

Water is an important input for a variety of economic activities. As presented in Figure 1.2, Annex 1, water extractions for agriculture and industry dominate consumptive water use in most countries in the region. In addition to these consumptive uses, hydropower generation is also an important non-consumptive user of water in LAC.

Agriculture

Agriculture is an important socioeconomic sector in LAC. Although its contribution to national Gross Domestic Product (GDP) varies widely across the region (see Figure 1.3, Annex 1), the agricultural sector plays an important social and economic role in LAC societies. For a group of smaller countries such as Nicaragua, Haiti, Paraguay, Guatemala, Honduras, and Bolivia, the contribution of the agricultural sector is above 20% of the total GDP (World Bank, 2001a). For the largest economies in the region (such as Brazil, Mexico and Argentina) however, the agricultural sector contributes a smaller portion to the total economy, representing between 6 and 9% of their GDP.

Although, in general terms, the contribution of agriculture to GDP has declined substantially over the last 30 years, agriculture still plays an important role in the employment of the rural LAC population. Agriculture provides a livelihood to millions of rural household farms, and is a source of income and employment to many rural workers. The proportion of the population employed in agriculture is high in many LAC economies, such as Bolivia, Guatemala, Haiti, Honduras and El Salvador, as illustrated in Figure 1.3, Annex 1 (World Bank 2001). By 1996, the average share of the economically active population in agriculture in LAC was 22 % (FAOSTAT, 2002).

For most Latin American countries, agricultural production for exports is an important element for their balance of payments, and a major source of foreign exchange. Figure 1.3, Annex 1, shows that for most LAC countries agricultural exports represent over 20% of total exports and for a significant group of countries, they account for well over 50% of total exports (World Bank, 2001a).

In the region agriculture is today the main user of water. Figure 1.2, Annex 1, shows that, with few exceptions, agricultural extractions represent over 70% of total water extractions. Land is the main (and not seldom the only) productive asset for a large share of the rural population in Latin America. For these producers, the productivity of their main asset depends (crucially) on timely and adequate supply of water.

There is some evidence in the region that irrigation can play an important role in increasing agricultural yields. For instance, as shown in Figure 1.4, Annex 1, yields for cereal production tend to be higher in countries where land under irrigation is a larger share of total cropland. In Mexico, irrigated lands account for about 15% of all employment over half of all agricultural production and two thirds of agricultural exports (World Bank, 1999). In Argentina, the agricultural area under irrigation is only 5% of total

agricultural land, while the value of production has ranged between 25% and 38% of total agricultural production. Nonetheless, 30% of the irrigated land is affected by drainage and salinization problems (Calcagno et al, 2000).

The social and economic benefits of adequate design, construction, management and operation of irrigation infrastructure cannot be overstated. However, irrigation is not all that is needed for successful agricultural production and development. Farmers need much more than water to grow and market their production. A particular World Bank example from Northern Brazil illustrates this. Under this project, commercial farmers bought some land with access to irrigation infrastructure previously underutilized by subsistence farmers. While subsistence farmers were unable to take advantage of the increased access to water sources, commercial farmers were able to solve the challenges of technological innovation, credit, and marketing providing working opportunities to poorer subsistence farmers (World Bank, 2002). Another illustration, from a recent study of irrigation districts in Mexico (World Bank, 1999), is presented in Box 1.1.

Box 1.1 Irrigation and development in Hermosillo, Mexico

In recent years, a new water economy has come into play in Hermosillo. At the macro level, Mexican agricultural policy has changed dramatically. Output and input subsidies (which accounted for about 30 percent of value in the early 1990s) have largely been replaced by non-distortionary direct payments to farmers.

There have been profound economic and social effects from this "revolution" in Hermosillo, which depends largely on groundwater. Most of these effects are positive. Many of the farmers of the area are well educated and well informed of technological and institutional possibilities (both at the farm and aquifer levels). Although total irrigated area has declined over the last 20 years the productivity of water has risen almost 3 fold, meaning that the 400 million cubic meters (mcm) a year which is now pumped in Hermosillo produces a greater economic return than the 1000 mcm pumped twenty years ago .

Equally important is the fact that one hectare of a high-value crop uses approximately twice as much labor as one hectare of a traditional crop, once again muting the effect of the decline in total irrigated area (Figure 1.5, Annex 1) .

Source: World Bank, 1999

Unfortunately, not every drop of the large amounts of water extracted for agriculture ends up at their targeted destination. Irrigation efficiency at the farm level is measured taking into account the difference between the volume of water captured and the actual delivery to the farms. This efficiency level is dependent on the type of irrigation system (e.g. flooding, channels, drop irrigation, etc.). Efficiency of irrigation in LAC is far from adequate. In many LAC countries, the levels of irrigation efficiency are in the range between 30% and 40%. It means that a precious -and scarce- element is being "wasted" (although environmentalists would contest this) with no productive use at a time when water is being demanded anxiously by other users and for other uses.

Industry

True or not, common knowledge places the food processing, pulp and paper, chemical, petro-chemical, and textile industries as the most water-intensive industries in LAC. These industries demand raw materials that are abundant in the respective countries, creating significant multiplier effects in the local and national economies. As an important source of employment and income for the local population, these industries are also the source of important income multipliers.

The participation of some of these industrial branches in the share of total manufacturing GDP for a selected group of countries is shown in Figure 1.6, Annex 1. Some show participation levels above 40% of manufacturing GDP. Water is an indispensable input for the economic activity of these industries. Water shortages can therefore plague economic activity and a source of employment and income for an important share of urban population. Access to water in the amount and quality demanded by these industries is therefore a challenge that must be taken seriously in the region.

The volumes of industrial water withdrawals are quite different not only between individual branches of industry, but also according to the production process, depending on the technology being used. Climatic conditions are also an intervening factor (Shiklomanov, 2000). The amount of water actually consumed by industry is usually a small fraction of the water intake. However, it also varies greatly depending on the type of industry, the nature of the water supply, technological process, and climatic conditions. In most industries water consumed amount to is 5 to 20 percent, but can reach 30 to 40 percent in some of them.

Energy

Thermal and atomic power generation are also major water users, requiring large amounts of cooling water. In thermal power generation, consumption is about 0.5-3.0 percent of the water intake.

Water is also an important source of energy in the region. Hydropower generation using the region's hydraulic resources makes an important contribution to national and regional development. LAC has about 22 percent of the world's potential for power generation (700,000 Megawatts). However, its installed capacity is substantially below that value (153,500 Megawatts). Hydroelectric plants produce 64 percent of total energy, while almost all of the rest (36 percent) is produced at oil-fueled facilities. In 1991, the total amount of energy produced in the region was estimated to be equivalent to 590,000

Gigawatt-hours. Demand is estimated to grow at a rate of about 5 percent per year (WMO/IDB 1996). Figure 1.7, Annex 1, shows the shares of hydropower generation as a percentage of total national electricity production. The Figure shows that for an important group of countries, hydropower represents more than 60% of total electricity production.

Electricity is important both as an input for production in industry and as an element contributing to improved living conditions of the population. Figure 1.8, Annex 1, shows a positive relationship between the share of hydropower generation and per capita energy consumption, which in turn reflects greater development possibilities due to access to larger amounts of energy.

Hydropower projects have also the possibility, if well planned and executed, to contribute not only by providing clean and renewable energy on a wider regional and national basis, but also by ameliorating social and environmental negative impacts, improving the living conditions of adjacent communities, and strengthening local governmental and non-governmental organizations. Box 1.2 presents the case of the Segredo Hydroelectric Project, an IDB-funded hydropower project in the State of Paraná, Brazil.

Box 1.2 Segredo Hydropower project and community participation, Brazil.

Since the mid-1970's and into the 1990s, Brazilian authorities have aimed to achieve specific goals in the energy field, namely: (i) the economic use of available domestic resources, (ii) replacing foreign sources of energy with domestic energy sources; (iii) acceleration to explore new sources; and (iv) conservation and rational use of energy. As a result of policy initiatives, investments to increase hydroelectric generation boosted capacity from 16,200 MW in 1975 to 45,600 MW in 1988. The Segredo Project includes a hydroelectric power plant on the Iguaçu river with a capacity of 945 MW along with its dam, spillway, powerhouse, associated structures and extension of the existing transmission lines. The project also included studies on potential environmental impacts and the implementation of measures to alleviate any adverse effects.

The creation of the reservoir affected some 550 families totaling approximately 2,750 people. Forty percent of these families were property owners or long-term occupants. Approximately 47% who owned houses occupied less than 25 ha; 50% of the households earned less than USD$ 110 per month. Resettlement was designed to assure land tenure, housing and the means to increase family income levels. Resettlement was geared to provide not only improved living conditions for the rural population but also to establish new homesteads on much better land for farming activities along with agricultural services. The company carrying out the project, COPEL, was actually the first hydroelectric company in Brazil to carry out, on its own, environmental plans and programs to preserve the natural surroundings and improve living conditions of the families in the affected region.

Already in 1986, five years before the project began to disburse, COPEL had established a group to propose solutions for the resettlement of families to be displaced by the project. In addition to representatives from various government departments, members from rural and city workers associations and unions, and the mayor's office of affected municipalities contributed to identify these solutions. Together they approved criteria, basic principles and procedures for the appropriation of land and relocation of the population.

Each resettled family has received operating funds to cultivate 12 ha of soybeans. At the community level, the electric company has provided 11 000 fence posts, 385 rolls of wire, lime for soils, the construction of bridges over two rivers, a health post with equipment, and legal assistance. In addition, COPEL has constructed churches, a community center, a state-run elementary school and provided telephone services. COPEL also agreed with local associations (representing the resettled communities) to establish a revolving credit fund. The Credit Fund is a common pool of resources to which all Association families have access. Typical investments include: mulching machines, milk cows, beef cattle, horses, bee hive boxes, sewing machines, refrigerators, tractors, and fruit trees. Loans can be paid back in sacks of corn.

Source: IDB (1999b).

Hydropower generation has some important advantages over other sources of energy for most LAC countries, especially for countries that are net energy importers and suffer from large external debts. Lower energy import bills can in turn reduce the total need for external financing. Countries which rely more heavily on fossil fuels for energy production tend to have more difficulties to balance their external accounts. Figure 1.9, Annex 1, shows for instance, that countries with higher shares of electricity production from oil sources tend to have more *negative* external balances (as % of GDP).

Tourism

Many countries in the region, which during many years relied on exports of agricultural products as their main source of foreign exchange, have made an important effort to diversify their economies. The development of the *tourism* industry has played an important role in these diversification efforts. Figure 1.10, Annex 1, shows that for several countries in the region, especially in the Caribbean, tourism represents well above 25% of their foreign exchange receipts.

Tourism offers developing countries the possibility of diversifying their export earnings, particularly given that (i) traditional exports are subject to price fluctuations and (ii) there is a trend toward reducing the administrative, monetary, and border formalities that affect international tourism mobility.

The most important economic feature of activities related to the tourism sector is that they contribute to three high-priority goals of developing countries: the generation of income, employment, and foreign-exchange earnings. In this respect, the tourism sector can play an important role as a driving force of economic development. The impact this industry can have in the different stages of economic development depends on the specific characteristics of each country. Given the complexity of tourism consumption, its economic impact is felt widely in other production sectors, contributing in each case toward achieving the aims of accelerated development (OAS-IIC, 1995).

The tourism sector in the Latin American and Caribbean countries contributes significantly to GDP earnings, although this contribution is not fully reflected in the domestic income and product accounts of most countries. In the Bahamas, tourism accounts for about one-third of GDP, and most sectors of economic activity are directly or indirectly linked to it. In Barbados, tourism is the leading economic sector, accounting for 15 percent of the GDP in 1992. In Jamaica, the tourism contribution to GDP was 13.4 percent in 1992, while in Mexico it was only 4 percent (OAS-IIC, 1995).

Tourism compares favorably with other economic activities as a generator of both employment and income, both directly and diffused through the economy. An OAS study on new hotel development in the Caribbean estimates that every investment of US$80,000 in the tourism industry in the region generates forty-one jobs (OAS, 1987). The same investment would create only sixteen new jobs in the petroleum industry and fifteen in metallurgy. According to the Caribbean Tourism Organization (CTO), the 77,319 hotel rooms in fifteen Caribbean countries equaled 88,697 jobs, or almost 1.15 per room (CTO, 1992).

Hotels account for about 75 percent of tourism employment (distribution, transport, finance and insurance, and entertainment make up the other 25 percent). Every room in a three- or four-star hotel in Venezuela generates one job, for five-star hotels, each room creates 1.3 jobs (IDB, 1989). Even before the 1990s (OAS, 1987), one job generated by a hotel generated one more job elsewhere in the tourism trade and two in the rest of the economy; thus one job generated an estimated three others.

Tourism can make an important contribution to a country's balance of payments. The IDB estimates that in the Latin American and the Caribbean five-star hotels can generate US$5.4 for each dollar spent in their operation. The figure for three- and four-star hotels averages US$4.2 (IDB, 1989). From an economic viewpoint, services performed in tourism are classified as exports. Tourism activity in the Caribbean does not usually require sophisticated technology, and can absorb more personnel without skilled training than other industries.

Without exception, in all countries in the region where tourism is an important contributor of foreign exchange and employment, the development of the industry relies and depends, directly or indirectly, on the proper management of water resources. Even in those countries, as in the Caribbean where the tourism industry is mainly based on their coastal resources, there are strong links with the management of "freshwater" resources. One is the case of the effects of lacking or non-functioning sanitation infrastructure and/or wastewater treatment facilities in urban areas over the quality of the coastal waters. Increased pollution of beaches and its associated health risks for tourists and local population constitute a threat for the development and survival of the tourism industry.

In these countries, it is therefore very important to assess the cost and benefits of investments in sanitation infrastructure with a national perspective. These are investments that will not only provide local populations with better and safer living conditions, but will also help to preserve and promote the development of an important industry with positive inter linkages with the whole economy.

Navigation

Navigation is important in several South American countries. In Brazil, the Ministry of Transportation reports that during the period 1998 – 2000, river freight transportation averaged 21.9 million tons per year. The Amazon River Basin contributed with 18 million tons in year 2000 (Ministério dos Transportes, 2001).

The eastern part of Colombia is generally well served by local roads during the dry season. However, during the rainy season, passenger and freight movement would be reduced to costly air transportation or straining horse back riding, were it not for the existence of a wide net of navigable rivers (Diaz, 1998). The Orinoco-Apure river basins have great potential for navigation in Colombia and Venezuela.

But nowhere is navigation more important than in the Rio de la Plata river basin, where the Paraná and Paraguay rivers provide a strategic link to the ocean for land locked Bolivia and Paraguay. This has prompted for extensive studies of what is known as the Hidrovía project, albeit not without well known major environmental and social concerns and controversy.

Social contributions of water

In addition to the important contributions of water resources to the local, national and regional economies in LAC presented in the previous section, water resources also provide important social contributions to the people of the region. The most significant social effects from proper water resource management can be grouped in three major areas: health, poverty alleviation, and reduction of vulnerability to natural hazards.

Health

Safe access to clean water and the proper disposal of wastewater are both important contributors to public health. Drinking water contaminated with human or animal excreta is the main source of water-related disease. These include most of the enteric and diarrhea diseases caused by bacteria, parasites and viruses, such as cholera, giardia and rotaviruses (McCartney et al, 1999). In LAC, the relationships between access to clean water and sanitation and health conditions is often revealed in serious and dramatic ways. One of the most recent events that help to illustrate these inter linkages was the epidemic of cholera that affected the region not too long ago. Figure 1.11, Annex 1, shows a negative relationship between the

coverage rates of water supply and the incidence of cholera cases in a selected sample of LAC countries (PAHO, 2001).

Improved general health conditions, facilitated by easy access to safe water supplies, in addition to proper disposal of wastewaters, may also be related to satisfactory levels of nutrition. Figure 1.12, Annex 1, shows a positive relationship between higher water supply coverage rates and nutrition indicators in a sample of LAC countries (PAHO, 2001). This relationship may in part be due to the relationship of both water coverage rates and nutrition levels to income, although it may well be that access to safe water has an impact on general household well being and income-generation potential.

Poverty alleviation

One effect of water resource management on the social conditions of the population is through the impact of infrastructure. Infrastructure can have positive impacts on the poor in several ways, among them through its effect on promoting economic growth. It has been estimated that in Latin America, a 1 percent growth in per capita income reduces the share of the people living in poverty by half a percentage point. Any contribution of infrastructure to growth will therefore have a poverty alleviation effect. This effect can be quite significant. In Bolivia, Colombia, Mexico and Venezuela, the elasticity of output to infrastructure stocks is around 0.14 to 0.16 (Estache et al, 2000).

Additional information on the influence of infrastructure on growth and poverty can also be gathered through the effect of infrastructure on the convergence between poor and rich regions within a country. In Argentina and Brazil, recent studies show that lack of access to sanitation and to roads over the last 20 years have been important impediments to convergence for some of the poorest regions (Estache et al, 2000).

Thus, with large percentages of the population employed in agriculture in the low-income economies of LAC, investments in irrigation and agriculture more generally and improvements in water management, in particular, can have substantial impacts on rural poverty alleviation.

Water development and management are potentially important instrument for poverty alleviation (World Bank, 2002; UNEP, 2000; PNUD, 1999). Often the poorest sectors of the population lack access to safe sources of potable water, and sanitation coverage rates among the poor are typically much lower than for higher-income groups. This situation has negative effects on the living conditions of the poor and

reinforces a vicious circle of poverty. Improved access to water sources and sound sanitation systems can contribute to better health and thus, to enhanced productivity potential among the poor.

Poor service delivery of water supply and sanitation to the poorest has often a negative distributive impact. Those households without access to tap water, usually the poorest, end up paying higher unit water prices than their better-off (and connected) counterparts.

Extending coverage rates for water supply and sanitation will affect the living conditions of the poor via better health, and increased potential labor productivity; through considerable cash savings (since their supplies must often be bought expensively, from water trucks, bottled water, etc.); and through reduced time use in bringing the water to the household.

The water consumption among the usually poor, unconnected households, is on average much lower than the average consumption of the usually better-off families with household tap connections. The fact that these unconnected, and poor, families have marginalized water consumption makes them more vulnerable

Box 1.3. Household water priorities in Central America

Water is a precious element for the economy and indispensable for human well being. This is also confirmed by the way households in Central America define their priorities concerning which public service they regard as the most urgent to improve.

Priorities for improvements in public services were determined according to household interviews performed in seven cities in Central America, covering about 10,000 households. The figures reported indicate that water is by far, the most important public service in need of improvement. Taken together with sewerage connections, water was preferred by about 45 % of the households surveyed, showing that this is the most seriously affected sector. Potable water is overwhelmingly the first priority for households without a water tap. It is also the first priority, but not by an equally large margin, for those with non-metered tap. Many households in the group with non-metered tap water are rationed and have water of poor quality, making them place high priority on water service improvements. Only those with adequate tap water gave relatively low priority to potable water.

The relationship between consumption and prices for metered tap and nontap households was illustrated by the survey made in these 7 selected cities in Central America.
The following features were made evident:

- As expected, average consumption of water is much higher for metered tap than for non tap households (about 5 times as high).
- Unit water prices are much higher for non tap households than for metered tap households (in some cases the latter were subsidized), on average about 13 times as high. These prices are quite variable across city for nontap households (and depend on the actual sources used in each city), while they are more stable for metered tap households.
- Total average money expense on water is about twice as high for nontap households as for metered tap households, despite the former consuming much less water.
- In addition, nontap households have substantial time costs of water hauling. This amounts to a large excess burden for those poorer households that are not connected to the water system.

These results confirm the potential positive effects that increased coverage rates may have on the poorest segments of the population. For those without tap water, access to water will represent considerable savings in cash and time.

to illness and nutritional deficiencies. LAC is no exception to this rule. It is to no avail then that improved access to potable water and sanitation services are often the most wanted public services among the population. See Box 1.3 for an illustration.

Natural hazard risk mitigation

Floods are the most frequent and damaging of all types of natural hazard. Few countries are spared from the effects of floods. Between 1991 and 1995 it is estimated that floods caused –on a global basis– more than US$200 billion in losses, almost half of all economic damage caused by all types of natural disasters during the same time span. Each year floods are responsible for 25% of the deaths due to natural disasters, and in 1996 alone, 60 million people were affected globally by this natural hazard (Miller, 1997). Natural hazards have had a lethal and destructive impact in the region. An important share (66%) of the events registered between 1900 and 1998 were related to weather or climate. The hazard events experienced by the region during that period can be classified as 34% due to floods, 5% due to droughts, 2% due to wildfires, and 25% due to wind related phenomena (OFDA/CRED, 1999).

Flood prone zones suffering from river flooding in LAC occur in the lower valleys of almost every major river, such as the Paraguay and Parana in Bolivia and Brazil; Magdalena in Colombia, Orinoco in Venezuela, Guayas in Ecuador and Beni in Bolivia. Flood-prone zones will get flooded whenever the water flows are higher than the capacity of the river bed. This may happen due to tropical cyclones or storms, heavy rains from El Niño, or other natural weather and climate related phenomena. Tropical cyclones hit especially hard the Caribbean Islands and the Caribbean coast from Mexico to Venezuela.

Estimates of damages caused by floods due to hurricane Mitch in Central America totaled 6 billion US$ in 1998, which is the equivalent of 16% of the affected countries previous year's GDP, 66% of exports, 96.5% of gross fixed capital formation, and 37.2 % of the total external debt (IDB, 2000). In Honduras alone, floods due to Hurricane Mitch caused US$ 58 million of damage (WHO/UNICEF, 2000). The devastation included the destruction of 85,000 latrines and 1683 rural water mains. About 75% of the rural population – approximately 4.5 million people – lost access to drinking-water and sanitation facilities. Devastation such as that caused by floods due to Hurricane Mitch may last for months or even years.

Floods also lead to large losses for urban households, commerce and urban infrastructure, especially accompanied by landslides. In Argentina, floods in 1982/83 and 1992 affected more than 4 million ha in 7

provinces with estimated damages in the order of 1.8 billion US$ (Calcagno et al, 2000). This natural problem is often aggravated by the settlement of squatters and low income population in flood-prone areas and/or unstable hillside slopes.

Natural hazards represent a permanent threat to the livelihood of the most exposed population. However, there are ways by which the population can organize itself to mitigate their negative consequences. Although by no means the only example in Central America, Box 1.4 shows how rural communities in Honduras, by making use of traditional farming techniques, were able to reduce the risks of natural hazards. At the same time their farming technique has shown to be a sustainable production system. This may well be taken as a generic example representing all projects of this type being executed in this sub region.

Box 1.4. Hurricane Mitch and Sustainable Farming in Honduras

The storm that devastated much of Honduras and northern Nicaragua went directly over the remote Honduran village of Guarita near the El Salvador border. There is however, little evidence of its passing. Much of the population is of Lenca Indian origin and illiteracy is at about 50 percent. However, while much of the country was devastated by the flooding caused by Hurricane Mitch, no one died in the south of Lempira and the damage was minimal. The explanation may well be an indigenous system for farming mountainsides that is being supported by the Honduran government and the FAO. The system was so successful that those using it only lost 10 percent of their crop after last year's drought and even after the flood, farmers have a grain surplus. The *Quezungal method*, is a stick and plant method that avoids the slash and burn technique that removes vegetation cover and damages watersheds. Almost 70 percent of the Honduran farmland is located on hillsides. When hurricane Mitch resulted in a record volume of water falling over the Honduran mountains, the lack of hillside vegetation led to rapid run off, the eroded soils and loose rocks caused devastation to human, livestock and farms.

The Prolesur project (Proyecto Lempira Sur), implemented by the Honduran government and FAO, works with 84 communities in the south of the province of Lempira. The number of farmers who slash and burn have now been reduced to single digit figures and the project works with local farmers to promote the Quezungal method of farming. This method involves planting crops under trees, whose roots anchor the soil, vegetation from pruning provides the soil nutrients and water retention and terracing reduces erosion. It is clear that by supporting local techniques and institutions, local communities can cope withthe greatest of natural disasters.

Source: Soussan et al, 1999

In contrast to floods, the lack of the right amount of water at the right place at the right time can also be very costly. Less often, the region is also affected by droughts. Droughts are regional phenomena and their effects depend on the level of preparedness in facing the events. The socioeconomic conditions of the affected people, together with the condition of their natural resources and the environment, will define the degree of vulnerability to such events.

Economic losses due to droughts have not been as well documented as those for floods. However, it has been reported for instance, that recent droughts in Brazil reduced the projected GDP growth by two percentage points (World Bank, 2001b).

In the case of natural hazard prevention, the costs of not acting can be very high. Increased public awareness and improved preparedness to face floods and droughts represents another important set of challenges for water management in the region. Facing such challenges constitutes a true development strategy. Natural hazards preparedness is important not only to avoid material and human losses, but also for sustained economic growth and social development.

Environmental contributions of water

Freshwater ecosystems

There cannot be a maximization of long-term economic and social returns from freshwater resources without proper management of freshwater ecosystems and, at the same time, conserving ecosystem processes and biodiversity (Bucher et al, 1997). Mismanagement of freshwater ecosystems may result in environmental degradation, destruction of ecosystem functions and loss of wildlife habitats with consequent losses for humankind (Braga, 2000). There are instances where human interventions in freshwater ecosystems have even induced, or at least contributed to, social disorder and violent conflict (McCartney et al, 1999). Freshwater ecosystems are also the living source of many valued plants and animals that provide natural means of living for local indigenous populations.

Environmental services

The dynamic process of flows within a water system (a watershed or river basin) is central to understanding the nature of water resources and their links to human needs, freshwater ecosystem dynamics and the inter-relationships between these ecosystems and social security. Water resources are more than just "water". They are best understood in terms of a range of goods and services that are derived from different stages in the water cycle and that satisfy a wide range of needs and demands, both for the environment itself as well as for society. For example: hydropower, transportation, recreation (including the aesthetic value of many freshwater ecosystems) or for the dilution of waste products from homes and industry. Water is also directly abstracted and consumed by people in their homes or used in agriculture or manufacturing. Much of this water re-enters the hydrological cycle, albeit in a different form (sometimes as water vapor) and place (generally downstream), perhaps with changed chemical characteristics (e.g., polluted or deoxidized). Thus, it is only fair that society compensates, directly or indirectly, for these services by investing in preserving the ecosystems that provide such valuable services.

Problems and Challenges in Water Management for Sustainable Development

In this chapter, a broad overview of the main challenges being imposed on the users and managers of water resources in LAC is presented. This chapter has been divided in four sections. The first section gives a general overview of the challenges and problems of water resources. Careful analyses of the main water resource problems in the LAC region and its sub-regions have been made in previous studies and reports. This paper does not aim to provide an exhaustive and definitive analysis of these problems, and thus will instead refer the interested reader to some of these authoritative sources, presented in Box. 2.1. In the second section of this chapter, an analytical framework to classify the different problems affecting water resources is presented. Later, an illustration of the "root" causes of most of these immediate problems and their consequences is provided. Finally, a summary of the key water resource problems in the different sub-regions in LAC is presented.

Box 2.1 Key sources for detailed descriptions of Problems in Water Resources in LAC

For the whole region

- CEPAL (1999), Tendencias actuales de la Gestión del Agua en América Latina y el Caribe.
- IDB (1998), Strategy for integrated water resources management.
- WHO/UNICEF (2000), Global Water Supply and Sanitation Assessment Report.

For South America

- GWP-SAMTAC (2000), Agua para el Siglo XXI: de la Visión a la Acción.

For Central America

- GWP-Centroamérica 2001, Situación de los Recursos Hídricos en los países del Istmo Centroamericano.
- SG-SICA 1999, Plan de Acción para el Manejo Integrado del Agua en el Istmo Centroamericano.
- PNUD (1999), El Estado de la Región.

For North America

- Vision on Water, Life and the Environment for the 21st Century (1999), Regional Consultations North America.

For the Caribbean

- CEHI (2001), An assessment of water resource management in the Caribbean, Background Discussion Paper.

Problems and challenges in water management

Water resources and all those activities that depend on these resources face a diverse set of problems and challenges in the region. Being a limited resource, water is under pressure by different users and increasing demands to satisfy different sector needs and aspirations. For clarity of presentation, the diversity of problems is grouped into four main categories. These categories are defined only for analytical purposes. In practice, it is more common that the myriad of problems being faced day-to-day by

users and water managers are more complex and most probably the types of "challenges" presented here overlap with each other.

According to this classification, the problems and challenges of water resources in LAC belong to the following categories:

- Social challenges
- Economic challenges
- Financial challenges
- Environmental challenges
- Institutional challenges

Each one of these challenges is discussed in the following paragraphs. Figure 2.1 shows an overview of the types of problems considered under each category.

Social challenges

According to Figure 2.1, social challenges can be summarized by the current needs to: (i) increase piped water coverage rates, especially among low income groups and in specific areas where coverage is low; (ii) improve health conditions of the population, especially reducing morbidity rates for water-borne diseases; and (iii) mitigate the risks of natural hazards.

Coverage rate estimates based on data collected as part of the WHO/UNICEF (2000) assessment, suggest that the region has relatively high service levels. For example, total "safe" coverage of piped water supply is approximately 85% of the population, while total sanitation coverage is slightly lower at 78%. Large disparities are apparent between urban and rural areas, with an estimated 87% of the urban population having "improved" sanitation coverage, but only 49% of the rural population having coverage. For water supply, 93% of the urban population enjoys coverage, while only 62% of the rural population is covered.

These average rates however mask significant differences across countries and cities. In may cities there is virtually universal water and sanitation coverage, while in others not much more than half the population is covered. It is also necessary to be aware of possible different local definitions of "safe" or "improved" service, as well as the different sources of information used. For example, some countries in the region, for which household surveys were not conducted, may have used higher standards when defining services. In these cases, the coverage figures may be underestimated. According to this particular

source, a total of 78 million people are without access to piped water supply in the region. In comparison, almost 120 million people are reported to be without access to regular sanitation services. (WHO/UNICEF, 2000).

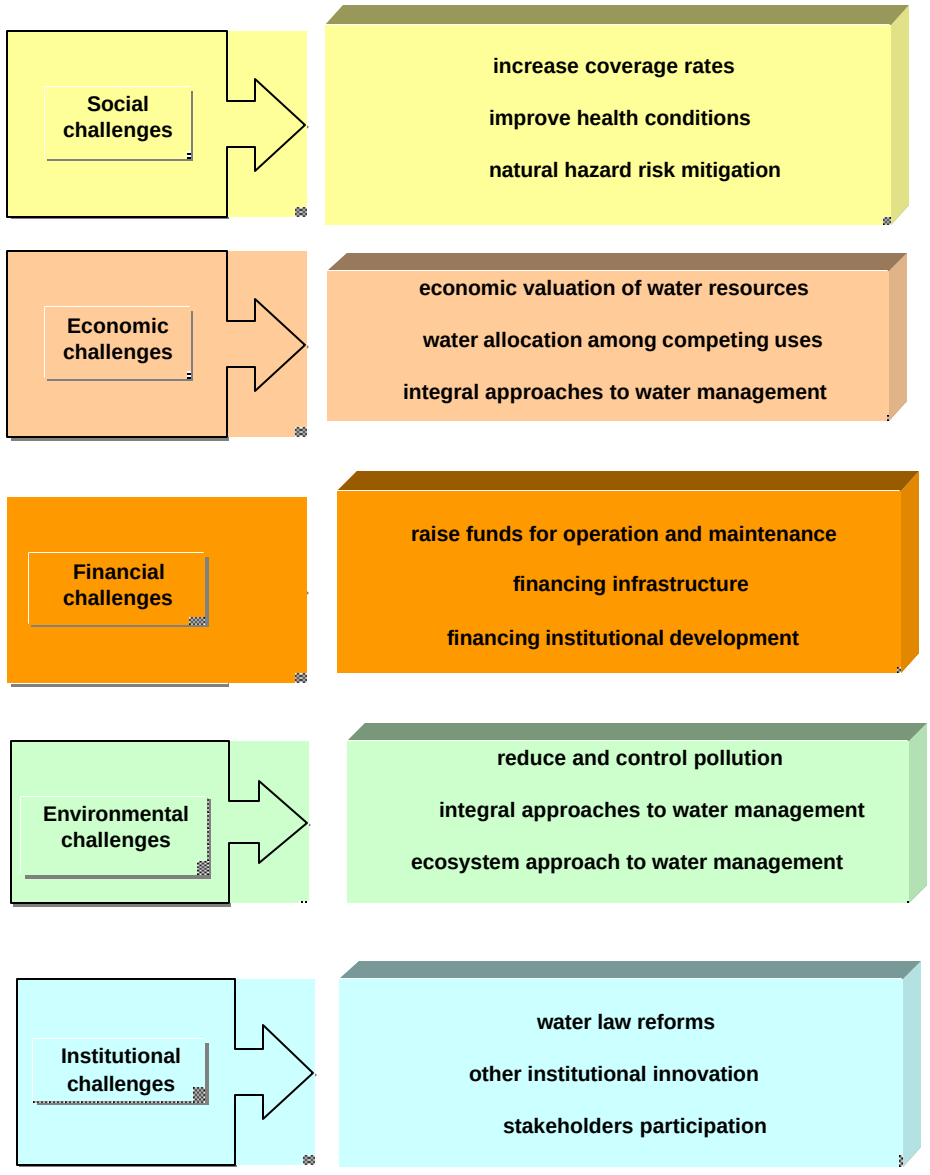

Figure 2.1 Challenges and problems for water resources in LAC

Despite the advances of the past ten years, access to safe water remains an important issue. In addition to the lack of coverage affecting poor sectors of the population, in Latin America as a whole, as little as 2 per cent of sewage receives any treatment (World Bank 1997). If action is not taken in the near future, these problems could present severe health and environmental risks.

During the past decade, environmental problems related to water have affected both urban and rural areas. In the arid and semi-arid areas, there has been increased competition for scarce water resources. Using polluted water for irrigation and of course for drinking and bathing, spreads infectious diseases such as cholera, typhoid and gastroenteritis. Several countries have had recent outbreaks of these diseases, which affect the urban poor in particular.

Economic challenges

Economic challenges in water resources are mainly related to the issue of water allocation among competing uses. Figure 2.1 groups the economic challenges under three closely related categories: (i) economic valuation of water resources; (ii) efficient allocation among competing uses; and (iii) integrated approaches to water management.

Lack of proper valuation of the economic benefits of alternative water use is leading to inefficiencies in water use and waste of water. Perhaps even worse, it hinders the realization of important gains for the economy and improvements in living conditions of the population. Increased awareness on the economic value of water and the economic benefits accruing to water has been a key determinant of water reforms leading to better water pricing and ventures into water markets. In Mexico, the elimination of distorting subsidies to water for irrigation lead to increased valuation of the resource resulting in large efficiency allocation gains (as previously illustrated in Box 1.1). Similar experiences can be found for irrigation water in Chile.

Demand for water is growing rapidly as population and industrial activity expand and irrigated agriculture (the largest water user) continues to increase (WRI, UNEP, UNDP and WB, 1996). Population growth, increased degrees of urbanization and economic growth are all factors contributing to the reduction of per-capita water availability in LAC (CEPAL, 1999). In the case of surface water, reduced availability mostly refers to reduced amounts of water of a certain *quality*. In the case of groundwater, availability refers to the *quantity* (stocks) of water that can be extracted from the aquifers. In certain locations in LAC, current patterns of water withdrawals are clearly unsustainable, such as pumping from aquifers at rates far greater than the rate of recharge. This is the case of many aquifers in Mexico (World Bank, 1999). Over-exploitation of aquifers implies significant negative externality costs, e.g. increasing pumping depths and costs and/or leading to investments in more expensive infrastructure, such as inter-watershed water transfers. Degradation of water quality may also occur, such as in Mendoza, Argentina,

reducing the amount of water available at lower depths, thus increasing the extraction costs. In the case of surface water, this also increases treatment costs.

Water availability has been a fundamental factor in the development of irrigation throughout the region. An area of 697,000 km^2 is currently irrigated, corresponding to 3.4 per cent of the region's territory (World Bank, 1996) but salinization and water logging are eating away the productivity of 40 years of irrigation investments in countries such as Mexico, Chile and Argentina (Winograd, 1995).

Table 2.1: Ratio of water withdrawal to water availability

LOW less than 2.5 percent		MEDIUM 2.5 to 10 percent	HIGH over 10 percent
Belize	Guyana	Argentina	Barbados
Bolivia	Honduras	Chile	Cuba
Brazil	Nicaragua	El Salvador	Dominican Republic
Colombia	Panama	Haiti	Mexico
Costa Rica	Paraguay	Jamaica	Peru
Ecuador	Suriname	Uruguay	
Guatemala	Venezuela		

Source: WMO/IDB 1996.

The combination of these two mutually reinforcing effects (increased demand and reduced availability) should be a warning signal for decision and policy makers to focus on improving current mechanisms and institutions for water allocation. Table 2.1 shows the ratios of water extractions to water availability for selected LAC countries. A ratio greater than 10 percent generally indicates that the water resource supply is inadequate and significant investments as well as management plans will be required to increase supply, reduce demand or both. The ratios represent both internal and external water supplies available to the countries (WMO/IDB, 1996).

Managing water resources with an integrated approach, instead of sectoral or partial approaches is a key economic challenge. Agreed procedures for water allocation among competing uses is an important component of any integrated water management plan, especially under water scarcity conditions.

Financial challenges

Financial challenges facing water resources are summarized in Figure 2.1 and grouped into two main categories: (i) raising funds for Operation and Maintenance; and (ii) raise funds for new investments.

Tariffs should serve as a proper signal to water users, on the opportunity cost of their water use. Tariff rates for water should, as a rule, provide operators with enough funds to carry out their operations and maintenance activities. When tariffs are "too" low and/or collection rates are deficient, water operators and specially water infrastructure suffer the consequences. Service delivery begins to fault and infrastructure decays at a much higher pace than it should. Although there have been some advances in the application of proper principles of water pricing and tariffs for industrial, agricultural and domestic uses, there are still challenges to be faced. The development and implementation of "correct" pricing, accurate consumption metering, and efficient and correct billing, constitute key financial challenges for water resource management in LAC.

This challenge is aggravated by the fact that actually the costs of supplying additional water are continually rising, with dramatic examples from large and growing urban areas. In Mexico City, water is pumped over elevations exceeding 1,000 meters into the Valley of Mexico, and in Lima upstream pollution has increased treatment costs by about 30 per cent (World Bank, 1997). Investments in sanitation and water supply offer high economic, social and environmental returns, but the next four decades are likely to see urban population rising threefold, and domestic water demand increasing fivefold in Latin America (WRI, UNEP and UNDP, 1996). An analysis of the World Bank's investments in the water sector showed that comparable projects tend to be much more expensive today than they were in the past. Their analysis of "repeater" water supply projects showed that the costs of bulk water for the "next project" are often 2 to 3 times greater than the "last project" (World Bank, 2002-draft).

Often water allocation problems find their roots in the institutional framework in which water is managed and used (IDB, 1998). Water resource problems cannot be solved only by increasing investments in infrastructure or improving the balance sheets of water operators. Improved water demand management requires improved institutional and regulatory frameworks, and these also need their fair share of financial resources to accomplish their responsibilities. Thus, another financial challenge is raising funds to cover not only the investment needs of new infrastructure, but also those of new institutional frameworks as well.

Environmental challenges

Figure 2.1 summarizes the environmental challenges of water resources in LAC. These are grouped into three main issues: (i) pollution control; (ii) integrated management; and (iii) eco-systemic approaches to resource management .

The main source of pollution of surface waters in LAC is the untreated discharges of municipal and industrial effluents, which not only contaminates them, but also adjacent groundwater aquifers. (CEPAL, 1999). This implies that the main water pollution problems in LAC are concentrated around the largest metropolitan areas. The major contributing factors are: (i) the concentration of population and industrial production in large metropolitan centers; (ii) expansion of conventional sewerage systems which have not been accompanied by corresponding treatment facilities; (iii) changes in economic structure, with increased emphasis on manufacturing; (iv) concentrated run-off from paved areas in the growing cities; and (v) the artificial regulation of stream flows. As recently as 1995, the Pan-American Health Organization (OPS, 1995) reported that on average, only 13% of domestic waste waters in LAC received some degree of treatment. As a result, the quality of water bodies near large metropolitan areas has been seriously compromised.

In the industrial sector, the main sources of concern are the effluents from the pulp and paper mills, chemical and petro-chemical industries, oil refineries, metallurgic, textiles and food processing industries (UNEP, 1999). On a smaller scale in micro watersheds, tanneries are a cause for concern in Central America.

The increased use of agrochemicals also causes important non-point pollution from agricultural land use, compounding the problem when they are located near large metropolitan areas. The Acelhuate in El Salvador and the Virilla in Costa Rica are just two examples of rivers heavily polluted by agro-industrial activities and metropolitan development.

A secondary source of point pollution comes from mining. Virtually all countries in Latin America have artisanal mining activities, of which gold is the most mined mineral. It is estimated that as many as one million artisanal miners are producing some 200 tons of gold annually. Since the beginning of the new gold boom in Latin America at the end of the 1970s, around 5,000 tons of mercury may have been discharged into the forests and urban environment (Veiga, 1997). Where industry, mining, and use of agricultural chemicals are expanding, rivers become contaminated with toxic chemicals and heavy metals. In the Andean countries in particular, pollution from mining activities is a major source of water pollution.

As industry, irrigation, and population expand, so do the environmental and economic costs of providing additional water supplies. In the Caribbean, housing developments continue to be sited in sensitive areas such as on steep hill slopes in the upper parts of water catchments areas, and too close to recharge areas of

sensitive groundwater aquifers. Freshwater resources are thus being degraded at the same time as demand for water is increasing.

An important source of groundwater pollution is seepage from improper use and disposal of heavy metals, synthetic chemicals and hazardous wastes. The quantity of such compounds reaching groundwater from waste dumps appears to be doubling every 15 years in Latin America (UNDP, 1997). Saltwater intrusion is also an important source of groundwater pollution.

In the past the effect of human activities on freshwater ecosystems was generally insignificant and of a local nature. In many cases, the natural systems had sufficient resilience to recover from the human-induced stresses placed on them. Under these circumstances, inter linkages among the different elements and functions of ecosystem were less evident for water users and managers. The situation has fundamentally changed during recent years. In many regions the effects of human activities are evident in terms of water resource development, water use, and land use change. In the past 50 years, increasing population, coupled with technological advances and intensive irrigation development has had an even greater impact (both intentional and inadvertent) on freshwater ecosystems. Changes in water balance and water quality have resulted in environmental degradation, destruction of natural habitat and/or loss of ecological functions, with serious implications not only for the integrity of these systems but also for the well-being of people (McCartney et al, 1999).

Given that ecosystem functions and mechanisms are complex and interdependent, the availability of water resources in a given situation may be critical to sustain the ecosystem as a whole. In other words, whatever takes place in the upper watershed will have an effect on the lower watershed. These key and unavoidable interdependences are critical issues to consider in planning the use and management of water resources (Bucher et al, 1997). The proponents of the ecosystem approach to water resources claim that the watershed approach is more fitted to deal with these interdependences and thus contributes to the sustainable use of the resource. But using the river basin as the basic unit for water resources planning and management is not only an important environmental challenge, but also a formidable institutional challenge, as will be discussed in the next section and in chapter 3.

Institutional challenges

Successful management and efficient use of water resources require a proper and sound institutional framework. Figure 2.1 summarizes the many institutional challenges under the following categories: (i) water law reforms; (ii) other institutional innovation; and (iii) stakeholder participation.

Institutional innovation in the water sector has been taking place in LAC especially after the end of the "lost decade" (IDB, 1998). Reforms during the nineties included mainly privatization of utilities and modifications in the regulatory frameworks for the provision of public services. However, reforms in the water sector in LAC still have to be completed. Obsolete legal frameworks, inadequate institutions and unclear policies are all part of the problem affecting the proper development, utilization and management of water resources in LAC.

Creating an adequate institutional capacity, including the legal framework under which water use and management take place is urgently needed. To achieve this goal, public awareness on the nature of the problems and on the current condition of water resources has to be raised. Politicians and decision makers must not only show commitment and willingness to face these issues, and search for practical solutions as well. This is by no means, a small challenge. In Central America, for example there have been attempts to modify water laws in several countries. However, the process has been extremely slow. In some countries the proposals for new water legislation have been in their parliaments for years without receiving approval. Table 2.2 shows an overview of the current status of water laws, organizations and policy in the sub-region.

Table 2.2 Overview of water laws, organizations and policy in Central America

Country	Water law	Water management organization	Water policy
Belize	No	No	Proposals
Guatemala	No	No	Sectorial
El Salvador	No	No	Sectorial
Honduras	Yes(1923)	No	Proposals
Nicaragua	No	No	Proposals
Costa Rica	Yes(1943)	No	Sectorial
Panama	Yes(1963)	No	Sectorial

Source: Colom (2000).

A great deal of coordination is required to avoid or reduce problems and conflicts among different water uses and water users. Conflict resolution requires the establishment of clear rules for water allocation, use and distribution. Integrated water resource management (IWRM) aims to provide such a framework by taking into account the needs and interests of all the actors or stakeholders involved. IWRM is still in an

early conceptual phase in LAC and there is still much to be gained by advancing in this direction. To bring this concept into real world reality is a real challenge.

Although noticeable advances have been achieved through decentralization and the constitution of watershed or river basin organizations (see Boxes 3.5 and 3.7 in the next chapter), many of these instances have not been able to contribute all their potential for water resources management. To a large extent, the cause for the generally limited success of this type of organization can be found in the tremendous challenges posed by their lack of resources, their poor coordination and the inappropriate existing legal frameworks (CEPAL, 1999). More about this is found in chapter 3.

Promoting stakeholders' participation also contributes to resolve conflicts and promote coordination among different water uses. In many countries, water policies and water management is still done in a top-bottom manner with little participation of the stakeholders. Advances in this aspect constitute the final component of the institutional challenge facing water resources in LAC (IDB, 1998). Increased participation from stakeholders also requires increased awareness on the nature and magnitude of the problems being faced. Improving the collection, systematization and dissemination of information on water resources is an area which needs much attention in the region. The lack of assessment and monitoring of the quantity and quality of the existing resources is a major shortcoming for its appropriate utilization and a major impediment for proper management (WMO/IDB, 1996). Many river basins in the region lack even the most basic information to conduct a water balance. Although this situation has improved in the last 20 years, it is in general still affecting the proper management of water resources in LAC (CEPAL, 1999).

Typology of water resource problems

As previously discussed, water resource problems evidence themselves in a variety of ways. The diagnosis of the causes for these problems can be improved by using an analytical approach to classify the different types of conflicts across water uses and among water users. One such analytical approach recommends classifying the different problems under the following categories: externalities, open access, and public goods (Lord & Israel, 1996).

Under this analytical framework, one of the most serious problems in LAC is the pollution and quality degradation of water supplies of downstream users resulting from untreated discharges of upstream parties. These types of problems arise because the actions of those located upstream often impinge

"external costs" on those using the resource downstream, while not necessarily representing any cost to them. Pollution of water resources is then, a typical example of a water resource problem originating from an "externality problem".

The second type of problem is the "open access" problem. This is the type of problem that often originates when multiple users have access to a resource, but yet no one can be excluded or it is too complicated or costly to exclude anyone from using the resource. Often, the use and exploitation of aquifers represent a typical case of an "open access" problem. Under such circumstances, people generally have incentives to follow their own short-term interests resulting in outcomes that are against the overall population's long-term interest (World Bank, 1999).

Another problem of relevance for many cities in LAC is caused by flood damages in urban and populated areas. The dilemma faced in flood control is to decide how much one should invest in structural or non-structural measures. The problem is that very often there is no agreement regarding the expected value or benefits from investments in flood control. Under these circumstances, as is the typical case in the provision of "public goods", there is under provision of the good. Since such goods are costly to provide, and there is uncertainty about their pay-offs, there is no clear incentive for the provision of the good up to a socially desirable level.

As Figure 2.2 graphically illustrates, it is also useful to differentiate between the immediate problems and their *consequences*, and the *roots* of these problems.

The *roots* of the problems

Water as a "special" type of natural resource

Although water in some instances can be treated as a commodity, it is by no means like any other commodity. Water is a precious natural resource providing essential services and benefits both to human and natural life. Water, is a source of life. Human life and the functioning of almost every ecosystem, depend on the availability of water. It is not possible to "substitute" water with any other element in order to fulfill their role in the functioning of the human or ecological systems. This special characteristic raises an extraordinary challenge upon all those who use, manage, and regulate the resource.

The proper management and regulation of water resources is further complicated by the fact that water, is used both as a productive input, and as a final or consumption good. This for one thing creates competing uses of water across different productive sectors or uses. No wonder then, that the management and regulation of water often becomes a formidable task.

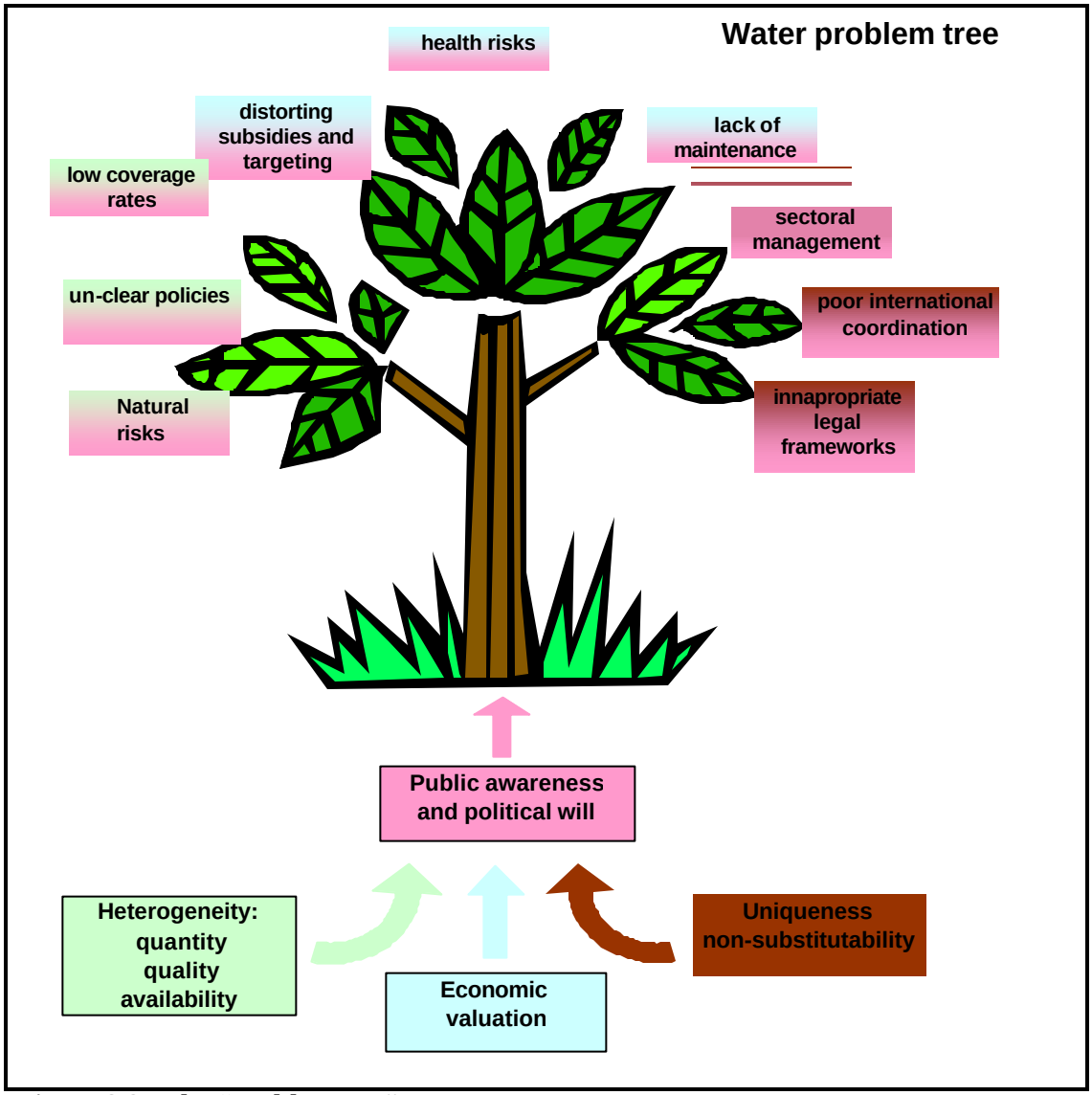

Figure 2.2 . The "problem tree"

In LAC the inter-sectoral demands for water and their related conflicts have been accentuated by the traditional sectoral organization of the State (CEPAL, 1994). This institutional feature has also contributed to the slow adoption of "comprehensive" or "integrated" water management approaches in the region (IDB, 1998).

Water is also a finite resource, since natural freshwater supplies are constrained by available precipitation. This fact is well known, but still not properly acknowledged by many water users, managers and regulators. Furthermore, since water availability is also widely variable, both in space and time, it is difficult to grasp this fact. In addition, the existence of water reserves with potential use, such as groundwater, do not warrant their accessibility. Existence and accesibility of water are two related, but different issues. Each one of them demands special considerations and analysis.

Economic valuation: social and environmental considerations

Underlying most problems affecting water resources is the lack of an appropriate economic valuation of the resource. Lacking information about the true economic ("opportunity") cost of using the resource, users, as well as managers and regulators, do not receive clear signals to help them guide its allocation among competing uses and users. But economic valuation of the resource needs to take into consideration not only the private/financial costs and benefits of its use, but also the social and environmental costs and benefits.

Pollution of water bodies for example, which is considered to be one of the crucial problems of water resources in LAC, can be linked to this problem (CEPAL, 1999). As mentioned earlier, pollution of water bodies is caused by the "external costs" exerted by some users of the resource over other users. This can be an example of lack of proper economic valuation of the resource. Had the polluters internalized the costs exerted on the other parties in their own costs, in theory they would have modified their behavior with respect to its use. It could be said that this example illustrates a case of how the lack of proper economic valuation of the resource can lead to environmental damages, and underscores the "polluter pays" principle.

Following the same argument, consider a not-at-all hypothetical case such as the lack of sanitation and appropriate handling of industrial effluents leading to health hazards. In this case, again, the lack of economic valuation/internalization of the "true" costs of not handling appropriately the municipal and/or industrial effluents leads to the degradation of living conditions for the population. This is an example where the lack of economic valuation leads to social disruption.

But reality introduces additional complexities. It may also be argued that under certain circumstances where upstream polluters are poor (such as the case of poor hill slope subsistence farmers, for example) and downstream dwellers are well off, the cost of applying the polluter pays principle may be prohibitive

and it is the latter who should pay for the benefit of removing the upstream source of pollution. There may also be circumstances where the pollution problem becomes a "public goods" problem.

It is also now more common to find that at the analytical level, the need for proper valuation of the resource is finding a more relevant place. A recent national report on the status of water resources in Colombia makes a direct reference to the link between the lack of proper social, economic and environmental valuation, and the shortage in water sector investments in infrastructure (Ojeda & Arias Uribe, 2000).

Heterogeneity of water's quantity, quality and availability

The Latin American region is extremely rich in water resources: the Amazon, Orinoco, São Francisco, Paraná, Paraguay and Magdalena rivers alone carry more than 30 per cent of the world's continental surface water. Nevertheless, two-thirds of the region's territory is classified as arid or semi-arid. These areas include large parts of central and northern Mexico, northeastern Brazil, Argentina, Chile, Bolivia and Peru (UNEP, 1999).

As an illustration, in Colombia, yearly precipitation varies from 300 mm/yr. in Península de la Guajira to up to 9,000 mm/yr in the Pacific Region. The national average is about 3,000 mm/yr, much higher than the Regional average (1,600 mm/yr) (Ojeda & Arias Uribe, 2000).

In other countries, such as Argentina, with a relatively large average per-capita annual water availability (22 500 m3/hab), two thirds of the territory is arid and semi-arid, with several provinces showing average availability levels well below the water stress threshold suggested by UNDP (Calcagno et al, 2000).

The variability in the availability of the resource often leads to variations in the institutions and instruments used for the proper management of the resource. As an illustration, in Chile, a country where water has been managed as an economic good during the last 20 years, resource availability has been shown to play an important role on the outcomes of water markets as a water allocation mechanism. For instance, in the Northern Limari and Elqui Basin located in a very arid area, water markets have been functioning very well and trading has been very active. On the other hand, in the much better watershed Maule Basin, the level of activity in the water markets has been very low (Briscoe et al, 1997).

In Central America the heterogeneity in the availability of resources is compounded by the unequal geographic distribution of the population across the sub-region. For instance, two thirds of the Central American population live in areas that drain into the Pacific Ocean, where 30% of the surface waters flow. The remaining one third lives on the Caribbean side, which generates 70% of the water wealth of the Isthmus (CATHALAC, 1999).

Presenting the problems and challenges by sub-regions

Table 2.3 presents a summary -by sub-Region- of the main problems faced by water resources in LAC. To organize the presentation, the main problems were classified according to three criteria: (i) the "root" causes (as presented previously); (ii) the immediate problems; and (iii) the consequences. The problems listed in Table 2.3 were compiled from different sources (see Box 2.1) and they may be consulted for further detail.

In all sub-regions the root causes and immediate problems generate relatively similar consequences. The most common consequences identified in the sub-regions include: (i) lack of coordination among institutions (due to sectoral approaches); (ii) reduced participation of stakeholders in water management decisions (due to existing institutions and policies); (iii) pollution due to untreated discharges (due to deficient legislation and/or monitoring, and lack of incentives for improved technologies); (iv) low coverage rates (due to low investment capacity and difficult financial situation of water operators); (v) un-exploited development opportunities (tourism, energy, etc. due to limited macroeconomic and water resource development frameworks); and (vi) over-exploitation of groundwater sources (due to distorting incentives, deficient legislation and/or weak enforcement).

Table 2.3 Summary of problems in water resources in Latin America and the Caribbean, by sub-region.

Root cause	Immediate causes	Consequences			
		Caribbean	Central America	South America	Mexico
Water needs an integrated or comprehensive approach	**Lack of integral approaches** Fragmented and sectoral approach to water resource management.	Poor coordination among multiple institutions participating in the water sector. Poor stakeholder participation / low awareness among public and decision makers.	Lack of multidisciplinary and multisectoral approaches for resource management Low political priority at the national level and low public awareness	Conflict of interest among different water uses.	Sectoral approaches

Root cause	Immediate causes	Consequences			
		Caribbean	Central America	South America	Mexico
Water is also an economic good	**Deficient economic valuation of water resources** **Economic**				
	Poor feasibility assessment of water projects	Water mainly considered a social and public good. Lack of pollution control and regulation is threatening the development of the tourism industry		Insufficient investments in maintenance and rehabilitation of water infrastructure Un-exploited potential for development, especially in hydropower.	Low efficiency in water utilities Lack of incentives for treating effluents (municipal and industrial)
	Social				
	Access and affordability	Lack of availability of safe water is threatening socio-economic development	Low coverage rates among the poor. The poor pay more per unit of safe water accessed	Low coverage rates for water supply and sanitation. Situation aggravated among the marginal and poorest sectors of the population	
	Lack of appropriate / direct / transparent targeting and subsidy policies				
	Environmental				Over-exploitation of aquifers
	Deficient urban & rural land use planning.	Deforestation, soil erosion, water resource degradation.		Deforestation and extension of agricultural frontier.	

Root cause	Immediate causes	Consequences			
		Caribbean	Central America	South America	Mexico
Heterogeneity of water quantity, quality and availability	**Insufficient information to support decision making**	Inadequate data collection and information management			
	Deficient capacity to deal with natural hazards		High vulnerability and weak preparedness to mitigate natural disaster hazards.	Lack of preparedness to mitigate natural disaster hazards.	In particular in Southern Mexico, settlements in flood prone areas.
	International river basins		Minimal exploitation of opportunities offered by international basins		Groundwater should be considered a strategic reserve to confront droughts.

Root cause	Immediate causes	Consequences			
		Caribbean	Central America	South America	Mexico
Public awareness and political commitment	**Deficient water legislation, regulatory and monitoring frameworks and institutions**	Each institution/agency has its "own" piece of legislation and mandate, limiting the scope for action and coordinated efforts. Water pollution from untreated municipal and industrial discharges	Pollution of water sources, difficulties to apply "polluters-pay" principle	Extended pollution and degradation of water resources Water pollution as a health hazard	Water pollution due to non-treated discharges
Public awareness and political commitment	**Water policies** Lack of stable water policies Un-clear definition of the "new" role of the state, regulatory agencies and river basin organizations in the water sector.	Weak technical capacities among water sector personnel. Lack of resources for research and technology Lack of consistency on policies to promote contribution of water resources to national economies.	"Free for all" situation regarding water extractions	Lack of consistency and sustainability for long-term planning and investments. Deficiencies and weaknesses among the decentralized and/or private service delivery firms.	Decentralization schemes have yet to mature

Source: Author is own elaboration based on information from sources indicated in Box 2.1

Confronting the problems: current responses

In the previous chapter an overview of the main problems faced by water resources in the region was presented. These problems are not new. Water users, managers and regulators are in general well aware of them. For most of these problems, diverse solutions have been sought with different degrees of success. In this chapter, an overview of some of the key approaches that have been, and are being used in the region, are discussed.

There is consensus on the need for new approaches and responses to the problems and challenges previously presented. Figure 3.1 summarizes some of the main approaches and responses that have been sought within water resources management. Equally or even more important is the challenge of learning from the missed development and poverty alleviation opportunities offered by proper water resources management. For example, the high political commitment shown at the sub-regional level notwithstanding, individual Central American countries have yet to tackle important challenges in water management posed by their respective national agendas (CATHALAC, 1999).

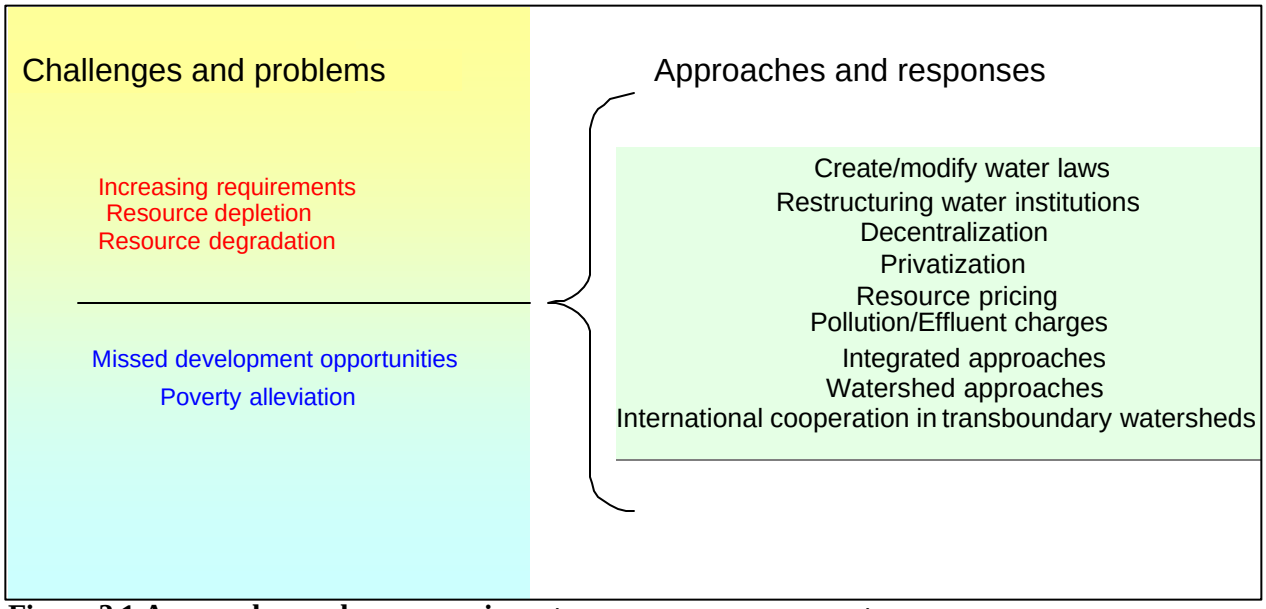

Figure 3.1 Approaches and responses in water resource management

In Figure 3.2, an illustrative matrix is presented showing (in the columns) the different problem or challenges (social, environmental, economic, financial, and institutional) faced by the countries in the water resources sector. Each row of the matrix presents a distinct approach, with each cell presenting the most common instruments used for the combination of challenges and approaches.

At least four approaches to meeting these challenges can be identified. *First*, there has been intense activity in almost every country in the region oriented to reform the institutional arrangement of the water sector. Legal frameworks and institutional arrangements are being discussed, revised, and often modified. In some cases this has ended up in the privatization of water services. There has also been a trend towards the decentralization of the provision of public services, as well as a general movement towards the transfer of the responsibility of providing public services (in the water sector) from the traditional/centralized public sector to local and/or autonomous operators that provide the services with a commercial criteria. There has also been a growing interest in increasing the role of the private sector in the water sector, especially in providing water supply and sanitation services. In this respect, although there has been much enthusiasm in the privatization of public service enterprises in the whole region, only in a few countries (mainly Chile, Argentina and Colombia) has the participation of the private sector reached any significant level (Jouravlev, 2001).

Second, there is an increasing understanding of the need to allocate water resources taking into account their multiple uses. This principle has been the cornerstone of the so-called "integrated" or "comprehensive" river basin approach. *Third*, and related to the previous one, is the spreading tendency to use the watershed as the basic planning and management unit. *Fourth*, in the case of transboundary river basins, there has been an increasing interest in international cooperation, most of the time relying on the two previous approaches: integrated and watershed water resources management.

Restructuring the water sector

Promoting the participation of the private sector

It is recognized that, especially in highly populated river basins with higher levels of economic activity, water resources have reached, or are about to reach a so-called "mature phase" (Randall, 1981). This mature phase is characterized by an inelastic supply of the resource and therefore requires a special approach to handle it. Under inelastic supply, and with increasing levels of water scarcity due to degrading quality, decreasing quantity (in ground water) and lack of availability at the required time and location, water managers and users have to shift their focus, from a focus on expansion of supply, towards a more efficient management of the demand and overall water use (IDB, 1998).

Traditionally the state has played a dominant role in managing water resources and in the provision of water related services. However, inefficient use of water, poor cost recovery for operation and

maintenance, the mounting cost of developing new water sources, and problems with the quality of service in agency-managed systems, has led to a search for more efficient alternatives (Dinar et al, 1997; Hearne and Trava, 1997). Row 1 in Figure 3.2 illustrates this approach by showing the most common intervention instruments, classified by the type of problems or "consequences" they pretend to solve and the challenge (social, environmental, economic, financial or institutional) they aim to confront.

Approaches		Problem Consequences	Challenges: Social	Environmental	Economic	Financial	Institutional
			Instruments				
	1.Structural reform of water sector	*Poverty* *Low coverage rates* *Health hazards* *Water pollution* *Water depletion* *Lack of investments* *Insufficient O&M*	Subsidies	Pollution charges	Water pricing		Restructuring Privatization Decentralization
	2. Integrated Water Resource Management	*Competing water uses* *Sectoral/partial approaches* *Deficient legal framework* *Institutional weaknesses* *Water depletion*	Participatory planning Participatory management		Allocation rules		Modern laws Reform/create institutions
	3. Watershed planning approach	*Pollution/externalities* *Deforestation/upper basin* *Erosion/sedimentation* *Health hazards* *Floods hazards*	Upper basin conservation Agro-forestry Land use planning		Compensatory fees/charges		Watershed planning River basin organizations
	4.International cooperation in transboundary watersheds	*International conflicts* *Resource depletion* *Resource degradation* *Transnational externalities* *Missed development opportunities*	Participatory planning Participatory management Upper basin conservation Agro-forestry Land use planning		Allocation rules Compensatory fees/charges		Modern laws Reform/create institutions Watershed planning River basin organizations

Figure 3.2. Problems and approaches in water resources management

Up until the 1980s, utility services in most countries in Latin America were provided by state-owned enterprises with local or national service monopolies. During the 1990s, fiscal constraints and growing dissatisfaction with poor efficiency, quality, and coverage of service provided by many state owned utilities generated the necessary political momentum for reform. The number of countries in Latin America that have pursued, or are pursuing utility sector liberalization policies, and are trying to rely on increased private sector participation grew dramatically in the last decade. These reforms have generated total (private plus linked government) investments of US$236.5 billion between 1990 and 1998 in Latin America, which represents almost half of all the investment in developing countries. While the reforms were initially concentrated in South America (Argentina, Bolivia and Chile were the leaders), Central America and the Caribbean are now starting their own privatization phase (Estache et al, 2000).

Coluntry	*Management Contracts*	*Concessions*	*BOT Contracts*	*Divestiture*
Argentina		W&S (1991-00) E (Gas) (92-98)	E (1992-99)	T (1990) E (1992-98)
Bolivia		W&S (1997-99)	E (1999)	T (1995) E (1995-97)
Brazil	W&S (1997-98)	W&S (1995-98) E (1998-00)	E (1984-99) W&S (1995-98)	T (1998) E (1998-99)
Cayman Island			WD (?)	
Chile			E (1990-97)	T (1988-90) E (1989-98) W&S (1999)
Colombia	W&S (1995-97)		E (1993-99) W&S (1994)	E (1996-98)
Dominican Republic			E (1989-96)	E (98-99)
El Salvador			E (1998)	T (1998)
Guatemala			E (1998)	T (1998) E (1998)
Mexico	W&S (1996-99)	W&S (1997-99)	E (1995-99)	T (1989) E (1998-99)
Peru			E (1997-99)	T (1993) E (1994-98)
Uruguay		W&S (1997-2000)	T (1995-97)	
Venezuela	W&S (1997)			T (1991)

Table 3.1: Overview of infrastructure reforms in Latin America and the Caribbean
Source: (Estache et al, 2000) and (CEPAL, 1999).
Note: W&S:Water & Sewerage; WD:Water Desalinization; E: Energy; T: Telecommunications

While infrastructure reforms are often associated with privatization, implying a sale of assets, the reality as seen in Table 3.1 is more complex. This table shows the distribution across sectors and contract types of contracts in a large sample of Latin American countries over the last decade. For comparative purposes, experiences of privatization of infrastructure for public services in several sectors, in addition to water and sewerage, are presented. As seen in the table, privatization contracts can be classified into four main categories: management contracts, concessions, BOT (Build-Operate-Transfer) contracts, and divestiture/sales. In water and sanitation, management contracts and concession contracts tend to be the norm. BOT contracts have been considered for major new constructions such as treatment stations but few deals have actually taken place. In energy and telecommunications, concessions and full divestiture are standard (Estache et al, 2000).

In *Argentina*, the privatization of public services in the water sector, which took place with greater intensity during the nineties, achieved considerable improvements in service coverage. In this case, it is

mainly through the system of concessions (usually for a 30-years period) that private actors are participating in the delivery of services. Currently, private enterprises are providing the services in the Greater Buenos Aires area, and in the main urban areas of the provinces of Buenos Aires, Corrientes, Formosa, Mendoza, Misiones, Salta, Santa Fe and Santiago del Estero. In urban areas it is estimated that private providers cover around 60% of the serviced population. Private participation in service provision has improved the quality of the services, stopped the gradual decaying of the infrastructure and has even increased the coverage rates. In the Greater Buenos Aires, after the first seven years of activity, the private operator increased the production of potable water in 37%; providing additional water supply and sanitation to 1.9 million and 1.1 million connections respectively. Despite the important contribution of such approach to face the social challenges of water supply and sanitation, there are still some areas in Argentina where additional efforts are needed. Especially in the operative and institutional aspects of the regulation of the services (CEPAL, 1999 and 2001).

In Bolivia, a combination of the flexibility of the private entrepreneur and the introduction of an innovative financial mechanism (micro-credit) opened the opportunity for the poor to have access to water supply and sanitation. While the operator may be a natural source of credit for connection costs as a way to promote the access to the services among poor households, many households will also need loans to cover the costs of complementary installations within the household (wiring, plumbing, etc.). Here, there is not such a clear case for the operator to be involved in providing credit, so that alternative sources of financing must be sought. Micro credit schemes are an attractive way of meeting this need, and have been used with some success (see Box 3.1). Microfinance may also provide an alternative to operator-based financing of connection costs, for example, if a high volume of loans to low income customers would lead to significant increases in the operator's marginal cost of capital, thereby raising the overall cost of financing investments in the network (Estache et al, 2000).

Water pricing and water markets

It is increasingly accepted that achieving the desired levels of coverage and quality of service requires that the delivery of the services take place under systems that are financially and economically viable (CEPAL, 1999). Several mechanisms have been proposed to allocate water efficiently and equitably. They include marginal cost pricing, social planning, user-based allocation, and water markets. However, experience in several countries has shown that no single approach is suitable for all situations. Usually countries try a mix of different allocation mechanisms simultaneously.

Box 3.1 Promoting access to water and sanitation in El Alto (Bolivia)

In 1997, the Government of Bolivia issued a 30 year concession to Suez Lyonnaise des Eaux consortium "Aguas del Illimani" for private provision of water and sanitation services in the cities of La Paz and El Alto. A major objective of the concession was to rapidly increase coverage of these services, particularly in El Alto, a city adjacent to La Paz formed in the last few decades as a result of migration from mining centers and agricultural areas. At the time of the concession award, coverage was 87 percent for water and 48 percent for sewerage.

Reflecting this over-riding objective, the bidding for the connection was done in terms of the number of new connections that would be offered in return for a predetermined water tariff. Specifically, the residential tariff was fixed at $0.22/m3 following a 35 percent increase immediately prior to privatization. This tariff, which covers both water and sewerage services, represents about half of the true cost of provision. The difference is covered by industrial customers who pay between $0.66/m3 and $1.18/m3. The winning bidder promised to achieve coverage close to 100 percent for water and 90 percent for sewerage in El Alto by 2001. The concession contract set connection charges at $155 for water and $188 for sewerage, well below the full economic cost of $300 and $400, suggesting that a significant proportion of the costs of network expansion are being recovered via cross-subsidies from the use of service charge.

In order to make connection more affordable for low income households, the concessionaire chose to expand the network in low income areas by means of the condominium system, which reduces the cost of network expansion by 10 percent to 20 percent for the water service and by 30 percent to 60 percent for the sewerage service. Households are also allowed to choose between backyard, sidewalk or indoor connections in increasing order of cost. As a result, when households contribute some of their own labor time, the cost of a sewerage connection can come down as low as $100. Following connection to water and sewerage networks, about 70 percent of households went on to build their own bathroom installations, about half of these with the assistance of micro credit facilities. The total cost of this investment is typically around $500. Micro credit is provided at interest rates of around 14 percent for a 5 year period.

Revenue recovery by the concessionaire has been as high as 98 percent, even in the low income areas of El Alto. One reason for this was the introduction of payment centers in the low income areas which enable customers to cover their bills by means of smaller, more frequent payments. The main commercial problem for the concessionaire has been the very low levels of demand, largely due to the lack of a local hygiene culture. Household consumption in El Alto is extremely low: $5m^3$ per month for households with water but no sanitary installation, and only $10m^3$ per month for households with full sanitary installations.

Sources: Komives and Brook-Cowen, 1998; Carbonel, 2000, Foster, 2001.

There are two aspects to consider when assessing the financial and economic viability of water investments. *First*, the establishment of payments for the utilization of water and to manage the generation of externalities associated to its utilization. *Second*, the use of an allocation mechanism in order to promote the utilization of water in those activities that provide higher use values and global benefits (Dinar et al. 1997; IDB, 1998).

Chile was one of the first countries in the world adopting market rules for the allocation of their water resources, and allowing the participation of the private sector in the management of the resource. The Chilean Water Code of 1981 treats water as an economic good based on the following principles: (i) water in not a factor of production only for agriculture, but for other sectors too, and must be transferable like any other economic input; (ii) separates the property rights from (mobile) water and (immobile) land resources; and (iii) deals water property rights as any other property right, allowing for leases and sales between willing buyers and sellers (Briscoe et al. 1997). Some of the benefits achieved by this approach are: water markets have been useful in the allocation of water under scarcity in expanding urban areas,

have opened the opportunity to satisfy the demands from important social and economic activities, have played a key role in mitigating the negative impacts from droughts, and have promoted private investments to increase efficiency in resource utilization (CEPAL, 1999). However, it has also presented some shortcomings and are not a panacea for solving all water problems (Lord and Israel, 1996). The case of Chile is amply illustrated in a parallel paper being presented to this seminar.

The use of effluent charges in a few countries in the region is another important contribution to water resource management. Effluent charges are important to reduce pollution and to provide incentives for the industries to invest in clean technology. In the region, the use of such charges has been reported in Colombia and, most recently, Brazil.

A recent experience in establishing effluent charges for pollution control in Brazil is illustrated in Box 3.2. There are three important lessons to learn from this experience. First, there is the importance of conducting a participatory process in order to socialize the aims of the instrument and enhance the understanding of the proposed methodology. Second, the simplicity of the method that allows general application and wide understanding of what is actually being charged for and why it is done so. Third, by defining unavailable water volumes, which take into account the dilution capacity of the reception bodies,

Box 3.2 Water use and effluent charges in Brazil

The Paraíba do Sul River Basin Committee (CEIVAP) has conducted a wide process of discussion regarding the methodologies to be established for "water use and effluent charges" during 2002.

The methodology aims to achieve the following three objectives: (i) consolidate the process of river basing management in the Paraíba do Sul River Basin and initiate the use of charges for water resources use; (ii) allow, in the short run, the implementation of environmental mitigation measures in the river basin, according to the priorities established by the CEIVAP; and (iii) obtain the financial resources required as counterpart funds from this Basin to contribute to the National Programme for Pollution Control in Watersheds from the Agência Nacional de Águas (ANA).

The methodological proposal for establishing water use charges in the Paraíba do Sul River Basin is framed by a previous proposal developed by the State of São Paulo, and the guidelines established by the Law 9 433. The design of the methodology is aimed to satisfy the following criteria, which were considered key elements for its successful implementation:

- simple calculations, in order to easily understand what is being charged for,
- reduce the risks of negative economic impacts on users/payers,
- generation of financial funds to support investments in basic sanitation,
- signaling about the importance of an efficient and sustainable utilization of water resources,
- contribute to a gradual implementation of key principles established in Law 9 433.

The proposed methodology to establish the payments is easy to understand and is based on easily quantifiable parameters, which were possible to define through a participatory process. Water charges are based fundamentally on extraction, consumption, and discharge volumes. In addition, the proposed methodology takes into account the impact of the discharge effluents on the water body. This latter impact is quantified by defining the concept of "unavailable water volumes"("volumes de água indisponibilizados") which takes into account the dilution capacity of the receptor water body.

Source: (ANA, 2001)

the method is also contributing to the education of the public on the specific impacts of the effluents (ANA, 2001).

Subsidies and targeting

A widespread concern about privatization is that it may impose welfare losses on the poorest sectors of the population. This makes it particularly important when assessing the potential impacts of reforms in the provision of public services from the point of view of access and affordability for the poor. Successful reforms *must help to improve* access and affordability for the poor. Row 1 in Figure 3.2 identifies the use of subsidies and targeting as an instrument aimed to face one aspect of this "social" challenge (Estache et al, 2000).

Often reforms offer the potential to improve services to the poor in two main dimensions: access and affordability. Access may be improved thanks to the availability of private financing which makes it possible to contemplate the expansion of infrastructure networks to reach previously unserved customers.Consumption affordability may be improved through significant reduction in costs stemming from the adoption of innovations and new managerial practices (Estache et al, 2000).

These benefits are particularly important in sectors where competition can be introduced, such as telecommunication services. In the other sectors, the effectiveness of reform in improving affordability will be driven to a large extent by the effectiveness of the *regulatory regime* and its enforcement. In particular, there are a number of common features of infrastructure reform processes which may have adverse impacts on both access and affordability for the poor unless properly addressed by the regulatory environment. For example, access may be jeopardized by high initial costs of connection and by regulations which limit the availability of alternatives to conventional utility provision; while affordability may be affected by tariff reforms and the tightening of standards for quality of service (Estache et al., 2000). In the water supply and sanitation sector in LAC, there are two countries which have accumulated some experience in targeting subsidies: Chile and Colombia. Box 3.4 provides some information on these cases.

Despite the opportunities and the important role that the private sector is called to play in the provision of water services, there are still sound reasons for governmental participation in water resource management (IDB, 1998). Box 3.4 provides an overview of some characteristics of water and water investments which justify the role for governmental participation in the sector.

Box 3.4 The Case for Government Involvement in Water Management.

Water has several distinguishing features that can define a role for public action:

- Large, lumpy capital requirements and economies of scale in water infrastructure tend to create natural monopolies, warranting regulation to prevent overpricing. Moreover, many water investments produce joint products, such as recreation, electric power, flood control, and irrigation, which make pricing and allocation decisions difficult.
- The large size and extremely long time horizons of some investments, given underdeveloped capital markets and the potential for political interference in many water infrastructure investments, reduce incentives for private participation in the sector.
- The uses of water within a river basin or aquifer are interdependent. Withdrawals in one part of the basin reduce the availability of water for other users; groundwater pumping by one user may lower the water table and increase pumping costs for all users; and pollution by one user affects others in the basin, especially those located downstream. These interdependencies suggest that having all users agree to the rules of the game--or lacking that, imposing government regulations, taxes, or both-could improve the social value of water resources.
- Certain aspects of water activities, such as the control of floods and waterborne diseases, are (local) public goods, which cannot easily be charged for on the basis of individual use. In such cases, public initiative may be required to ensure that levels of investment are appropriate.
- Water resources are often developed because of their strategic importance to national security and regional development. Governments thus typically maintain ownership of water thorough fares, providing services such as the coast guard and traffic regulation. Some regions are subject to periodic droughts. Because water is essential to sustaining life, governments may take control of water.

Source: World Bank 1993.

Integrated Water Resource Management

There are two elements which characterize the main responses and approaches that have been employed to face the institutional challenges facing water resources in the region: (i) comprehensive and (ii) participatory approaches. Row 2 in Figure 3.2 illustrates the different instruments classified by the type of challenge.

Integrated and comprehensive approaches

The intensification of the sectoral demand for water, together with the decentralization and privatization processes in progress in the Region have accentuated the recognition that water resources should be best analyzed and dealt in a "comprehensive" manner. (IDB, 1998; CEPAL, 1999). This has also led to the discussion about, and the creation of local instances for conflict resolution . Only an approach that goes beyond a sectoral and partial view of water uses can warranty efficiency and equity in allocation.

While investments to improve access and increase the supply at certain locations are still badly needed, they are no longer the panacea to solve all the problems in the water sector. Investments are *still* a necessary, but not a sufficient condition to solve the problems of water management and utilization in LAC (IDB, 1998; CEPAL, 2001). Successful management and development of water resources demand restructuring the institutions, the mechanisms, and the incentives that frame the use of these resources.

For that reason, there is a gradual, but progressive shift from supply-oriented efforts towards approaches that search for contributions from both: the supply and demand side to achieve the most favorable use of the resource (Garcia, 1998). This shift is taken place parallel to the increased acknowledgment that water

Box 3. 5 River Basin Committees and Water Agencies in Brazil

In Brazil, responsibility for water resources management is shared by the Federal Government and the states. At the federal level, the National Water Resource Policy Law (Law No 9,433 of 8 January 1997) provides for the creation of the River Basin Committees and the Water Agencies. The law stipulates that the River Basin Committees can act in the following spheres:

- an entire river basin;
- the river sub–basin of any tributary to the principal watercourse of the basin, or any tributary of that tributary; or
- a group of contiguous river basins or sub–basins. The establishment of the River Basin Committees for rivers that are the property of the Union must be by act of the President of the Republic.

The River Basin Committees have the following responsibilities in their respective areas of action:

- to promote the discussion of issues relating to water resources, and to coordinate the work of the entities involved;
- to arbitrate, as the first administrative recourse, conflicts relating to water resources;
- to approve the Water Resources Plan for the river basin;
- to monitor the execution of the Water Resources Plan for the river basin and suggest the measures required for its goals to be met;
- to establish mechanisms for fees collection for the use of water resources and suggest the fees to be charged; and
- to establish criteria for and promote the apportionment of the cost of multiple–use projects of common or collective interest.

The River Basin Committees are composed of representatives of:

- the Federal Government;
- the States or the Federal District in which they are located, even if only partially, in their respective areas of action;
- the Municipalities in which they are located, entirely or in part, in their areas of action;
- the water users in their areas of action; and
- civil water-resources agencies that have a demonstrated record of action in the basin.

The Water Agencies serve as the executive secretariats of the River Basin Committees. They have the same area of action as one or more River Basin Committees. The creation of Water Agencies must be authorized by either the National or the State Councils on Water Resources at the request of one or more River Basin Committees.

The creation of a Water Agency is subject to the fulfillment of the following requirements:
the prior existence of the River Basin Committee or Committees; and financial viability ensured by fees for the use of water resources in its area of action. At the local and municipal level, there is a tendency for the municipalities belonging to the same river basin to form intermunicipal river basin consortia or municipal associations in order to deal with water-related problems of common concern. The responsibilities of these entities are principally related to water supply and water pollution control.

The Brazilian experience with the River Basin Committees suggests that, in order to achieve success in their creation and operation, it is advisable to: (i) ensure the participation of water users and civil society; (ii) avoid excessive regulation; and (iii) establish them only where and when it is really necessary. They should be created, first and foremost, where there are potential conflicts among water users and where there is a local agenda with water-related problems highly positioned in the ranking of the most significant issues.

Source: Dourojeanni (2001)

cannot be efficiently and successfully managed and utilized if it is done in a fragmented and sectorial manner. An integrated and comprehensive approach towards water management is the correct way to face the challenges of managing a multiple-use resource, such as water. To conduct and implement the changes needed to facilitate this shift in the approach, new laws, regulations and institutions are needed. That is why so much effort has been placed lately in reforming water laws and institutions in our region (IDB, 1998).

Important institutional changes are currently taking place in the management and regulation of water resources. One such change is the creation of an independent entity or "referee" with the responsibility of formulating water policies, and coordinating and allocating water among its multiple uses. This regulatory role cannot be played by any of the traditional water users (Garcia & Valdes, 2000). Box 3.5 shows some background information on the framework created around the Agencia Nacional de Aguas (ANA) in Brazil.

Comprehensive and/or integrated water resource management has been emphasized as a means to incorporating the interest of the multiple users and uses of water in the planning process. There is a generalized consensus in the region, which acknowledges the obstacles and limitations of managing water resources in a segregated and partial manner (IDB, 1998). Sectoral approaches, while very common in the recent past, are nowadays leading to increased conflicts among users, deficient use, and deterioration of water resources (Solanes and Getches, 1998).

Stakeholder articipation

Most recently, Mexico finished a new National Water Program (Programa Nacional Hidráulico (PNH)) for the period 2001 - 2006. The PNH is a good example of a participatory planning process and illustrates very well a useful approach to face the institutional challenges affecting water resources in the region. The Plan recognizes –rightly enough- the social, environmental and economical values of water (see Box 3.6).

The stated participatory planning process of the Mexican PNH 2001-2006 was based on five guiding principles, which may serve to illustrate a growing consensus in the region concerning the new "paradigm" in water resources management. These five elements are: (i) development has to be achieved on a sustainable basis; (ii) water is a strategic resource for national security; (iii) the basic unit for water

management is the river basin; (iv) management of natural resources should be integrated; and (v) decisions should be taken with the participation of local communities (CNA, 2001).

Box 3.6 Participatory strategic planning in Mexico

The participatory process stated in the Mexican PNH can be characterized by: (i) the tasks that took place; and (ii) the participatory mechanisms employed. During the participatory planning process three main tasks were attempted:

- Regional Hydraulic Diagnostics
- Regional Strategic Guidelines for Hydraulic Development
- Regional Vision Programs 2001-2025

Four mechanisms were considered to attain public participation during the planning process:

- River Basin Councils
- Consultative Water Council
- Consultative Experts Group
- Public Consultations with the general public

By September 2001, there were already 26 River Basin Councils, 6 River Basin Commissions, 4 River Basin Committees and 47 Technical Groundwater Committees (COTAS). The management of natural resources in the context of the dynamic evolution of a river basin, more generally known as river basin management, is one of the possible options for organizing the participation of users of natural resources within the process of environmental management. A river basin is uniquely fitted to serve as the basis for the co-ordination of the actions of all those involved in the use of a shared resource –water– and for the evaluation of the effects of environmental management measures on that resource. Water quality largely reflects the environmental management capacity within the basin in question.

Source: (CNA, 2001)

Watershed approaches to resource management

The water management process requires many different agents acting in a coordinated manner, in spite of their differences of approach and the fact that some of them are not aware of the effects of their decisions on the hydrological cycle. This is why it is so important to have stable coordination mechanisms and, at the very least, a permanent river basin centre or authority. Row 3 in Figure 3.2 shows the typical instruments and initiatives suggested by this approach in order to face the different challenges within water resource management.

Physically, a river basin represents a natural area of catchment and concentration of surface and ground water and therefore has an essentially gravitational and hydrological connotation. At the same time, the water collected in it represents a source of life for humankind, but also a source of potential conflicts and problems, due to the possibility of extreme natural phenomena and/or pollution.

Following an idealized concept, a "well managed" watershed may show a balanced situation in which human beings and nature are in perfect harmony. This also requires perfect harmony among the human beings themselves. When compared against an actual background of reality, many discrepancies arise, mainly caused by conflicts between development and conservation goals. And many are also caused by different needs, goals and aspirations of the varied stakeholders inside and outside the watershed. So the harmony is in reality a concerted one, whose achievement has required compromise in order to reach a balanced situation agreeable to all (Garcia, 2001).

International cooperation in transboundary river basins

Many countries in Central and South America are highly dependent on transboundary waters because the origin of most of their water resources is not within their territory (IDB, 1998). At the highest level, the LAC countries have expressed their commitment, through the use of existing transboundary agreements, to the sustainable use of water resources. Situations in which rivers and lakes border multiple countries, rivers flow from one country to another, and aquifers underlie more than one country, are numerous and represent potential sources of conflict, but also opportunities for cooperation (Garcia, 1999).

Agreements for equitable and reasonable use have been reached between several countries through lengthy negotiations (IDB, 1998). Some examples of bi- or tri-national initiatives in the LAC region are: Comisión Trinacional para el Desarrollo de la Cuenca del Río Pilcomayo, composed by the Governments of Argentina, Bolivia and Paraguay; Comisión Binacional para el Desarrollo de la Alta Cuenca del Río Bermejo y Río Grande de Tarija composed by Government representatives from Argentina and Bolivia; Autoridad Binacional Autónoma del Sistema Hídrico del Lago Titicaca, Río Desaguadero, Lago Poopó y Salar de Coipasa established by the Governments of Bolivia and Perú. In addition, there are other initiatives in the river basin of Catamayo-Chira, and Putumayo-Tumbes rivers shared by Ecuador and Perú; in the San Juan River Basin and adjacent Coastal Zone shared by Costa Rica and Nicaragua; and in the upper Lempa River Basin, shared by El Salvador, Guatemala y Honduras and which is being managed by a tri-national commission.

The Central American experience in water management can be used to illustrate the following aspects: (i) regional political priority to water resource management; and (ii) multinational efforts for water management. Regarding the commitment with a common future for their water resources at the highest political spheres, it is worth mentioning that both the Agreement 39 of the Central American Alliance for Sustainable Development (ALIDES) and the 1994 "Carta Centroamericana del Agua" of the Central American Congress (PARLACEN), reflect this commitment. More recently, this commitment has been reinforced by the launching of the Regional Action Plan for Integrated Water Resources Management, known as the PACADHIR (SG-SICA, 1999). Their common problems, exacerbated by the fact that more than 25% of the water resources are located in transboundary basins constitute a strong incentive to integrate a shared sub-regional vision on the future of their water resources.

Box 3. 7 River Basin Councils ("Consejos de Cuenca") in Mexico

Background

The National Water Law, adopted in December 1992, provides for the creation of River Basin Councils, defined as bodies for coordination and consensus–building between the National Water Commission (CNA), the offices and units of federal, state or municipal agencies and representatives of the users of each particular river basin, in order to develop and carry out programmes and initiatives for improved water administration, development of water control works and the respective services and the preservation of resources in the river basin. Consequently, the River Basin Councils constitute the primary tool for integrated water resources management.

The organization of River Basin Councils acknowledges four territorial levels (river basin, sub–basin, micro–basin and aquifer) to coordinate the interests of the different users recognized in the National Water Law, those of non–governmental organizations and the three levels of government (Federal, State and Municipal).

Results

Over a three-year period a support organization was created for joint water management. As of September 2001, 26 River Basin Councils, 6 River Basin Commissions countrywide, 47 River Basin Committees and 38 Technical Groundwater Committees in the aquifers which display the worse degrees of over–exploitation haven been created. Each River Basin Council has a Follow-up and Evaluation Group which involves all the parties and meets regularly to analyse and discuss the river basin's water issues, in line with an established annual programme of activities.

In summary, the achievements have been: (i) the establishment of River Basin Councils that are strong enough to survive the change of government and which have regulated organizational and operational bases, which should facilitate water planning and management; (ii) wider and better participation by users, based on water information and basic documentation; (iii) better integration of all the actors involved; (iv) regular, programmed training processes; (v) full assimilation of the concept of River Basin Councils and their role in water management by river basin, both by the institutions of the water resources sector and by water users; and (vi) stronger public and governmental support for the financial consolidation of the programmes. Each River Basin Council will focus its attention on the issues relevant to each individual river basin, as far as its consolidation and maturity allows.

As the River Basin Councils begin to participate more widely and directly in the process of planning water uses in each river basin, the new forms of joint water resources management should provide:

- a new order for administering and using water better;
- programmes that are better structured and more deeply rooted in the regional culture in order to improve: efficiency, conservation and regulation;
- greater awareness of the shared responsibility of users and governments to resolve water availability problems and improve water quality; and
- new ways of financing the provision of water services and hydraulic infrastructure systems in the river basin and making them financially self-sufficient.

Source: Douroujeanni, (2001).

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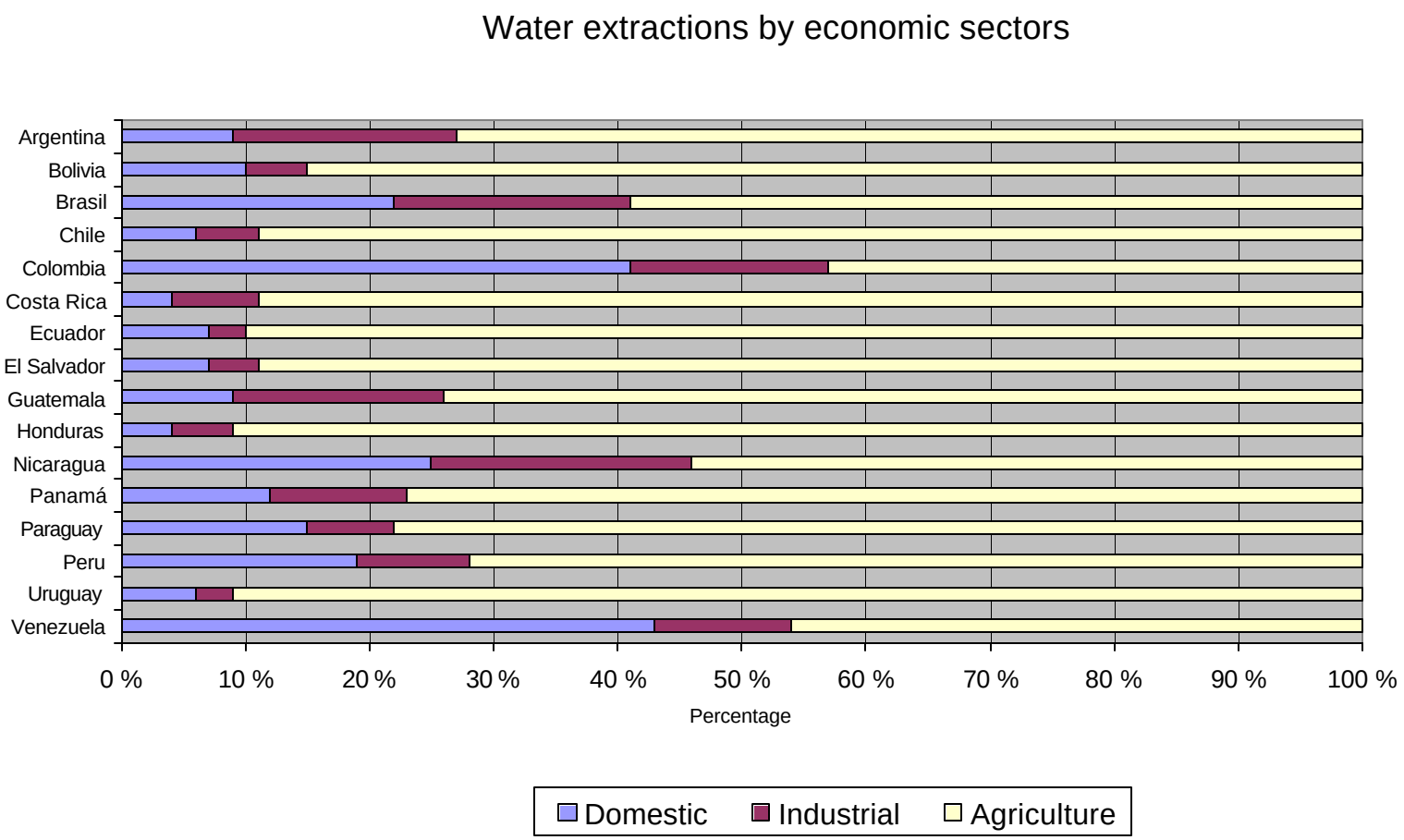
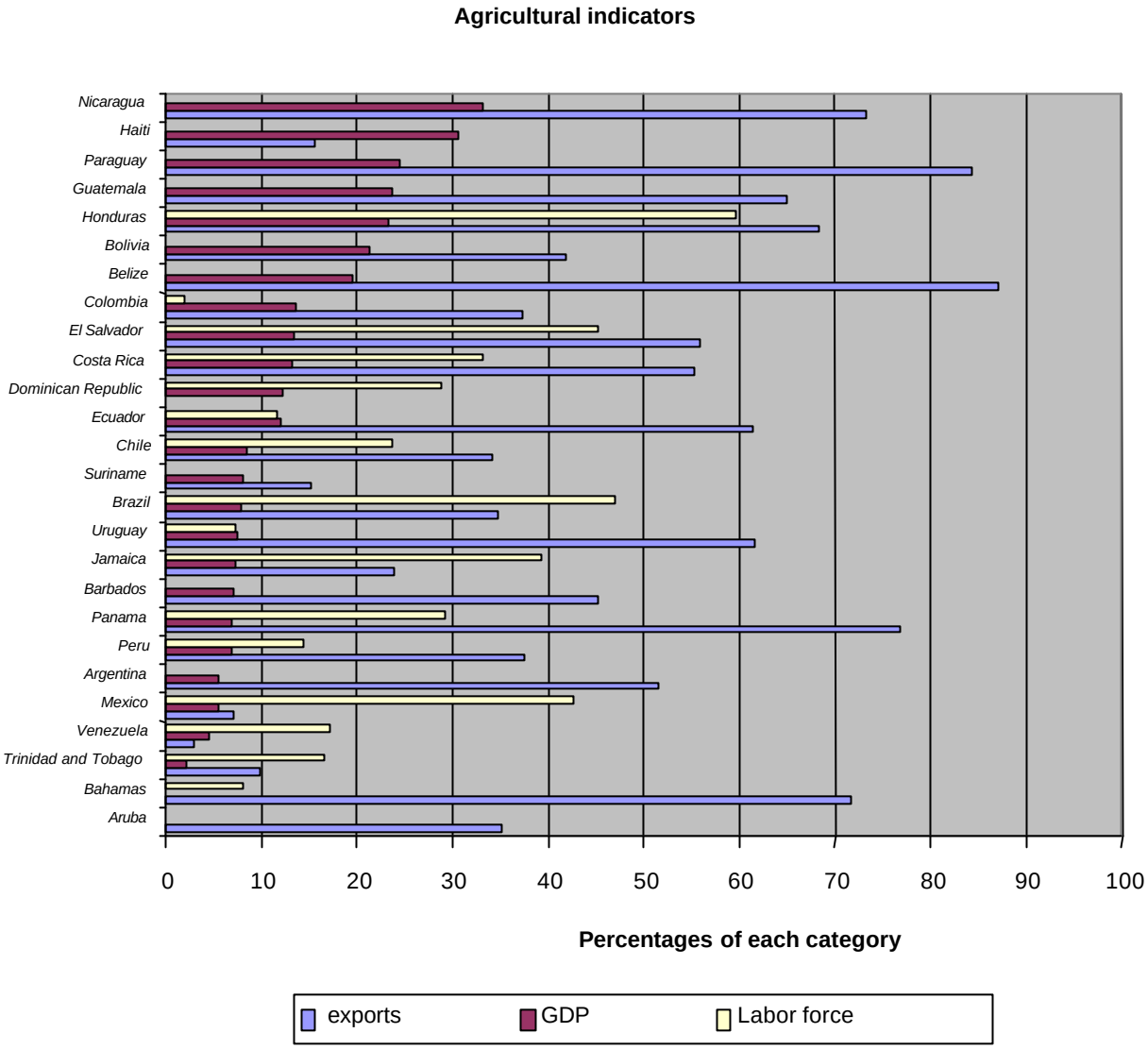
Figure 1.2 Water extractions for consumptive use



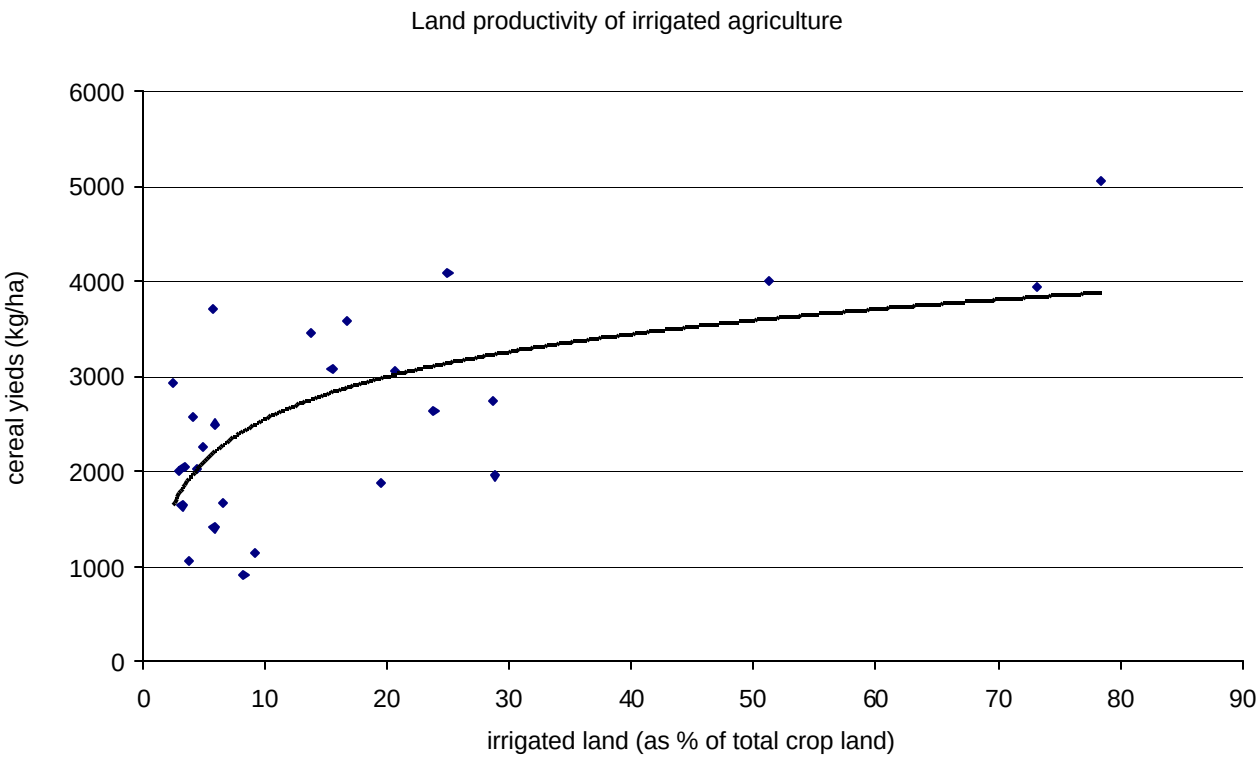
Source: GWP-SAMTAC (1999); GWP-CATAC (1999).

Figure 1.3 Contributions of agriculture in LAC



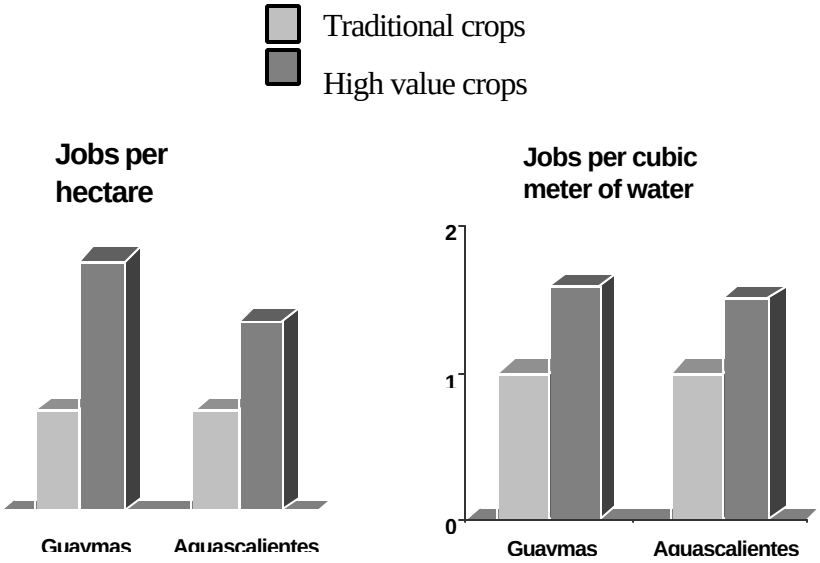
Source: World Bank (2001), World Development Indicators 2001, Washington DC.

Figure 1.4 Agricultural yields and irrigated land in LAC



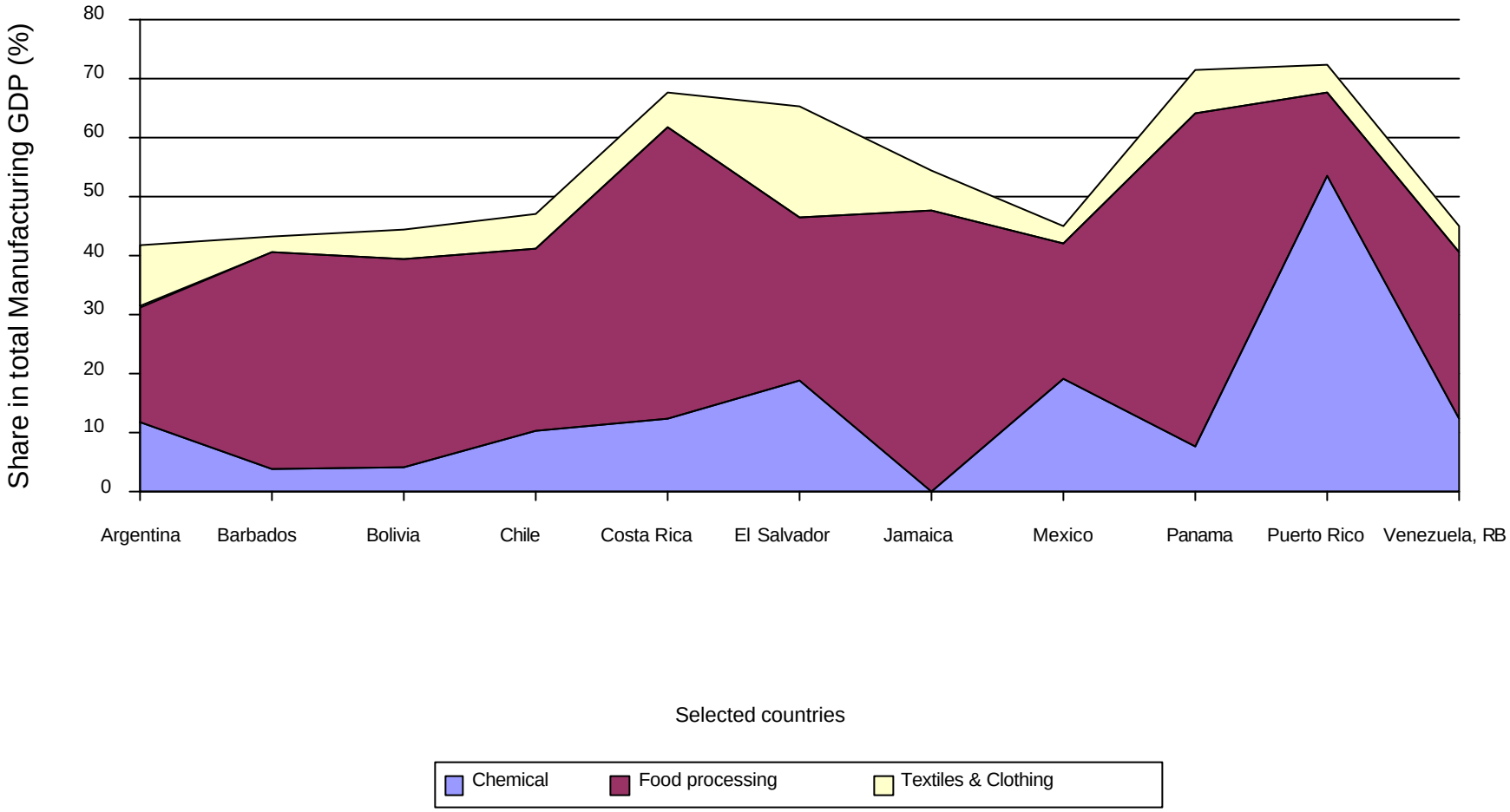
Source: World Bank (2001), World Development Indicators 2001, Washington DC.

Figure 1.5 Gains of irrigation in some regions in Mexico



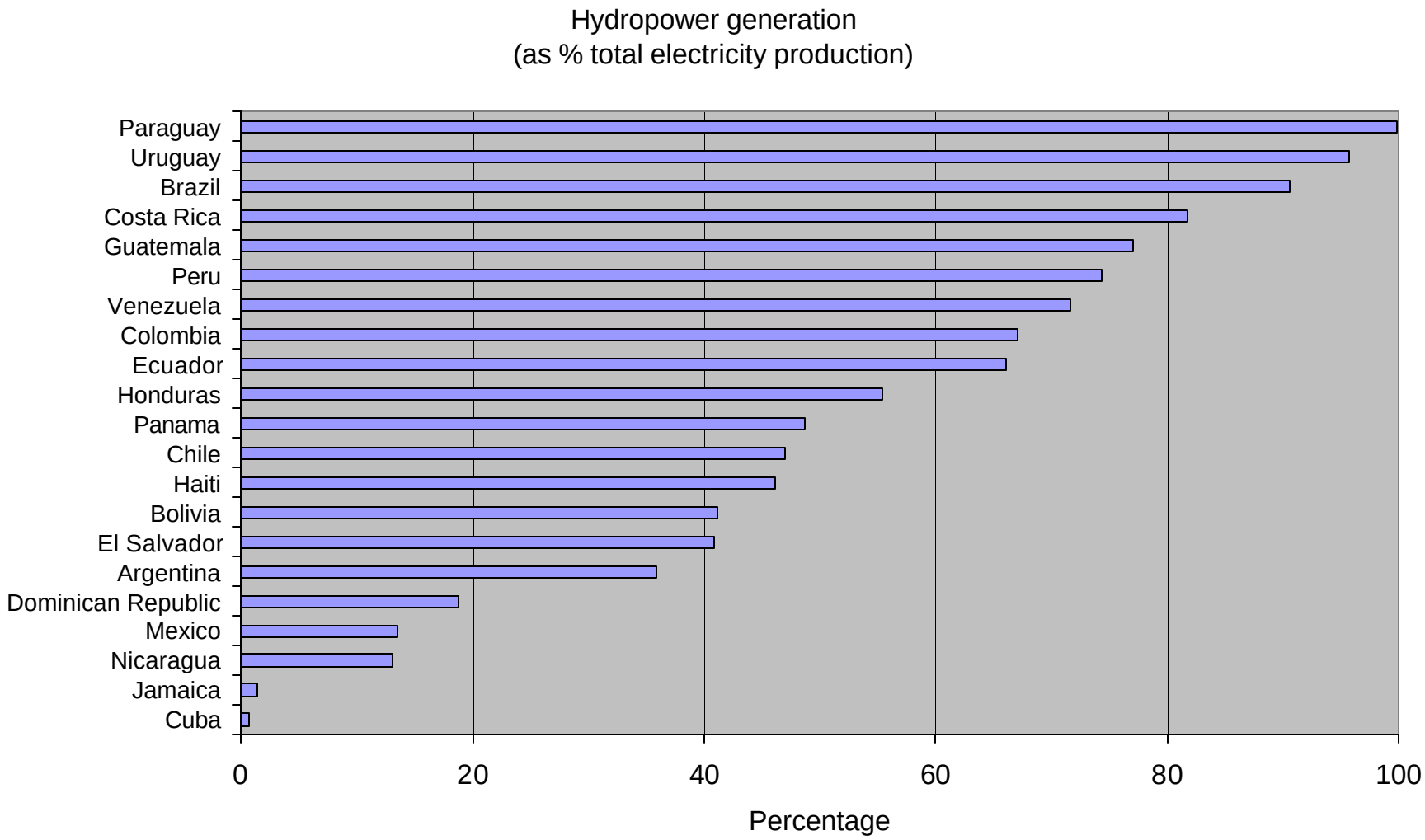
Source: (World Bank, 1999)

Figure 1.6 Participation of water-intensive industries in Manufacturing GDP



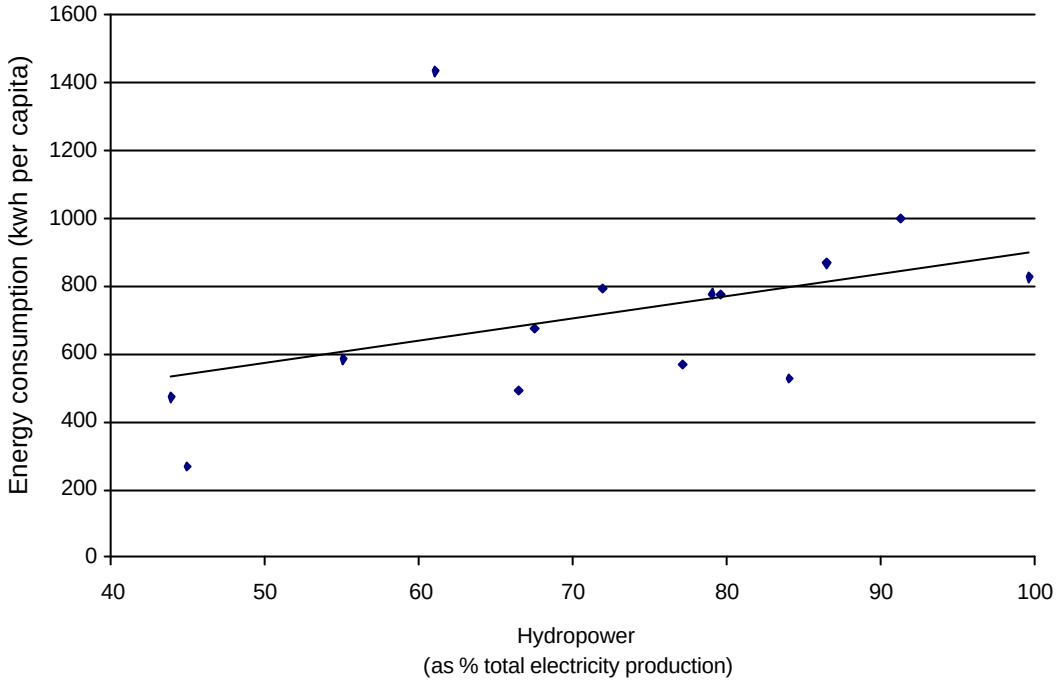
Source: World Bank (2001), World Development Indicators 2001, Washington DC.

Figure 1.7 Hydropower participation in electricity generation in LAC



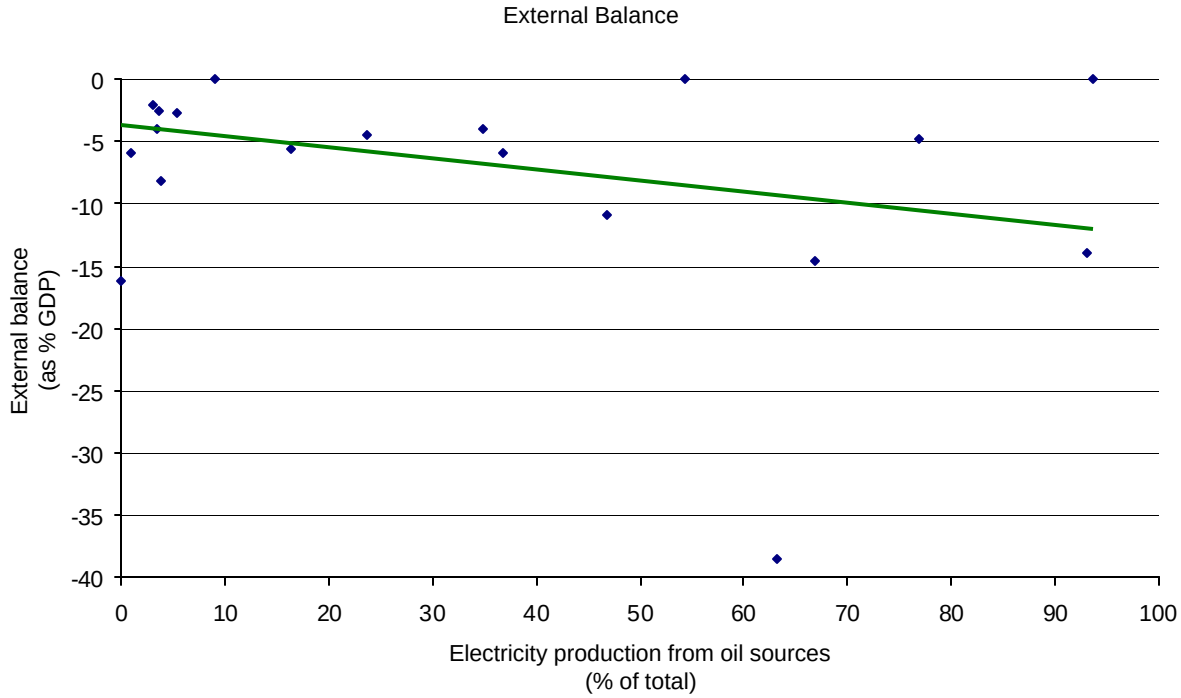
Source: World Bank (2001), World Development Indicators 2001, Washington DC.

Figure 1.8 Energy consumption (per capita)



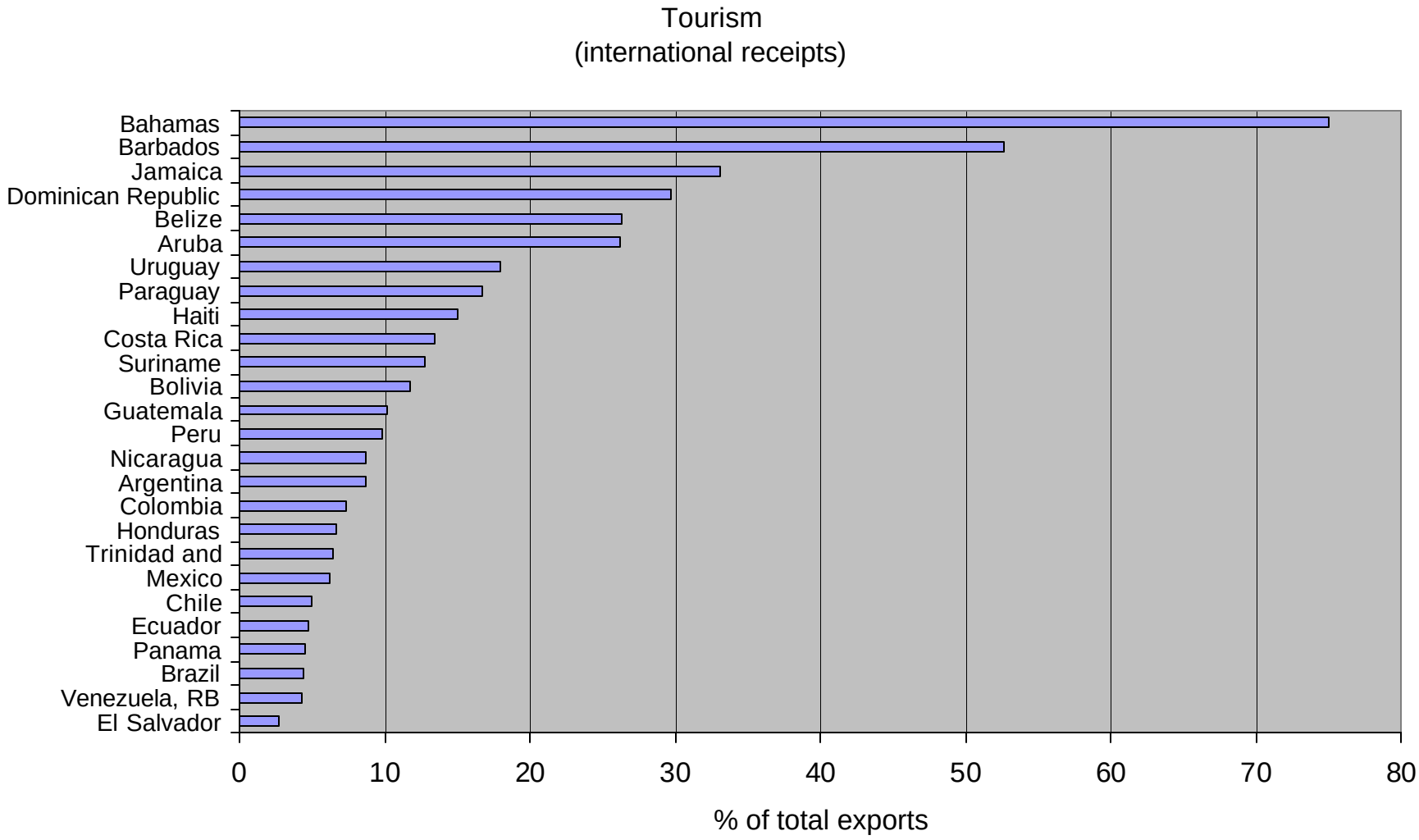
Source: World Bank (2001), World Development Indicators 2001, Washington DC.

Figure 1.9 External balances for selected oil-importing countries in LAC



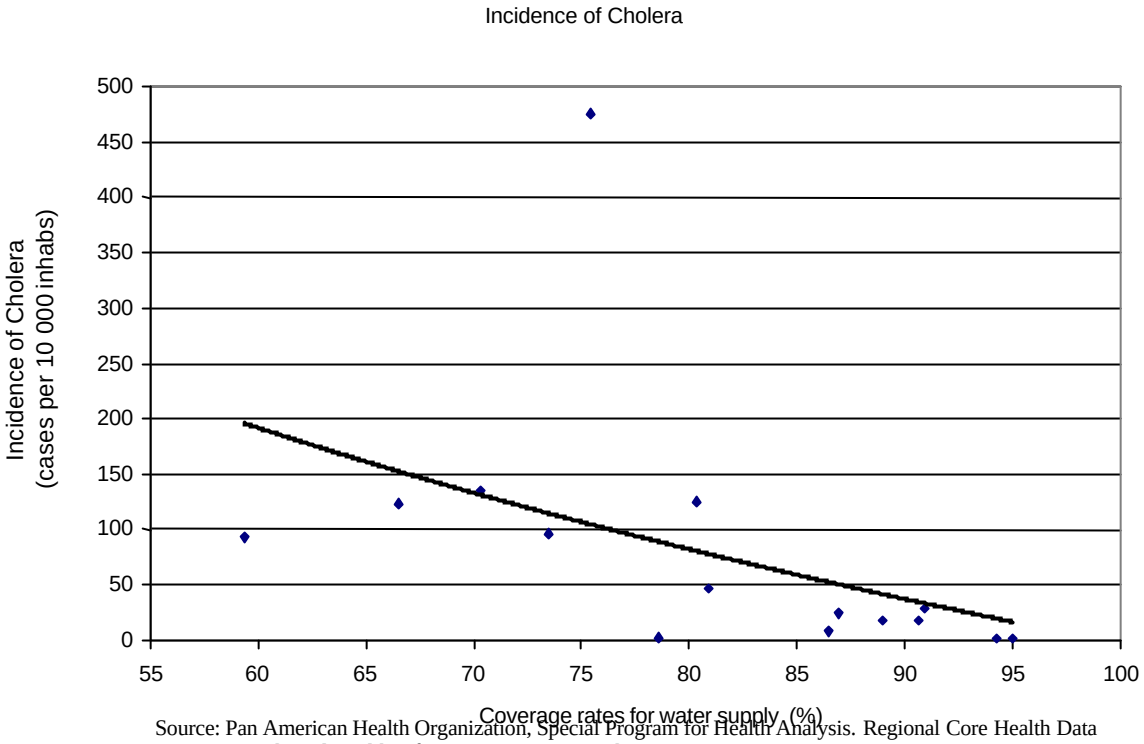
Source: World Bank (2001), World Development Indicators 2001, Washington DC.

Figure 1.10. Contribution of tourism in foreign exchange receipts



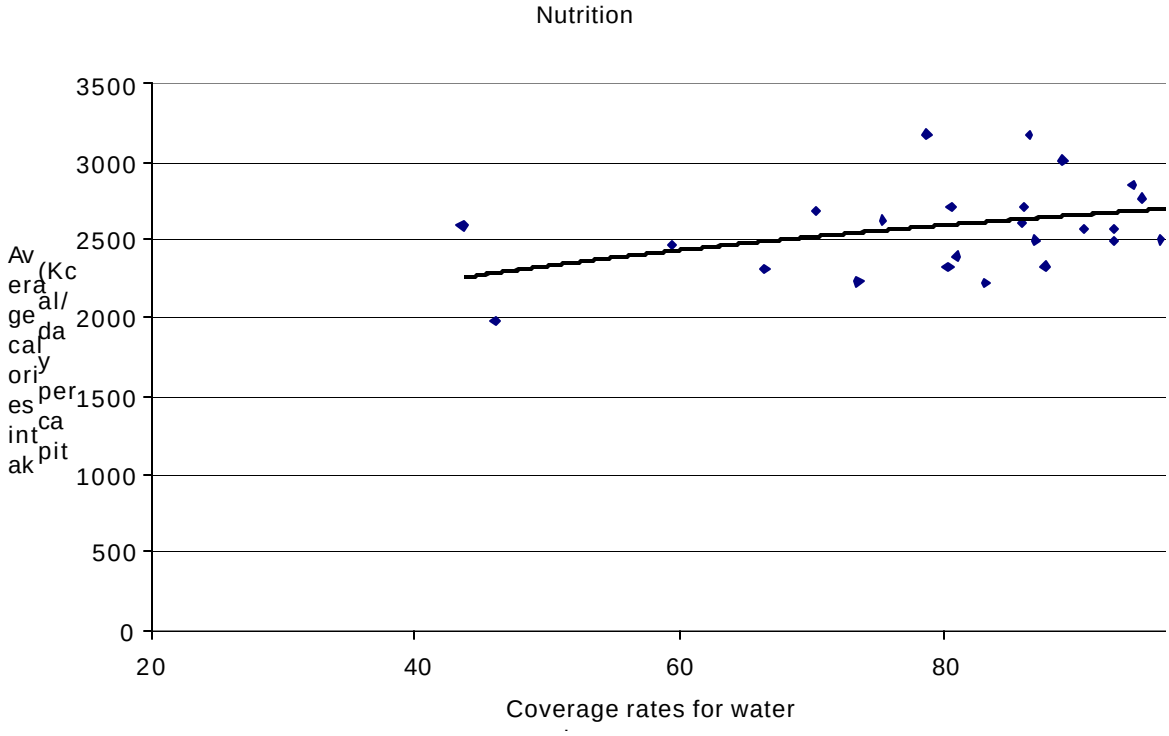
Source: World Bank (2001), World Development Indicators 2001, Washington DC.

Figure 1.11 Incidence of Cholera in selected LAC countries



Source: Pan American Health Organization, Special Program for Health Analysis. Regional Core Health Data Initiative; Technical Health Information System. Washington DC, 2001.

Figure 1.12 Nutrition indicators in selected LAC countries



Source: Pan American Health Organization, Special Program for Health Analysis. Regional Core Health Data Initiative; Technical Health Information System. Washington DC, 2001.