Sectoral Analysis in Water Supply and Sanitation in Cuba

Sectoral Analysis Series No. 3

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ABBREVIATIONS AND ACRONYMS

ANAP	National Association of Small Farmers
ANIR	National Association of Innovators and Planners
BTJ	Youth Technical Brigades
CCS	Credit and Service Cooperatives
CDR	Committees in Defense of the Revolution
CDS	Sustainable Development Commission
EEC	State Committee on Statistics
CEN	State Committee on Standardization
CENHICA	National Center for Hydrology and Water Quality
CNIC	National Center for Scientific Research
CIESPAL	Center for Social Research Studies for Latin America
CIH	Center for Hydraulic Research
CIQ	Center for Chemical Research
COMARNA	National Commission on the Environment and Natural Resources
CONACA	National Commission on the Water Supply and Sewerage System
CPA	Agricultural and Livestock Production Cooperatives
DIAPSA	International Decade on Drinking Water and Environmental Health
ADD	Acute Diarrheal Diseases
FAO	Food and Agriculture Organization of the United Nations
FMC	Federation of Cuban Women
FMCUD	World Federation of Cities United for Development
ICRT	Cuban Radio and Television Institute
INHEM	National Institute for Hygiene, Epidemiology and Microbiology
INRH	National Institute of Water Resources
INSIE	National Institute for Research and Statistical Services
IPF	Institute of Physical Planning
ISPJAE	José Antonio Echeverría Senior Polytechnic Institute
MEP	Ministry of Economy and Planning (previously JUCEPLAN)
MES	Ministry of Higher Education
MICONS	Ministry of Construction
MIMC	Ministry of the Construction Materials Industry
MINBAS	Ministry of Basic Industry
MINED	Ministry of Education
MINSAP	Ministry of Public Health
MINSIME	Ministry of the Sidero-Mechanical and Electronics Industry
MMP	Millions of Cuban Pesos
MMUSD	Millions of United States Dollars
MP	Thousands of Cuban pesos
MUSD	Thousands of United States Dollars
NC	Cuban Standard
WHO	World Health Organization
NGOs	Nongovernmental Organizations
UN	United Nations Organization

OPD	Objectives, Purposes and Directives of the MINSAP
PAHO	Pan American Health Organization
PANAPS	National Drinking Water Supply and Sanitation Action Plan
PCC	Communist Party of Cuba
PIAS	Regional Plan for Investment in the Environment and Health
PIHA	Comprehensive Plan for Environmental Cleanup
PNMAD	National Program on the Environment and Development
UNDP	United Nations Development Program
CR	Construction Regulations
REDCAL	Water Quality Network of the INRH
SNPMA	Environmental Protection Standards System
UATS	Unit of Analysis and Trends in Health
UBIT	Basic Units of Jurisdictional Information. IPF
UBPC	Basic Units of Cooperative Production
UNICEF	United Nations Children's Fund
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UM	Unit of Measure

INTRODUCTION

The economic effects caused by the profound changes that have taken place in the Republic of Cuba's normal international trade relations over the last five years, together with the expansion of the unjust blockade that the country has been subjected to for more than 30 years, have prevented the fulfillment of the proposed goals in the 1991 National Action Program concerning the drinking water supply and sanitation. The objective of this program was to increase the coverage of these services, thereby fulfilling the agreements reached at the World Summit for Children.

The difficult circumstances deriving from the sharp reduction in purchasing power, caused by the interruption of the normal flow of trade and forms of enhanced production that had developed up to 1989, have yielded a severe shortage of basic resources that are essential to the development of the drinking water and sanitation sector and for its ongoing stable management. Under these conditions, there is a basic two-part strategy for the sector, the first of which is to preserve the coverage levels that have been achieved, taking into account their effect on the health and quality of life of the population. The second part of the strategy is to work on the objectives concerning the development and expansion of coverage, which are included in the National Action Plan for the year 2000, during two phases that extend to the year 2004.

Within the framework of the Regional Plan for Investment in the Environment and Health (PIAS), prepared by the Pan American Health Organization (PAHO) pursuant to Resolution XVII of the XXXV Meeting of the Directing Council of the Organization, and in response to the mandate issued by the First Ibero-American Summit of Heads of State and Government, PAHO last year requested the Cuban water supply and sanitation sector authorities to submit a sectoral study to be evaluated within the PIAS. During the second two weeks of the month of March 1994, a PAHO delegation visited Cuba. During this visit the Cuban group presented the document *Terms of reference and programming of the work* which, based on the PAHO document *Methodological guidelines for the performance of drinking water and sanitation sectoral analyses*, would serve as a basis for the preparation by Cuba of this *sectoral study on water and sanitation*, with the collaboration of a team of experts hired by the Organization.

In order to prepare the sectoral study, statistical, policy, institutional and legal information was obtained, along with the plans of all of the institutions related to the sector, with the participation of experts in water resources, health, economy and planning, finance and prices, science, technology and environment, education, radio and television and nongovernmental organizations (NGOs). This effort began during the month of April and lasted until the month of August. As a result of these activities, the six working groups created for this evaluation presented the preliminary version.

During the second two weeks of September, the final document, the *Sectoral study of drinking water and sanitation: Republic of Cuba*, was produced with the participation of PAHO experts.

The study consists of 10 technical chapters. The first seven chapters describe the physical, geographical and socioeconomic characteristics of the country; the management and performance of the drinking water and sanitation sector; institutional analysis and legal framework; plans, policies and programs; a technical analysis of the sanitary infrastructure; management and community participation; and financial analysis. The final three chapters assemble the critical issues that have been identified; the strategies, policies and recommended actions; and the profiles of priority projects.

EXECUTIVE SUMMARY

The population that enjoys water and sanitation services has experienced a progressive decline in service quality over the last five years. This decline includes a reduction in water potability indexes, service continuity and per capita fees collected. During the same period, the problems have increased as a result of sewerage system obstructions and the lengthening of septic tank cleaning cycles. As a result of these developments, it has become necessary to restore and sustain the qualitative and quantitative indicator levels for the sector that had been achieved in prior years. It is also necessary to continue to extend drinking water and sanitation coverage to localities that need it through projects that have a positive impact on the quality of life of the population in the short and medium term, in accordance with jurisdictional priorities. The comprehensive analysis and evaluation of the sector's institutional, financial, technical and social aspects will serve as a basis for planning the national development policies for the sector with a view to overcoming the lack of coverage and improving the conditions in which these services are provided.

General overview. The population of Cuba was 10.99 million inhabitants in 1993, distributed among the 14 provinces and the Isla de la Juventud special municipality. Only three provinces have a population greater than one million: Havana, which is also the capital of the country, has 2.17 million inhabitants; and Santiago de Cuba and Holguin have 1.02 million each. There are eight provinces with populations that range from 0.51 to 0.82 million inhabitants and three with populations from 0.38 to 0.44 million. Isla de la Juventud has a population of 0.08 million inhabitants. In 1993 it was estimated that 75.8% of the population was urban and 24.2% of the population rural, which means an urban population of 8.28 million inhabitants and a rural population of 2.64 million. The growth rate for the period 1990-2000 has been estimated at 0.8%. This rate has been declining, from 3.31% in 1907 to 1.03% in 1985, and showing a slight increase to 1.11% in 1990. The country has sufficient surface and ground water resources to respond to water supply needs. In the western half of the country most of the water supply systems capture groundwater, with disinfection as the only treatment required. In the eastern half, most of the water supply systems are fed by surface water treated in drinking water treatment plants using sedimentation-filtration-disinfection procedures. Only 21.6% of the wastewater collected receives treatment, with the remainder running off into rivers and streams or to the sea. The recycling of wastewater has only been used in a limited way, basically with the use of fertilized irrigation of sugar cane areas. It is believed that the treatment of wastewater through the construction of systems for this purpose should be supported in short and medium term plans. In 1993, the coverage of household water service reached 83.0% in urban areas and 30.0% in rural areas; the coverage of sewerage systems reached 39.6% and 5.2% of urban and rural areas respectively. This coverage is associated with water supply system and sewerage networks, a high percentage of whose technical conditions are either average or poor, with 30% of them needing rehabilitation due to their long period of use and deficient maintenance.

The above has resulted in water supply service being unreliable: water does not reach all of the planned sites, and there are also areas that receive only hourly service. Similarly, sewerage services suffer ongoing obstructions and overflows due to insufficient resources for their operation and maintenance. In addition to the coverage levels indicated, 13.1% of the urban population and 55.8% of the rural population receive water by means of tank trucks or public taps. In addition, 31.6% of the population of urban areas and 46.8% in rural areas dispose of their waste in septic tanks or other devices. In the last five years, the impossibility of maintaining coverage levels and expanding them through the implementation of new projects has caused delays in achieving the goals of the National Drinking Water Supply and Sanitation Action Plan (PANAPS). The lack of financial resources, when added to the impossibility of purchasing products and equipment for the sector in nearby markets due to the prohibitions associated with the economic and commercial blockade that the country has been subjected to, directly affect the completion of this program. In addition to all of the above, one should note that Cuba, located as it is in the Caribbean, periodically suffers the disastrous effects of tropical storms that sometimes destroy water supply or sanitation systems, and especially water disinfection facilities.

Management and performance characteristics. The evolution of the coverage of water supply and sanitation services has shown sustained growth since the 1960s that is indicative of the Government's policy to devote its greatest efforts to the economic development of the country as well as to the satisfaction of the social and environmental needs of the population. During that decade water supply service was increased to more than one million people that did not have it. During these years and until 1975 a program was implemented to increase water potability, and was sustained by reequipping and exercising better control over operations. The training of hydraulic and sanitary engineers was begun at the same time, as well as the development of the building materials industry, in order to respond to program needs. The results of these efforts made it possible for household water supply service to reach 4.9 million people in 1980, doubling the 1960 level for this indicator. During the decade from 1980 to 1990, the number of beneficiaries increased by 1.6 million for the water supply system and by 1.2 million for sewerage. Especially notable for this decade was the increase in water service to rural areas, which also doubled, rising from 250,000 to 550,000 beneficiaries. The number of towns provided drinking water service was increased by 343 to 1,098, with the most important results in the rural community sector. The 584 urban settlements were provided with drinking water service through pipe systems, although these systems do not cover the entire population. Of the 2,896 rural towns with 200 or more inhabitants, 800 had access to water for human consumption, through household connection or public service. With respect to sanitation, the number of towns provided with sewerage service increased between 1980 and 1990 from 106 to 374. The 584 urban settlements

were provided sanitation service through sewerage systems, septic tanks or latrines. Of the 2,896 rural towns, only 560 had adequate sanitation service.

Institutional analysis and legal framework. The Republic of Cuba has an institutional structure to attend to the activities required by the drinking water and sanitation sector. The State assumes full responsibility for the sector, as well as responsibilities related to the preservation of health and the environment, areas that are closely related to water and sanitation. The National Institute of Water Resources (INRH) is the regulatory institution that represents the sector to Cuban State and international agencies. The Ministry of Public Health has the responsibility to establish requirements for the physical, chemical and bacteriological quality of drinking water, controlling and monitoring these elements. The National Water Supply and Sewerage Systems Bureau, belonging to the National Institute of Water Resources, is the specialized body that attends to the drinking water and sanitation sector. There is a provincial water supply and sewerage systems bureau and a provincial hygiene and epidemiology center in each of the 14 provinces of the country; similarly, in each of the 169 municipalities there are water supply and sewerage system bureaus and municipal hygiene and epidemiology units. These provincial and municipal institutions are part of the governing bodies at these levels. In addition, numerous institutions and extrasectoral public entities interact in this sector, contributing necessary economic, social and environmental elements to the sector. The interrelationships that are generated among the institutions of the sector and the extrasectoral institutions are regulated by procedures that are officially established in legal provisions that specify the powers and roles of each. Comprehensive and detailed planning at the national and jurisdictional levels determines the activities needed for the management and development of the sector's infrastructure for the purpose of ensuring hygienic and sanitary conditions for the population, industry and services, as well as the control and conservation of water and environmental resources. The execution of projects of all kinds requires the prior approval of the appropriate water and sanitation regulatory agency, with respect to their physical location, as well as the demand for water and the disposal of waste. There is a national information system, but it needs to be enhanced and supplemented so that it provides the elements necessary to make decisions at the various management levels of the sector and other extrasectoral agencies. The state and jurisdictional standards system that impacts the sector should be updated on the basis of the economic circumstances of the country, which influence the potential for construction projects and access to technology. Professional staff resources should be trained in accordance with the new system of standards, as well as in managerial and technical activities. The application of fees to be charged for water supply and sewerage system services beginning in October 1994 requires the sector to make an improvement in a relatively short time. Administrative and financial activities, as well as the efficiency of service, billing and collections, need to be strengthened. In the rural sector, the water supply and sanitation program has generated community participation, but this program

needs to be increased given that at the current rate of implementing 80 to 90 rural water supply systems annually, 25 years would be required to resolve the supply and sanitation problem. Together with the increase in the plan, it is also necessary to expand community participation not only in project construction but also in the operation and maintenance of the constructed systems. The decentralization of roles and responsibilities toward the provincial and municipal water supply and sewerage system bureaus that began in 1993 requires the sufficient provision of technical, administrative and financial resources at these levels.

Technical analysis of the sector. The deterioration of the quality and quantity of the services in recent years has been significant. There is a large deficit in the coverage of sanitary infrastructure services. With respect to drinking water, 17.0% of homes in urban areas and 70.0% of homes in rural areas do not have household connections, and with respect to sanitation, 59.6% in urban areas and 94.8% in rural areas. Projects to address coverages are not always comprehensive, with priority status usually accorded to water supply solutions and not to sanitation. The standards for design, construction and quality control require analysis and discussion in order to update and complete them. The quality of the services provided is affected by the following factors: deficient condition and inadequate maintenance of the water supply and sewerage network and collector systems; discontinuity of drinking water service caused by insufficient pumping equipment stations; insufficient equipment to ensure the performance of measurements and the lack of diagnostic and detection techniques in sources and networks that would contribute to the most efficient operation of the systems; reduction in the efficiency of water supply systems and the effects on the rational use of water caused by high levels of loss; insufficient depots to store trucks, pipe and spare parts in order to ensure the supply in affected areas and the distribution of water by public services; highly intermittent disinfection of the water provided to the population; lack of chemical products used in the treatment of water at the supply sources and the insufficient maintenance of treatment plants; insufficient depots to store trucks to clean septic tanks, and to store other specialized equipment and replacement parts in order to ensure the cleaning, maintenance and efficient operation of sewerage and septic tank systems; deficient technical and operating conditions in the five existing wastewater treatment plants; deficits in the development of investment programs that make it possible to continue to increase the coverage of drinking water and sanitation services to correspond with the implementation of priority projects that would ensure sustained economic, social and environmental development; insufficient number of sewer treatment systems; infrequent introduction of alternative systems to collect and treat liquid wastes generated by small settlements and the peripheral areas of cities; insufficient production and introduction of technologies to increase the efficient use of water, such as low consumption toilets, fittings and stream gauges; the nonexistence of a systematic program for the transfer of operating and maintenance technologies and

procedures, as well as for the transfer of efficient managerial methods to management staff.

Sector financing. With the disappearance of socialism and the intensification of the North American blockade, which has made the normal access of the country to international markets very difficult, the supply of the minimum indispensable resources to ensure water supply and sanitation services has been affected over the last five years. The most significant expenditures of the current State budget have reduced the allocations to water and sanitation services from $86.0 million in 1990 to 82.6 million in 1991, and to 79.6 million in 1992. The annual investments for the development of infrastructure have also been declining to levels that are 25% to 30% of the amounts allocated five years ago; external financing to complement national efforts has only included the counterpart organization UNICEF, totaling US$ 1.2 million from 1980 to 1992 to support water supply and sanitation programs in rural areas. Similarly the Ministry of Public Health has been the recipient of collaborative efforts from WHO and PAHO that have basically addressed other objectives, and only a small part has reached the sector through PAHO's Environmental Health Program. A new economic adjustment program is currently being implemented in the country in order to ensure the employment and income of workers; maintain the social goals that have been achieved; facilitate the capture of financial capital through the creation of semipublic enterprises with foreign capital; prioritize economic programs that are capable of generating new sources of foreign exchange; continue traditional exports; implement strict planning of fuels; expand the possibilities of independent employment; and transform state agricultural companies, both sugar cane and non-sugar cane, into production cooperatives, transferring the land in use. The collection of a fixed fee for drinking water and sewerage service starting in October 1994 will permit the self-financing of the sector and directly influence the understanding that all users should have regarding the economic value of these services. An initial estimate of the investments required has been carried out in order to address the demand for drinking water and sanitation up to the year 2004, which, although it does not resolve the total needs for sewerage, would indeed give a large boost to the sector: total financing of US$ 1,390.0 million is required over the next 10 years, with 46.3% targeted to the repair and recovery of existing systems, and 53.7% targeted to the National Action Program (see table 7.8).

Strategies and recommended actions

Institutional aspects. The need to enhance the sector's information system has been evaluated, and the improvements would make it possible to regulate in a systematic way and with a single criterion the current work and the development that is possible to achieve. It would also make it possible to improve the process of reviewing and monitoring the management of provincial and municipal entities. The

sector will reorder and update its system of standards, which will make it possible for the process involving the design, projection, construction and operation of water supply and sanitation service systems to be brought into line with the economic conditions of the country.

Technical aspects. The first priority for the sectoral planning at the national and regional levels will be the restoration of the service levels reached at the end of the 1980s through the program to repair and optimize the existing drinking water and sanitation system. The tasks directed to this goal of the National Action Program and to the efficient use of water should receive sustained support. At the same time, the process of investing in infrastructure in order to increase the coverage of the sector should be undertaken in accordance with the program that has been developed.

Financial aspects. The economic readjustment policy that the government is conducting, the prioritization of support for the sector in accordance with the funding available, together with the establishment of the fees to charge for these services, should be accompanied by the enhancement and modernization of technical and managerial activities. This will make it possible to increase the efficiency of the services provided and improve the utilization of financial resources.

Social aspects. The strengthening of community participation in the activities undertaken by the sector will be an essential objective over the coming years. The results achieved in the implementation of rural water supply systems is evidence of the value of such participation. The participation of women and schoolchildren ensures the formation of valuational concepts concerning the management and care of water supply and sanitation systems, and also concern for water conservation and the preservation of water resources. The participation of users, through the payment of fees for services received in order to make the sector self-financing, will allow users to form an accurate assessment of the value of water resources.

Priority projects. On the basis of the comprehensive analysis included in this report, along with the participation of the working team comprised of the various groups, PAHO experts, and regulatory and extrasectoral agencies, and taking into account policies, strategies and recommended actions, 21 project profiles have been prepared. Each of these profiles includes a brief description, the definition of specific problems, goals and objectives, strategy, interested parties, geographical area and beneficiary groups, current situation and situation upon project completion, and the duration and estimate of the investment effort. The projects encompass solutions that address infrastructure, maintenance and rehabilitation, technical modernization, institutional development, sectoral restructuring, human resources development, and community participation, among others.

1. PHYSICAL AND SOCIOECONOMIC CHARACTERISTICS OF THE COUNTRY

1.1 Location and land area

The Republic of Cuba is located in the Caribbean between the 19th and 24th parallels north latitude and the 74th and 85th parallels west longitude. It is formed by the Cuban Archipelago, the most western of the Greater Antilles, with a land area of 110,922 km²; of which 105,006.7 km² consists of the Island of Cuba, 2,199.6 m² La Isla de la Juventud, and 3,715.2 m² the 1,600 islets and remaining keys. The Island of Cuba has a long and narrow shape: in its widest part it measures 210 km and at its narrowest it is 32 km; it is 1,200 km long with an average width of some 100 km. Its coastline exceeds 5,746 km, distributed over the northern and southern coasts.

1.2 Political and administrative organization

The Republic of Cuba is a socialist and democratic state where power is exerted directly through the National People's Assembly and other organs of the State that derive from it, in the forms and according to the standards established by the Constitution and the laws. The National People's Assembly is the supreme organ of State power and the only body with constitutive and legislative power in the Republic. Between sessions, the National People's Assembly is represented by the Council of State, which carries out the decisions of the Assembly and fulfills the other functions that the Constitution attributes to it. It is collegial in character and, for domestic and international purposes, it is the highest representative of the Cuban State. The Cabinet is the maximum executive and administrative organ and constitutes the Government of the Republic. The role of administering justice is exercised by the People's Supreme Tribunal and the other tribunals that the law establishes.

The national territory, for politico-administrative purposes, is divided into provinces and municipalities, which are local entities, juridically incorporated for all legal purposes, and organized politically by law. The provinces are the intermediate link between the central government and the municipal level. The municipalities have land areas that are determined by the required economic and social relationships of their populations and have the ability to meet their minimum local needs.

The provincial and municipal people's assemblies are the highest local organs of State power in the political and administrative jurisdictions into which the national territory is divided, and are invested with the highest power to exercise government authority. In order to perform their functions, the municipalities are supported by 1,251 people's councils constituted in cities, towns, neighborhoods, villages and rural areas, which represent the jurisdictions where they act and at the same time represent the organs of the people's power at the municipal, provincial and national levels.

Since 1976, the country has a new political and administrative division that is comprised of 14 provinces and 169 municipalities, one of them a special case.

Table 1.1
Municipalities by province

Provinces	No. of municipalities
Pinar del Río	14
Habana	19
Ciudad de La Habana	15
Matanzas	14
Cienfuegos	8
Villa Clara	13
Sancti Spíritus	8
Ciego de Ávila	10
Camagüey	13
Las Tunas	8
Holguín	14
Granma	13
Santiago de Cuba	9
Guantánamo	10
Isla de la Juventud[a]	1
Total	*169*

[a] Isla de la Juventud Special Municipality, which is directly subordinate to the National Assembly as well as the provinces.

1.3 Population

1.3.1 *Population growth*

The country's population has grown in the following manner:

Table 1.2
Population growth of Cuba, 1907-1993
(Figures in thousands of inhabitants)

Census	Population					Growth rate in the period
	Total	Urban		Rural		
		inhabitants	%	inhabitants	%	
1907	2049.0	899.7	43.9	1149.3	56.1	3.31
1919	2889.0	1291.0	44.7	1598.0	55.3	2.29
1931	3962.3	2035.0	51.4	1927.0	48.6	2.61
1943	4778.6	2607.5	54.6	2171.0	45.4	1.59
1953	5829.0	3324.3	57.6	2504.4	43.0	2.11
1970	8569.1	5187.8	60.5	3381.3	39.5	2.16
1981	9723.6	6712.0	69.0	3011.6	31.0	1.14
1993*	10925.7	8284.1	75.8	2641.6	24.2	0.96

* Estimated population according to the State Committee on Statistics. December, 1993.

Source: Cuba: Population projection, national and provincial levels. Period 1993-2000. INSIE, July 1990.

The estimated population growth rate for 1990 was 1.11%, corresponding to a birth rate of 1.76% inhabitants and a mortality rate of 0.68% inhabitants. The annual growth rate per 100 inhabitants has varied, as can be seen in the above table.

1.3.2 *Current population and projections through the year 2004*

The population of Cuba was estimated on 31 December 1992 at 10,869,781 inhabitants (INSIE). As can be seen in table 1.3, the declining trend in the population dynamics of the country is evident.

Table 1.3
Current population and projections through the year 2004
(Figures in thousands of inhabitants, through 30 June of each year)

Province	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	%*
Cuba (millions)	10.92	11.02	11.12	11.21	11.29	11.37	11.45	11.53	11.59	11.66	11.72	11.78	0.69
Pinar del Río	713.2	719.9	726.8	732.0	737.4	742.7	747.9	752.7	758.3	761.4	765.1	768.6	0.68
La Habana	664.3	670.3	676.2	681.3	686.2	690.9	695.2	699.0	706.0	706.7	710.2	713.6	0.66
Ciudad Habana	2187.6	2209.8	2227.1	2243.8	2259.4	2273.3	2284.9	2297.2	2308.2	2318.4	2328.2	2337.9	0.69
Matanzas	630.6	637.5	643.1	653.7	662.8	671.8	680.0	688.7	696.7	705.1	713.1	720.2	1.19
Villa Clara	822.3	827.2	832.0	835.7	839.8	841.4	843.5	844.8	846.2	847.2	847.8	848.3	0.29
Cienfuegos	378.1	382.2	386.3	389.9	393.5	397.1	400.5	403.8	406.8	409.5	412.9	416.2	0.85
Sancti Spíritus	442.8	447.0	451.1	454.2	457.5	460.7	464.1	467.2	469.9	472.6	475.2	477.7	0.68
Ciego de Avila	383.7	389.1	394.5	400.1	405.7	411.2	416.4	421.8	426.9	422.3	437.4	442.0	1.28
Camagüey	760.9	774.7	782.5	789.2	795.8	802.4	808.8	815.0	821.0	826.6	832.2	837.7	0.80
Las Tunas	510.2	515.8	521.6	527.7	532.4	537.7	543.0	548.2	553.2	557.9	526.7	556.5	0.95
Holguín	1020.8	1027.8	1034.1	1040.5	1046.4	1051.8	1056.7	1062.1	1065.9	1069.9	1073.8	1077.0	0.48
Granma	816.1	823.7	831.4	836.7	841.8	846.8	851.5	855.9	860.3	864.1	867.5	870.7	0.59
Santiago de Cuba	1021.0	1030.6	1040.3	1049.0	1057.4	1065.5	1073.3	1081.8	1088.6	1095.5	1101.9	1107.2	0.73
Guantánamo	508.9	512.0	514.8	516.5	518.2	519.9	521.8	523.6	525.1	526.2	527.1	527.8	0.33
Municipio Isla de la Juventud	75.4	76.3	77.1	77.8	78.4	78.9	79.4	79.8	80.2	80.6	81.1	81.5	0.70

* Projected growth rate.

Source: Cuba: Population projection, national and provincial levels. Period 1993-2000. INSIE. July 1990.

1.3.3 *Classification of the population and urbanization rate*

The classification of the urban population is based on the official parameters from the 1981 census, i.e. more than 2,000 inhabitants or the presence of the following features: water supply system, sewerage system, electric power, paved streets, educational centers, medical care. A new census has not been taken, and as a result the urban population estimate was performed on the same settlements that were defined as such in 1981. In 1990 the urban population was estimated at 7,899,000 inhabitants, 73.9% of the total, and the rural population at 2,794,000, 26.1% of the total, with their distribution by province as shown in table 1.4.

Table 1.4
Urban and rural population by province, 1990

Province	Urban		Rural		Total	
	inhabitants	%	inhabitants	%	inhabitants	%
Pinar del Río	412290	59.0	285696	41.0	697986	6.5
La Habana	504726	77.5	146413	22.5	651139	6.1
C. Habana	2119059	100.0	...	...	2119059	19.8
Matanzas	487430	79.2	128273	20.8	615703	5.8
Villa Clara	594175	73.1	218618	26.9	812793	7.6
Cienfuegos	282632	76.6	86361	23.4	368993	3.4
S. Spíritus	297373	68.7	135690	31.3	433063	4.0
C. de Avila	274374	74.0	96604	26.0	370978	3.5
Camagüey	563470	75.2	185705	24.8	749176	7.0
Las Tunas	289629	58.1	208670	41.9	498299	4.6
Holguín	572562	57.1	430247	42.9	1002809	9.4
Granma	463752	56.8	344649	43.1	798401	7.5
Santiago de Cuba	683603	68.4	316516	31.6	1000119	9.4
Guantánamo	299112	59.6	202703	40.4	501815	4.7
I. Juventud	65378	88.2	8755	11.8	74133	0.7
Total	*7899565*	*73.9*	*2794900*	*26.1*	*10694465*	*100.0*

Source: Demographic Yearbook, Cuba, 1990. INSIE. April 1992. (Cuba).

The urbanization rate progressed at an annual average of approximately 1.8% between 1981 and 1990; the percentage at the national level rose from 69% in 1981 to 73.86% in 1990 (see table 1.5).

Table 1.5
Population urbanization projection, 1985-2005
(% of total population)

Province	1981	1985	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Pinar del Río	48.8	51.7	55.9	58.9	60.1	61.3	62.5	63.9	65.3	66.7	68.2	69.7	71.2	72.7	74.2
La Habana	73.1	74.6	78.4	80.2	80.8	81.2	81.8	82.0	82.4	82.8	83.2	83.6	84.0	84.2	84.6
Ciudad Habana	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Matanzas	75.6	77.5	78.7	80.3	80.7	81.3	81.9	82.5	83.1	83.7	84.2	84.8	85.5	86.1	86.7
Villa Clara	68.7	70.8	73.2	74.8	74.8	74.9	75.2	75.5	75.8	76.1	76.4	76.7	77.0	77.3	77.6
Cienfuegos	72.0	74.1	75.4	76.4	76.6	77.2	77.6	78.0	78.4	78.8	79.2	79.6	80.0	80.4	80.8
Sancti Spíritus	62.3	65.9	69.6	71.0	71.4	71.8	72.2	72.6	73.0	73.4	73.8	74.2	74.6	75.0	75.4
Ciego de Avila	66.7	68.6	72.8	74.7	75.3	75.9	76.3	76.7	77.1	77.5	77.9	78.3	78.7	79.1	79.5
Camagüey	72.4	74.2	75.4	76.0	76.3	76.6	76.9	77.2	77.5	77.8	78.1	78.4	78.8	79.2	79.6
Las Tunas	48.8	54.8	58.0	61.6	62.4	63.3	64.2	65.2	66.2	67.2	68.2	69.2	70.2	71.2	72.2
Holguín	50.0	53.2	57.1	59.7	60.6	61.5	62.4	63.4	64.4	65.4	66.4	67.5	68.6	69.7	70.8
Granma	60.8	64.6	67.6	68.8	69.9	60.0	61.3	62.2	63.1	64.0	64.9	65.8	66.7	67.6	68.5
Santiago de Cuba	62.0	64.8	68.1	69.9	70.5	71.1	71.1	72.3	72.9	73.5	74.1	74.7	75.3	75.9	76.5
Guantánamo	52.8	56.4	60.5	62.1	62.5	62.9	63.3	63.7	64.1	64.5	64.9	65.3	65.7	66.1	66.5
Municipio Isla de la Juventud	81.6	83.4	84.1	84.6	84.8	85.0	85.3	85.6	85.9	86.3	86.7	87.1	87.5	87.9	88.3

Source: Cuba: Population projection, national and provincial levels. Period 1993-2000. INSIE, July 1990.

The percentage of the country's population that was urban in the years 1981, 1985 and 1990 was 69.0%, 72.4% and 73.9% respectively, and it is expected that by the year 2000 the urban population will be 83.6%.

1.3.4 *Classification of the population by sex*

The total population was 50.3% male and 49.7% female in 1990.

The following percentages are projected for the future:

	1995	2000	2005
Male	50.2	50.2	50.1
Female	49.8	49.8	49.9

1.3.5 *Composition of the population by age*

Table 1.6
Composition of the population by five-year age groups, 1990

Years	Urban		Rural		Total	
	Inhabitants	%	Inhabitants	%	Inhabitants	%
0 - 4	638601	71.5	254298	28.4	892899	8.3
5 - 9	558130	71.0	227490	29.0	785620	7.3
10 - 14	526473	70.4	221280	29.6	747753	7.0
15 - 19	754835	70.5	315170	29.5	1070005	10.0
20 - 24	319149	27.8	829123	72.2	1148292	10.7
25 - 29	835468	75.0	278478	25.0	1113946	10.4
30 - 34	557776	74.7	188655	25.3	746431	7.0
25 - 39	545003	75.8	174270	24.2	719273	6.7
40 - 44	515139	76.7	156097	23.3	671236	6.3
45 - 49	455535	77.0	136368	23.0	591903	5.5
50 - 54	395535	76.8	119515	23.2	515050	4.8
55 - 59	305020	76.1	95595	23.9	400615	3.7
60 - 64	271069	76.4	83948	23.6	355017	3.3
65 y más	723578	77.3	212947	22.7	936535	8.8
Total	*7899565*	*73.9*	*2794900*	*26.1*	*10694465*	*100.0*

Source: Demographic yearbook. Cuba. 1990. INSIE; April 1992.

The population of working age was 6,398,984, or 59.8% of the total.

1.3.6 *Migration rate*

The internal migration rate of the population, calculated on the basis of the 1970 1981 censuses, yielded a value of 24.6/1000 inhabitants, a rate that rose to 74.0/1000 inhabitants in the case of the dispersed population. The internal migration component in recent years has reached levels ranging from 170,000 to 180,000 individuals migrating on an annual basis, from provinces with high birth rates toward those with lower rates, where there is the greatest degree of economic development in the country.

Table 1.7
Internal migration rate (1981, 1985, 1990)
(Figures per 1,000 inhabitants)

Province	1981	1985	1990
Pinar del Río	-1.3	-2.6	-1.4
La Habana	3.3	0.7	3.4
Ciudad de la Habana	6.3	6.1	6.3
Matanzas	1.7	2.5	3.1
Villa Clara	-0.3	-1.8	-1.9
Cienfuegos	2.8	3.7	2.9
Sancti Spíritus	-1.6	-1.6	2.9
Ciego de Avila	3.9	4.1	6.0
Camagüey	4.7	2.7	0.9
Las Tunas	...	-0.2	-2.2
Holguín	-3.1	-1.9	-3.9
Granma	-9.7	-8.0	-6.7
Santiago de Cuba	-5.2	-5.8	-5.8
Guantánamo	-9.9	-9.3	-9.0
Isla de la Juventud	15.5	16.2	6.1

Source: Demographic Yearbook. Cuba. 1990. INSIE; April 1992.

The movement of external migrants declined after 1980, which did not affect population growth. External migrations have proceeded at rates of:

1953: 0.4 per 1,000.
1958: 0.7 per 1,000.
1959: 1.8 per 1,000.
1960: 8.9 per 1,000.
1970: 6.6 per 1,000.
1980: 14.6 per 1,000 (Mariel)
1990: 0.5 per 1,000.

For the projection, the net external migration was estimated at -26,421 between 1990 and 1995; from 1995 to 2000 at -30,000; and from the year 2000 to 2005 at -30,000.

The migration from rural to urban areas generated values on the order of 100,000 persons per year between 1970 and 1981, and this migration had a considerable impact on the decline of the rural population in absolute terms, as the movement of the dispersed population and those who lived in locales with fewer than 200 inhabitants became evident. This flow, which was initially linked to the capital, has changed with time, with an increase first toward the provincial capitals, and currently toward base urban settlements and municipal seats.

1.3.7 *Population density by province*

Table 1.8
Population density by province

Province	pop./km²
Pinar del Río	63.9
La Habana	113.6
Ciudad de la Habana	2913.3
Matanzas	51.4
Villa Clara	93.8
Cienfuegos	88.3
Sancti Spíritus	64.2
Ciego de Avila	53.7
Camagüey	46.9
Las Tunas	75.6
Holguín	107.8
Granma	95.4
Santiago de Cuba	162.1
Guantánamo	81.1
Isla de la Juventud	30.9
Density for the country	*96.5*

Source: Demographic Yearbook. Cuba. 1990. INSIE: April 1992.

1.3.8 *Structure of the settlement system by city*

The system of population settlements is structured on the basis of the following political and administrative levels:

- Ciudad de la Habana
- 12 provincial seats
- 33 cities of the intermunicipal hierarchy (former regional seats with more than 20,000 inhabitants)
- 106 urban municipal seats
- 3 rural municipal seats

The rest of the system is comprised of the so-called base periphery, which includes the population that lives in concentrated or scattered settlements that lack any political or administrative structure. This base periphery is comprised of 430 urban settlements and some 6,000 rural settlements. Some 13.0% of the population of this area resides in locales with more than 200,000; 3.4% in places with fewer than 200 inhabitants; and 8.6% of the people live in dispersed settlements.

Table 1.9
Ranking by population range for municipalities and municipal cities (1981 census)

Population/inhabitant ranges	No. of municipalities
> 100000	14
100000 - 50000	36
50000 - 40000	16
40000 - 35000	12
35000 - 20000	59
< 20000	17

Table 1.10
Cities, 1990
(Estimated figures)

population/inhabitant ranges	No. of cities
> 2000	1
500000 - 100000	11
100000 - 50000	5
50000 - 20000	34
20000 - 10000	47
10000 - 5000	37
5000 - 2000	12

Source: Population and Dwellings Census, 1981.
Nomenclatures of inhabited places. EEC; 1982.

Table 1.11
Population of principal cities, 1981-1990
(Estimated figures)

City	Population		Growth rate (%) 1981-1990
	1981	1990	
Pinar del Río	96660	124100	2.25
La Habana (capital)	1929432	2119059	0.85
Matanzas	100813	115466	1.23
Santa Clara	172123	197189	1.23
Cienfuegos	102791	125000	1.77
Sancti Spíritus	71949	87388	1.77
Ciego de Avila	74280	89018	1.62
Camagüey	245525	286404	1.38
Las Tunas	84857	120897	3.15
Holguín	186943	232770	1.96
Bayamo	100622	128167	2.15
Santiago de Cuba	347279	418721	1.67
Guantánamo	167255	203371	1.77
Nueva Gerona	31119	41267	2.53

Source: Demographic Yearbook. Cuba. 1900. INSIE; April 1992.

1.4 Geography and climate

1.4.1 *Topography*

The topography is varible. The origins of its formations lie in the coexistence of multiple endogenous and exogenous processes that have interacted over several geological epochs to arrive at the current structures. The country has 4 mountain systems: the Cordillera de Guaniguanico in the west, the Grupo Guamuaya in the center, and the Sierra Maestra and the Grupo Sagua-Baracoa in the east, which altogether occupy 19,594 km^2 (17.7%) of the total land area. The highest peak is Pico Real del Turquino, which is 1,974 m above sea level. The plains represent the most widespread topological morphology (approximately 80% of the total area), with their origins in a variety of processes, ranging from the typical coastal plain to fluvial plains, where carsic, biogenic and weathering processes have operated, with the lowest areas consisting of marshes and coastal marshes.

The utilization of the topography in terms of agriculture, livestock and wood products has been determined by the areas with their morphometric characteristics. In certain cases there has been more exploitation than the resources of the land could bear, and on other occasions the inverse has been the case, so that at present certain changes in these usage patterns are required.

1.4.2 *Soils*

Cuba is widely covered with soils, and there are 10 groupings and 29 fundamental types as a result of the various genetic conditions involved in their formation. Among the most widely distributed soil types are ferric, ferrous, dark, humic, carcimorphic, hydromorphic, alluvial soils, etc. All of these soils support various possibilities for the development of agricultural, livestock and forestry activities, with the latter in particular for areas with intense processes.

Table 1.12
Productive categories of soils

High	Medium	Low
La Habana	Pinar del Río	Las Tunas
Ciego de Avila	Matanzas	Holguín
	Cienfuegos	Granma
	Villa Clara	Santiago de Cuba
	Sancti Spíritus	Guantánamo
	Camagüey	

Source: *UBIT summary surveys.* IPF; 1991-1994.

The productivity patterns of the soils affect the results of production, output and the policy that is pursued concerning the proper management of the soil and improvement of its qualities.

1.4.3 *Relevant geographical characteristics that affect water supply and sanitation*

The geographical configuration of the national territory makes it possible to generate hydraulic potential that is distributed throughout the entire national territory and, although its density is not uniform, the serviceable resources by region provide coverage to the supply needs of the population, industry, livestock industry, and to a great extent, irrigation.

The structure of the hydrographic network in topographical conditions that are for the most part moderate, and the existence of a considerable number of carsic aquifers, have permitted the development of a hydraulic infrastructure that is low in complexity in a high percentage of cases. The completion of this infrastructure according to plans will make it possible to fulfill long term demand. However, there are some regions where local geographical conditions make the supply of water difficult, as, for example, in:

- Mountainous areas: the southern slope of the Sierra Maestra experiences a pattern of precipitation between 800 and 600 mm during the rainy season (May to October). The geological formations and topography of this region have only permitted the existence of small aquifers, making difficult the construction of adequate reservoirs to satisfy demand.

- Coastal areas: in some areas there are problems with saline intrusion, affecting groundwater. In these cases, water can only be supplied with surface water, whose regulation is sometimes impossible (flat areas).

With respect to floods, the greatest problems are in flat areas with impermeable soils, areas with bad drainage and areas that experience floods due to seasonal rains and tropical hurricanes. The northern region of Camagüey and Ciego de Avila; north of Las Tunas; the Valle del Cauto (Granma and Holguín); and the Valle de Guantánamo are typical cases. In addition, there are problems with excessive salinity of soils and water, basically in the Valle del Cauto and the Valle de Guantánamo.

1.4.4 *Climate*

The archipelago has a climate with predominantly tropical marine conditions with a seasonal distribution of precipitation. Solar exposure is at a maximum in the months from April to July with 20 MJ/m², and at a minimum in December and January with 12 MJ/m², with local variations resulting from the orography. Solar exposure rises to a total of 2,900 hours of light per year along the coasts and only 2,500 hours in the mountains.

The annual average temperature is 25,4° C, with the average daily minimum values and the average maximum daily values between 20-25 and 25-35° C respectively. The minimum and maximum values are on the order of 2° and 38° C. The prevailing winds come from the northeast, with local variations caused by the pattern of coastal breezes. The most extreme values are caused by the passage of frontal systems and hurricane disturbances. The average relative humidity is 80%, with daily variations from a maximum of 95% in the morning to a minimum of 60% at noon.

1.4.5 *Precipitation*

The annual average precipitation is 1,375 mm over two distinct periods, the rainy season from May to October (80%), and the dry season from November to April (20%). The extreme values for rainfall are reached in the eastern area, and are greater than 2,400 mm annually in the Sagua-Baracoa massif and less than 600 mm annually in the southeast, near the coast; the latter is the most arid region in the country.

Evaporation ranges from a maximum of 2,300 mm annually in coastal and interior areas to a minimum of 1,200 mm annually in mountainous areas. The most extreme meteorological conditions in the country are generated by hurricanes and cold and southern fronts, which affect the western half of the country to the greatest extent.

1.4.6 *Natural disasters*

In recent years, natural disasters have been linked to the occurrence of extreme meteorological events, among them:

- Extratropical hurricanes (February 1992): intense rains, penetration of the sea into the Capital and floods.

- The Storm of the Century (March 1993): losses totaling on the order of US$ 1,000: penetration of the sea into Ciudad de la Habana, problems for the population and agriculture in 8 provinces as a result of extensive floods caused by intense rains and high velocity winds.

- Tropical depressions (November 1993): problems caused by intense rains in the eastern region of the country and the loss of more than 100 lives; damage to the agricultural and livestock sectors, homes and communication channels.

In addition to these situations, there is the potential for other disasters when tropical hurricanes cross the country with their devastating effects resulting from high velocity winds and intense rains, as well as the possibility of floods caused by the rains.

1.4.7 *Vegetation and reforestation*

The country has 32 distinct formations of forest plants, thickets, herbaceous vegetation and vegetation complexes, and there are more than 6,000 floral species of which 51% are considered endemic. The current forested area covers 25,817.3 km² (18% of the total surface area), a number that could rise to 25-30% in accordance with the reforestation plans that are being carried out in mountain areas.

1.4.8 *Relevant hydrogeological characteristics*

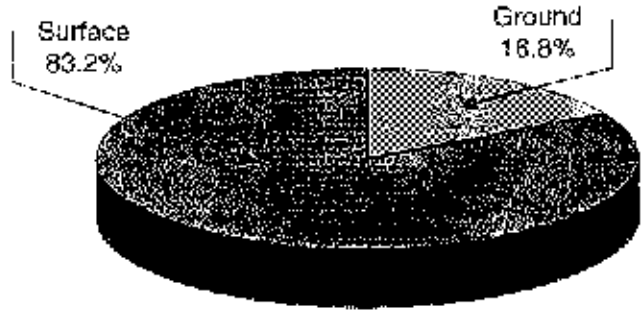
Some 65% of the national territory is composed of highly carsified calcareous formations, which have given rise to open and closed, confined and free aquifers with high water generating potential, whose waters are approximately 80% exploited (or have been evaluated). Some watersheds present saline intrusion problems. In order to improve the quality of the groundwater, a broad system of artificial reservoirs has

been developed with the appropriate use of special catchments, with which the exploitable resources can be increased in the areas where they are required. Parameters have been established to protect important sources that need to be protected against contamination.

1.4.9 *Water resources*

Potential. The total hydraulic potential of the country has been evaluated at 38.1 km³ per year, consisting of 31.7 km³ for surface water and 6.4 km³ for groundwater.

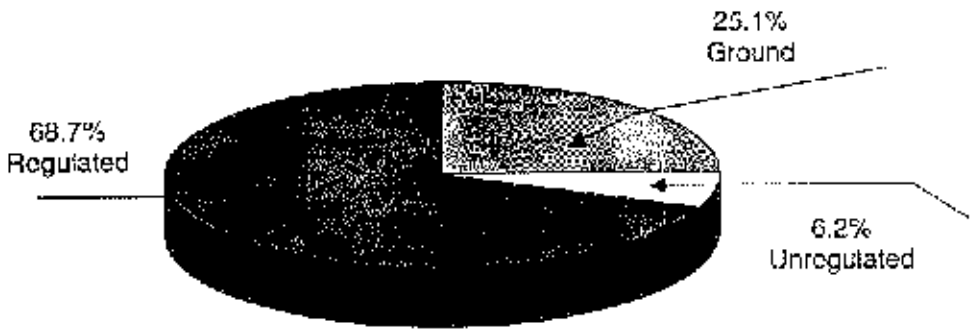
Figure 1.1
Total Hydraulic Potential (%)



Source: *INRH Report to the National People's Assembly*. INRH; July 1992.

Of this potential, 23.9 km³ per year can be used, consisting of 16.4 km³ of regulated waters, 1.5 km³ of unregulated water and 6.0 km³ of groundwater.

Figure 1.2
Available Water Resources (%)



Source: *INRH Report to the National People's Assembly.* INRH; July 1992.

Table 1.13
Available water resources by province, 1993[a]

Province	Total	Surface Water		Not Regulated	Groundwater
		Total	Regulated		
Nación	*23888*	*17894*	*16363*	*1531*	*5994*
Pinar del Río	2437	2200	1700	500	237
La Habana-C. Habana	2533	780	750	30	1753
Matanzas	2016	570	400	170	1446
Cienfuegos	1501	1155	1100	55	346
Villa Clara	1105	799	765	34	306
Sancti Spíritus	2087	1869	1804	65	218
Ciego de Avila	1134	266	244	22	868
Camagüey	1863	1626	1501	125	237
Las Tunas	931	800	720	80	131
Granma	1928	1724	1554	170	204
Santiago de Cuba	1081	1060	1000	60	21
Guantánamo	3261	3220	3120	100	41
Isla de la Juventud	325	235	209	30	90

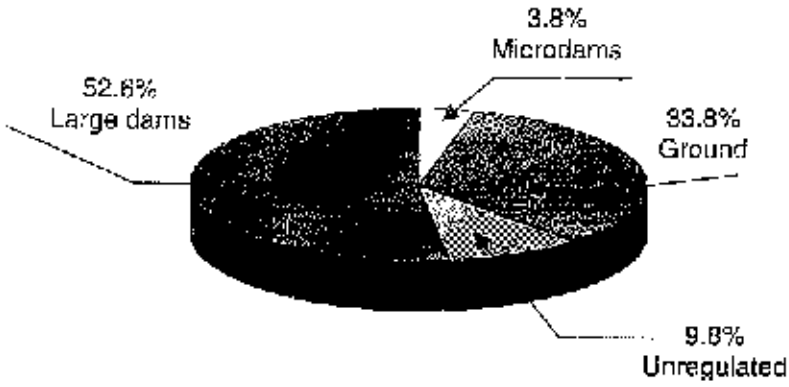
[a] UM: 10^6 m^3

Source: INRH Report to the National People's Assembly. INRH; July 1992.

Availability. At present because of the hydraulic development that has been achieved in the country since 1959, it is possible to utilize a volume of 13.3 km³ per year for various purposes according to the following chart:

Figure 1.3
Total Availability of Water (%)

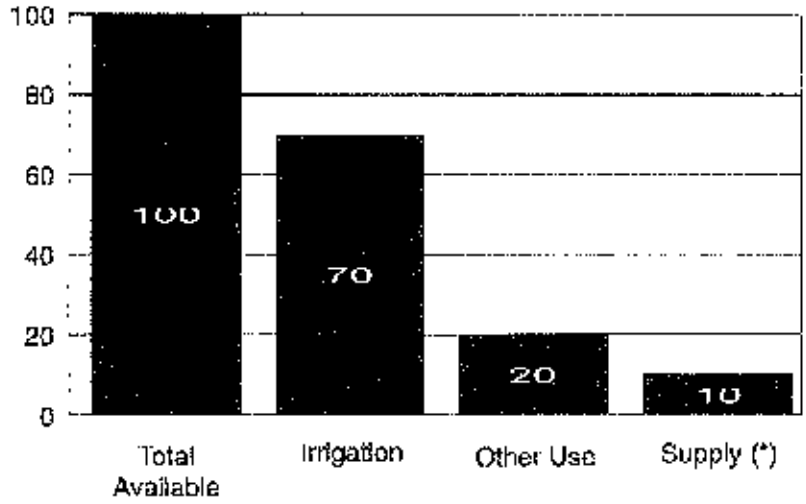
Large reservoirs 7.0
Ground 4.5
Unregulated 1.3
Microdams 0.5



Source: *INRH Report to the National People's Assembly*. INRH; July 1992.

This available potential is distributed according to the following uses:

Figure 1.4
Potential Water Resources (%)



(*) Does not include the dispersed rural sector

The availability of water resources and the demand from users, including the population, agriculture and industry as a whole, indicate a favorable situation. However, efficient management of this resource should be implemented, by introducing advanced irrigation techniques, the reuse of water and the treatment and use of wastewater for various purposes, with a view to protecting available water resources.

Table 1.14
Available water resources by province, 1993[a]

Province	Total	Surface Water				Groundwater
		Total	Regulated		Unregulated	
			Dams	Microdams		
Nación	*13280.8*	*8785.6*	*7011.3*	*510.9*	*1257.5*	*4495.2*
Pinar del Río	1382.1	1156.4	938.9	49.0	168.5	225.7
La Habana	1506.8	418.5	341.7	58.3	18.5	1088.3
Ciudad Habana	333.0	43.8	20.3	17.0	6.5	289.2
Matanzas	1373.7	163.0	70.0	30.9	62.1	1210.7
Cienfuegos	918.1	729.8	635.1	37.3	57.4	188.3
Villa Clara	700.3	564.1	490.4	16.2	57.5	136.2
Sancti Spíritus	1195.4	1135.5	921.8	23.1	188.6	61.9
Ciego de Avila	973.9	149.9	97.0	2.1	50.8	824.0
Camagüey	1427.7	1209.3	923.7	113.8	171.8	218.4
Las Tunas	382.1	291.0	192.6	54.1	44.3	71.1
Holguín	509.3	478.0	384.8	49.2	44.0	31.3
Granma	1432.7	1329.6	1070.9	14.6	244.1	103.1
Santiago de Cuba	716.1	707.3	607.9	34.6	64.9	8.8
Guantánamo	286.1	270.2	187.1	6.5	76.6	15.9
Isla Juventud	163.5	141.2	135.1	4.2	1.9	22.3

[a] UM: 10^6 m^3

Source: INRH Report to the National People's Assembly. INRH; July 1992.

Utilization. Of the volume of water available for use (13.3 km^3 per year), 70% is utilized in the irrigation of the primary crops (sugarcane, rice, various crops, citrus and fruit trees, fodder, grains, coffee and tobacco), and the rest for the water supply and other uses. Using the hydraulic infrastructure that has been created, various needs including replenishment, salinity control, aquaculture, water power, and tourism, etc. are also met.

At present the country has 12,000 m^3 of water per inhabitant per year. This indicator shows a more positive situation in the provinces of Sancti Spíritus (2.7) and Ciego de Avila (2.6), and a less favorable situation in the provinces of Holguín (0.5), Guantánamo (0.6) and Las Tunas and Santiago de Cuba (0.7). In the utilization of

water resources, the guaranteed users are the population and industry, and in second place, irrigation.

The preferred supply to the population is groundwater, with this source being more important in La Ciudad de la Habana and the provinces of Habana, Matanzas and Ciego de Avila because of the abundant existence of carsic aquifers. For their supplies the provinces of Holguín, Granma, Santiago and Guantánamo basically rely on regulated surface water, so that these provinces experience the greatest limitations in their supply because of the need to construct new sources and delivery systems.

Variations in the runoff pattern. The geographical location and the long and narrow configuration of Cuba give the island certain peculiarities with respect to its network of rivers. Among other features there is a central divide that runs the length of the country and two slopes (north and south). This configuration means that 85% of the rivers are less than 40 km in length and have watersheds under 200 km^2. In addition, the rainfall pattern is characterized by two annual periods: the rainy season (May to October) with 80% of the precipitation, and the dry season (November to April) with the remaining 20% of the precipitation. All of the above means that most of the rivers go through a dry period, and in some cases the flow is completely shut off. Another significant element are the droughts that, to a greater or lesser extent, reduce surface and groundwater runoff and correspondingly the availability of water.

1.5 Social characteristics and educational levels

As is well known, Cuba currently faces serious difficulties of an economic nature. Despite this, the population is not living in poverty conditions (0%), since the country's resources are distributed equitably to the entire population. In addition, medical care and basic education are free, and state-funded welfare covers the basic needs of families with social problems or of families that have no income.

The progress in education can be seen through a review of the following indicators:

- Care is provided to 57% of the child population from 0 to 5 years of age through teaching institutions and in nonformal ways;
- Enrollment of 100% of the child population from 6 to 11 years of age and 93% of the students from 12 to 14 years of age at the secondary level;
- The continuation of studies for those graduating from the basic secondary level to the upper middle level is approximately 92%;

Table 1.15
Volume of water utilized
(Figures in cubic hectometers)

Province	Ground					Surface					General Total
	Total	Irrigation	Population	Industry	Other	Total	Irrigation	Population	Indust.	Other	
Pinar del Río	93,407	26,501	65,648	1,078	0,180	478,405	414,900	6,013	7,491	48,001	571,812
La Habana	334,284	204,928	95,916	28,622	5,803	83,160	69,418	1,600	11,464	7,688	417,444
C. de La Habana	472,003	0,653	466,785	3,382	1,183	13,836	0,237	13,217	0,382	...	485,839
Matanzas	345,756	182,273	128,687	33,454	1,342	43,187	41,600	..	1,523	0,064	388,943
Villa Clara	88,859	28,254	26,478	13,512	0,615	449,295	238,041	41,833	153,233	14,194	538,158
Cienfuegos	90,154	33,855	44,278	6,818	5,203	29,214	20,517	5,697	2,700	.	119,368
Sancti Spíritus	21,370	7,119	10,742	3,188	0,323	576,121	528,284	27,046	20,040	0,801	597,491
Ciego de Avila	300,760	212,747	38,531	45,600	3,472	58,639	53,348	0,253	4,465	0,573	359,388
Camagüey	45,679	33,569	6,084	6,026	...	413,488	324,685	80,456	8,761	8,567	459,167
Las Tunas	30,860	4,029	22,561	4,290	...	56,442	46,272	1,327	8,842	..	87,302
Holguín	39,785	2,379	24,362	8,621	3,423	144,468	54,506	28,960	55,642	7,360	184,253
Granma	62,867	8,188	27,561	14,556	1,348	774,270	731,123	12,278	13,902	16,967	826,937
Santiago de	18,355	0,561	16,743	0,379	0,672	134,197	43,908	73,913	11,496	4,880	152,552
Cuba	4,104	0,018	4,086	...	...	118,813	40,100	78,828	0,493	0,392	123,917
Guantánamo	16,724	0,970	13,903	0,485	0,366	71,638	17,961	0,053	0,720	8,684	87,362
I. Juventud	1933,742	747,040	993,486	166,409	24,828	3394,197	2822,171	361,571	302,154	118,301	5327,939
Cuba											

Notes: The volume of water that one province provides to another province is included for the province that receives and utilizes the water.
Losses are not considered in the usage figures.
In 1993, an unreported volume of 868 hm³ was reported, of which it is estimated that approximately 50% was utilized.

- Level of residual illiteracy is approximately 2% in the population from 15 to 49 years of age;

- Graduation from the sixth grade of more than 1.5 million adults and more than 900,000 from the ninth grade, out of a population of more than 11 million inhabitants;

- As of 1994 there were an estimated 1,400,000 mid-level technicians and qualified workers and some 500,000 higher level workers who were qualified in various specialties.

1.6 General health situation

The changes that have taken place in the health status of the population over the last three decades are an expression of the high priority accorded to health by the Revolution, and the efforts it has undertaken in the social sphere and in the qualitative transformation its citizens' standard of living. In public health, a powerful organization was developed that was structured around an extensive network of units that employs more than 300,000 workers and that is provided with important technological, medical and nonmedical resources. This system is currently a force that is capable of fulfilling the large strategic objectives proposed for the sector by the highest administrative levels in the country.

Before the triumph of the Revolution, the situation in the sector was very poor and was characterized by:

- The absence of a national health system, the lack of the most elementary coordination of the services that did exist, and the lack of vertical programs that would pursue solutions to the highest priority problems;

- Quantitative insufficiency of the services and poor coverage: there were 161 clinics in very vulnerable conditions in urban areas and there was no rural medicine; 63% of the physicians and 61.7% of hospital beds were concentrated in the capital;

- Low quality of public services in comparison with the relatively better quality of private services. The public health budget was some 20 million;

- All the services were curative in nature, and there was no preventive medicine;

- Teaching of medicine that was not responsive to social needs: education of physicians for private practice curative care; there were 6,000 physicians, of

whom more than 3,000 abandoned the country during the initial years of the Revolution;

In 1958, the number of university professionals employed in the Ministry of Health included the following: 1,103 physicians, 23 stomatologists and 146 pharmacists, 828 nurses and 873 mid-level technicians;

- Almost total lack of health statistics;

- A large number of people, especially children, became ill or died every year from infectious diseases such as poliomyelitis, malaria, diphtheria, tuberculosis, tetanus and gastroenteritis; acute diarrheal diseases were the third most frequent cause of death in the country among all age groups;

- Infant mortality greater than 60 per thousand live births in the first year; life expectancy less than 55 years;

- There was only one blood bank and only one school of medicine which, as of 1959, graduated around 300 physicians per year, many of whom migrated because of a lack of work; around 80 nurses were graduated on an annual basis.

Since the early 1960s, programs have been implemented to fight infectious diseases, which at that time were important causes of disease and death. Poliomyelitis was eradicated in 1963, malaria in 1968 and diphtheria in 1971. The programs to fight diarrheal diseases, eradicate malaria, control tuberculosis and increase immunization generated successful results through their continual organizational enhancement, community participation, the support of community organizations and health education. All of these efforts together with the introduction of new research techniques, new drugs, vaccines, etc., made possible a sustained reduction in these diseases, which today constitute only 1.5% of total deaths. The experience acquired in implementing these programs, the introduction of new vaccines and technical diagnoses that are anticipated in the coming years, and the unprecedented increase in the coverage of activities that facilitate the expansion of comprehensive medical care provided by family physicians and nurses should ensure even more notable results expressed in the reduction morbidity and mortality from infectious diseases.

At the beginning of the 1970s our public health system identified the population group of women and children as deserving of the highest priority for medical care. The maternal and child program is an example of the potential generated by uniting all of the efforts of the health system with extrasectoral support. This program is also the result of efforts by political authorities and the Government to accord it priority

status in the attainment of a strategic objective that made it possible to reduce infant mortality by 50% in its first decade and by a similar figure in its second decade, an extraordinary achievement. The program is currently consolidated: more than 3,600 pediatricians, neonatologists and gynecologists/obstetricians work in the program, and more than 1,800 are trained as residents in these three specialties. Linked to them there are also family doctors, 7,769 pediatric nurses, 1,476 neonatal physicians and 2,095 obstetricians. The service network covering the entire country, including pediatric and neonatal intensive therapy clinics, special perinatology care, the development of child cardiac surgery, laboratories for the prenatal detection of birth defects, among other developments, constitutes a strong base for the provision of high quality care and advanced technology. All of these efforts, together with promotion, prevention, curative and rehabilitation activities provided by family physicians and nurses should ensure the ongoing improvement of the health indicators for this priority population group.

At the end of the 1980s, Cuba implemented an approach that focused on health activities in the field. The Family Physician Plan was based on the work of health workers committed to family health care in city neighborhoods, in rural communities or in areas with dispersed populations. Equipped and located in physician's offices that cover defined territorial areas, these medical personnel deal with the health problems of people and families, investigate the epidemiological profile of the community in which they works and live, carry out health promotion activities, and work to inculcate healthy habits in the population. Within the broader framework of health, the family physician's office (including the nurse) is the basic cell of activity of the polyclinics in urban areas, and of the hospitals in rural areas, where attempts are being made to link the capacities of the secondary and tertiary care levels. At present, more than 22,000 physicians are working in this plan, with coverage provided to 90.1% of the population of the country.

The effective implementation of these programs, in addition to the other positive transformations that have taken place in Cuban society, including the active and organized participation of the community, have led to the changes in the health situation of the population. Noncommunicable diseases and accidents currently constitute the leading causes of death in our country, and their reduction has become the highest priority strategic objective in order to achieve new transformations in the health situation that correspond to the level of development of our public health system.

Table 1.16
Leading causes of death in all ages
1963-1965, 1970, 1980, 1990 and 1993

Causes	Number of deaths				
	1963-1965	1970	1980	1990	1993[a]
Heart disease	9435	12704	16303	21241	21787
Malignant neoplasms	7444	8460	10427	13620	14050
Cerebrovascular diseases	4477	5155	5407	7015	7457
Accidents	2708	3089	3716	5197	5675
Influenza and pneumonia	2532	3602	3777	3213	4447
Diseases of the arteries, arterioles and capillaries	1710	b	2284	b	3319
Suicide and self inflicted injuries	842	1011	2083	2143	2349
Diabetes mellitus	840	847	1081	2271	2269
Bronchitis, emphysema and asthma	753	1070	689	1071	1167
Cirrhosis and other chronic diseases of the liver	733	576	568	881	1042
Certain perinatal diseases	5054	3562	1289	819	b

[a] Provisional
[b] Not among the leading causes of death.

Source: National Bureau of Statistics, MINSAP

Table 1.17
Number of deaths per 100,000 inhabitants

Causes	1963-1965	1970	1980	1990	1993[a]
Heart disease	123,4	148,6	166,7	200,3	199,6
Malignant neoplasms	97,4	98,9	106,6	128,5	128,5
Cerebrovascular diseases	58,8	60,3	55,3	66,2	68,3
Accidents	26,8	36,1	38,0	49,0	51,9
Influenza and pneumonia	28,9	42,1	38,6	30,3	40,7
Diseases of the arteries, arterioles and capillaries	22,4	b	23,5	b	30,4
Suicide and self-inflicted injuries	11,0	11,8	21,4	20,2	21,5
Diabetes mellitus	12,3	9,9	11,1	21,4	20,8
Bronchitis, emphysema and asthma	9,8	12,5	7,0	10,1	10,7
Cirrhosis and other chronic diseases of the liver	9,6	6,7	5,8	8,4	9,5
Certain perinatal diseases	66,1	41,7	13,2	7,7	b

[a] Provisional
[b] Not among the leading causes of death.

Source: National Bureau of Statistics, MINSAP

Grouping the activities designed to combat these causes of death is perfectly possible, since they have common precursor and conditioning factors that can be

modified if one addresses the following intervention levels or planes:

1) Changes in lifestyle (promotion)

2) Control of the environment and the elimination of risk factors (prevention)

3) Preservation of life through the timely diagnosis and treatment of disease, in order to prevent complications and maintain the chronic patient in a state of recovery

4) Treat limitations and sequelae in order to eliminate or reduce them to the minimum possible level, and incorporate the patient into the fulfillment of his social, work and emotional life (rehabilitation)

Each of these four levels of action envisages a complex system of activities that the public health sector, other state sectors and the society as a whole should carry out, which will bring as a result an increase in the prospects and quality of life of the population.

The significant transformations that have occurred in the health status of the population and the extraordinary achievements entailed in the reduction of indicators, reveal the important ground that has been covered and the advanced position of the country at the international level as a result of its development in this sphere. What is now required is a redefinition of the objectives in order to consolidate what has been achieved and to continue the development toward greater objectives in the improvement of the health of the population. For this purpose, efforts, priorities and activities should be reordered to concentrate on the vast scientific, technological and human potential of the health system with respect to the principal strategic directions that should be properly identified.

Chief among the progress that has been achieved is the increase in life expectancy at birth and the increase in live births in health institutions, as well as the reduction in infant mortality to a rate of 9.4 per 1,000 live births in 1993, the lowest in Latin America and comparable to that of many developed countries.

Table 1.18
Life expectancy at birth by sex, 1955-1995

Period	Men	Women	Both Sexes
1955-1960	59.8	63.8	61.8
1961-1965	63.3	67.0	65.1
1966-1970	66.8	70.3	68.5
1971-1975	69.3	72.6	70.9
1976-1980	71.1	74.4	72.8
1981 1985	71.4	75.2	73.6
1986-1990	73.5	77.1	75.2
1991-1995*	73.9	77.6	75.7

* Estimate for the five year period

Source: State Committee of Statistics, MINSAP. 1986 and 1990 Annual Report.

Table 1.19
Selected indicators on the birth rate, 1963-1993

Years	Total live births	Birth rate per 1,000 inhabitants	Live births in health institutions	
			Number	%
1963	260244	35.1	164396	63.2
1965	267611	34.3	194172	72.6
1970	237019	27.7	216926	91.5
1975	192941	20.8	190356	98.7
1980	136900	14.1	134830	98.5
1985	182067	18.1	179907	98.8
1990	186668	17.6	186254	99.8
1991	173896	16.3	173455	99.8
1992	157349	14.5	157051	99.8
1993*	152233	13.9	151885	99.8

* Provisional

Source: National Bureau of Statistics, MINSAP

Table 1.20
Infant mortality by province
1975, 1980, 1985, 1990 and 1993
(Rate per 1,000 live births)

Province	1975	1980	1985	1990	1993*
Pinar del Río	31.5	20.7	14.9	8.3	9.2
La Habana	25.1	16.0	15.2	9.8	10.1
Ciudad Habana	24.1	17.2	14.0	10.0	9.0
Matanzas	23.0	14.4	14.5	12.0	11.3
Villa Clara	18.8	18.0	15.3	7.6	0.6
Cienfuegos	25.2	18.3	17.0	9.9	7.3
Sancti Spíritus	20.3	19.0	18.6	7.7	8.2
Ciego de Avila	35.1	20.8	15.4	11.6	10.7
Camagüey	31.2	21.9	15.7	11.4	10.2
Las Tunas	34.5	22.5	21.9	12.9	0.6
Holguín	31.2	19.8	16.9	12.0	7.6
Granma	26.9	22.4	19.0	13.6	11.3
Santiago de Cuba	28.9	19.9	16.4	11.4	9.4
Guantánamo	29.8	24.2	18.9	10.8	11.6
Isla de la Juventud	31.6	18.9	23.7	10.4	10.8
Total	27.5	19.6	16.5	10.7	9.4

* Provisional
Source: National Bureau of Statistics, MINSAP.

Table 1.21
Selected indicators of mortality
in children under 5, 1969-1993
(Rate per 1,000 live births)

Years	Mortality in infants under 1 year*	Mortality in children under 5 years (TMM5)*	% children surviving to 5 years
1969	46.7	53.6	94.6
1975	27.5	32.8	96.7
1980	19.6	24.3	97.6
1985	16.5	19.7	98.0
1990	10.7	13.2	98.7
1991	10.7	13.4	98.7
1992	10.2	13.1	98.7
1993*	9.4	12.2	98.8

* Provisional
Source: National Bureau of Statistics, MINSAP

To this point cholera cases have not been reported in Cuba; however, the country is not exempt from the risk of introduction of this disease which, if it should occur, would create a complex situation both from the health and economic point of view.

In 1992, the Ministry of Public Health drafted the principal lines of action to achieve the goals, objectives and directives to improve the health of the Cuban population through the year 2000. The general directives are designed to strengthen and enhance the system as a whole; the specific directives encourage actions with a direct effect on the causes of disease and death that they have been designed to reduce, among which are those related to the water and sanitation sector. Among the principal goals to be attained are the following:

Table 1.22
Measures of health indicators

Goal	1990*	1993*	1995	2000
To reduce infant mortality (rate per 1,000 live births)	10.7	9.4	10.0	9.0
To reduce mortality in children under 5 years (per 1,000 live births) TMM5	13.2	12.2	12.0	11.0
To reduce preschool mortality (1-4)	7.0	5.9	6.4	6.0
To achieve a decline in the mortality rate from diarrheal diseases in:				
- children under 1 year	0.5	0.3	0.4	0.3
- children under 5	0.6	0.3	0.5	0.4
- 65 - 74 years	6.6	...	5.9	5.3
- cholera cases	...	...	..	...

* Levels that have been achieved.

Source: OPD and the National Action Program.

1.7 Economic characteristics

In the economic sphere, Cuba is confronting one of the most complex situations that it has faced in the last 30 years. The transformations that have taken place in the political and economic arenas in the countries that were its normal trading partners have had repercussions of any entirely different order on the availability of resources for production and consumption and for the generation of foreign exchange.

Between 1959 and 1989, the Cuban economy was able to maintain sustained growth: the per capita GDP grew an average of 3.1% on an annual basis (surpassing the average for Latin America as a whole, which was 1.8%); industrial production during this period grew around 4% annually on average, agriculture grew 2.9%, and labor productivity 2%. All of the following were thus possible: the development of the technical infrastructure of the country; the generation of electricity and transmission networks; the development of roads, railroads, ports, warehouses of all types, and technical transportation infrastructure; the mechanization of agriculture, construction, mining, work in ports and warehouses, the sugar cane harvest and other productive activities; the development of the merchant and fishing fleets, aviation and the airport network, the mechanical industry and the steel industry; the growth of the textile, electronics, the building materials industries; the increase in geological information on soils; the extraction of oil and nickel, the genetic bases of the livestock industry; the development of citrus production and other areas. All of this progress is a testament to the enormous efforts that have been made over more than 3 decades in establishing the foundations of a truly strong and comprehensive economy. Even more important have been the efforts to develop human capital, which are addressed in other chapters.

The abrupt disappearance of fundamental external, commercial and financial relationships and the hardening of the policy imposed by the North American government caused the practical disappearance of the foundations of the Cuban economic model. In addition to the limitations on obtaining fuel, raw materials, replacement parts and other supplies, markets and financing mechanisms, have been added very adverse climatic conditions, especially a pattern of precipitation and severe temperatures, which have had extremely unfavorable repercussions on agriculture in general. The energetic intensity of our production is in general high as a result of the technology to which we have had access and which trade relations with and fuel supply guarantees by the former USSR have made possible. To these limitations can be added the unfavorable price ratios between Cuban exports and oil imports.

These adverse factors have resulted in:

- High underutilization of capacities in the textile, manufacturing and mechanics industries, among others;

- A whole set of investments and programs were not able to be fully utilized, temporarily or definitively, because they were conceived on the basis of market characteristics that were different than current market factors;

- Transportation has been affected considerably, especially of passengers, causing great difficulties for the population and also affecting the necessary work discipline;

- The supply of durable consumer goods has been practically eliminated since 1991 and food and other consumer goods have all become subject to the rationing system, which before only existed for a group of basic products;

- The scarcity of fuel also affects the generation of electricity and does not permit the efficient utilization of agricultural machinery and irrigation, complicating the cultivation, transportation and preservation of products. In industry, the stability of processes has been affected, with all of the implications that this entails;

- The lack of financial resources and specific supplies has affected the maintenance and replacement of the basic means of the country, already evident as an important problem to be resolved in the medium term.

In comparison with 1989, the last year with more or less normal conditions, and in accordance with the assumptions of the current economic model, production was reduced considerably, especially production for domestic consumption. Imports declined nearly 70%, exports 50%, the gross investment of capital by something more than 60%, and consumption has been reduced approximately 30%. Social consumption has been prioritized, and it declined approximately 18%. Another significant element of economic policy began in 1959 with state intervention into consumer prices, guaranteeing the availability of basic products. Wages have increased at an average rate of approximately 1% in recent years. The exchange rate for the Cuban peso in relation to other currencies, which is set by the State, is currently being studied in order to adjust it to prices on the international market and in order to determine the real cost of our products in foreign exchange. The Cuban response to these tremendous difficulties has been to accept reality and do everything possible to preserve the basic victories of the revolution and bring a new dynamism to the economy on its own foundations.

Among the measures taken to confront the crisis are the following:

- To facilitate the implementation of economic adjustment with equity, which has guaranteed the income and jobs of the workers in the first phase, and a distribution of available consumer goods in the most egalitarian way possible;

- To maintain as far as possible the achievements in education, public health and other social programs;

- To facilitate the generation of financial resources through the creation of semipublic enterprises with foreign capital and all kinds of modalities, in various sectors of the economy;

- To accord priority status to economic programs that are capable of generating new sources of foreign exchange or replacing imports: tourism, biotechnological production and food production;

- To continue with traditional exports such as sugar, nickel, fishing, tobacco, citrus fruits and others;

- To implement strict planning for fuels, the application of conservation measures and the implementation of a program to develop national sources, with the participation of foreign companies in the exploration and application of new techniques to extract oil;

- To expand the population's potential for independent work, such as service alternatives and employment alternatives;

- To transform state agricultural, sugar cane and non-sugar cane companies into production cooperatives (UBPC), transferring the land in use. Nearly 2,600 cooperatives of this type have been formed in less than a year which, together with some 1,200 agricultural and livestock production cooperatives that previously had been established, should facilitate the organization of the most effective production under the existing conditions of scarce supply. In total, with the three modalities of cooperatives, including the credit and service cooperatives, the country currently has some 6,000 cooperatives and some 4 million hectares that comprise nearly 70% of the agricultural area of the country.

In the economic realm, the measures that have been applied have made it possible to reorient development toward lower capital and energy intensive activities in sectors such as tourism that are based on a high growth potential in their markets and natural resources or on high-technology production in the biomedical area, where the scientific infrastructure that has been created and the already well developed health system provide comparative advantages. In addition, in the sphere of economic planning there has been a modification of work methods, with the progressive adoption of systems for allocating resources in more decentralized ways, with greater commercial autonomy and more indirect planning methods.

Moreover, although the policy to guarantee employment and income to workers has been an important cohesive factor in confronting the necessary economic adjustment, this policy cannot be maintained indefinitely because its financing has been carried out through monetary issuance that already surpasses tolerable limits. In addition, the excess personnel levels distort costs, impede the rational organization of production and generate budget subsidies. Annual State expenditures have reached more than 14,000 million pesos in the 1990s. Given the stagnation of productive

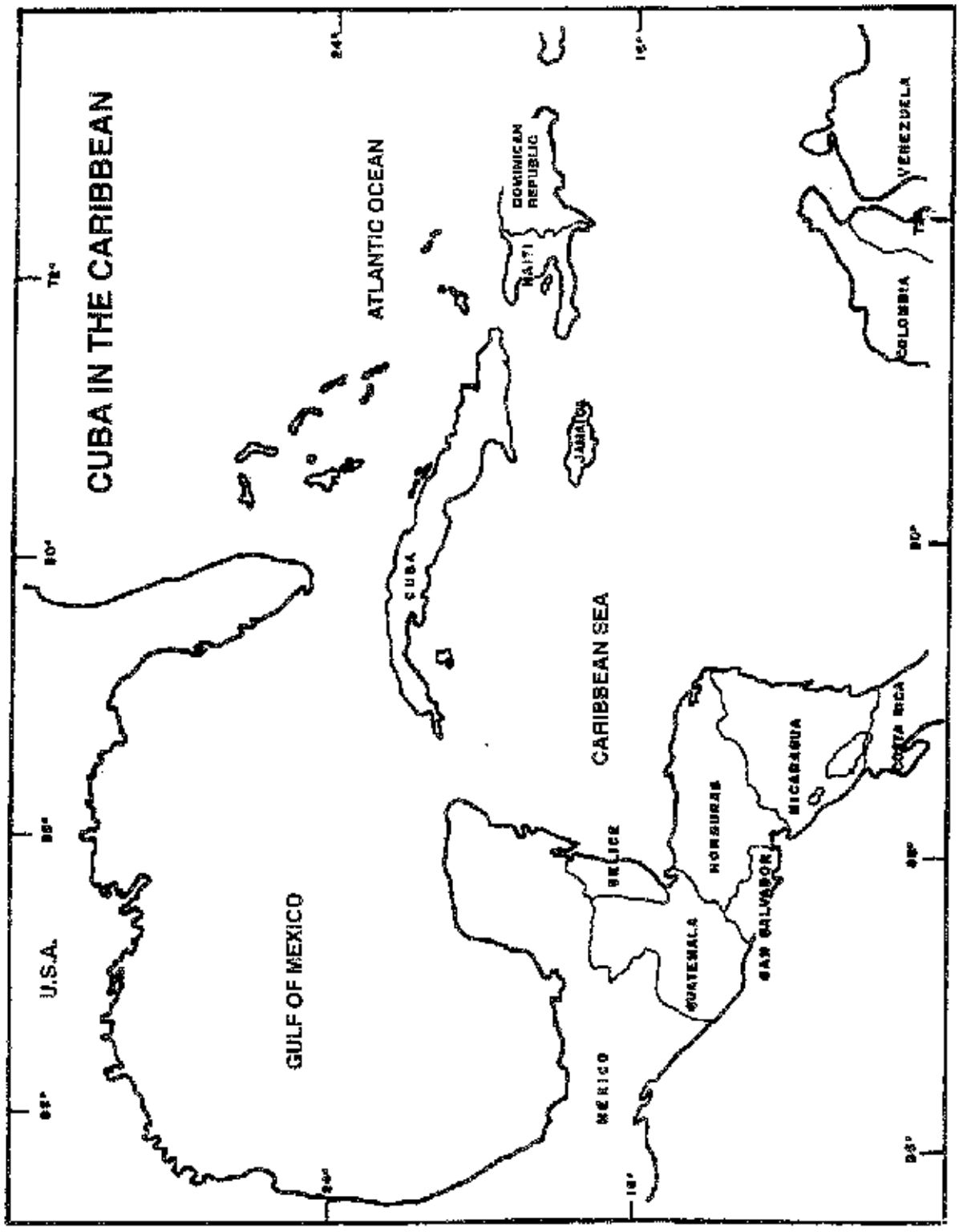
activity because of a lack of raw materials and supplies, there has been a considerable reduction in revenues, entailing a tripling of the budgetary deficit. The anticipated deficit for 1994 is 3,249.5 million pesos (Legal Decree No. 148 concerning the 1994 State Budget).

The foregoing means that the measures that have been implemented to date have to be supplemented and intensified. Among other measures, a decision has been made to proceed with a progressive cleanup of internal finances. To this end a series of measures has been announced, including a rise in the prices of cigarettes, tobacco, alcoholic beverages, gasoline, electricity, air, rail and inter-city bus transportation; the establishment of fees for water supply and sewerage system service; shifting the cost of workers' dining rooms; and other measures. Decisions were also made to confiscate the property of those who obtained it illegally from the State; reduce the budget deficit; progressively restructure productive capacities and employment; and effect the institutional reorganization of the central management entities of the State. Together with all of the above, work is proceeding on the implementation of new planning concepts and models for managing the economy which, while maintaining the essence of the socialist economic model, will make it possible to adjust the approaches that have been used to accord with the objective changes that are taking place in the country.

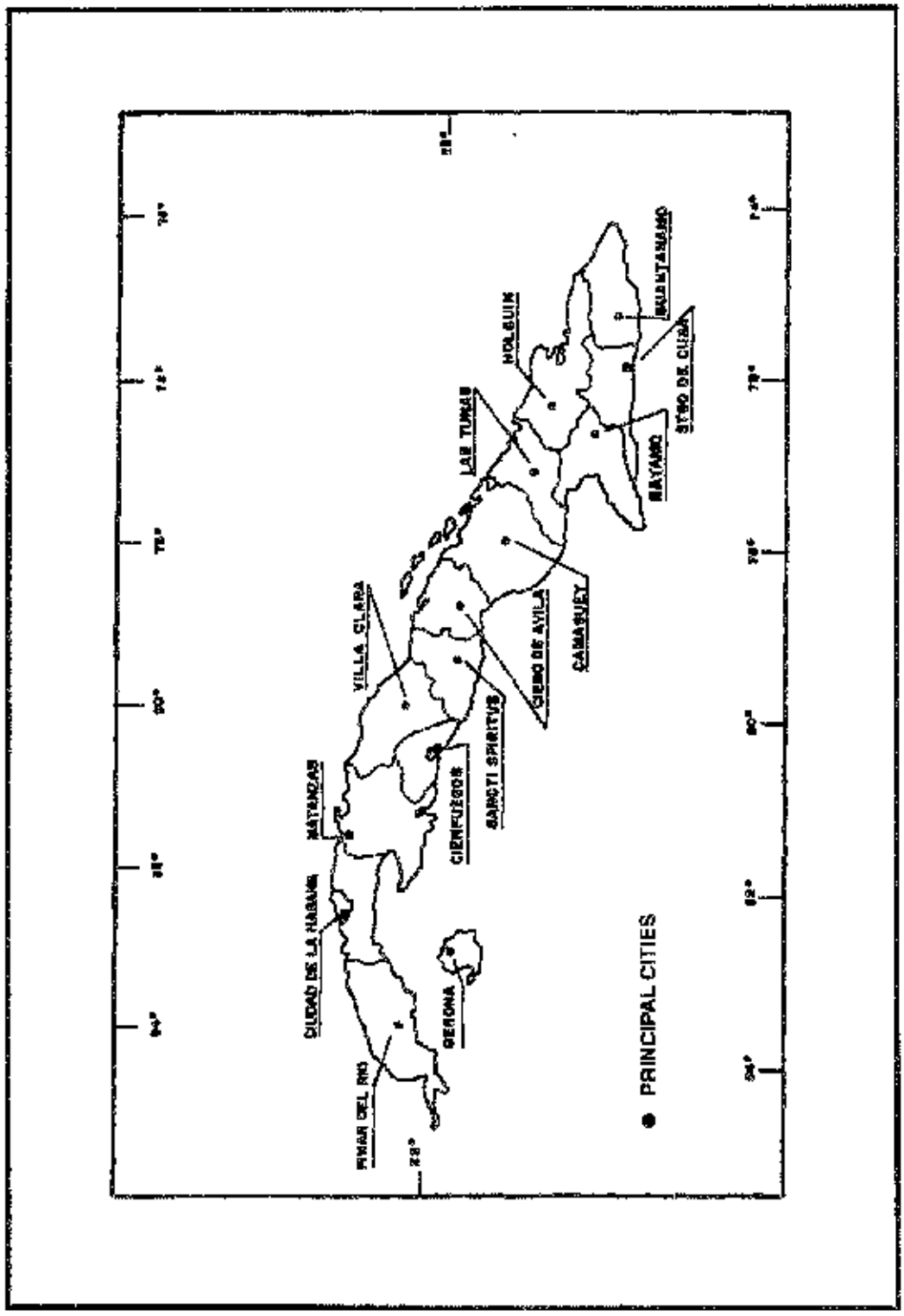
With respect to the activities in which the State has been associated with foreign companies, there has been a very significant revival of tourism, and also a very promising renewal of oil exploration and extraction. The exports of citrus fruits and biopharmaceutical products is growing, and there are good prospects for the export of steel, cement and nickel, among others.

This is the context for the development of the policies and actions addressing the water and sanitation sector that are fully described in other sections of this document.

Map 1.1 Cuba in the Caribbean



Map 1.2 **Cuba:** political-administrative division



2. MANAGEMENT AND PERFORMANCE CHARACTERISTICS

2.1 Evolution of the sector

The coverage of water and sanitation services showed sustained growth from the beginning of the 1960s: between 1960 and 1970, water service was increased by more than one million people. During that period and until 1975, a program to improve water potability was carried out, and in 1980, household water service reached 4.9 million people, double the population served in 1960.

During the decade from 1980 to 1990 there was an increase of 1.6 million people benefiting from water supply systems and an increase of 1.2 million people provided sewerage services. During this decade there was a:

- Doubling of household water service in the rural sector, which grew from 250,000 to 550,000 people served;

- Increase in the number of towns provided drinking water, which grew from 198 to 343 towns, mainly in rural settlements;

- Realization of important expansions in the water and sanitation systems in all the provincial capital cities;

- Increase in the number of settlements with sewerage services, which grew from 106 to 374 settlements.

During the three-year period from 1990 to 1993, household water service decreased from 83.0% to 81.1%, and sanitation service changed slightly from 39.1% to 40.4%. There are significant sectors of the population that depend on other le... appropriate forms of service that are mainly present in rural areas: the manual o. vehicular transport of water and the use of latrines.

Table 2.1
Evolution of the sector
(figures in thousands)

Year	Population					Population with service %			
	Total	Urban		Rural		Drinking water		Sanitation	
			%		%	Urban	Rural	Urban	Rural
1960	6.71	3.95	58.8	2.76	41.2	65.0[a]	...	29.0[a]	...
1970	8.57	5.18	60.5	3.38	39.5	71.0[a]	...	37.0[a]	...
1980	9.71	6.71	69.0	3.01	31.0	73.6[a]	67.8	85.9	62.2
1990	10.60	7.82	73.8	2.78	26.2	83.6	77.8	96.1	68.2
1993	10.92	8.27	75.7	2.65	24.3	94.2	83.0	96.6	72.2

[a] Only includes household connections.

Note: The information on the rural sector was incorporated into the Statistical System in 1980.

Sources: Population - Institute of Demographics and the Census, State Committee on Statistics.
Coverage - National Institute of Water Resources. National Action Program.

2.2 Aspects of health that are related to the sector

Sanitation barriers against communicable diseases, such as acute diarrhea, typhoid fever and others, were achieved rather effectively in the 1980s through the provision of adequate drinking water and sanitation services. At the end of this decade these services began to suffer a progressive deterioration in their operation as a result of the economic situation in the country. There was a drop in the water potability, interruptions in the operations of treatment installations and failures in the maintenance of sewerage and septic tanks. As a result, there have been changes in morbidity and mortality from communicable diseases over the last four years, with rising trends both in the number of cases and in their rates.

The number of medical consultations for ADD is high throughout the country, mainly in adults. On an annual basis, these diseases consume important resources that must be devoted to their care, and also affect the productive levels of the population.

Table 2.2
Incidence of water borne diseases
1989-1993

Disease	No. of cases				
	1989	1990	1991	1992	1993[a]
Typhoid fever	48	59	100	63	256
Bacillary dysentery	...	285	209	450	179
Amebic dysentery	...	356	475	929	1660
Dysenteries (subtotal)	...	641	684	1388	1839
Viral hepatitis A	2570	5834	19863	21180	12150
ADD[b]	888316	1062633	1179872	1095275	1115616

[a] Provisional
[b] ADD: Acute diarrheal disease (medical consultations)

Source: National Bureau of Statistics. MINSAP.

Table 2.3
Morbidities from water borne diseases
1990-1993
(figures per 100,000 inhabitants)

Disease	1990	1991	1992	1993[a]
Typhoid fever	0.5	0.9	0.5	2.0
Bacillary dysentery	3.0	2.0	1.0	1.6
Amebic dysentery	3.0	4.0	9.0	15.2
Dysenteries (sub-total)	6.0	6.0	10.0	16.8
Hepatitis A	50.0	190.0	190.0	110.0
ADD[b]	100.2	110.3	101.2	102.3

[a] Provisional
[b] Cases seen in consultations
[c] Rates per 100,000 inhabitants

Source: National Bureau of Statistics. MINSAP

2.3 Coverage and access to water and sanitation services

2.3.1 *Access to water service*

The following chart indicates the coverage levels for the access of the population to drinking water by type of service as of December 1993:

Table 2.4
Drinking water supply, 1993
(figures in millions of inhabitants)

Sector	Total population		Population with coverage of drinking water%						Without drinking water service
	inhabitants	%	Appropriate service				Deficient service	total with service	
			home connect.	public service	easy access	total			
Urban	8.27	75.7	51.1	10.1	3.0	64.2	30.0	94.2	5.8
Rural	2.65	24.3	27.2	23.1	22.7	73.0	10.0	83.0	17.0
Total	10.92	100.0	46.3	13.3	7.8	68.3	25.1	91.5	8.5

Source: National Institute of Water Resources

Of the population supplied, 25.1% receive deficient service caused by the condition of the installations, and 8.5% do not have adequate access to drinking water.

2.3.2 *Access to sanitation service*

Sewerage service coverage extends to 39% of the population. Some 37% of the population does not have sanitation services or their services are inadequate.

Table 2.5
Sanitation services, 1993
(figures in millions of inhabitants)

Sector	Total population		% of population with sanitation service					Populati on without service %
	inhabitants	%	Appropriate service			Inadequate solutions	Total with service	
			Sewerage	Tanks and latrines	Total			
Urban	8.27	75.7	35	31.6	66.6	30.0	96.6	3.4
Rural	2.66	24.3	52	46.8	52.0	20.0	72.0	28.0
Total	10.92	100.0	39	35.2	74.2	27.6	90.6	9.4

Source: National Institute of Water Resources

2.4 Availability of water

The water resources that are available in the country amount to 13.28 cubic hectometers per year, 66% of which are of surface origin and the remainder groundwater. In 1993, 5,328 Hm^3 (40%) of the available potential was used: 1,345 Hm^3 of water was used to supply the population, representing 10.1% and 25.2%, respectively, of the available and utilized water resources.

Table 2.6
Availability and use of water resources, 1993

Available water resources				Volume of water utilized (Hm^3/year)							
Total Hm^3/year	Surface (%)	Ground (%)	Total	Irrigation		Population		Industry		Other	
				V	%	V	%	V	%	V	%
13280,8	66	34	5327.9	3360.2	63	1344.9	25	470.5	9	143.2	3

Source: National Institute of Water Resources.

Table 2.7
Availability and use by consumer and type of source, 1993

Water resources	Groundwater						Surface water					
	Available	Utilized					Available	Utilized				
		Irrig.	Pop.	Indust.	Other	Total		Irrig.	Pop.	Indust.	Other	Total
Hm^3/year	4515.0	747.0	990.4	169.4	24.9	1933.7	8765.3	2823.2	354.6	302.1	118.3	3394.2
%	100.0	16.5	22.0	3.7	0.5	42.8	100.0	29.8	4.0	3.4	1.3	38.7

Source: Bureau of Water Utilization. National Institute of Water Resources.

2.5 Quality of service and quality of product.

2.5.1 *Continuity*

The mean times of water service, which had been raised in the decade from 1980 to 1990 from 12.3 to 15.1 hours per day, show a continuous decline. This is due to two causes: interruptions in pumping (90.9% of the supply is provided by pumping and the rest by gravity) as a result of the deterioration of equipment and energy failures; the other causal factor is the increase in water losses resulting from the reduction in network maintenance.

2.5.2 *Water treatment*

Some 92% of the volume of water provided by the water supply systems is from groundwater and only requires disinfection. Disinfection is effected in 935 chlorine gas and hypochlorite installations. Most of the surface water captured for supply is treated in 49 drinking water treatment plants, where it is subjected to complete treatment: flocculation, sedimentation, filtration and final disinfection.

The quality of the water supplied has seriously declined in recent years, mainly as a result of the reduction in chlorine and aluminum sulfate supplies.

Table 2.8
Relationship between water provided and treated water. National level, 1988-1993
(figures in millions of cubic meters)

Year	Water supplied	Treated water %	Chlorination Continuity (%)
1988	1242.6	92.4	93.0
1989	1294.5	88.5	89.6
1990	1264.0	85.2	82.2
1991	1374.7	82.5	75.4
1992	1350.0	78.6	71.4
1993	1376.2	69.5	51.0

Source: National Institute of Water Resources.

Table 2.9
Supply of chlorine gas and aluminum sulfate for water treatment, 1988-1993
(Annual supply in MT)

Product	1988	1989	1990	1991	1992	1993
Chlorine gas	3504	2663	1914	2245	2224	1688
Aluminum sulfate	4834	3742	3983	2770	1632	730

Source: National Institute of Water Resources.

In 1993, only 69.5% of the total volume of water supplied was treated, and the continuity of chlorination installation operations was 51%. These figures reflect a serious drop in the delivery of water of potable quality, caused by growing inadequacies in the supply of chemical products and the deterioration of installations.

2.5.3 *Treated wastewater*

The wastewater collected by the 384 existing sewerage systems is purified in five plants and 564 stabilization ponds. In 1993, of 502.4 million cubic meters collected in sewerage systems, 108.5 million cubic meters (21.6%) received treatment; the rest was channeled into the sea or into surface watercourses. The principal problem with the operation of the purification installations is linked to the reequipping of the treatment plants, on the one hand, and the restoration of monitoring of the operation and maintenance of these installations and the five hundred constructed lagoons on the other. Table 2.10 indicates the evolution of the percentages of wastewater treated in recent years.

Table 2.10
Discharged and treated wastewater
Trends at the national level for the years 1988, 1992, 1993

Year	Discharged water		Treated water	
	M³/year	%	M³/year	%
1988	485978.6	100	98005.0	20.1
1992	487697.3	100	114561.1	23.5
1993	502451.4	100	108524.0	21.6

Source: National Institute of Water Resources.

2.6 Data on administrative and financial management

- No macromeasurement and micromeasurement policies have been defined at the national level; only a few cities have minimum coverages of users with measurement records;

- Detailed studies on water that is not accounted for have not been carried out; in the existing distribution systems it is estimated that this percentage ranges between 30% and 40%;

- There is no well structured jurisdictional policy; beginning with the month of October of this year, a process of jurisdictional collections will be initiated at the national level;

- The current expenses of the water supply and sewerage systems, including the cost of tank truck and septic tank cleaning services, were some $79.6 million in 1993;

- In 1994, revenues at a level of $40.3 million should be produced with the incorporation of the fixed rate in the last quarter of the year. Beginning next year, these revenues will reach $130 million, which means that, after expenses and depreciation, profit margins of between 30 and 40 million annually will be able to be generated;

- The current number of workers employed in the management, operation and maintenance of the water supply and sewerage systems is 17,200 people; of these, 456 have university degrees.

- The ratio between the number of workers in the sector and the number of users with drinking water and sewerage service in the years 1988 and 1993 is reflected in the following table:

Table 2.11
Water and sanitation services: user/ employee ratio

Year	Population with drinking water service		Population with sewerage service		Total users*	No. Employed	Users/ employees
	Population (x 1,000)	No. users (x 1,000)	Population (x 1,000)	No. users (x 1,000)	(x 1,000)		
1988	9690.2	1486.7	2872.3	638.3	2125.0	14546	140
1993	7665.3	1797.8	3393.8	755.3	2463.1	17224	143

* Does not include the users of public services, nor the users of tank cleaning services.

Source: National Institute of Water Resources.

3. INSTITUTIONAL ANALYSIS

3.1 Structure and institutional relationships

3.1.1 *Agencies of the sector*

The country has an institutional structure that enables it to implement the activities needed to operate the drinking water and sanitation sector, and to generate the dynamics necessary for its growth and development. The complex system of relationships that has been established is the result of the improvement of the Cuban State that began in 1976, although there were important developments in this sector in previous years.

The State assumes full responsibility for the sector, as well as for all matters related to the preservation of health and the protection of the environment, elements that are closely related to the sector. The agencies responsible for managing the sector are the National Institute of Water Resources and the Ministry of Public Health.

National Institute of Water Resources. The 1989 Legal Decree 114 establishes the functions of the National Institute of Water Resources, including in them the leadership of the water and sanitation sector, which amounts to standardizing and controlling the sector's activities. In this regard, the institution acts through the National Water and Sewerage Systems Bureau, which is a specialized agency dedicated to the oversight of the water and sanitation sector.

The principal functions assigned to this Bureau are:

- To propose development policy for water supply and sewerage system activities, coordinating and controlling the execution of approved plans;

- To control the placement and development of water supply and sewerage systems in order to provide for appropriate decision-making, as well as to generate information and evaluations for consideration and decision at the Government level;

- To systematically attend to the materials required for the sector to function, balancing imported resources with domestically produced resources that are centrally allocated for this purpose;

- To provide technical advisory services to fulfill the standards established for the activity and coordinate all matters concerning the development policy of the sector.

The water supply and sewerage system bureaus at the provincial and municipal levels are subordinated administratively to the administrative councils of provincial and municipal governments and, in the methodological area, to the national agencies.

Ministry of Public Health. This Ministry is legally responsible for setting the requirements for the physical, chemical and bacteriological quality of drinking water, as well for the control and monitoring of compliance with these requirements and for the quality of liquid wastes. The Hygiene, Epidemiology and Microbiology Area of the Ministry directs the country's health policy through two national administrative agencies, the National Bureau of Epidemiology, National Environmental Health Bureau, and the Health Trends and Analysis Unit. The Hygiene, Epidemiology and Microbiology Area works directly with sanitation activities and has four research institutes.

The principal functions of the Hygiene, Epidemiology and Microbiology Area are:

To perform state sanitary inspections (SSIs) at the various levels of the subsystem. The objective of the inspection is to enforce and control compliance with sanitary provisions and provisions aimed at fighting epidemics that are designed to prevent and eliminate environmental pollution, clean up work and educational conditions of the population, and control the organization and application of sanitary standards that are intended to prevent and reduce disease and other health problems;

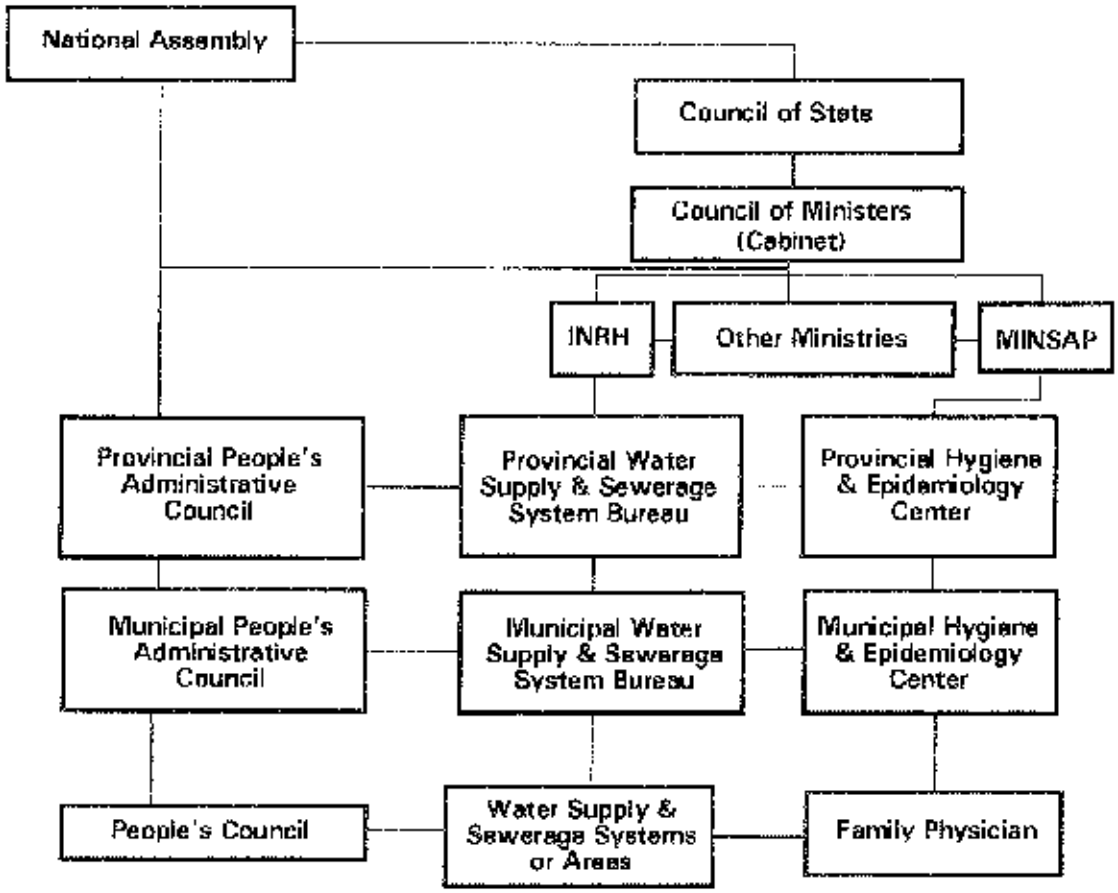
- To impart education in mid-level technical schools and medical schools, train specialists and master's students in environmental and occupational health;

- To undertake studies and research related to environmental and sanitation cleanup;

- To coordinate with the staff members responsible for the protection of the environment at the various levels, cleanup, the water supply, the disposal of liquid waste, the collection of solid waste, street cleaning, physical planning, tourism and other activities.

There are 14 provincial hygiene and epidemiology centers in the country, a special municipal center on Isla de la Juventud and 168 municipal centers or units with coverage of health and entomology laboratories for the entire national territory. The Family Physician Plan that was created at the end of the 1980s consists of establishing properly equipped physician's offices in specific areas of city neighborhoods, rural communities and dispersed population areas. These offices constitute the basic cells for the control of hygienic, epidemiological and environmental conditions.

Figure 5
General organizational chart for the operation of the water and sanitation sector



3.1.2 *Extrasectoral agencies*

The extrasectoral agencies that affect the real operational dynamics of the sector at the various jurisdictional levels contribute the necessary elements related to economic, social and environmental matters through economic planning, physical planning, financial mechanisms, materials production activities, constructive elements and equipment, project activity and applied research projects, construction activity, the supply of technical material, standardization and quality control, environmental management, scientific research, professional and technical training and the prevention of natural disasters. The interrelationships that have developed among the above elements and the sectoral agencies are regulated by procedures that are

officially established through a variety of legal provisions that specify the powers and functions of each institution. These interrelationships are developed not only at the national level, but they receive concrete expression at the jurisdictional levels (provinces and municipalities).

a) *Economic planning*. The Ministry of Economy and Planning provides leadership in economic planning, which is based on a model of centralized relationships concerning material and financial balances. This Ministry is responsible for directing and applying State and Government policy to the planning function, and among its principal roles and powers is to propose fundamental directives for the development of the national economy, evaluate and approve investments and prepare their material balances. In addition, the Ministry collaborates with the agencies in the development of the proposed State budget. Due to the current economic situation, financial planning and the balance of resources have undergone a certain decentralization for specific prioritized activities such as tourism, biotechnology, etc.

This Ministry evaluates and approves the proposed investments in the sector that are generated by the jurisdictional governments and endorsed by the National Institute of Water Resources. The proposals are generated pursuant to Decree N°5, Regulation of the Investment Process, which regulates the relationships between the entities that participate in the process. In order to support these relationships, there are regulated relationships between the National Bank of Cuba, the Ministry of Finance and Valuation and the Ministry of Economy and Planning.

b) *Physical planning*. Physical planning, an activity undertaken by the Institute of Physical Planning and its national network, makes it possible to establish spatial frameworks and temporary horizons for the proposal of solutions to drinking water supply and sanitation problems through some of its basic instruments: master plans for human and municipal settlements and the process of locating investments at the micro level. The master plans, conceived as basic ingredients of the jurisdictional management process, are supported on four fundamental axes: the long-term prognosis, ongoing planning, the comprehensive nature of the solutions, and institutional and citizen participation.

It is in this context that the interests of the sector are included and the outlines of the new networks and the location of installations are conditioned. In addition, priorities are established in order to respond to the new investments and to enhance the current systems. The process of locating investments at the micro level is implemented by consulting with all institutions that are related to the investment in question. This process allows the various elements of the

sector to express their approval or call attention to the ways in which their interests may be affected and, if it is their own investment, to be governed by the regulations that are established for this purpose.

c) *Financial mechanisms.* The financial mechanisms are implemented by the Ministry of Finance and Prices the regulatory agency for this activity. Through this agency, the guiding figures are established in a centralized manner in order to satisfy the current financial needs that are anticipated for a group of activities, including sector activities. The activities are disaggregated by the administrative councils of the territories into various specific activities. In the preparation of these figures, local agencies intervene by contributing the necessary elements. In addition, a monitoring table has been established that makes it possible to maintain control of the destination of financial resources that have been allocated and to develop new needs. Moreover, in the development of methodologies related to financial aspects, rates, etc., representatives of this Ministry and the National Institute of Water Resources participated in a coordinated manner.

d) *The production of materials, construction elements and equipment.* The activity of producing materials, construction elements and equipment is basically carried out by the Construction Materials Industry Ministry, the Basic Industry Ministry (production of chemical products) and the Sidero-Mechanical Industry Ministry. The objective of the current pattern of relationships is to produce the necessary physical elements required by the sector and to this end the necessary equilibria are maintained between these institutions and the Ministry of Planning and Economy. In addition, for the production of elements that contain scarce components, the investment agency of the sector allocates its own resources or the resources of another institution that is a direct beneficiary of the investment, in order to obtain the necessary assurances to produce these elements. At present, the production of materials is constrained by the lack of imported raw materials, which are inaccessible because of a lack of financing. Annex B.1 details the building materials industries that are related to the sector and their annual production capacities.

e) *Project activity and applied research.* In all stages of this activity, various state agencies and companies play a role, among which are included the comprehensive project companies of the Ministry of Construction, the companies attached to the National Institute of Water Resources and the companies and entities linked to provincial government bodies. Usually, project activity and applied research are regulated in accordance with the provisions of the Regulation concerning the Investment Process and should contribute studies, plans, reports and other technical and financial documents, in order to ensure the efficiency and timely implementation of the investment and its

placement into operation. In the development of the projects and applied research, there are mechanisms to obtain the necessary information from the various entities that have it, either from those concerned with the management of the jurisdiction, or from agencies concerned with the supply of materials, equipment and other items. Project activity and applied research have the required regulatory framework, which has been developed with the participation of the various institutions on the basis of national experience and necessary information from the international realm.

f) *Construction Activity.* The construction projects related to the sector are carried out through the Ministry of Construction, which has 31 brigades for the construction of water supply systems, sewerage systems, treatment plants and drinking water plants. In addition, there are contractor companies in the jurisdictions that are subordinated to local governments. The Regulation concerning the Investment Process clearly defines the Ministry's roles and powers concerning construction activity, from the first moment of conception of the projects up through their completion; this Regulation ensures the necessary interrelationships between the builder and the investor, the project developer and the supplier.

g) *Supply of technical material.* The supply of technical material for water supply and sewerage systems is carried out through the National Institute of Water Resources, the regulatory agency, and through other agencies of the national economy. The Institute prepares plans for importing equipment, spare parts and specialized parts for these systems and in turn controls their implementation. One of the agency's entities is the Compañía CubaHidráulica, a trading company whose fundamental function is to import and distribute specialized resources for this hydraulic activity. In addition, other importing and distribution companies participate in the supply of materials to the sector.

h) *Standardization and quality control.* The National Office of Standards, which is under the Ministry of Planning and Economy, assists the various agencies in the development of their standardization plans, including the preparation of documents and measures for implementing their contents, training and the necessary research. Annex B.2 provides a detailed account of state standards and the branches in the country with respect to the various areas and activities of sector.

i) *Environmental management and scientific research.* Overall leadership in the areas of environmental policy and scientific research is the responsibility of the Ministry of Science, Technology and Environment. Environmental management, understood as State and social action in general that promotes the sustainable use of natural resources and the protection of the environment, is included in

an integral way in the activity of the sector. Such environmental management includes planned activities for the conservation or transformation of resources; systematic struggle against the causes and conditions that contaminate or damage these resources; the application of pertinent preventive measures; and rehabilitation when necessary. Environmental protection measures must be included in every investment project that is implemented, as well as in all land management activities. In addition, fully valid requirements are established for the agencies of the sector to incorporate scientific advances and techniques in the solution of problems related to this sphere, and to establish adequate monitoring systems in order to ensure compliance with pertinent standards and measures.

Given the transectoral character of environmental management, the latter is designed in a systemic way by integrating various subsystems into those pertaining to specific areas of protection. In this particular case, the Terrestrial Waters Protection Subsystem, a responsibility of the National Institute of Water Resources, is particularly important, encompassing both the protection and rational use of surface and ground waters, and the application of protective measures to their watersheds. There is also the Human Settlements Protection Subsystem, the responsibility of the Ministry of Public Health, which encompasses the protection and cleanup of the rural and urban environment.

Scientific research is organized into scientific and technical programs in a broad network that encompasses practically all of the agencies of the country, through Science and Technical Units and other modalities that bring together researchers and resources to work on topics of interest for the development of the national economy. In Cuba there are 7 basic research centers that are linked to the sector, whose activities are detailed in Annex B.3.

j) *Professional and technical training.* There are close relationships between the Ministry of Higher Education, the Ministry of Education and the Ministry of Public Health, which are responsible for the education of professionals and technicians. The objectives of the relationships are the projection and analysis of annual training plans for specialized intermediate and higher education; the preparation of professional profiles and curricula for specialized intermediate and higher education; the placement of graduates from upper and mid[illegible] technical schools, an activity that is led by the Ministry of Economy [illegible] Planning and the Ministry of Labor and Social Security; and graduate-le[illegible] education and technical training.

k) *Prevention of natural disasters.* The Civil Defense is a system of resources which, under the leadership of the Armed Forces Ministry, involves all of the agencies of central state management, local governments and other institutions

and nongovernmental organizations that are dedicated to preventing the potential effects of natural disasters or extreme situations by acting in an organized manner when such emergencies occur. These structures, through their various levels, develop general and specific plans that are controlled and tested in theoretical and practical ways according to an established schedule.

The Civil Defense chiefs of the various agencies are the presidents of the defense councils, and are in charge of implementing the disaster relief plans to respond to any situations that may arise. For example, there is a hurricane and excessive rain plan that guides the health protection of the evacuated population with respect to drinking water and the disposal of liquid and solid waste. In addition, work is proceeding on a plan to restore damaged sector installations that are located in vulnerable areas.

3.2 Planning and information

3.2.1 *Planning*

Sectoral planning is performed on the basis of municipal and provincial demands that are expressed through their administrative councils in coordination with the provincial water supply and sewerage system bureaus. Once endorsed by the jurisdictional and national agencies, these proposed plans (investments and current expenditures) are presented to the Ministry of Economy and Planning for its analysis and incorporation into the Economic Plan. Once this plan is approved by the National Assembly, the budget is channeled through the Ministry of Finance and Prices through the provincial and municipal administrative councils, which are responsible for their execution through their agencies, in this case the provincial and municipal water supply and sewerage system bureaus.

3.2.2 *Information*

The current information system does not fulfill all the requirements of the various external users and of users within the sector itself. There is a systematic information system that generates data from the provincial water supply and sewerage system bureaus that collects the principal management indicators on an annual basis. This system is inadequate, because of both the number of indicators and their frequency. With respect to the information issued to the sector by the agencies of the Ministry of Public Health through established systems, there have been some inadequacies that are currently being improved on. In general there are limitations with regard to computer processing capability.

3.3 Human resources

3.3.1 *Human resources who participate in the sector*

The work force employed by the provincial water supply and sewerage system bureaus, assisted by the administrative councils, which perform management, operations and system maintenance activities, reached a level of 17,200 workers at the end of 1993. This figure exceeds the number of employees in 1985 by 33%. The following table provides the staffing structure with respect to the number and percentages of professionals, technicians, administrative staff and workers.

Table 3.1
Personnel working in the management, operation and maintenance of the water supply and sanitation systems by occupational category

Provinces	Total	Directors	Admin.	Prof.	Tech.	Labor	Svcs.
Pinar del Río	1284	26	62	9	30	1142	25
La Habana	1279	35	41	13	33	1125	32
Ciudad de la Habana	5381	371	573	261	257	3067	852
Matanzas	779	25	45	37	9	626	37
Villa Clara	787	38	28	26	67	590	38
Cienfuegos	599	23	27	10	32	457	50
Sancti Spíritus	422	18	18	15	28	297	45
Ciego de Avila	262	12	11	11	15	203	10
Camagüey	1077	26	46	16	41	896	52
Las Tunas	204	12	13	4	7	157	11
Holguín	830	40	43	7	40	631	69
Granma	1515	41	55	55	38	1224	92
Santiago de Cuba	1763	47	94	44	70	1359	148
Guantánamo	815	30	41	23	18	648	54
Isla de la Juventud	217	2	8	...	2	200	5
National Total	*17224*	*746*	*1105*	*531*	*689*	*12622*	*1531*
Structure (%)	*100*	*4*	*6*	*3*	*4*	*74*	*9*

Source: Statistical Bulletin. INRH 1993.

In addition, in the health sector 17,600 workers are employed in the Hygiene and Epidemiology Network, of which 31.5% are professional and technical. Of these employees, 10,100 work in ongoing vector control activities.

receiving appropriate training courses for 18 months, these workers become hygiene and epidemiology technicians. In the engineering field, the Instituto Superior Polytécnico José Antonio Echeverria (ISPJAE) in Havana this year began to offer a graduate program in Sanitary Engineering in the School of Chemical Engineering, and a graduate program in Hydraulic Engineering in the School of Civil Engineering, which will take two years.

Each year through the Ministry of Foreign Investment and Economic Collaboration specialization programs (at the masters level) are offered in Sanitary Engineering, Water Management and Quality and other programs of interest in which no more than 10 engineers from the sector participate, given that they are offered by Dutch institutes of higher learning. Professional improvement programs are organized in the provinces with the most specialized personnel with a view to disseminating the new technologies. The INRH organizes between 2 and 3 courses of this type per year. Many professionals participate every year in these forms of graduate-level education, although these programs are insufficient for the sector and especially for professionals who work directly in operations and maintenance and in sanitary engineering activities.

With regard to the preparation of technicians and qualified workers, there are 18 training schools in the Ministry of Construction that offer short training courses for masons, carpenters, plumbers, mechanics and crane operators in all of the provinces, with the exception of Pinar del Río, Havana and Matanzas. These schools are fed by those who have been demobilized from military service or whose work is connected with them. The provincial and municipal administrations organize training courses that they can conduct themselves with their own resources on their job sites.

Table 3.4
Number of higher education centers offering specializations in the sector

Provinces	Total	Ministry of Higher Education	Ministry of Public Health
Pinar del Río	2	1	...
La Habana	1	...	-
Ciudad de la Habana	3	2	1
Matanzas	2	1	...
Villa Clara	3	2	1
Cienfuegos	2	1	...
Sancti Spíritus	2	1	...
Ciego de Avila	2	1	...
Camagüey	2	1	...
Las Tunas	2	1	...
Holguín	3	2	1
Granma	2	1	...
Santiago de Cuba	3	2	1
Guantánamo	3	2	1
Isla de la Juventud	1	...	...
Total	*33*	*19*	*13*

Source: Ministry of Higher Education and Ministry of Public Health.

Table 3.5
Number of technical and professional teaching centers where specialties related to the sector are studied

Provinces	Total	Ministry of Education	Ministry of Public Health
Pinar del Río	8	4	...
La Habana	7	4	3
Ciudad de la Habana	30	18	12
Matanzas	9	5	4
Villa Clara	7	5	2
Cienfuegos	7	6	1
Sancti Spíritus	4	1	3
Ciego de Avila	7	5	2
Camagüey	12	8	4
Las Tunas	5	3	2
Holguín	17	10	7
Granma	7	5	2
Santiago de Cuba	13	10	3
Guantánamo	5	3	2
Isla de la Juventud	1	...	1
Total	*139*	*87*	*52*

Source: Ministry of Education and Ministry of Public Health

3.3.3 *General considerations*

Professional training. In all of the higher education centers in the country, graduate courses are organized in various subjects, but they do not cover all of the elements that are specifically of interest to the sector. At present, graduate-level academic training is required in order to fulfill the requirements for a sanitary engineer who is not trained in the country. It is necessary to work on this issue at the national level and to seek methods of international cooperation. In order to generate such cooperation the PAHO centers of excellence should be considered, which offer specialization courses to personnel who work in sanitary engineering. These centers include the Pan American Center for Sanitary Engineering of Lima, Peru (CEPIS), the Center for Human Ecology and Health (ECO), and other specialization centers such as the Mexican Institute of Environmental Technology (IMTA) and the Center for Environmental Sanitation Technology (CETESB) in Sao Paulo Brazil. In addition to other information resources, the Pan American Network for Information and Documentation in Sanitary Engineering and the Environmental Sciences are used. However, there are currently significant financial limitations that are ongoing barriers to the timely arrival of information to interested personnel, limiting self study, which constitutes one of the most important forms of professional improvement.

Of the elements that have been analyzed, the planning of a comprehensive and complete professional improvement and training program that corresponds with the introduction of new installation operations and maintenance technologies, projects and other aspects of sanitary engineering would be very useful, in order to achieve the ongoing and systematic improvement of staff resources. Within the development programs, it is considered fundamental to offer basic courses, seminars, graduate courses, technical training, bibliographic updates, technical journals and other methodologies directed to sector workers. Management staff require special emphasis in their technical preparation and in administrative sciences in order to raise the efficiency and quality of their management with a view to optimizing sector output. Weaknesses are can be seen in the managerial area given that many directors need to update their skills in modern leadership and management techniques. In the managerial area, courses are required that address topics in finance, accounting, critical case analysis, commercial organization and other areas. There are schools in the region with broad experience in management courses, such as the Instituto Centroamericano de Administración de Empresas (INCAE). Coordination and financing are required in order to achieve the participation in these activities of technicians from all over the country.

Other considerations

- There are some 1,518 workers in managerial positions in the water and sanitation sector. For the most part they are university graduates with an average tenure in the position of five years or more.

- The managers connected to the Hygiene and Epidemiology Network are physicians, usually have more than four years in their positions and their average age is 40 years.

- With respect to staff turnover and wage incentives, the Ministry of Labor and Social Security, at the request of the sector's regulatory agency, has recently approved the incorporation of higher paying jobs in order to improve the relationship between the wages of technicians and management personnel and the corresponding wages of other sectors. However, working conditions and professional incentives, which are inadequate, still need to be improved.

- The laborer workforce is not stable because of the nature of the work itself and because these individuals try to improve their position, given that they do not have sufficient incentives in comparison with other sectors.

- The country is considered to have sufficient professionals and technicians in all the specialties in order to address the basic needs of the sector, as well as to provide advisory services to other countries in design and construction.

3.4 Legal aspects

3.4.1 *Supreme organs of the people's power and the legal decrees they issue*

In the judicial sphere at the national level the Law has maximum regulatory authority, and it is through the Law that the State expresses its will. The power to approve, modify or repeal laws and submit them to the prior consideration of the people when it considers this proper, is the purview of the National People's Assembly, the only organ with constitutive and legislative power in the Republic. It is also the prerogative of the National Assembly to decide on the constitutionality of laws, legal decrees and other general provisions and to revoke, wholly or partly, the legal decrees promulgated by the Council of State. The laws, except for those concerning the reform of the Constitution, are approved by a simple voting majority and enter into effect on the date stated by the law itself and its publication in the Official Journal.

The Council of State is the organ of the Assembly that represents it between sessions, intervals during which it issues legal decrees and provides general and mandatory interpretations to current laws if necessary. These legal decrees have the same standing as the laws passed by the National Assembly. However, the Council of State must inform the Assembly of the approval of these decrees and the Council of State can revoke them or modify them.

The Council of Ministers or Cabinet is the maximum executive and administrative organ and constitutes the Government of the Republic. It is the Cabinet's role, among other functions, to carry out the laws and agreements of the National Assembly and the legal decrees of the Council of State and, if necessary, to issue the corresponding regulations. The Cabinet also issues decrees and provisions on legal bases and in compliance with current laws and controls their implementation. It's role is therefore executive in nature and not legislative.

3.4.2 *Local organs of the people's power*

The local organs of the people's power are established in the politico-administrative jurisdictions into which the national territory is divided. One must note that, given that the country is formed into provinces and municipalities that are legally incorporated, there are municipal and provincial people's assemblies. However, the Constitution points out that the Law can establish other divisions, so that the formation of other local assemblies is accordingly possible. These local organs enjoy the highest authority for the exercise of state functions in their respective jurisdictions, in which they perform government functions for the purpose of which local administrations are constituted to direct local financial, production and service entities.

The administrative bodies established by provincial and municipal people's assemblies function on a collegial basis and their composition, membership, powers and functions are established by law.

The assemblies have the power to issue decisions on administrative matters relating to their territorial jurisdiction within the framework of the constitution and other applicable law. The assemblies are supported in their functions by the people's councils that are constituted in cities, towns, neighborhoods, villages and rural areas as representatives of the local organs, and are comprised of delegates that are elected in electoral districts, with their organization and functions regulated by Law.

3.4.3 *State Administrative Agencies and recent reforms*

Subordinated to the Cabinet are the state administrative agencies, which are responsible for the various departments, offices and general activities in the socioeconomic life of the country. The chiefs of these agencies have the power to issue resolutions, instructions and other provisions that are mandatory in nature within their sphere of influence.

Among the legal reforms that have affected the regulation of the sector, the elevation to constitutional standing of environmental protection should be noted first. Article 27 of the Constitution establishes that:

> "The State protects the environment and natural resources of the country. It recognizes the close relationship of the environment with sustainable economic and social development in order to make human life more rational and to ensure the survival, well-being and safety of current and future generations. The competent organs have the power to implement this policy."

On 10 January 1981, Law N°33 concerning the Protection of the Environment and the Rational Use of Natural Resources was promulgated as a legal framework that establishes the basic principles for the conservation, protection, improvement and transformation of the environment and the rational use of natural resources, in accordance with the comprehensive development policy for the country. Based on this law, Legal Decree No. 138 concerning Terrestrial Waters was promulgated, and the Cabinet is developing the final version of the corresponding regulations for final approval. Article 124 of Law N°33 empowers the Cabinet to issue supplemental provisions that regulate compliance with specific measures.

At the institutional level, the entities that participate directly in the sector are the National Institute of Water Resources and the Ministry of Public Health, whose functions and legal framework were described above. The reorganization of the central administrative agencies pursuant to Legal Decree No. 147 of 21 April 1994

ratifies the powers and functions of the INRH and MINSAP with regard to the water and sanitation sector.

The principal structural changes that are important to the water and sanitation sector have taken place in the extrasectoral and global agencies. In the first place there is the Ministry of Science, Technology and the Environment which, pursuant to Legal Decree No. 147, is charged with formulating environmental policy and monitoring compliance with it. It is also responsible for integrating activities to protect water resources in their interaction with elements such as the atmosphere, human settlements, soil and forest resources, among others, which with this Ministry are viewed from the global perspective of sustainable development, even if there are sectoral agencies that are related to these elements.

Substantial changes are also being introduced into the agencies responsible for economic projections and physical planning. For example, the Central Planning Board is changing to the Ministry of Economy and Planning, to which have been added the functions of the former State Committees on Statistics and Standardization. In addition, national offices are being created for this purpose that are attached to the new Ministry, and which also incorporate some of the powers and functions of the State Committee on Technical and Material Supply. A new agency, known as the Ministry of Finance and Prices, has been formed from the former two state committees that were responsible for these functions.

It is important to mention that on 5 August 1994 Law N°73 concerning the Tax System was promulgated, which establishes a tax on public services that is assessed on entities that provide such services and that includes, therefore, those that provide water and sanitation services.

3.4.4 *Regulations concerning infractions*

The Regulations concerning Administrative Infractions or Violations are addressed in Legal Decree N°99 of 25 December 1987, which constitutes the basic legislation concerning personal infractions. Such infractions are defined as infractions of legal standards or provisions that are not socially harmful because of the limited importance of their results, and which are dealt with in an administrative manner. In this vein, the greatest gap is seen to be the absence of standards for institutional violations, which would be particularly effective in this area if they could properly sanction corporations with higher and more severe penalties.

In addition to fines, the current regulations anticipate sanctions that impose an obligation to act in such a way as to hinder ongoing illegal behavior or to require activities that restore things to their condition prior to the violation; definitive or temporary suspension of activities; the modification of licenses, permits or

concessions granted in accordance with current legislation; and the seizure of the instruments or effects of the violation. This standard only contains the general regulations pertaining to infractions and not the standardized behaviors as such, nor the applicable sanctions in every case, areas that are addressed by various decrees issued by the Cabinet. These decrees correspond to various spheres: in the case of terrestrial waters, the regulations concerning infractions have yet to be promulgated, and the fines that this proposed Decree envisages range from 20 to 50 pesos.

3.4.5 *Mechanisms to ensure compliance with the provisions*

As a mechanism to ensure the most effective compliance with the prevailing standards, inspection by the state has been instituted, which is regulated in general by Decree No. 100, which, for both water resources and public health, supporting inspection regulations have been issued that are applicable to the sector. In order to carry out these inspections the agencies have staffs of professional and temporary inspectors whose activities encompass the monitoring of compliance with all current legislation that is applicable to the sector. The measures recommended by these inspectors require strict compliance according to the stated terms. Those out of compliance, in accordance with the severity of the finding, can be disciplined by their superiors up the chain of command, material responsibility can be applied to them, they can be sanctioned administratively, and they may even be subject to the criminal code, as may be the case.

In addition, Article 194 of the Penal Code (Crimes against Community Safety, the chapter on Crimes against Public Health) includes the crime of contaminating the water and the air, and imposes sanctions of up to a year of incarceration or fines. The area of infractions is also addressed in penal legislation, through inclusion as unlawful the crime identified as "Noncompliance with obligations caused by the commission of violations."

3.4.6 *Legislative prospects*

As was indicated above, the Ministry of Science, Technology and the Environment is being created as the entity that formulates environmental policy, including policy concerning water resources. The development that has taken place indicates the need to reform the Law concerning the Protection of the Environment by updating it to address recent trends in this area. The changes that are made will transcend the water and sanitation sector, not only because they will contain express references to water as a resource, but also through the introduction of concepts and principles such as a cautionary approach, procedures for the evaluation of environmental impacts, and financial mechanisms to incentivize or deincentivize various activities that have environmental impacts. As a result of the new law and

its supplemental provisions, there may also be changes to the body of current administrative sanctions.

3.4.7 ***Considerations***

The change process that the country is experiencing will result in a review of current legislation, including legislation concerning water and sanitation. It is necessary keep in mind that both Legal Decree N°54 concerning Basic Sanitary Provisions and Legal Decree 138 concerning Terrestrial Waters, have been issued in support of and as supplemental standards to the Law concerning the Protection of the Environment. The legislation that regulates the sector should be adapted to current needs. It is necessary to review legislation in relation to prevailing technical standards, modify it in accordance with currently applicable technical requirements, and promulgate new legal provisions whose objectives are:

- To clearly define the purview of the state entities that intervene in the sector, in order to avoid the duplication of functions;

- To define new forms of state organization, including changes in the economic and planning sectors that affect the water and sanitation sector;

- To regulate existing laws in order to define their scope of application; for example, the Regulation concerning Legal Decree N°138 on Terrestrial Waters.

In addition, it is recommended that a systematic compilation by subject matter be carried out on all ministerial resolutions and laws that affect the sector, and which may serve as a basis for analysis and possible modifications and additions.

As was stated above, the country has laws that are designed to preserve the environment and water resources and a staff of inspectors who monitor strict compliance with current legislation. However, there are obstacles to the fulfillment of certain areas, given that the legislative structure of the sector has not yet been completed and a process of reviewing current legislation should begin, in addition to strengthening the monitoring and control mechanisms in this area. Finally, there is definitely a need to study the entire legal framework that regulates the sector and adapt it to the new trends in state organization and sustainable development policies.

3.4.8 *Legal provisions that regulate the sector*

Among the laws, decrees and regulations that comprise the legal framework of the sector, the following should be noted:

- *Constitution of the Republic of Cuba*

- *"Law concerning the Protection of the Environment and the Rational Use of Natural Resources" (Law No. 33, 1 October 1981).* This law establishes the basic principles for the conservation, protection, improvement and transformation of the environment and the rational use of natural resources, as well as the organization of such protective measures. The law defines what is understood by terrestrial waters, soils, mineral resources, marine resources, flora and fauna, air, agricultural and livestock resources, human settlements, scenic and tourist resources. It prohibits the extraction of sand from beaches and of the island foundation. It establishes that actions or omissions that do not constitute crimes related to environmental protection shall be addressed with administrative fines and, if need be, with measures that include withholding, sacrifice, distribution, seizure, reshipment, restoration of damages and other actions.

- *"Law concerning Public Health" (Law N°41, 13 July 1983).* This law establishes the basic principles for the regulation of social relationships in the field of public health, to assist in ensuring the implementation of health promotion, disease prevention, restoration of health, the social rehabilitation of patients and social welfare. It provides that the MINSAP will direct science and technical activities into the health area, and it establishes the requirements and procedures for issuing valid documents that govern the social security area. The law establishes that it is the responsibility of the MINSAP to conduct state health inspections and the control of environmental health, with respect to pollution prevention and the control of air, soil and water quality.

- *"Law concerning Terrestrial Waters" (Legal Decree N°138, 1 July 1993).* The objective of this law is to develop the basic principles established in Article 27 of the Constitution of the Republic and the Law concerning the Protection of the Environment and the Rational Use of Natural Resources, with respect to terrestrial waters, both surface and ground.

- *Legal Decree No. 260/27, 1 March 1927.* This law modifies Decree 259/13, which provides for the regulation of mineral and medicinal baths and waters, establishing a new version. From this point forward this regulation will be understood as the version established in this Decree.

"Basic Health Provisions" (Legal Decree No. 54/82, 23 April 1982). This law establishes regulations and controls to prevent the contamination of waters used for human consumption, as well as the requirements that water supply and sewerage systems need to meet in order to fulfill minimum potability conditions. It also addresses the body of administrative infractions established in this Legal Decree with administrative measures and fines.

- *Decree No. 100/82, 28 January 1982.* This law provides for state inspections, consisting of the control of compliance with the prevailing legal provisions and standards that is carried out by central state administrative entities within their own systems or in the exercise of their regulatory functions, or by local government bodies, the latter through their administrative agencies, with respect to administrative, production and service activities.

- *Decree No. 2244/59, 20 November 1959.* This law modifies paragraphs 6 and 9 of article 3, chapter I of Decree 674/14, Health Ordinances, with respect to the conditions that should be met by water tanks and pipe fittings or conduits for drinking water containers.

- *Decree No. 3132/55, 29 September 1955.* This law modifies paragraph 6 of article 3 of Decree 674/14, Health Ordinances, providing a new version, in the sense that water tanks will be provided with manholes for cleaning purposes with the necessary dimensions for men to enter without difficulty, and whose metallic covers will have another smaller opening that can be easily opened for periodic inspection.

- *Decree No. 1274/41, 7 May 1941.* This law provides for the regulation of the bottling and sale of water and other beverages. It repeals Decree 1440/22.

- *Decree 1128/38, 25 May 1938.* This law expands article 3 of Decree 624/14, Health Ordinances, in order to regulate the construction of water tanks and raintanks that provide for the supply of water to homes.

Resolutions:

- *Resolution No. 67 of 20 April 1984 of the Ministry of Public Health.* This resolution approves and puts into effect the requirements for the physical, chemical and bacteriological quality of drinking water, which were developed on the basis of the health quality of water for consumption. It establishes the bases that govern the quality of water for consumption that is delivered by any public, individual or special water system.

- *Resolution No. 64 of 4 June 1984 of the Food Industry Ministry.* This resolution assigns responsibility to the Science and Technical Bureau of this Ministry for the orientation, coordination and control of the work needed to achieve the proper use and disposal of industrial waters and other polluting wastes resulting from food production. In addition, with respect to environmental protection within the sphere of production, it establishes the duties and functions of other organizational units that participate in this activity.

- *Resolution No. 245 of 25 May 1988 of the Ministry of Construction.* This resolution defines the projects that are to be executed for the first time, and rehabilitation, repair and reconstruction projects for water supply or sewerage system networks in urban areas in order to define the responsibilities of the MICONS.

- *Resolution No. 55 of 12 April 1990 of the National Institute of Water Resources.* This resolution prohibits drilling for the purpose of hydraulic utilization, the overflow or dumping of wastes or any kind of pollutant in both rural and urban areas, establishing the mandatory nature of prior authorization by the provincial bureau of water resources.

- *Resolution No. 67 of 15 May 1990 of the National Institute of Water Resources.* This resolution prohibits the execution of any public work or project in the area of the Vento watershed that is designed to capture, derive, dam, drain off or infiltrate terrestrial waters whose project documentation has not been reviewed from the beginning and approved by the National Institute of Water Resources.

- *Resolution No. 12 of 09 April 1991 of the National Institute of Water Resources.* This resolution requires the authorization of the President of the INRH for the utilization of any volume of dammed waters or waters generated by damming, in dams that are in operation or are planned as a source of supply to the population or industry.

- *Resolution No. 45 of 15 October 1991 of the National Institute of Water Resources.* This resolution approves and puts into effect the water consumption indexes for the non-agricultural sector of the economy.

- *Resolution N°25 of 27 October 1993 of the National Institute of Water Resources.* Regulation concerning the State Inspection of Water Resources.

3.5 National infrastructure to support the sector

The country has an infrastructure of industry, construction, scientific research, project research and applied research that supports the sector, and which to a great extent responds to the growth and consolidation prospects for this activity.

3.5.1 *Industry*

Existing industries are grouped into the jurisdiction of various ministries of the national economy, with the fundamental industries generating production for the sector: the Construction Materials Industry Ministry (MIMCI is concerned with the production of pipes and connections of all types, the production of sand silica, lime hydrate and other materials; the Basic Industry Ministry (MINBAS) is concerned with the production of chlorine gas, sodium hypochlorite and aluminum sulfate, among other materials; the Sidero-Mechanical and Electronics Industry Ministry (MINSIME) is concerned with the production of water pumps of various types, motors, valves, plastic pipes, windmills, fittings, connections, grafts, regulators, etc.; and the Ministry of Construction (MICONS) is concerned with the production of air valves in specialized workshops. Currently, industry on a national level is deeply affected by the lack of imported raw materials that are needed for their production. Annex B.1. provides a detail of the industries related to the sector and their production capacities.

3.5.2 *Construction*

The construction activity in the sector is basically carried out through the Ministry of Construction, which consists of 21 brigades that carry out water supply and sewerage system projects on conduits and principal networks and 10 brigades that specialize in the construction of solid waste and water treatment plants. They also participate in the construction of sector projects, from the territorial level to the municipal level and other subjurisdictions up to the provincial water supply and sewerage system bureaus, except in the province of Havana, which possesses a water supply and sewerage construction contractor. The National Institute of Water Resources, through the Drilling and Construction Company that is organized into provincial entities, carries out the construction of wells. In the current situation, these construction entities are not working at full capacity, and some of them are inactive.

3.5.3 *Projects and applied research*

The country has a broad network to implement projects and applied research on the water supply and sanitation system that is basically concentrated in the system of the National Institute of Water Resources. The water supply and sewerage bureau of the City of Havana has a projects department. The Ministry of Construction also carries out urbanization projects with smaller water supply and sewerage system

networks, and other companies from other agencies also carry out water supply and sanitation projects.

Applied research studies (hydrologic, hydrogeological and topographical) are basically carried out by the Research and Projects Union of the INRH and other entities in smaller numbers in the field of topography. This activity is also seriously affected as a result of the depressed level of investment in the sector. Part of this work force is also devoted to planning projects in the tourism sector.

4. PLANS, POLICIES AND PROGRAMS

4.1 Plans and programs

For more than 30 years and especially since the last decade, a set of plans and programs that are national in character have been implemented that establish the objectives to achieve with respect to water and sanitation. These programs and goals are listed below:

International Conference of Mar del Plata. The integration of Cuba into these projects that led to the International Decade for Drinking Water and Environmental Health had an important effect on the goals and activities that were planned and carried out in the sector in the 1980s.

Hydraulic Program. This program was approved by the Government in 1985 and made it possible to specify the objectives to achieve through the year 2000 in the field of water resources. Within this initiative the following goals were set for the water and sanitation sector:

- To achieve a coverage level of 90% of the urban population with household connections to the water supply system;
- To ensure 100% disinfection (chlorination) of the water supplied to the population, as a way to achieve a sustained reduction of morbidity from acute diarrheal diseases;
- To increase the hours of service of water supply systems to a level of no fewer than 20 hours per day on average.
- To reach a coverage level of 65% of the urban population with sewerage service, ensuring the treatment of wastes at least at the primary level;
- Reduce the losses from water supply systems to a maximum level of 20%;
- Provide water supply and sewerage system operation and supply entities with the human resources and materials necessary for this activity.

National Action Program. This program was developed to fulfill the goals of the World Summit for Children and is being implemented within the framework of a process to adapt the national economy to the international context. It was motivated by the profound changes that have occurred in the economies that used to constitute Cuba's regular international trading partners. This National Action Program has the following general objectives:

- To help consolidate and improve the health levels that have been attained with respect to maternal and child care;

- To support the expansion of drinking water and basic sanitation coverage so as to cover the entire population of the country;

- To help develop a nonformal initial education program for children from 0 to 5 years of age;

- To promote the establishment of an educational communication program that is national in scope and centered on aspects of health, hygiene, nutrition, physical-affective development and social relations (Education for Life);

- To attend to the prevention and educational needs of minors with social problems.

With respect to the goals established for the water and sanitation sector, there is a change in and further specification of the objectives that were proposed in 1985, as follows:

Drinking water:

1) Urban sector

To expand the coverage of household connections by 1.5 million people, increasing the coverage from 83% to 95%. Ensure public service to the remaining 5% of the population (0.4 million people);

- To reduce the current levels of water losses by 10% in 40 cities and repair no less than 100 km of pipes per year by applying reconstruction technologies.

2) Rural sector

- To increase by 260,000 people the rural settlement population that has household water connections (increase in coverage from 52.7% to 70%);

- To increase by 76,000 people the rural settlement population that has public services (increase in coverage from 25.8% to 30%);

- To increase by 125,000 people the dispersed population with household connections (increase in coverage from 15% to 20%);

- To increase by 460,000 the people with public services (increase in coverage from 29.3% to 50%) and with easy access by 130,000 people (increase in coverage from 25.7% to 30%) in dispersed rural areas.

Sanitation:

1) Urban sector

- To increase by 0.9 million the people provided sewerage service (increase in coverage from 39.1% to 50%) and maintain septic tank and sanitary latrine service for 50% of the urban population.

2) Rural sector

- To increase by 100,000 the people provided sewerage service in the rural settlement population (increase in coverage from 3.2% to 15%);

- To increase by 105,000 the people provided septic tank and latrine services in the rural settlement population (85% coverage);

- To increase by 345,000 the people provided with sanitary latrine service in the dispersed rural population (100% coverage).

National Program on the Environment and Development (PNMAD). This program includes a set of proposals, topics and activities that link the environment and development, comprising a viable plan for the environmental policy of the country, and which can serve as a reference for current and future national activities that should be promoted by the National System for the Environment. The policies of the water and sanitation sector are included in this program.

With the objective of drafting the development strategy to follow for the country's water systems, a series of plans have been prepared that are premised on a prognosis of systematic and proportional growth of the various branches of the hydraulic economy. One of the topics that has been analyzed concerns the supply to the population, industry, livestock production and tourism, as well as the removal and treatment of their solid wastes.

These projects are described within the systematic planning framework developed by the Institute of Water Resources with the objective of proposing a hydraulic development, water sanitation and hydroelectric strategy for the country, on the basis of the directives outlined by the Government to respond to the economic and social development programs that have been approved. At the same time, these projects ensure the preservation and rational use of water resources.

Public health. Plans and national programs have been designed in the area of public health that make it possible to improve the sanitary and hygienic condition of the country and enhance the epidemiological surveillance system. The following are included in these plans and programs:

Comprehensive Environmental Health Plan (PIHA): The objective of this plan is to improve the sanitary and hygienic condition of the country, with an emphasis on the provincial capitals and on certain closed centers that are of economic, political and social importance. The specific objectives of the Plan include the following:

- To achieve a sufficient water supply in quantity and quality;
- To achieve the proper treatment and final disposal of liquid waste;
- To achieve the efficient collection and final disposal of solid waste;
- To apply control measures in order to reduce infestation from vectors;
- To disseminate broad and detailed information to the population in order to implement environmental health activities;
- To increase environmental surveillance activities and implement current health legislation;
- To train the human resources necessary to improve environmental health.

The struggle against leptospirosis is especially important because of the number of cases reported in 1993 (1,446 cases, a rate of 0.13 per 1,000 inhabitants), the highest figure reported in recent years, basically the result of the increase in the movement of large numbers of people to agricultural areas, increasing the risk of exposure to this disease. In addition, there is not an adequate supply of vaccines for immunization.

The fundamental strategic approach of this plan is the conception that all actions that are undertaken should lead to a strengthening of decisions at the local level with the broad participation of the sectors, communities, groups and individuals in the task of promoting individual and collective health activities. This approach is closely linked to environmental conservation and protection and to the rational use of natural resources in relation to sustainable development.

Sanitary control program for water: The sanitary control of water implies the realization of state sanitary inspection activities and the monitoring of installations where water of four levels of quality is handled, used or distributed. These water quality levels correspond to the specific purposes the water is used for:

a) Water for human consumption (drinking water). Sanitary control of

water supply systems is carried out as established in the prevailing Cuban standards. The principal activities to implement are:

Periodic inspections of the sources of supply, storage tanks and conduits;

- Periodic sampling of the water for bacteriological and physical chemical analysis of the sources of supply, storage tanks, conduits and distribution networks;

- in the case of contamination problems or the lack of chlorine, the necessary measures to resolve the situation are taken.

b) Water for recreational or sports use. The sanitary control of water for recreational or sports use in swimming pools and at beaches, international or national tourist hotels, social clubs, public beaches, camping sites, sports centers, etc. as established in current Cuban standards in force. The principal activities implemented are:

- Periodic inspections of the beaches and swimming pools to confirm compliance with the requirements established in the standards;

- Periodic sampling of the water at beaches, in swimming pools, rivers and dams for bacteriological analysis;

- In case of contamination, swimming pools are emptied, cleaned and disinfected;

- Sampling of water for physical-chemical analysis in stages of classification or when contamination is suspected at beaches and dams and in rivers.

c) Water used in hemodialysis. The principal measures taken in the sanitary control of this water are the following:

- Monthly inspections of the hemodialysis units of each hospital;

- Periodic sampling of water for physical-chemical and bacteriological analysis.

Program to Control Intestinal Parasitism: Despite the socioeconomic and cultural transformations that began with the victory of the Revolution, certain ecological situations persist in Cuba that keep the problem of intestinal

parasitism at a certain level of importance. This means that it is necessary and feasible to focus control efforts specifically on a group of helminths and protozoans that are considered medically important through a program to control intestinal parasitism in the long and medium term. The general objective of the program is to reduce infestation from intestinal parasites in the population under 15 years old, the most vulnerable group that presents the highest infection rates. The program has the following specific objectives:

- To reduce the prevalence of the following helminths in children under 15 years of age:
  . *T. trichiura*
  . *N. americanus*
  . *A. lumbricoid*

- To reduce the prevalence of the following protozoans in children under 15 years of age:
  . *A. histolytic*
  . *G. lamblia*

- To implement and systematize research, instructional and education activities that serve as a foundation to optimize the program.

The strategy to follow is based on:

- Prevention of infection through environmental sanitation, food control and hygiene, and health education with the active participation of the community;

- Location of cases through active and passive searches and controlled treatment; health education provided by individual family physicians and group instruction to those infected with parasites and those with whom they live.

Given the population's capacity to change its habits and customs favoring the transmission of intestinal parasites, the incorporation of the family doctor is especially important to the proposed program implementation strategy, because this innovative primary care model provides the potential of working to prevent infection.

Action Plan to fight cholera: Cholera cases have not been reported in the country to this point. Although a program as such has not been established to fight against this disease, there is an Action Plan to prevent its introduction. This Plan is coordinated by the Civil Defense, and other agencies such as Public

Health, the Commission on the Environment, the National Institute of Water Resources, etc., participate in it. This plan consists of environmental and clinical monitoring of *Vibrio cholerae*, which is tracked by the National Institute of Hygiene, Epidemiology and Microbiology and the Pedro Kourí Institute, respectively. The following activities are implemented:

- Analysis of fecal samples to search for choleraic vibrio in foreigners from endemic countries with acute diarrheal disease, and analysis of samples from populations affected by outbreaks of diarrheal disease;
- Surveillance of hidrobiological foods and liquid wastes;
- Survey of the availability of drugs and other resources;
- Ongoing training of participating personnel.

4.2 Policies

4.2.1 *Technical aspects*

Standardization. The National Office of Standards, of the Ministry of Economy and Planning, carries out the policy of the country with respect to sector standardization. These standards are classified as: State (national in scope), and area (applicable to a given sector of the national economy). There is a consultation process with interested agencies in order to approve them. The principal sector standards are related to the following activities:

- Water quality,
- Sanitary protection of water sources,
- Projects and applied research,
- Design, construction and assembly,
- Materials and products,
- Hydraulic installations,
- Regulation of the investment process.

Certain standards need to be updated, adapted and completed.

Protection of watersheds and water. Protecting watersheds is a national policy. Given that water constitutes a fundamental element in a watershed, there is a network to monitor water quality that is operated by the National Institute of Water Resources, an agency that has the responsibility for monitoring terrestrial waters. In addition, there are programs coordinated with other agencies that are directed to the reforestation of watersheds and rivers, the territorial management of these areas, etc. In addition, various entities and agencies intervene in policy decisions, such as the Institute of Physical Planning, the Ministry of Public Health, the Ministry of Science, Technology and Environment, the Ministry of Agriculture, the Sugar Ministry and other

agencies that participate to a lesser extent.

Rehabilitation and optimization of existing water supply and sewerage systems. With respect to the repair of drinking water pipes, an internal overlap technology of German origin has been introduced into the country with cement mortar applied under pressure (ZMA), and the domestic manufacture of equipment for this purpose has been achieved. The application of this technology is currently being affected by limitations of a financial nature on the importation of components that are fundamental to its use. With regard to optimization, the country has had specific experience, basically in the City of Havana, where existing water supply systems have been completed and interconnected.

Monitoring and control of water quality. The national policy is to ensure that the water provided to the population meets the quality standards that have been established. The policy is implemented through the monitoring and control that is performed by the following agencies:

- INRH: Monitoring and control of water quality at water sources.
- Provincial water supply and sewerage system bureaus: control of water quality in water supply systems.
- MINSAP: Provincial and municipal hygiene and epidemiology centers.

There is a surveillance network that deals with the periodic monitoring of water sources and distribution networks at the local level. In addition, there are research centers that undertake studies to prevent possible impacts on sources of supply that are caused by anthropogenetic contaminations.

Rational use of water. There is a national policy that is designed to encourage the rational use of water through the control of water losses and reuse. The control of water losses is effected through a preventive maintenance program, macro and micromeasurement, standards and a structure at the various levels of water supply and sewerage system activities.

Macromeasurement of water mains and channels has been insufficient, dependent as it has been on portable equipment and instantaneous measurements. Micromeasurement in the domestic sector is limited to Havana City and Varadero. In the state sector, some cities such as Ciudad de la Habana, Santiago de Cuba, Pinar del Río and Matanzas use micromeasurement. With regard to reuse, only limited results have been achieved.

Identification and selection of sector projects. In the 1970s a working group of Cuban and Soviet specialists was created in order to develop a hydraulic development plan for the entire country that was known as the General Plan for Water

and Agrarian Resources for the Republic of Cuba. Subsequently, in a second stage of the work, specific regional plans were developed that concluded at the end of the 1980s, and served as a basis for the development of five-year plans that are translated into annual plans. While attending to local requests and verifying their compatibility with these regional plans, investment proposals for the sector are approved and implemented.

4.2.2 *Economy and finances*

National policy is directed to cleaning up internal finances and achieving more efficient management through fees charged to the residential and state sectors. After many years when for all practicable purposes fees were not collected, a program to implement a collection system for water and sewerage service for the residential sector has been set up to begin in the fourth quarter of 1994. The collection of fees from the state, social and commercial sectors began previously and is currently being expanded, in addition to other services that are provided. With respect to the cost system, the system that is currently in effect should be enhanced so that it serves as an instrument of measurement and control.

It is the intention of the country to set the water supply and sewerage system entities on the road to self-financing in national currency. Under the current conditions of financial limitations, the State allocates the essential minimum in foreign exchange for an activity on the basis of an analysis of priorities and availabilities that is aimed at seeking other sources of external financing that will make it possible to undertake the investments that are planned for the water and sanitation sector.

4.2.3 *Education*

The country's educational policy is based on a set of fundamental principles where the Cuban State, with the participation and the support of political organizations and the people, is responsible for structuring and operating the National Education System. The principles that govern education are:

- Universal character of education
- Combination of work and study
  Participation of the entire society in the tasks of educating people.
- Instruction that is free and provided by laypeople

Qualified sector personnel are trained in higher education centers and technical and professional education centers (see tables 3.4 and 3.5). In the decade from 1980 to 1990, work was done to introduce the environmental dimension in three ways:

- Environmental education of teaching personnel:

- A focus on environmental content in the curriculum;
- Development of outside teaching and extracurricular activities.

4.2.4 *Technical scientific development*

The Ministry of Science, Technology and the Environment is the agency in charge of policy that governs the development of the scientific and technical research sector. This ministry approves research topics that, as a fundamental principle, are associated with concrete solutions to the economic and social problems of the country.

In addition to the research centers, there are organizations such as the National Association of Innovators and Planners (ANIR) and the Youth Technical Brigades (BTJ) that encompass all of the invention, innovation and planning projects that technical professionals and laborers undertake throughout all sectors of the economy. At present, as a result of the importance accorded to these projects and the assistance they have provided in the solution of concrete problems, Science and Technology Forums are organized annually.

4.2.5 *Environment*

The State exercises its governance over the environment and natural resources of the country. The protection of these resources is a State and social obligation that extends to the entire citizenry and thus has a constitutional foundation. Environmental protection activities are planned in relation to sustainable development, with man at the center of these activities, and with the essential purpose of planning for his survival and ensuring the well-being and safety of the current and future generations. The formulation of environmental policy is the responsibility of the Ministry of Science, Technology and the Environment, which also monitors its fulfillment and coordinates actions with other entities and bodies.

4.2.6 *Prevention of natural and chemical disasters*

This policy is carried out through the Civil Defense, the entity that is responsible for prevention and action in case of disasters. There are disaster prevention plans and protection plans against intense rainstorms and hurricanes, chemical accidents, the introduction of cholera and seismic movements, at the national level and at the level of agencies related to the water and sanitation sector.

4.2.7 *Institutional enhancement of the sector*

In the last two years a policy has been implemented that is intended to restructure the administrative apparatus in provincial and municipal agencies, and to

strengthen activities in a technical way. This policy has made possible a better foundation for these organizations, which can adjust the dynamics of their work to the rigorous conditions imposed by special periods. This institutional enhancement will evolve to the extent that the economic and financial conditions induced by the self-management that is planned for the sector changes.

4.2.8 *Cooperation and international assistance*

This policy is expressed through relationships with international agencies and country cooperation programs, as a basis for seeking part of the externally financed support required by the sector. United Nations agencies such as UNICEF, UNESCO, UNDP, FAO and PAHO have established programs. In addition, there are NGOs, among which are Physicians without Borders, CARE, KATE and others with which projects are being implemented or who have projects in the planning process.

4.3 Agencies and programs that cooperate with the sector

The goals of the World Summit for Children concerning water supply and sanitation were the basis for the formulation of a National Action Program for the sector. The goals of the National Action Plan for the Drinking Water Supply and Sanitation Sector (PANAPS) have been used as a basis to seek the financial support of various international cooperation organizations and agencies. Of the three areas of activity that are defined in the PANAPS, the urban, rural settlement and rural dispersed sectors, the rural settlement sector has benefitted the most with respect to generating sources of external financing to develop installations that will provide a better quality of life. However, only limited financial resources have been able to be obtained for initiatives in the urban sector.

The United Nations Children's Fund (UNICEF) has been providing ongoing and effective assistance since 1980. In the decade from 1980 to 1990, the cooperative assistance directed to the rural sector reached US$ 860,000, supplemented with the equivalent of US$ 17 million in national investments. With these efforts, the population served in this sector rose from 250,000 to 550,000 people.

In May 1992, an interagency coordination meeting on water and sanitation was organized with the objective of analyzing the planning of cooperation efforts for the mobilization of resources that would be regional and global in character. The participating agencies of the United Nations, UNICEF, UNESCO, UNDP, FAO and PAHO issued a Declaration of Support for Cuba's efforts in carrying out its National Action Plan for the Drinking Water Supply and Sanitation Sector. They were especially supportive with respect to the maintenance of the levels that had been reached and the achievement of measurable progress. For this purpose, a portfolio

of projects was prepared that expressed the fundamental need to mobilize the resources requested. At this time UNICEF cooperation for the rural sector is being maintained and some aid from the UNDP has been received that is targeted to technical assistance.

In order to enhance the resources needed to disinfect water, financial support has been received from Physicians without Borders. In addition, projects have been promoted for water supply systems that were damaged by weather disturbances in areas of the province of Guantánamo, with assistance from CARE and Canada. However, these projects have yet to materialize. Additional support has also been obtained from KATE and German NGOs for the construction of some rural water supply systems in the province of Holguín.

Cuba has been incorporated into the CIUDAGUA Program, which is concerned with drinking water and sanitation issues in the urban sector. This program is assigned to the World Federation of Cities United for Development (FMCUD). Within this framework, some projects have been identified to address the most serious aspects that are affecting the sector. So far, this program has not generated the financing that will make it possible to ensure the funds required by the projects, since the limited resources it has are obtained through contributions from the governments of cities that are members of the FMCUD, and are basically targeted to technical assistance services and other low cost collaboration activities.

The elements related to ensuring the drinking water supply and environmental sanitation have always been present in the international work of the national authorities. The integration of Cuba into the projects of the International Conference of Mar del Plata, which resulted in the International Decade on Drinking Water and Environmental Sanitation, as well as the later New Delhi Conference (1990) and the Dublin Conference (1992), the latter during the preparatory process for the United Nations Conference on the Environment and Development (Rio de Janeiro 1992), are evidence of this. The content of chapter 18 of Agenda 21 that was adopted in Rio, gathers into various program areas the principal goals to be achieved by the developing countries with respect to drinking water and environmental sanitation. Its interaction with chapter 6, on the promotion and development of health, is very explicit in its various parts.

As a result of this entire process and the responsibility with which the national authorities of the sector are approaching their international commitment to the National Program on the Environment and Development, and specifically the Cuban adaptation for the application of Agenda 21 and taking into consideration economic, social and environmental characteristics, topics related to the water supply and environmental sanitation problems are being developed according to specifications and needs. The Cuban institutions with an interest in these matters attend to and exercise

control over these objectives.

As an expression of the determination of the Government of Cuba to generate results and evaluate its problems in these areas, and as part of its fulfillment of international commitments, the current conditions and situation of this sector were presented in the 2nd Session of the Commission on Sustainable Development (CDS) that was held in May 1994.

Cuba, as a member of the developing countries, needs the international community to allocate new and additional financial resources to this sector, and it also needs access to advanced technologies under advantageous conditions. In addition to these needs there are also the difficulties resulting from the hardening of the financial, economic and commercial blockade that the country is suffering from for political reasons. All of these factors have a direct effect on maintaining the progress that has been made in this sector and the achievement of higher goals.

5. ANALYSIS OF THE PHYSICAL AND TECHNICAL CHARACTERISTICS OF THE SECTOR

As indicated in chapter 1, 76% of the national population resides in urban sectors and 24% in rural areas. The urban population is distributed in 524 localities, while the rural population is distributed in 3,234 localities, smaller settlements, or is dispersed.

The population served is classified into three groups: urban, which includes the principal cities of the country and all of the urban towns; rural settlements, which are comprised of settlements from 200 to 1,999 inhabitants who do not live under urban conditions; and rural dispersed people, including the population living in more isolated dwellings.

5.1 Physical infrastructure

5.1.1 *Physical water supply systems*

Existing systems. There are 1,261 localities in the country with household drinking water systems. The remaining localities are supplied through public services including tank trucks and other informal solutions within easy access (distances not greater than 200 m from the dwelling). There are 49 drinking water treatment plants in the country that treat a total of 11.5 m^3/sec of surface water. The greatest number of supply installations capture groundwater and only incorporate disinfection processes.

In the rural sector, there are 900 localities with an approximate population of 780,000 people who have potable water supply from distribution systems with household connections that are administered by provincial entities. Another 200,000 people are supplied by systems administered by agricultural or industrial companies. In the rural settlement sector there are, in addition to household service, public services and the transport of water from sources or public standpipes to distances not greater than 300 meters. In addition, in the dispersed rural sector, public services and easy access services predominate. In tables 5.1 and 5.2, part of this information is detailed by province.

Table 5.1
Localities with residential supply of drinking water at the national level, 1994

Province	No. of Localities
Pinar del Río	95
La Habana	175
Ciudad de La Habana	1
Matanzas	106
Villa Clara	54
Cienfuegos	39
Sancti Spíritus	100
Ciego de Avila	60
Camagüey	59
Las Tunas	70
Holguín	89
Granma	127
Santiago de Cuba	102
Guantánamo	165
Isla de la Juventud	19
Cuba	*1,261*

Source: National Institute of Water Resources.

Table 5.2
Types of treatment, number of systems and covered population, 1993
(figures in thousands of inhabitants)

Province	Drinking water treatment plants		Disinfection		Total systems	Beneficiary Population
	No.	Beneficiaries	No.	Beneficiaries		
Pinar del Río	8	29.9	77	348.3	85	378.2
La Habana	4	18.0	108	384.8	112	402.8
C. de la Habana	1	96.8	43	1,948.3	44	2,045.1
Matanzas	...	...	93	425.1	93	425.1
Villa Clara	3	190.5	52	205.9	55	396.4
Cienfuegos	5	152.2	23	60.8	28	213.0
Sancti Spíritus	6	158.5	41	75.7	47	234.2
Ciego de Avila	1	7.9	55	202.8	56	210.7
Camagüey	6	330.3	33	115.2	39	445.5
Las Tunas	2	14.0	92	228.0	94	242.0
Holguín	5	225.6	46	168.2	51	393.8
Granma	2	2.0	97	498.9	99	500.9
Stgo. de Cuba	5	366.7	50	205.2	55	571.9
Guantánamo	1	115.0	101	252.0	102	367.0
I.de la Juventud	...	...	24	119.5	24	119.5
Cuba	*49*	*1,706.4*	*935*	*5,239.7*	*984*	*6,946.1*

Source: National Institute of Water Resources.

Sources of supply. Of the 1,376 million m³ of water provided to the population on an annual basis, 72% is from ground sources and 28% comes from surface sources. The productivity of the sources is related to the availability of water resources in the territory. In the western sector of the country and in the province of Ciego de Avila, where groundwater is abundant, the execution of catchment projects to fulfill demand is relatively inexpensive, meaning that in these provinces water sources are relatively in balance with demand.

In the center of the country and especially in the eastern provinces, the ground sources are less productive or the water has high saline content, as in the Cauto watershed, which makes it necessary to implement projects to regulate surface water courses, requiring much greater investment levels. The program to construct hydraulic works made it possible to expand the sources in important cities such as Holguin, Camagüey and Sancti Spiritus, or to initiate construction projects in Santiago de Cuba, Palma Soriano, Santa Clara and Cabaiguán. Currently, restrictions on the sources of supply for 11 populated settlements have been identified, affecting more than 500,000 people: Las Tunas, Manzanillo, Puerto Padre, Banes, Placetas,

Guáimaro, Colombia, San Luis, Niquero, Campechuela and Guisa. Table 5.3 provides details on the origin of the water supplied to the population by province.

Table 5.3
Origin of the water provided by water supply systems, 1993
(figures in millions of m^3)

Provinces	Total water supplied	Ground %	Surface %	Galleries %
Pinar del Río	80,147.3	86.0	14.0	...
La Habana	107,158.5	98.8	1.2	...
Ciudad de la Habana	477,838.5	96.8	3.2	..
Matanzas	128,652.4	100.0	...	...
Villa Clara	75,898.9	31.4	59.1	9.5
Cienfuegos	60,027.8	20.7	79.3	..
Sancti Spíritus	44,776.6	21.9	76.6	1.5
Ciego de Avila	43,477.0	100.0	...	...
Camagüey	71,043.3	11.1	88.9	...
Las Tunas	23,103.4	97.8	2.2	.
Holguín	50,696.2	50.4	49.6	...
Granma	45,672.8	88.2	8.1	3.7
Santiago de Cuba	100,306.2	20.1	79.9	...
Guantánamo	67,588.3	15.7	67.0	17.3
Isla de la Juventud	10,175.9	100.0	...	...
Cuba	*1,376,563.4*	72.0	26.5	1.5

Source: National Institute of Water Resources.

Type of supply source. Ninety percent of the water provided by the supply systems requires energy for its extraction and delivery. Table 5.4 presents the number of stations in the drinking water and sewerage systems and their energy sources by province; separate information by service is not available.

Table 5.4
Existing pumping stations in water supply and sewerage systems. 1994

Province	No. Stations	% of Water Supplied		
		Pumping		Gravity
		Electricity	Gasoil	
Pinar del Río	172	95.6	1.0	3.2
La Habana	170	97.9	2.1	...
Ciudad de la Habana	171	92.8	...	7.2
Matanzas	139	99.2	0.8	...
Villa Clara	54	80.6	5.3	14.1
Cienfuegos	60	92.0	...	8.0
Sancti Spíritus	90	88.8	1.5	9.7
Ciego de Avila	48	98.1	1.9	...
Camagüey	152	99.4	0.5	0.1
Las Tunas	74	87.6	12.4	...
Holguín	93	85.4	9.0	5.6
Granma	180	92.0	2.6	5.4
Santiago de Cuba	93	49.8	5.0	45.2
Guantánamo	170	74.9	7.2	17.9
Isla de la Juventud	42	97.3	2.7	...
Cuba	*1,719*	*88.8*	*2.14*	*9.1*

Source: National Institute of Water Resources.

Types of treatment. In the period from 1983 to 1993, the number of chlorination installations rose from 355 to 936, and the number of drinking water treatment plants from 30 to 49 units. Of the 1,261 water supply systems administered by operating entities, 967 systems that serve practically the entire supplied urban population and most of the rural settlement population have water treatment installations. The drinking water treatment plants that treat surface water are the conventional type with complete treatment processes (flocculation, sedimentation, rapid descent filtration and final disinfection). The technology utilized in most of these plants is Cuban with foreign equipment. The first installations are more than 45 years old; a second group was constructed in the 1960s; and the last, using French technology, entered into operation at the end of the 1960s. The general technical condition of these drinking water treatment plants is deficient, basically due to the years of use of the first group, which in some cases have been remodeled and had their capacity expanded, and as a result of the financial difficulties faced by the country in recent years, which have limited the purchase of the replacement parts and supplies necessary to carry out required maintenance.

Table 5.5
Treatment systems and disinfection types
Number of installations by province, 1993

Province	Drinking water treatment plants		Disinfection systems		Total	
	Chlorine gas	Hypochlorite	Chlorine gas	Hypochlorite	Chlorine gas	Hypochlorite
Pinar del Río	4	1	14	83	18	87
La Habana	-	4	13	85	13	89
C. de la Habana	1	-	22	20	24	20
Matanzas	-	-	9	84	9	84
Villa Clara	3	-	12	40	15	40
Cienfuegos	3	2	2	21	5	23
Sancti Spíritus	3	3	...	41	3	44
Ciego de Avila		1	5	50	5	51
Camagüey	5	1	5	28	10	29
Las Tunas	2	-	2	90	4	90
Holguín	5	-	13	33	18	33
Granma	-	2	3	82	5	84
Stgo. de Cuba	5	-	12	38	17	38
Guantánamo	-	1	11	80	11	81
I.de la Juventud			2	22	2	22
Cuba	*31*	*18*	*128*	*807*	*159*	*825*

Source: National Institute of Water Resources

The treatment plant support infrastructure (laboratories, repair workshops and transportation of chemical products) has been established in all these entities for more than 10 years. The population that is supplied from individual sources is not subject to an extended treatment program, although the rural program that is co-sponsored by UNICEF promotes the utilization of manual disinfection devices. There are 296 installations of this type with the following distribution:

Table 5.6
Smaller rural disinfection installations

Province	No. installations
Cienfuegos	2
Sancti Spíritus	6
Las Tunas	64
Holguín	34
Granma	84
Guantánamo	86
Isla de la Juventud	20
Total	*296*

The rest of the population receives smaller quantities of water treated with mechanical devices. A significant percentage of the population consumes water that is not treated, although there are domestic treatment practices using domestic filtration or boiling.

Distribution networks. In 1993, the 1,261 water supply systems administered by the operating entities had a total of 15,600 km of pipes, which means a water pipe density of 2.0 m per person served. The number of residential connections in 1993 was 2.12 million. In 1980, an inventory and diagnosis of the existing water supply systems in the country was carried out. In this study the conditions of deterioration of the distribution systems were determined as described in table 5.7.

It is currently estimated that 40% of the distribution networks are exhibiting serious deterioration or have exceeded their useful life. Approximately one third of the household connections are in poor physical condition. In a large number of drinking water systems there is a large deficit of reserve volumes, which makes the operation of the networks even more difficult. There are serious deficiencies in the system operation and maintenance processes, made greater as a result of the lack of equipment, vehicles, parts and supplies required for repair and operational control.

Table 5.7
Technical condition of the pipe networks, 1980

Water Supply System	Total Km	Technical Condition %		
		Good	Fair	Poor
Conduits	2,158	58.1	31.5	10.4
Networks	8,038	27.8	27.2	45.0
Connections	4,659	26.9	38.0	35.1

Source: Report on the Maintenance of the water supply, sewerage and storm sewer system National People's Assembly.

Average age of the systems. The water system installations of most of the principal cities of the country are very old. Some of their components even date from the last century, as in the case of the City of Havana, presenting serious problems for system operation and maintenance. Beginning in 1960, significant expansions were made to cover the demand from the population. For reference see table 5.8, which indicates the age of existing drinking water treatment plants in the country.

Most of the rural systems were constructed or rehabilitated in the 1980s in the context of the rural program that was launched at that time. Its oldest components are the pumping equipment, whose useful life is frequently exceeded. For the

population that receives public services, the vehicles have been used for a very long time and suffer from frequent breakdowns due to problems requiring spare parts and accessories.

Table 5.8
Age of drinking water treatment plants
(figures in liters/second)

Name	Capacity	Date of Construction/ Expansion
Guane	70	1964/1978
República de Chile	5	1979
Cidra	5	1974
Dimas	5	1976
Cajalbana	15	1978
Bahía Honda	100	1980
La Palma	100	1984
Viñales	100	1986
Canasí	20	1961
Mariel 1	20	1983
Mariel 2	20	1984
Cabañas	20	1966
N. Habana	600	1973
Agabama	300	1927
Manicaragua	70	1967/1984
Ochnita	600	1994
Hanabanilla	300	1957
Paso Bonito	1,200	1978
Cumanayagua	120	1966/1984
Rodas	40	1965
Camarones	40	1967
Trinidad	1000	1985
Yayabo	150	1883/1977
Saltadero	30	1975
Jarbonico	100	1982
Tres Alejas	15	1980
Trinidad	100	1955
El Asiento	15	1960
Amistad Cubano Búlgara	1,800	1982
Nuevitas	600	1977
Pontezuela	700	1951/1978
San Miguel	100	1957/1978
Guaimaro	40	1967
Jimaguayú	30	1973
Mejipacoa	30	1985
Cayojo	40	1990
Cayoyogüin	280	1962
Güirabo	300	1981
Holguín 2	600	1991
Gibara	50	1968
Marcané	50	1982
Río Yara 1	10	1962
Río Yara 2	10	1962
Santiago 1	1,050	1961
Santiago 2	600	1982
Paradas	300	1985
Palma Soriano	125	1951
El Frente	50	1988
Guaso	600	1982

Source: National Institute of Water Resources.

Coverage and conditions of the drinking water supply. The following information on the coverage and conditions of the supply of water to the served population has been taken from the Second Evaluation Report for the National Action Plan, (December 1993):

Table 5.9
Coverage of drinking water supply at the national level, 1993
(figures in millions of inhabitants)

Population	Total	Served total	Household connections %	Public service %	Easy access %	Total served %
Urban	8.27	7.79	81.1	10.1	3.0	94.2
Rural	2.65	2.20	27.2	28.1	27.7	83.0
Total	*10.92*	*9.99*	*68.0*	*14.5*	*9.0*	*91.6*

The service deficit is 8.5%, which means a population of 930,000 inhabitants without drinking water service.

Table 5.10
Coverage of household supply by province, June 1994
(figures in thousands of inhabitants)

Province	No. places with water systems	Total population			Urban population		Rural population	
		Estimated	Benefic.	%	Estimated	Benefic. %	Estimated	Benefic. %
Pinar del Río	95	713.2	445.8	63	420.1	99	293.1	10
La Habana	175	804.3	672.1	84	532.6	94	131.6	93
Ciudad de la Habana	1	2,167.6	2,100.0	97	2,167.6	97	...	..
Matanzas	106	630.6	557.6	88	506.4	95	124.2	60
Villa Clara	94	822.3	568.4	69	660.3	70	162.0	17
Cienfuegos	39	378.2	281.0	74	281.0	81	97.2	21
Sancti Spíritus	100	442.8	268.5	69	338.3	66	104.5	34
Ciego de Avila	60	383.0	263.4	69	286.7	82	97.1	30
Camagüey	58	764.0	366.9	48	582.9	58	184.1	10
Las Tunas	70	510.2	227.7	45	313.6	61	196.4	16
Holguín	89	1,020.6	413.0	41	606.8	81	411.8	11
Granma	127	816.2	419.4	51	484.0	76	332.2	15
Santiago de Cuba	102	1,021.0	901.3	76	713.7	94	307.3	44
Guantánamo	186	508.0	389.4	76	310.1	79	192.9	72
Isla de la Juventud	13	76.9	77.9	99	71.2	100	7.7	87
Cuba	*1,261*	*10,926.7*	*7,718.0*	*71*	*8,282.1*	*83*	*2,641.6*	*30*

Source: Estimated population: State Committee on Statistics
Covered population: National Institute of Water Resources
Places with water systems: National Institute of Water Resources

Other smaller systems are administratively assigned to sugar, agricultural or industrial companies, serving some 200,000 people residing in some 250 towns.

In this sectoral study, a qualitative estimate of the coverage (table 5.11) has been made, classifying the services as "appropriate" and "deficient service", based on the general diagnosis of the condition of the drinking water systems. In the urban sector, it has been estimated that some 30% of the coverage has deficient service, which would correspond to the estimated users who do not have regular service with respect to either quantity or continuity, and important projects and activities to rehabilitate and improve the systems must be carried out. In the rural sector, it has been estimated that 10% of the population is provided deficient service, considering the current problems with public service systems and easy access systems, which should be improved or replaced with more efficient conventional systems (table 5.11).

Table 5.11
Coverage of drinking water, national level, 1993
(figures in millions of inhabitants)

Sector	Total population	%	Covered population with drinking water service %						Population without drinking water service
			Adequate service				Deficient service	Total with service	
			Household connection	Public service	Easy access	Total			
Urban	8.27	75.7	51.1	10.1	3.0	64.2	30.0	94.2	5.8
Rural	2.65	24.3	27.2	23.1	22.7	73.0	10.0	83.0	17.0
Total	*10.92*	*100.0*	*45.3*	*13.3*	*7.5*	*66.3*	*25.1*	*91.5*	*8.5*

Source: National Institute of Water Resources

Principal characteristics of the physical systems and service delivery.

Continuity and reliability of service:

The improvement in the continuity of water service was one of the initiatives that achieved significant results during the past decade. At the beginning of the 1980s, the service periods were an average of 12.3 hours per day. Through a software program applied to the capacities of water sources, delivery, storage and distribution and better managed operations, an increase in the per capita volumes and hours of service was achieved. Most of the cities and towns had an average daily supply of 15.1 hours per day in 1988. In recent years, interruptions in the energy supply have contributed to discontinuity in the operations of an ever-increasing number of systems. Currently in seven provinces (Havana, Villa Clara, Cienfuegos, Camagüey, Las Tunas, Holguín and Granma), the continuity of service is less than 12.0 hours per day and the national average has declined to 13.1 hours per day.

Table 5.12
Average time of water service of the country's water supply systems by province. Comparison with 1988
(figures in hours per day)

Province	Average time of service			
	1988	1991	1992	1993
Pinar del Río	17.0	15.8	15.8	15.8
La Habana	16.7	16.0	14.0	14.0
Cdad.de La Habana	16.0	16.0	16.0	8.0
Matanzas	23.0	21.9	21.8	22.1
Villa Clara	11.5	11.0	8.0	8.0
Cienfuegos	11.4	10.7	9.6	9.1
Sancti Spíritus	20.1	17.4	17.3	15.4
Ciego de Avila	21.4	12.5	12.5	16.0
Camagüey	12.5	21.0	18.0	10.0
Las Tunas	11.5	12.0	5.0	6.5
Holguín	10.6	10.6	...	...
Granma	12.3	13.0	6.0	10.0
Santiago de Cuba	6.9	13.1	12.0	12.4
Guantánamo	19.0	18.0	18.0	18.0
Isla de la Juventud	20.1	10.0	14.0	18.0
Cuba	*15.1*	*14.1*	*13.4*	*13.1*

Source: Supplemental Statistical Information System

The search for alternatives turns out to be somewhat complex: in only 4 cities of the country is part of the supply provided by gravity. Significant capacities in reserve tanks do not exist that would attenuate the effects of electrical outages in a significant way, which means that as far as possible, the system attempts to keep the most important water pumps going without loss of electricity. Other important causes of supply stoppages are caused by deficiencies in the pumping equipment required by most of the systems. The progressive decline in the purchase of this equipment in the last five years, as well as the drop in the supply of spare parts, has reduced the equipment in operation to practically critical levels. A large number of pumping stations do not have backup equipment, which means that substitute equipment cannot be put into service in the event of breakdowns, and prolonged stoppages occur until the equipment can be repaired.

Consumption and demands:

The gross per capita volume delivered by the water supply systems in 1993, which express the ratio between the water extracted from the sources and the population connected to these systems, varied by province from 278 to 632 liters per person per day.

Table 5.13
Average per capita gross volume of water supplied by the provinces in 1988 and 1993
(figures in liters/person/day)

Province	Supply	
	1988	1993
Pinar del Río	561	492
La Habana	525	472
Ciudad de La Habana	513	623
Matanzas	725	632
Villa Clara	537	426
Cienfuegos	687	468
Sancti Spíritus	494	473
Ciego de Avila	546	452
Camagüey	674	532
Las Tunas	283	278
Holguín	347	331
Granma	361	299
Santiago de Cuba	529	343
Guantánamo	585	476
Isla de la Juventud	779	368
Cuba	*509*	*489*

Source: National Institute of Water Resources.

Although this table does not directly provide the real residential supply by including losses from the system and consumption by the industrial, public and commercial sectors, its trends serve to identify the extremes in the supply situation. Four provinces (Las Tunas, Granma, Holguín and Santiago de Cuba) as well as the municipality Isla de la Juventud present per capita averages that are far below the national average. These provinces also have low service levels in their territories, in which significant investments in water supply systems have not been made (except in the city of Holguín) over the last decade. In La Isla de la Juventud the variation indicates a reduction in pumping capacity caused by electrical outages.

The volumes in table 5.13 are excessively high. It is worth recommending here the review of the per capita demand levels for system design established by Cuban Standard NC 53-91: 1983. The requirements are very high, which means that they should be adjusted to current technical, economic and social conditions. As a sample, table 5.14 analyzes the demand and deficit in 11 cities of the country.

Table 5.14
Restrictions on water sources in 11 Cuban cities, 1993
(figures in liters/second)

City	Inhabitants	Water demand	Current supply	Deficit
Las Tunas	130,000	662	210	452
Manzanillo	118,000	601	320	281
Puerto Padre	45,000	244	120	124
Banes	40,000	217	62	155
Placetas	45,000	244	56	188
Guaímaro	20,000	83	40	43
Colombia	20,000	83	30	53
San Luis	25,000	104	79	25
Niquero	19,500	81	25	56
Campechuela	20,000	83	30	53
Guisa	20,000	83	45	38
Total	*502,500*	*2,485*	*1,017*	*1,468*

Source: National Institute of Water Resources.

There are several projects designed to improve this deficit that are still pending or are in process:

- Las Tunas, Puerto Padre and Colombia: Expansion of capacities in sources and conduits by 600, 300 and 200 liters per second, respectively. In Colombia, in addition, the construction of a good part of its distribution network.

- Banes, Placetas, Guaímaro and San Luis: Expansion of source and conduit capacities by 100 liters per second in each one of them, and in Guaímaro, in addition, the capacity of its drinking water treatment plant.

- Granma: Execution of projects in Bayamo, Manzanillo, Guisa, Niquero and Campechuela, which include increases in their source and conduit capacities.

Water quality:

There are currently serious problems with the quality of the water provided to the population due to the operation and maintenance conditions of the systems, and difficulties with the procurement of chemical products for treatment, and equipment and spare parts for the existing installations. Up to 1989, the supply of equipment and replacement parts for these installations was regular and stable. This stability in the supplies allowed the extension of chlorination to practically all of the urban systems and a good part of the rural systems in the country. The continuity of operation of these installations came to exceed 9 out of every 10 days.

The 49 existing drinking water treatment plants in the country have deficiencies in their operations. The sharp decline in the manufacture of aluminum sulfate in the country and the reduction in the national production of chlorine gas have seriously affected the quality of the treatment. Table 5.15 shows the serious decline in the delivery volumes of aluminum sulfate in recent years, and by 1993 only 8% of the demand was covered.

Table 5.15
Trend in the delivery of aluminum sulfate used to treat water in drinking water treatment plants, 1988-1993
(figures in metric tons)

Year	Deliveries	Demand %
1988	4,834	54
1989	3,742	42
1990	3,983	44
1991	2,770	31
1992	1,632	18
1993	730	8

Source: National Institute of Water Resources

Equally critical is the reduction of the production volumes and deliveries of chlorine gas for the water disinfection process. Table 5.16 indicates the drop in the delivery volumes in recent years, so that by 1993 only 44% of the demand was covered.

Table 5.16
Trend in the delivery of chlorine gas to water supply systems for the treatment of water provided to the population, 1988-1993
(figures in metric tons)

Years	Deliveries	Demand %
1988	3,504	98
1989	2,663	74
1990	1,914	53
1991	2,245	62
1992	2,224	58
1993	1,688	44

Source: National Institute of Water Resources

The disinfection of water with sodium hypochlorite has also run into serious difficulties, both in production and in transportation, because of the poor technical condition of the special vehicles required. With respect to calcium hypochlorite, the principal impact has been the short supply caused by the lack of the foreign exchange needed to buy it on the international market.

Cuba's industry has the potential factory capacity to meet the current demand for chlorine gas, aluminum sulfate, sodium hypochlorite and hydrate of lime. However, electrochemical operations have difficulties because of a lack of replacement parts and analyzer equipment; 49% of the stoppages in the chlorine gas installations in 1993 were the result of breakdowns, while in 1988 and 1989 breakdowns caused only 2.8% and 3.8% of stoppages, respectively. The above has affected the continuity of water chlorination, which was higher than 90% in 1988, but has experienced a sharp drop over the last 5 years.

Table 5.17
Continuity of water chlorination
(figures in percentages)

Year	1989	1990	1991	1992	1993
Continuity	89.6	82.2	75.4	71.4	51.0

At the national level, the reduction of the volume of treated water has shown the trend indicated in table 5.18 below.

Table 5.18
Water supplied vs. water treated, by province, 1988-1993
(figures in millions of m³ and percentages)

Province	1988		1989		1990		1991		1992		1993	
	S*	T*	S	T	S	T	S	T	S	T	S	T
P. del Río	75.2	93.2	78.2	91.3	80.9	79.4	80.7	74.2	83.8	68.2	80.1	44.6
La Habana	118.1	84.2	120.8	79.7	120.9	67.6	115.9	70.0	108.9	52.5	107.1	34.8
C. Habana	375.1	99.9	375.2	99.7	417.9	99.7	483.3	99.6	476.4	99.6	477.8	99.2
Matanzas	110.2	89.6	116.8	90.7	118.5	84.4	124.7	79.6	126.7	68.0	128.6	41.3
V. Clara	77.3	93.9	75.9	77.1	75.5	53.9	76.9	58.8	40.5	42.5	75.9	57.2
Cienfuegos	47.4	97.0	50.0	96.6	50.7	95.8	51.3	78.3	48.0	96.7	50.0	95.0
S. Spíritus	38.7	82.2	39.9	80.7	43.1	79.6	45.4	66.2	39.4	66.5	44.7	60.2
C. Avila	34.7	96.1	37.3	87.4	38.6	84.4	42.3	94.6	44.6	71.7	43.5	41.8
Camaguey	83.4	95.5	82.3	71.4	91.2	90.4	91.0	58.0	83.4	78.7	71.0	50.8
Las Tunas	20.3	90.1	22.1	89.6	22.8	81.6	23.9	92.1	18.8	91.5	23.1	84.4
Holguín	43.0	92.5	45.4	87.0	48.3	75.8	52.4	87.7	51.2	63.7	50.7	63.0
Granma	46.7	91.8	51.6	80.3	50.5	75.5	49.2	77.2	46.4	65.1	45.6	61.8
S. Cuba	82.2	95.1	86.0	84.4	89.7	73.7	91.1	71.3	90.8	65.8	100.3	67.0
Guantánamo	77.2	88.2	72.1	84.9	75.5	80.2	76.1	82.2	63.1	56.9	67.6	32.4
I. Juventud	16.5	97.6	20.3	93.0	18.0	95.5	14.9	97.8	19.2	51.9	15.2	98.0
Cuba	1242.6	92.4	1294.5	88.5	1264.0	85.2	1374.7	82.5	1350.0	78.6	1376.2	69.3

* S = Water supplied * T = % Water treated

Source: National Institute of Water Resources.

It is noteworthy that the population that does not have formal water disinfection services resorts to alternative processes, and especially boiling, despite the fact that these processes increase the consumption of fuel and electrical energy. The water treatment problems indicated here, together with the failures in the supply continuity caused by the increased breakdowns of pumping equipment and the increase in unattended leaks, has frequently caused the quality of the water received by the population to be affected in a significant number of systems. This development represents the weakening of one of the areas where the country had succeeded in making notable improvements.

Losses and unmetered water: There is no established technical program to rehabilitate and optimize existing drinking water systems, nor have intensive loss recovery projects been undertaken. The general condition of the systems with respect to their conduit, storage and distribution components, and their deficiencies in established operation and maintenance processes, have caused very high rates of unmetered water, with estimates that vary between 30 and 60% for the various localities. The suppression of leaks in conduits or distribution networks, which require the supply of imported materials, is not limited to significant breakdowns: there are also growing losses of water, low water pressure and additional expenditures on electricity for pumping. The suppression of water leaks, in the thousands, has declined in comparison to 1988, as indicated by the following table:

Table 5.19
Suppression of water leaks
(figures in thousands)

Year	1988	1990	1991	1992	1993
Leaks eliminated	141.4	114.6	112.1	102.0	105.6

Macromeasurement and micromeasurement: The reestablishment of household meter systems was initiated in 1973 in the City of Havana, from a national stream gauge factory with a capacity of 60 thousand units per year. Meters are currently installed in 340,000 dwellings in the city, of which 28% have operating problems caused by a need for repair. The industrial, public and commercial sectors have also been metered. This program has not been extended to the rest of the country.

In the absence of a micromeasurement and distribution control program, the per capita gross volumes mask supply problems. In cities such as Havana, Camagüey, Cienfuegos and Santa Clara, the per capita averages do not correspond with the real supply in substantial areas of the residential sector. This deficient service is not only associated with the supply capacities, but also with imbalances in distribution that are caused by technological problems: diameters of water mains, the closing of circuits

and overconsumption by the largest users in relation to their real demands. Macromeasurement programs have not been established in the supply systems, conduits and principal distribution pipes.

There has not been sufficient stationary equipment to adequately measure sources, which means that the system has depended on portable equipment and precise instantaneous measurements. Under these conditions the operational control of the distribution systems has been totally deficient. Micromeasurement is limited to the City of Havana, with a plan that has been in effect for almost 20 years, Varadero and the State consumers of the cities of Santiago de Cuba, Pinar del Río and Matanzas. The national production of stream gauges and the procurement of accessories for their installation are currently affected, which means that the micromeasurement program has had to be limited to current levels.

Operating and maintenance conditions: As noted previously, there are 1,261 water supply systems in the country that provide household supply. As a complement to the water supply system, there is the distribution of water by tank trucks, with a fleet of 476 vehicles in 1993 that distributed 8.8 million m^3 of drinking water. Distribution capacities for this public service are severely affected and the procurement of replacement parts and accessories (tires and batteries) for the vehicles is currently very restricted: of 515 vehicles, 40% are not able to function for lack of such parts. The support infrastructure for the operation of these services includes 21 workshops for mechanical and electrical repairs, 14 provincial laboratories and 37 treatment control plants. There are currently 26 commissions pursuing pitometric studies and 15 technical groups working on operations.

The pumping of water has been affected since 1991, mainly in urban and rural towns, as a result of the significant drop in the energy and fuel potential of the country. There has been a resulting reduction in the per capita volume of water received by these populations by pipe. Attempts are being made to attenuate some of this impact, especially in the rural sector, through the utilization of alternative devices and the extension of the use of public fountains. To this end, a center has been created for the development of rural water supply and sanitation technologies, which has made it possible to begin to produce two models of windmills, handpumps and a hydraulic ram, as well as a constant charge manual chlorinator and the adaptation of polyethylene irrigation pipes for supply purposes.

In the rural sector, however, the role of water system administrations has been increased. They provide support and promote a program to increase these services among the rural population, contributing to higher prestige in these communities and having a modest impact on peripheral urban areas.

In general, the operating and maintenance conditions of most of the systems are poor and have an impact on the economic problems of the country, the lack of equipment and materials, the age of the systems and their hydraulic conditions, and the deteriorated state of the physical structure of the installations.

5.1.2 *Physical sanitation systems*

Existing systems. In the urban sector there are 384 localities that have some kind of sewerage system. It has been estimated that these systems collected approximately 502.4 million cubic meters of wastewater in 1993, amounting to some 36.5% of the water supply; the remaining percentage was disposed of in septic tanks, or other solutions were used.

Table 5.20
Coverage of sewerage systems by province, 1993

Province	Localities with sewerage
Pinar del Río	21
La Habana	81
Ciudad de La Habana	1
Matanzas	11
Villa Clara	23
Cienfuegos	3
Sancti Spíritus	28
Ciego de Avila	34
Camagüey	46
Las Tunas	22
Holguín	31
Granma	52
Santiago de Cuba	12
Guantánamo	7
Isla de la Juventud	12
Cuba	*384*

Source: National Institute of Water Resources.

Sewerage systems are frequently still incomplete in the most important cities, which means that these systems coexist with septic tank disposal. During the last decade projects to construct collectors were initiated, primarily in provincial capitals. Although at the end of the decade some of these projects were interrupted and others have not completed the installation and connection of their secondary networks, significant growth in the sanitation of the cities was achieved, which still needs to be continued. The population living in rural areas widely uses latrines, with smaller numbers using septic tanks and only some 90,000 with connections to sewerage systems. In the dispersed rural sector (1.6 million people), most of the population utilizes individual sanitation devices, basically latrines.

Waste treatment installations. There are five wastewater treatment plants in the country whose situation is totally critical: in the evaluation that was conducted in 1993, only the María del Carmen plant in the City of Havana was functioning, and below capacity because the sewerage system had not been completed. The remaining plants are out of commission because of equipment failures, the lack of maintenance and operating problems. The total design capacity of the treatment plants in the country is 1,020.0 liters per second, which would represent 33% of the total volume of urban waste treated. However, due to the irregular operation of the plants, only 21.6% of the wastewater evacuated by urban sewerage systems received treatment in 1993, a volume that was even less than the volume treated in 1992.

Table 5.21 shows the list of existing purification plants and their design capacities.

Table 5.21
Wastewater purification plants, 1993

Province	Plant	Capacity l/s
La Habana	Bejucal	150
Ciudad de Habana	María del Carmen	600
	Quibú	100
	Cangrejeras	20
Villa Clara	Santa Clara	150

Source: National Institute of Water Resources.

There are a total of 1,780 stabilization ponds in the country that treat residential, industrial and agricultural and livestock wastewater.

Table 5.22
Stabilization ponds, 1993

	Facultative	Anaerobic	Aerobic	Total
Population	472	60	32	564
Schools	643	22	18	683
Industries	140	63	23	226
Agric. and Livestock	175	122	10	307
Total	*1,430*	*267*	*83*	*1,780*

Source: National Sanitation Bureau.

Facultative lakes are the most numerous and are distributed throughout the entire country; the provinces of Villa Clara, Havana, Matanzas and Pinar del Río have the greatest number. Table 5.23 indicates the distribution by province of existing facultative lakes.

Table 5.23
Distribution of facultative lakes by province, 1993

Province	Facultative lakes No.
Pinar del Río	138
La Habana	141
Ciudad de La Habana	49
Matanzas	140
Villa Clara	142
Cienfuegos	30
Sancti Spíritus	77
Ciego de Avila	47
Camagüey	117
Las Tunas	93
Holguín	109
Granma	91
Santiago de Cuba	75
Guantánamo	78
Isla de la Juventud	103
Cuba	*1,430*

Source: National Sanitation Bureau.

The annual volume of wastewater collected in the sewerage systems in the country in 1993 was approximately 502.4 million cubic meters, of which the estimated volume treated was some 108.6 million cubic meters. Accordingly, the volume treated was only 21.6%, of the collected volume. Of the 108.6 million cubic meters treated during the year, 15 million were treated in the María del Carmen plant and 93.6 million in other systems, basically through a total of 564 stabilization ponds in the country that cover a considerable volume of urban (21.6% of the population), industrial, agricultural, livestock and school wastes.

Coverage and sanitation conditions. The evaluation in the December 1993 National Action Plan estimates the coverages of the sanitation services provided by sewerage systems, septic tanks and latrines. The service deficit in urban areas amounts to 280,000 residents (3.4% of the total urban population). In the rural sector, 740,000 inhabitants do not have any sanitation service (28.0% of the total rural population). Table 5.24 provides this coverage data.

Table 5.24
Sanitation coverage at the national level, 1993
(figures in millions of inhabitants)

Sector	Total population	Total served population	Sewerage %	Septic tanks & latrines %	Total served %
Urban	8.27	7.99	40.4	56.2	96.6
Rural	2.65	1.91	5.2	66.8	72.0
Total	*10.92*	*9.90*	*31.8*	*58.8*	*90.6*

Source: National Institute of Water Resources.

The deficit in these services amounts to some 1.02 million people who lack adequate sanitation. Over the next 10 years there will be a 0.78 million person increase in the population of the country, people who will also require these services.

The sectoral study included a general diagnosis of the conditions and characteristics of the sanitation systems. A qualitative analysis of the coverages provided in table 5.24 should consider the serious problems with the existing systems that require better technical and sanitary solutions. Table 5.25 provides estimates of the coverage with adequate service and inadequate solutions that should be addressed. It has been estimated that 5.4% of the population of urban areas have inadequate sewerage service that requires significant rehabilitation. It has also been estimated that 24.6% of septic tanks and latrines are inadequate considering the current maintenance problems and the need for partially substitutes for sewerage systems. In rural areas it has been estimated that 20% of the current population served with septic tanks and latrines receive service with unsuitable solutions, and it

is necessary to improve the operating and maintenance processes or substitute sewerage systems or other collective disposal solutions for them.

Table 5.25
Sanitation coverage with suitable and unsuitable service
(figures in millions of inhabitants)

Sector	Total population	%	Population with sanitation service (%)					Population without service %
			Appropriate service			Population inappropriate solutions	Total with service	
			Sewerage	Tanks & latrines	Total			
Urban	8.27	75.7	38	31.6	66.6	30.0	96.6	3.4
Rural	2.65	24.3	52	46.8	52.0	20.0	72.0	28.0
Total	*10.92*	*100.0*	*39*	*35.2*	*74.2*	*27.6*	*90.6*	*9.4*

Source: National Institute of Water Resources

Drainage systems. The existing drainage systems are typically in urban areas, and are limited to sections of cities where rainwater runoff surpasses the evacuation and infiltration capacities of the land. Urban drainage projects are relatively expensive. The growing urbanization has increased the demand to protect the population, and provide economical installations and delivery in flood prone areas. In the last decade, drainage works have been built in parts of the City of Havana, Bayamo, Ciego de Avila and to a lesser extent in other cities. These projects have helped relieve the effects of the floods in these areas, although their capacities are not sufficient to protect the large streets which, over the last three years, have increased in number in several cities of the country.

Operations and maintenance. In the districts of cities with sewerage system networks, overflows are caused by the rise of tributaries and obstructions and excessive rain. The removal of obstructions and the reduction of sewer overflows are dependent on the maintenance cycles for sewerage systems and the cleaning schedules for septic tanks. The worst sanitary impacts of limited evacuation capacities are sewer overflows in urban areas, caused by inadequate maintenance and the contamination of watercourses that flow through urban areas or areas along the coast.

Table 5.26
Removal of sewerage obstructions

	1991	1992	1993
Obstruction removals	46,300	60,800	64,900

Source: National Institute of Water Resources

The capacity to clean septic tanks is much lower than the demand as a result of two causes: the technical condition of vehicles, with 40% of them currently out of service for lack of spare parts and tires; and second, the limitation on the availability of fuel. There is also the low operating capacity of a large number of septic tanks because they are too small or there is too little infiltration potential in the soil where they were constructed. These factors cause their cleaning cycles to be too frequent. The dispersed rural population widely uses latrines and, to a much lesser extent, septic tanks. The former are dry and their excavation is the responsibility of users; the cleaning of septic tanks, with the limitations discussed above, is provided by operating companies. Table 5.27 shows the number of tank cleaning trucks and their condition, by province.

Table 5.27
Tank cleaning trucks and their number in service, 1994

Province	Tank cleaning trucks	
	Total	Out of service
Pinar del Río	26	6
La Habana	46	17
Ciudad de La Habana	130	21
Matanzas	12	2
Villa Clara	28	16
Cienfuegos	9	6
Sancti Spíritus	19	10
Ciego de Avila	14	7
Camagüey	40	15
Las Tunas	20	11
Holguín	31	16
Granma	82	46
Santiago de Cuba	41	25
Guantánamo	11	8
Isla de la Juventud	6	2
Total	*515*	*208*

Source: Ministry of Public Health. Hygiene Table

The principal problems affecting the operating condition of plants that treat sewer water and the water in stabilization ponds, have to do with maintenance and the operation of these systems. The equipment in these plants needs to be replaced in order to regenerate their operating capacities.

5.2 Technical, administrative and logistical support

5.2.1 *Management of services*

Over the last three years the administrative reorganization process has been accelerated in the drinking water and sanitation service area. These services are currently administered by provincial water supply and sewerage system bureaus, with municipal administrations and agencies that are dependent financially on the State budget. The revenues of these agencies, which include excess charges for metered water, the supply of water by tank trucks, the cleaning of septic tanks and repair service provided to other entities, covered 24.8% of their administrative expenditures ($79.6 million) in 1992. In May of this year, a decree was issued that authorized charges for water and sewerage services for the entire population, with a specific but sufficient rate to cover administrative expenditures. The application of fees to the State sector (public, commercial and industrial) should be carried out at the same time as they are applied to the residential sector, and while final regulations are studied for the foreign exchange area. These measures have two immediate implications for the administration of these services: a new reorganization, given the weight of the commercial area in the generation of revenues from this sector and, because of the volume of these revenues, the viability of an independent State budget for these entities.

The percentage of university graduates in water supply and sewerage system agencies has seen vigorous growth. The reorganization process, which conferred higher status on their functions, provided for higher wages as well. Both incentives attracted an appreciable number of qualified staff. Of a total of 17,200 workers, 1,220 are professional and mid-level technical staff. From 1990 to 1993, the number of professionals grew from 230 to 456 with the selection of one of its most dynamic components. Although this growth is not sufficient by itself, because some time is required to consolidate the working groups and their specializations, it still represents valuable strengthening of the technical capacity of these agencies for the future.

A necessary step for their improvement is the establishment of service control centers. These offices are linked by telephone or radio with the supply and sanitation systems of the entire province and receive daily information on their operations, giving instructions on operations, pump failures, treatment and distribution, and linking workshop services and technical areas and the movement of supplies. This

information is recorded, processed and stored, for the most part by microcomputer. These offices have been established in all of the provincial bureaus, and, even with their inadequate communication and recording systems, are still facilitating more stable service in all of the systems and improving the levels of operation. The experience of these centers is being expanded to the most important supplies of each province.

However, the pitometric study committees are lagging in their functions. Formed as specialized working groups within the operations area, these committees should carry out systematic source measurement programs, determine the consumption and loss levels of the most important users, update the pipe networks, increase the efficiency of pumping and detect non-visible water leaks, as well as conduct service quality surveys to support the operating programs to put into place in each water supply system. Although these committees have existed in many provinces for more than 20 years, they have not received assistance from operations advisory groups. This lack of support has meant that they must frequently limit themselves to the detection of leaks and the resolution of disputes with users, abandoning their principal tasks of planning water distribution and increasing service quality.

It takes a very short time for the utilization of computer techniques in operating these systems to yield significant results. The recording and processing of operations data has begun, but the use of specific programs for this purpose has not yet been extended to water supply system bureaus. In spite of this, the country has useful programs and procedures and sufficient staff with knowledge of information science languages and systems.

There is a more complicated situation in the rural systems.
Water supply system entities are responsible for administering many of them, but a significant number (approximately 250 systems) are associated with sugar and agricultural companies. Although the latter do not exercise systematic supervision through the branch institution of the sector, local governments frequently function as alternative coordinators in rather effective ways.

5.2.2 *Information systems*

The water supply and sewerage entities have established a system to record primary data on their operations and maintenance. These primary data collection systems are established in each pumping station and treatment installation of the water supply and sewerage systems, and the data is sent to municipal bureaus weekly to be processed. Each provincial territorial bureau records and processes this information and systematically stores the data, usually with the use of microcomputers. A selection of essential data includes the following aspects:

financial, consumption, extension and operating. This information is reported to the national water and sanitation agency, the National Institute of Water Resources. This decentralization of the sector's administrative information accords due authority to the provincial bureaus and also helps to simplify the national statistical system. In turn, the Ministry of Public Health has established a health information system to monitor water potability and sanitation.

The beginning of commercial activity in these entities during this year should expand the universe of data on the sector. In addition, there is no systematic recording of the coverage of an important segment of the population that does not receive services from the water supply and sewerage system entities. Nor is the dispersed rural population included. The current National Action Program for this decade includes in its activities the implementation of a territorial system that would integrate all types of service by population sector, as well as the processing of this data in order to provide a national picture that could be compared with other countries of the Region. This system implies a redesign and reformulation of the current data collection, recording and processing system that would complete its extension and relate it to the reorganization that has taken place in the sector in recent years, and particularly to the recent inclusion of commercial activity.

5.3 Technical plans and programs that have been implemented in the sector

The report on water supply systems, sewerage systems and drainage systems issued by the National Assembly in 1979 established the elements to regulate the sector starting at that time. These regulations consolidated the maintenance program, among others, and identified a specific construction program for these systems. In addition, the regulations facilitated the implementation of the rural water supply program that was initiated during the previous decade, increased the number of students and resulted in the creation of a specialty in hydraulics studies. Other programs, such as the water treatment program, which were already in effect, were also strengthened as a result of the provisions of the report.

The promulgation of the International Decade on Drinking Water and Environmental Sanitation by the United Nations had ancillary effects on the sector. The creation of a national committee and goals for the decade from 1981 to 1990 produced a greater integration of water and sanitation activities and facilitated the implementation of the only collaborative project in this sector with the United Nations System, with UNICEF and the Government of Cuba coordinating a rural program that is still operating. These programs were operating during practically the entire previous decade. At the end of the decade, increasing financial and commercial problems required a reduction in the volume of several of these programs and the reformulation of others.

The current situation of these programs is the following:

Construction program. This program of new construction and repair projects reached annual levels of $48.0 million at constant prices, and represented a doubling of such levels in the 1970s. The public works program was established in all of the provinces, and provided support in such areas as construction equipment, labor and building materials, including the supply of pipes produced in Cuba. This program has been one of the most affected. It is proceeding at barely one third the annual rate of the previous decade and is currently directed to public works that cannot be delayed in order to solve service crises or to supply export or tourism industries.

Preventive maintenance program. In the late 1980s the creation of brigades and workshops was expanded and technologies were introduced for the inspection and repair of pipes. The consumption of maintenance materials averaged US$ 5.0 million for the purchase of fittings, equipment and accessories. The program has been reduced as a result of limits on imported supplies, and, to a lesser extent, on equipment, which has had a direct impact in terms of a reduction in maintenance on the networks and technological equipment. However, the creation of repair workshops has continued to expand. More maintenance and repair work is being performed with the use of available construction capacities and, in the case of certain supplies, alternative solutions are sought. The development of new procedures and technologies, such as chamber inspections and the reconstruction of pipes with cement mortar under pressure (ZMA), has been suspended for lack of the financing needed to purchase equipment and supplies.

Macro and micromeasurement. The function of measuring sources, pipelines and channels has not succeeded in generating a sufficient allocation of stationary equipment, meaning that the system has been dependent on portable equipment and spot measurements. This has slowed down the establishment and updating of distribution plans and supplies for the large water supply systems and has not provided for much application to sewerage systems, because of the limited work capacities of the pitometric study committees. Micromeasurement is limited to sections of a small number of cities. The national production of stream gauges and the purchase of fittings to install them are currently affected; for this reason, the micromeasurement program has had to be maintained at current levels.

Pitometer measurement. Pitometric studies have been conducted in the country for the last fifty years. During seasonal crises caused by drought and overloaded systems, these studies have made it possible to establish distribution plans to attenuate the effects of such contingencies. In addition, these studies have provided for the rational use of water sources and pumping systems, and they can detect water losses and excessive consumption. In the last 30 years, pitometric studies have been carried out in practically all of the provincial capital cities, and controls have been

established on extraction from sources, above all through monitoring of salinity. There are pitometric study committees in all of the service provider entities, with variable degrees of experience in this work. Their programs need to be updated, especially with respect to their relationship to fee collection activities, the efficient use of water and census techniques.

Censuses. The survey and recording of water supply and sewerage system installations was kept updated until the 1960s. Subsequently some attempts were made to update this information on the basis of inventories and operations studies. At least the principal cities have been rather completely surveyed. The census of users and their records, which was one of the unfinished aspects of the survey, has recently been completed as part of the activities to organize the collection of water fees. After the diagnoses of the condition of the installations that were conducted throughout the country in 1979 and 1983, the procedure has only been followed in some systems. The procedure requires the utilization of specialized techniques, for which sufficient equipment is not available. This program still needs to be consolidated in order for it to be applied to all of the entities.

Control of leaks. The reduction of water losses in the water supply systems is one of the activities that has had the greatest effect in improving service levels. The increase in the availability of water for consumption and the reduction of administrative expenditures are associated with macro and micromeasurement, pitometer and maintenance programs. Complete measurements of their magnitude are not yet available, but it has been estimated that losses amount to more than 30% of the water extracted from sources. These losses involve the overuse of water resources, excessive expenditures on electricity and fuel and a deterioration of service levels, especially in the delivery schedules and the per capita quantities of water. The program to repair residential leaks is currently paralyzed by limitations in the production and quality of the sanitary fittings, so that few measures remain to be applied to the residential sector, which is the most numerous. For this reason, these efforts are being directed toward the control of leaks from State users.

Efficient use of water. This program is still in the formation stage. It includes elements and activities of other programs: measurement, pitometers and leak control, for which there are variable degrees of experience in all the territorial service companies. A national prototype of low water consumption sanitary equipment has been produced, but industrial production has not yet occurred. There has been even less progress in the area of regulator fittings. The establishment of the new financial system that develops contractual ties with users should promote the implementation of efficient water use programs as way to reduce administrative expenditures and stabilize service levels. All of these elements need to be integrated within a program that is designed to raise the operating efficiency of these services. This type of

program turn has been particularly well received when used with populations that have experienced some restrictions in their water supply.

Water treatment. This program is one of the oldest existing programs in the country's drinking water sector. The drop in the availability of chemical products, equipment and parts, as explained above, have put the operation of these installations in a critical situation. In recent years, the development and use of water treatment technologies and materials has been promoted, including the use of auxiliary coagulation products and filter materials and the production of equipment chlorinator prototypes. The production of type MOGGOD gas oxidant generating equipment and *in situ* producers of sodium hypochlorite was begun. Their development has been limited by the lack of material support. In rural towns, the use of manual chlorinators and improvements in catchment works have been expanded. In addition, potability monitoring systems are being reformulated, in order to generate greater decentralization to compensate for the limitations on fuel and supplies currently being experienced by treatment control laboratories, 14 in all, belonging to the water supply companies and the 40 public health sanitary monitoring entities.

Rural program. Initiated in the last decade as a DIAPSA activity, during the 1980s this program succeeded in doubling the rural population supplied by household connection, which grew from 0.22 to 0.55 million in 1990. The search for alternative solutions made it possible to reduce program expenditures and adapt to the current limitations on energy and materials. These developments led to the use of more effective equipment and materials, such as windmills, hydraulic rams, handpumps and plastic pipe produced in Cuba from the beginning of the 1990s. In its implementation, more flexible standards than the design and construction regulations established for the urban sector have been used. These regulations make it possible to use shorter design periods, reduce the per capita water volume and the coefficients of irregularity, and use smaller diameter pipes. Together with strong community participation, this has permitted the consolidation and extension of the program to all of the provinces. The rural program receives support from UNICEF through collaboration projects that are renewed every three or four years. The rural sanitation extension program has advanced more slowly due to limited progress in the introduction of improved latrines and other solutions.

5.4 Monitoring and control of water quality

5.4.1 *Institutions responsible for water quality*

Water quality control and sanitary monitoring are carried out by the National Institute of Water Resources and the Ministry of Public Health, and there is close cooperation between these agencies in order to coordinate the results obtained and

decision-making in case sanitary problems should arise. The quality control of treated water is carried out through provincial laboratories and water supply and sewerage system plants. The sanitary control of water is the sanitary monitoring activity that is conducted by the Ministry of Public Health through provincial hygiene and epidemiology centers, the municipal hygiene and epidemiology units and centers and the health areas. This control includes State sanitary inspections and the monitoring of installations where water for human consumption is handled, used or distributed, and of sites where wastewater is generated, treated or evacuated. These activities also include verification of compliance with the hygiene requirements established in the prevailing national sanitary standards. General control over the quality of water sources for all uses and the monitoring of spillages in terrestrial water resources is carried out by the provincial water resource bureaus using REDCAL for monitoring.

Water quality control and drinking water and wastewater sanitary monitoring programs have been in operation for the last three decades. However, monitoring activities have declined because of a lack of reagents, culture media and other materials needed by the various techniques, and also because of the breakdown of laboratory equipment, lack of replacement parts, batteries and tires for vehicles, the scarcity of fuel and electric power problems. This situation, which has developed over the last three years and has become acute since 1993, is reflected in the size of the population that received no sanitary monitoring during the past year.

Table 5.28
Population supplied with water without bacteriological control in 1993, by province

Provinces	No. inhabitants	%
Pinar del Río	31,083	6.6
La Habana	b95,238	99.5
Ciudad Habana	...	...
Matanzas	15,745	4.9
Villa Clara	...	...
Cienfuegos	18,064	7.3
Sancti Spíritus	1,400	0.7
Ciego de Avila	60,478	56.3
Camagüey	51,815	15.9
Las Tunas	43,266	18.5
Holguín	116,427	23.9
Granma	235	0.1
Santiago de Cuba	...	...
Guantánamo	...	...
Isla de la Juventud	1,250	2.1
Cuba	*936,001*	*12.5*

Source: Ministry of Public Health.

5.4.2 *Factors that cause declines in water quality*

Most of the water systems of the country are supplied with groundwater, and in general their bacteriological quality is considered good. Of the total water supplied, 26.5% is from surface sources and some of them have serious problems. The real difficulties result from deficient treatment of surface water for lack of resources. There are also problems with disinfection, the current condition of water and sewerage networks and discontinuous service, among other problems, which sometimes prevent water of the required quality from reaching the population.

5.4.3 *Morbidity and mortality from waterborne diseases*

Beginning in 1990, the difficult international situation that Cuba has faced has had adverse repercussions on the national economy and, particularly, on the equipment and resources available to the water and sanitation sector. For this reason, a gradual deterioration in the sanitary conditions of the country is taking place, which is more accentuated in certain provinces. These developments have also brought:

- Problems in the water supply and the lack of chlorine treatment, on occasions;
- Improper treatment and final disposal of liquid wastes;

- Inadequate collection and final disposal of solid waste;
- Increase in infestation rates from vectors.

As a result of these situations, changes have taken place in the morbidity and mortality from communicable diseases over the past four years. In both absolute numbers and rates there has been an increasing trend for typhoid fever, dysenteries and hepatitis A, especially, which have almost tripled their rates. Among other things, these increases mirror the deterioration in water quality caused by insufficient disinfection, ruptures and accidents in conduits, limited maintenance, etc. Although the country has continued to make efforts to counteract this situation, the situation may get worse if the essential financial structure is not provided to carry out the policy to maintain the coverage and quality levels that have been achieved, including the implementation of other activities, primarily in new communities.

Table 5.29
Incidence of waterborne diseases, 1989-1993

Disease	No.				
	1989	1990	1991	1992	1993[a]
Typhoid fever	48	59	100	53	256
Bacillary dysentery	...	285	209	450	179
Amebic dysentery	...	356	475	939	1,660
Dysenteries (subtotal)	...	641	684	1,388	1,839
Viral hepatitis A	2,570	5,834	19,863	21,180	12,150
ADD[b]	888,318	1,062,633	1,179,872	1,095,275	1,115,616

[a] Provisional
ADD: Acute diarrheal disease
[b] (medical consultations)

Table 5.30
Morbidity rates from waterborne diseases, 1990-1993

Disease	1990	1991	1992	1993[a]
Typhoid fever[b]	0.5	0.9	0.5	2.0
Bacillary dysentery[b]	3.0	2.0	1.0	1.6
Amebic dysentery[b]	3.0	4.0	9.0	15.2
Dysenteries (subtotal)[b]	6.0	6.0	10.0	16.8
Hepatitis A[b]	50.0	190.0	190.0	110.0
ADD[c]	100.2	110.3	101.2	102.3

[a] Provisional
[b] Rates per 100,000 inhabitants
[c] Cases seen in consultations, rate per 1,000 inhabitants

Source: National Bureau of Statistics. MINSAP

The number of medical consultations for ADD is high throughout the country, basically in adults, where the trend is rising. ADDs consume great quantities of material resources on an annual basis.

Table 5.31
Mortality from acute diarrheal diseases, 1962-1993
(Rates per 1,000 inhabitants)

Year	Deaths	Rate	Total %
1962	4,157	0.57	8.2
1970	1,510	0.17	2.8
1975	637	0.06	1.3
1980	307	0.03	0.6
1985	437	0.04	0.7
1989	285	0.03	0.4
1990	378	0.04	0.5
1991	433	0.04	0.6
1992	452	0.04	0.6
1993[a]	743	0.07	1.0

[a] Provisional

Source: National Bureau of Statistics, MINSAP.

With regard to mortality and morbidity from ADD, a slightly rising trend began in 1990. This rising trend pertained to adults, and is currently a health problem for those older than 65 years of age. It should be noted that mortality from ADD in children is lower than the goals for the sector for 1995. This contradictory behavior of ADD with respect to both morbidity and mortality in children under 15 years of age in relation to the marked reduction in water quality, is explained by the priority status accorded to child health care programs and in general, the level of sanitary care provided by parents to their children, and specifically the boiling of water for small children, even with the shortage of fuel.

5.4.4 *Patterns of waterborne diseases by province*

In general, the behavior of waterborne diseases varied from province to province, as can be observed in Table 5.32 below, and is linked to maintenance and to the current condition of the drinking water and sewerage systems, among other factors.

Table 5.32
Incidence of waterborne diseases by province, 1993

Province	Typhoid fever		Bacillary dysentery		Amebic dysentery		Viral hepatitis A	
	#	%	#	%	#	%	#	%
Pinar del Río	.	...	...	...	577	34.7	480	3.9
Habana	...	...	...	...	11	0.6	2,813	22.1
Ciudad Habana	1	0.3	...	...	13	0.7	4,388	36.1
Matanzas	7	2.7	..	...	..	...	894	7.3
Villa Clara	48	17.9	5	2.7	77	4.6	1,376	11.3
Cienfuegos	1	0.3	...	...	918	55.1	227	1.8
Sancti Spíritus	..	0.7	12	6.7	1	0.06	111	0.9
Ciego de Avila	0	..	1	0.5	...	...	288	2.3
Camagüey	...	1.5	126	70.3	...	...	150	1.2
Las Tunas	0	...	...	...	8	0.4	33	0.2
Holguín	3	1.1	1	0.5	...	...	394	3.2
Granma	1	0.3	...	...	56	3.3	189	1.5
Santiago de Cuba	180	70.3	34	18.9	1	0.06	578	4.7
Guantánamo	1	4.2	...	...	...	...	117	0.9
I.de la Juventud	..	...	..	...	...	...	110	0.9
Cuba	*256*	*100*	*179*	*100*	*1,690*	*100*	*12,150*	*100*

Source: National Bureau of Statistics, MINSAP.

There were six outbreaks of typhoid fever in the country during the year, in all cases resulting from water contamination.

Table 5.33
Incidence of outbreaks and numbers of cases of typhoid fever by province, 1993

Province	No. outbreaks	No. cases
Matanzas	1	4
Villa Clara	3	38
Guantánamo	1	6
Santiago de Cuba	1	180
Total	*6*	*228*

Note: The 28 remaining cases were isolated.

Source: National Bureau of Hygiene, MINSAP.

Of the typhoid fever cases recorded in the country, 89.1% were linked to local outbreaks, with the greatest incidence in the province of Santiago de Cuba as a result of water contamination caused by a construction accident. This province was responsible for 70.3% of the cases at the national level, significantly raising morbidity from 0.5 in 1992 to 2.0 in 1993.

6. SOCIAL COMMUNICATION AND COMMUNITY PARTICIPATION

6.1 Introduction

The educational and mass communication activities related to water and sanitation have been given a multisectoral approach and have been part of agency, organization and institutional plans. In Cuba, there are administrative, government, education and media structures, as well as political and broad-based organizations that facilitate mass communication and community participation in drinking water and sanitation projects and services. Citizens are able to participate and influence the decision-making process and help solve their community problems through a broad system of mass organizations including:

- Committees in Defense of the Revolution (CDR)
- Federation of Cuban Women (FMC)
- National Association of Small Farmers (ANAP)
- "José Martí" Pioneer Organization
- Other nongovernmental organizations

It is estimated that with these elements and other material assistance, sector plans and projects can be undertaken with real possibilities of success.

6.2 Community participation mechanisms

Community participation in the presentation and solution of sector-related problems is channeled through an administrative and government structure at the municipal level. At the community level, participation is effected through community councils that operate in small neighborhoods or areas (see annex C.2).

In these councils, which are comprised of delegates that are elected by the people, work plans are developed that address the principal activities, tasks and problems of the community. The representatives of the State sectors to this level, as well as agency and organization representatives, are involved in and assume responsibility for carrying out these plans. The citizens of each community express their problems and demands openly in assemblies, and also individually to their representatives (delegates). These delegates must report on their management periodically to the community assemblies.

The institutional sector at the community level is represented by these delegates from community councils (neighborhoods), political agencies, educational institutions (schools), and cultural and recreational, etc. organizations. The non-institutional sector is represented by various community organizations such as the CDR, the FMC and other nongovernmental organizations and by the citizens who live in the community itself.

This politico-administrative and organizational structure of the country at the community and municipality level (in the cities and in rural areas) provides for the execution of drinking water and sanitation plans, projects and programs with community participation. In addition, the educational level of the Cuban population, both urban and rural, facilitates the assimilation of information, its processing in order to implement activities, and the search for alternatives to resolve local drinking water and sanitation problems.

6.3 Physical planning

In the execution of these plans, assistance is available from municipal planning agencies, materials are provided by State companies, technical services are contributed, and citizens provide labor and other skills that can respond to problems. This form of community participation facilitates and makes viable the execution of plans and projects that are related to the sector.

Given the importance of community intervention in improving water and sanitation services, it has become necessary to implement mechanisms to facilitate their participation in local water and sanitation projects. These projects should have strong community self-management components, and benefit from local resource allocation policies. The participation mechanisms can take various forms, depending on the phase, content and objectives of the local water and sanitation projects, as well as on the structure of the organizations and available local resources. Various possibilities and forms have been explored in order to incorporate the community into the solutions to their environmental problems.

With respect to jurisdictional transformation processes (physical planning), various mechanisms are researched in order to optimize the use of local resources. These mechanisms are based on organization, state and community structures in which the basic element is the council delegate, elected community leaders who represent their constituents and have the support of local and neighborhood organizations (community council, CDR, FMC, family physicians, etc.), and with the authority to mobilize the community to undertake projects to improve their environment.

Certain projects have succeeded in garnering community participation in tasks such as:

- Rapid diagnoses of water and sanitation problems;
- Leak inventory and control.
- Maintenance of stormsewer drainage ditches and systems;
- Execution of small public works to improve the local water supply;

- Construction of light structures to evacuate wastewater;
- Support for local, low-cost urbanization projects;
- Evaluation of the local water and sanitation management process.

Despite this recently created support structure (community councils), the councils need to be strengthened: they need trained social communicators and material support in order for them to make their messages, communication and information more effective through attractive and innovative media.

6.4 Health education and institutional dissemination

Women actively participate in the projects through their basic organization, the FMC, or as citizens involved in community tasks. Currently the FMC has a network of women's houses and family education programs that, closely connected to health specialists, undertake environmental education work. The sanitary FMC brigade workers do direct personal work with families on:

- Improving the hygienic conditions of housing;
- Mobilizing women, children, young people, adolescents and the population in general in order to undertake environmental sanitation work;
- Providing education on methods of disinfecting water;
- Communicating the need to boil drinking water for the whole family, and especially for children;
- Identifying the diseases that are transmitted through contaminated water;
- Learning techniques to conserve and treat water;
- Eliminating standing water.

The National Health System has a network of national, provincial and municipal health education and promotion centers whose fundamental objective is to induce the population to reflect on self-care with respect to individual and community health, actively participate in the solution of their health problems, and consciously adopt more healthy lifestyles. Environmental health topics have always been a priority within the educational strategy of the health sector, either directly or as essential elements in the control of water-borne diseases.

The Ministry of Education works to introduce the environmental dimension into all curricula in three ways: environmental education of teaching staff, environmental focus of the content of textbooks and programs, and the development of teachers' aides and extracurricular activities. The curriculum has programs, methodological orientations and textbooks that introduce content on water quality and protection. Extra-curricular activities also deal with and reflect on drinking water and sanitation topics extensively.

The mass media of the country, including national television and radio, reach the entire national territory and transmit programs, educational messages, etc. that provide for the dissemination of information about the problems of the sector. From the point of view of territorial coverage, there are practically no silent areas, given that the mass media have covered 96% of the country since 1970 (see annex C.1).

The foregoing does not mean that these media constitute a system or a generalized practice throughout the entire country, or that they are exempt from errors and do not need strengthening to make them more effective and expand them to a larger number of communities in the country.

6.5 General considerations. Strengths and weaknesses

6.5.1 *Strengths*

- State institutions and community agencies and organizations, as well as citizens and natural leaders, participate in the development of water and sanitation plans;

- There are public companies that participate directly with the communities in the solution of technical problems, concerning planning, materials, etc., to the extent of their capabilities and in accordance with conditions in the country at the time;

- The general educational level of the people is high;

- The communities work to find local solutions that rely on their own resources, contributing their labor and also participating in decision-making;

- Group participation is organized in order to implement sector projects;

  Individuals have the right to think freely, criticize and exert pressure on local government agencies or institutions when there are unjustifiable obstacles to the execution of plans and projects or certain of their elements or parts;

  Hygiene and health programs receive general dissemination through mass media and the schools;

- There are no major obstacles to implementing programs, organizing leadership or implementing appropriate hygienic practices;

- Women get involved in all aspects of the management and execution of sector plans and projects and in particular are organized as sanitary activists of the FMC.

6.5.2 *Weaknesses*

- The community work that facilitates the specialized intervention of community workers to strengthen the community should be improved in order to more accurately identify the felt needs of the population, and to identify and promote natural leaders and community awareness activities;

- There should be better coordination between the work of institutions and the work performed by community organizations and the people in order to make sector programs more effective;

- Community education needs more material support (resources). These resources are related to the preparation and training of community activists and communicators, the delivery of workshops and seminars that involve various kinds of support materials, the expansion of radio and television programming, the publication of books, pamphlets, posters, etc.;

- It is necessary to ensure the coordination of health education messages that are related to the sector, through television, radio and other media;

- The awareness of the population should be increased with respect to water conservation;

- Community participation in the solution of problems related to the supply, conservation, treatment and final disposal of wastewater and solid waste has not reached the level desired outside of specific projects;

  There is insufficient intersectoral coordination on water and sanitation topics with respect to the mass media;

- The efficiencies and results obtained by the communities have only been evaluated in certain specific sector programs.

As is obvious, community participation can be carried out with greater probabilities of success in small rural and semiurban communities. However, such participation needs greater strategic and organizational effort in the cities.

6.6 Final considerations

The organizations, human resources and educational level of the community needed to confront water and sanitation problems are present. However, sector programs and projects should be broadened and extended. In this respect, the population needs to achieve a higher level of awareness by strengthening the dissemination of this information through radio and television. In addition, the mechanisms of interaction between local governments, institutions, State agencies, community and policy organizations, NGOs and the community need to be improved in order to make administration, management and community participation more efficient. Financial and material resources are needed to take advantage of the cumulative potential of the population, in order to make more effective use of mass communication and community participation in the water and sanitation sector.

7. FINANCIAL ANALYSIS

7.1 Size of the sector

Table 7.1 shows some of the most significant current items in the State Budget, as well as items related to the water and sanitation sector.

Table 7.1
Most significant current expenditures in the State budget
(figures in millions of Cuban pesos)

Budgeted expenditures	1990		1991		1992	
	$	%	$	%	$	%
Current expenditures						
Total budget	7,371.1	100.0	6,367.1	100.0	6,192.2	100.0
Spending on the water and sanitation sector	4,006.1	54.3	3,893.4	61.1	3,825.1	61.8
Education	1,619.5	22.0	1,504.6	23.6	1,426.7	23.0
Public health	937.4	12.7	924.9	14.5	938.3	15.2
Social security	1,164.1	16.0	1,225.7	19.3	1,348.0	21.8
Community administration	284.1	3.9	238.8	3.8	212.1	3.4
. Water and sanitation service	86.0	30.3	82.6	34.6	79.6	37.5
. Other	198.1	69.7	156.2	65.4	132.5	62.5

Source: State Budget Report. 1990, 1991 and 1992.

The current allocation that the State Budget targets to community administration includes water and sanitation services and other community activities that help improve the standard of living of the population and its surroundings. In 1992 community administration represented 3.4% ($212.1 million) of the total budget. Within the community administration allocation, 37.5% was targeted to the water and sanitation sector in 1992. However, the funds allocated to the water and sanitation sector represent little more than 1% of the total budget and, as can be seen, are minimal when compared with other activities financed by the budget, such as, for example, education and social security.

The table shows that the funds allocated to public health represent 15% of the 1992 budget. Thus, given the interrelationship between the sectors, the resources and achievements of this system could be increased even more through increases in the resources targeted to the water and sanitation sector, yielding additional benefits. In addition, to the current budget can be added the capital investments that the State Budget makes directly in community administration, and which in recent years have amounted to little more than $200 million. A part of this figure was allocated to the water and sanitation sector. During the period from 1986 to 1991, the annual average investment in water supply and sanitation projects was $30 million.

Table 7.2 shows the composition of the current budget for the water and sanitation sector broken out into its principal elements.

Table 7.2
Current budget of the water and sanitation sector
(figures in millions of Cuban pesos)

Budget group	1990		1991		1992	
	$	%	$	%	$	%
Water system service	54.2	86.3	52.5	87.2	53.8	90.0
Water pipe service	8.6	13.7	7.7	12.8	6.0	10.0
Total water service	*62.8*	*73.0*	*60.2*	*72.9*	*59.8*	*75.1*
Septic tank cleaning	3.1	29.5	2.6	26.5	1.1	13.9
Sewerage	4.0	38.1	4.1	41.9	4.0	50.6
Urban drainage	3.4	32.4	3.1	31.6	2.8	35.5
Total sanitation	*10.5*	*12.2*	*9.8*	*11.9*	*7.9*	*10.0*
Other	12.7	14.8	12.6	15.2	11.9	14.9
Total	*86.0*	*100.0*	*82.6*	*100.0*	*79.6*	*100.0*

Source: State Budget Report, 1990, 1991 and 1992.

This table shows that the most of the sector's resources are concentrated on the water supply system with around 75% of the allocation. This area has the greatest number of workers and the greatest expenditures on electricity and materials, among other items. The table shows that over these three years during which the North American blockade of Cuba intensified, there was a significant reduction in the funding allocated to these elements due to greater limitations on the purchase of material resources from the exterior.

In accordance with the country's current budget organization, the budget groups as expressed in this table are a synthesis of the financial allocations related to specific programs. In turn, the allocations to these groups are duly classified into titles and line items that better define their contents, such as, for example, wages, food, energy, materials and services, etc. In Annexes D.1 to D.5 of this report, the financial resources expended by the provinces of the country are presented in the five principal groups that comprise this sector.

7.2 Sectoral financing

Water system and sanitation service in Cuba are currently financed by the budget units of each provincial water supply and sewerage system bureau in the country, each of which controls the expenditures of their municipal establishments. With the disappearance of socialism, the collapse of the USSR and the intensification of the North American blockade, making Cuba's normal access to the international markets very difficult or impossible under current circumstances, and after more than three years where it has not been possible to provide this sector the minimum essential resources to maintain pumping stations, networks and conduits, specialized transportation equipment and water disinfection equipment, critical problems with these services have begun to appear, which have been aggravated by power outages. All of these factors have created inconveniences for the population and have been the object of proposals in the Constituent Assemblies. In the last five-year period, during which stable trade relationships were maintained with the now defunct socialist countries, approximately US$ 4 million was allocated for the purchase of material resources, supplemented by imports from socialist countries, all of which provide an adequate response to the resources needed to operate and maintain the systems of the sector.

Cuba's drinking water and sanitation sector is completely public although, because of the economic transformations in the country, the participation of external capital in these services has not been ruled out. This participation should be developed in viable ways within the conditions of Cuba's economy.

Once per year the Ministry of Finance and Prices proposes the budget figures for each jurisdiction for the following year, in accordance with the draft directives provided for the sector by the State. These figures are communicated to each of the jurisdictions through the provincial finance and price bureaus, they are analyzed by the water system bureaus and the jurisdictional governments and discussed with this Ministry. Subsequently, the reconciled figures are submitted for the definitive approval of the National People's Assembly. The estimates and projections for the following year are made on the basis of the actual expenditures from prior years, using unit expenditures and planned activity levels. For this reason, in the planning of these allocation levels, data is used on the population with covered needs and the potential for new investments and services.

With regard to capital investments, the process to determine the need for new construction or the repair of existing installations is based on the results of the efficiency indicators that are used to characterize and measure these activities, which are generated in the delivery of services, or in their absence for lack of the necessary installations. This entire process is based on the planning of medium and long term investments, starting from information on the current situation. The construction

programs are planned for each territory over a five to ten year period, and determine the increased standard of living of the population that will be achieved by operationalizing these installations. These proposals are made by the operating units of the service, and are discussed and analyzed in the various administrative agencies. Subsequently, this draft is sent to the Ministry of Economy and Planning and to the National Institute of Water Resources, which evaluate their technical, financial and economic viability, in order to be approved and included in the economic plans as appropriate. The only source of financing for all capital investments is the State budget.

There is no counterpart external financing to complement national efforts, except for the collaboration of UNICEF in the rural sector during the period from 1980 to 1992 that totaled US$ 1.2 million and which, supplementing the total of 17.1 million pesos in national investments, has a large impact on the supply of the water supply to the rural sector. Similarly, the Ministry of Public Health receives specific collaboration from WHO and PAHO but, as is to be expected, these resources are basically targeted to other objectives of the Ministry and only a small portion affects this sector, for example, through PAHO's Environmental Health Program (HPE).

7.3 User fees, rates and rate setting

The fee systems for water service that are used in Cuba have always been linked primarily to the value of the real property served, depending on the quantity of residential installations and the number of faucets in each dwelling. Since the 1950s, meter programs have been implemented but have never been completed.

The charging of fees for water was eliminated in the middle of the 1960s, and in 1976 a program was established to utilize meters primarily in the residential sector, in the City of Havana. The central objective of the program was to promote water conservation through the type of fees that were established. This system was extended to some 360,000 dwellings (almost 70% of the total), but has currently leveled off as a result of the breakdown of stream gauges that have not been able to be replaced under current conditions. In 1989, a meter program was also begun in Varadero, which currently encompasses more than 80% of the dwellings, with a satisfactory reduction in consumption, and with the same rates charged as for the City of Havana.

The measurement and fee system in the residential sector of the City of Havana and Varadero consists of delivering 100 liters per capita per day free of charge and, above this level, the dwelling is charged at a rate of 50 cents per m^3 from 101 to 150

liters, 75 cents per m^3 from 151 to 200 liters, and $1.00 per m^3 above 200 liters. The fundamental objective of this rate structure was to save water, not to generate income from the services provided.

Currently, and as a part of the cleanup of the country's internal finances, it has been decided to charge for household water service using a fixed monthly rate of $1.00 per person, and increasing by $0.30 for sewerage service. The dwellings that have meters will continue to pay using the above rate system. The implementation of this system to allocate costs to water and sanitation system activities will make it possible to set rates with a view to the self-financing of the sector.

Starting from the month of October of this year, all residential users of the country will be charged, as explained above, which will mean revenues of around $100 million annually. Considering that the sector's current expenditures are around $80 million, it will be possible to study a self-financing system and free up the budget from providing subsidies to this area.

The rates charged for water and sewerage service were proposed by the National Institute of Water Resources and the Ministry of Finance and Prices, and approved by the Government Administration. The entire billing and collections process for the metered system, as well as the system that will be initiated in October, is mechanized and the fees will be collected by staff who will visit user residences. The system to begin in October, which is currently in the preparation stage, anticipates a system of charges for late payments and a program of measures to prevent payment evasions. Given that the monthly minimum wage of the workers in the country is $100.00, the anticipated rate represents a small percentage of this wage.

7.4 Composition of the sector's budget

The fundamental strategy to achieve the targets of the National Action Program consists of using other alternative solutions that are adapted to Cuba and accepted internationally, in addition to traditional solutions for household water and sewerage service. They include public water service and easy access, as well as the individual disposal of excreta by means of septic tanks and sanitary latrines. These alternatives make it possible to attain rapid growth in coverage and facilitate progress toward better forms of service. Table 7.3 below provides the projected revenues and expenditures for the sector over the next 6 years.

Table 7.3
Revenue and expenditure budget for the sector
(figures in millions of Cuban pesos)

	1994	1995	1996	1997	1998	1999	2000
Revenue	40.3	130.0	132.7	135.4	138.0	140.7	143.4
Net result	-43.1	40.4	38.1	36.8	36.4	36.0	35.6
Resources generated	-29.8	53.7	55.1	56.5	57.9	59.3	60.6

Note: The 1994 revenues only figure in 3 months of billing customers using the fixed rate.

Annex D.6 includes detail on the revenues and expenditures for the sector over the next 10 years.

With respect to the financing needed for the investments over the next years, it is worth distinguishing two large groups of projects: urgent projects that should be carried out immediately, and projects that should be implemented over the medium and long term.

7.4.1 *Investments and total estimated financing needs for the sector*

The sectoral study performed a preliminary estimate of the financial resources needed to repair the existing systems, with a view to increasing the service levels and in order to respond to the National Action Plan. This estimate resulted in a requirement of US$ 1,390.00 million over the next 10 years: US$ 643.08 million for the system rehabilitation program and US$ 747.30 million for the National Action Plan. With respect to the first objective, a group of priority projects has been identified that are described in chapter 10.

Table 7.4
Estimated investments for priority projects
(figures in millions of US$)

Project name	1995-2000			2000-2004		
	Total	National	External	Total	National	External
a) Repair						
1. Repair and additions to water supply systems	20.56	9.99	10.57	...	...	...
2. Maintenance improvements and additions to existing sanitation structures	33.10	23.63	9.47	18.30	17.50	0.80
3. Recovery and extension of the treatment levels of the water provided to the population	4.97	4.32	0.65	...	...	...
4. Repair of the Venta water supply conduit	1.80	1.00	0.80	...	...	...
b) Extension						
5. Drinking water supply and sanitation to the rural population through the use of alternative technologies	5.92	4.17	1.75	...	...	...
6. Community promotion and participation in water and sanitation activities and their incidence on health	8.00	4.55	3.45	...	...	...
c) Operational development						
7. Optimization of principal water system operations through the use of modern measurement, diagnostic and automation techniques	10.22	6.99	3.23	...	...	...
d) Support						
8. Program to control and monitor water quality for human consumption	3.83	3.01	0.82	...	...	...
9. Management and technical development program	1.31	0.20	1.11	...	..	...
10. Enhancement of the national information system on the sector	0.12	0.06	0.06	...	...	...
11. Implementation of micromeasurement and fees in the principal cities of the country	0.12	0.07	0.05	...	..	...
12. Reorganization and updating of the sector's system of standards	0.12	0.07	0.05	...	..	...
13. Development of the sector's cost system within the scope of the budget unit	0.12	0.09	0.03	...	...	
Total	*89.99*	*58.15*	*31.84*	*18.30*	*17.50*	*0.80*

7.4.2 National Action Program

Estimates have been made of the investments needed to fulfill the goals of expanding and increasing drinking water and sanitation services as indicated in the National Action Program, whose scope was described in previous chapters of this document. Over the next 10 years, approximately US$ 747.4 million needs to be invested. Table 7.5 below offers a general description of the anticipated investments.

Table 7.5
Estimated investments in drinking water services
Goals of the National Action Program
(figures in millions of US$)

No.	Item	1995-1999	2000-2004	Total
1.	*Urban sector*			
	Household supply to 1.5 million inhabitants and public service to 400,000 inhabitants	94.5	281.4	375.9
2.	*Rural sector*			
2.1	Water supply with household connections for 260,000 inhabitants of the settlement population	10.8	32.1	42.9
2.2	Water supply with public service to 76,000 inhabitants of the settlement population	1.6	4.9	6.5
2.3	Water supply with household connections for 125,000 inhabitants of the dispersed population	3.3	9.9	13.2
2.4	Water supply with public service to 460,000 inhabitants and easy access to 130,000 inhabitants. Dispersed population	10.8	32.0	42.8
	Rural subtotal	26.5	78.9	105.4
	Total	*121.0*	*360.3*	*481.3*

Table 7.6
Estimated investments in sanitation services
Goals of the National Action Program
(figures in millions of US$)

Nº	Item	1995-1999	2000-2004	Total
1.	*Urban sector*			
	Sewerage service to 900,000 inhabitants and maintenance of septic tanks and sanitary latrines for 50% of the urban population	56.7	168.8	225.5
2.	*Rural sector*			
2.1	Sewerage service to 100,000 inhabitants of the settlement population	4.3	12.3	16.5
2.2	Septic tank and latrine service to 105,000 inhabitants of the settlement population	2.6	7.8	10.4
2.3	Sanitary latrine service to 345,000 inhabitants of the dispersed population	3.5	10.2	13.7
	Rural subtotal	10.3	30.3	40.6
	Total	*67.0*	*199.1*	*266.1*

Note: Calculated at a rate of US$ 1 = $1.

Table 7.7
Summary of investments in drinking water and sanitation
Goals of the National Action Program
(figures in millions of US$)

Item	1995-1999		2000-2004		Total	
	US$	%	US$	%	US$	%
Drinking water	*121.0*	*64.4*	*360.3*	*64.4*	*481.3*	*64.4*
Urban sector	94.5	78.1	281.4	78.1	375.9	78.1
Rural sector	26.5	21.9	78.9	21.9	105.4	21.9
Sanitation	*67.0*	*35.6*	*199.1*	*35.6*	*266.1*	*35.6*
Urban sector	56.7	84.6	168.8	84.8	225.5	84.7
Rural sector	10.3	15.4	30.3	15.2	40.6	15.3
Total	*188.0*	*100.0*	*559.4*	*100.0*	*747.4*	*100.0*

The estimated general values in the above three tables were obtained on the basis of reference values obtained from the IBRD, PAHO and local studies, in order to calculate the cost of services per inhabitant in the urban and rural sectors. Details on these calculations are provided in annexes D.7 and D.8.

7.4.3 *Total financing needs for the sector*

In accordance with the analysis and calculations performed above, financing is needed for the operations of the sector and in order to ensure investments. These needs have been planned for in the following way:

Table 7.8
Total estimated investments in the sector
(figures in millions of US$)

Item	1994-1999		2000-2004		Total	
	US$	%	US$	%	US$	%
Repair programs	471.15	73.3	171.93	26.7	643.08	46.3
National Action Program	187.90	25.1	559.40	74.9	747.30	53.7
Total	*659.05*	*47.4*	*731.33*	*52.6*	*1390.38*	*100.0*

Annex D.7 contains a detailed description of the investments to be made annually, and the resources needed to finance the sector.

8. KEY CRITICAL ISSUES

Through the work of the groups, important aspects have been identified that affect the development of the drinking water and sanitation sector and that are fully treated in the various chapters of the report. It should be noted that almost all of the institutions that participated agreed in their analysis. In addition, in most cases, the diagnosed problem was fully known to the institutions and people who are most directly responsible in the sector, even prior to the realization of this diagnosis. This is why there is agreement on the actions to take to resolve the most urgent issues identified here, which the Government and sector authorities are carrying out. All of this activity is constrained, of course, by the financial limitations that the country faces.

8.1 Critical technical issues

In the last five years there has been a progressive deterioration in the quality of services provided to the population with drinking water and sanitation systems. Of the various critical technical aspects, water treatment is very important because of its seriousness and the implications it has for the health of the population. In addition, the reduction of service stability and continuity is problematic in water supply systems with household connections, which supply 7.72 million people. They require the repair and reequipping of pumping systems, the continuation of current measures to protect the energy supply to these systems, better maintenance of conduits and distribution networks, and an improvement in operating conditions and methods. Moreover, the cleaning cycles of sewerage systems and septic tanks are affected by the technical condition of the vehicles used for this purpose.

It is essential to make investments in the sector in order to replace worn system components, deal with growth rates and urbanization, and address the sanitation needs of peripheral areas of the cities. Although the demand for drinking water in the rural sector is receiving some level of response through current programs, these programs need to be strengthened, above all with respect to sanitation. In addition, there is also the need to establish a program to provide current technical information on operations and maintenance, as well as modern managerial methods to line staff and managerial staff who carry out these functions. Lastly, the system to monitor water treatment, drinking water quality and wastewater quality needs to be strengthened, reorganized and completed to include the entire sector.

8.2 Critical institutional issues.

- Limitations on the support infrastructure and material resources that affect the management of the water and sanitation system operating entities. These limitations are generating weaknesses in the sector's operating entities, affecting credibility and creating a poor image because of the limited capacity to respond to the demands of the population;

- National system to standardize the sector, from design all the way up through exploitation, without unified standards. The prevailing standards are not up to date with respect to international trends;

- Insufficiency of the sector's National Information System for planning and decision-making;

- Lack of a comprehensive staff development program for the sector, with an emphasis on the specialization in sanitary engineering, managerial training, recertification and staff retraining;

- Limited opportunities to interact with external institutions that are related to the sector.

8.3 Critical financial issues

- Need to finance and monitor the execution of investments in order to maintain the existing infrastructure and increase coverage, in accordance with planning for both the timeframes and quality of execution. Although there is a long-term investment program, planning has not been completed in time, basically because of the lack of foreign exchange resources that has been aggravated by the economic and commercial blockade of the country, and there are now critical problems with the operations of the water and sanitation sector;

- Deficient cost system by area of responsibility. There is a cost system in the Havana water supply system that still needs to be studied and improved so that it can be used to create and revise the fee structure, and be used as a management tool;

- Need for an evaluation of consumption and the economic feasibility of the sector's fees. The inability to deploy stream gauges has slowed down the increase in the number of metered users and even caused a reduction in these users, thus reducing revenues from this source.

8.4 Critical issues in community participation and mass communication

- Insufficient relationships among institutions, community organizations and the people with respect to the work performed to make sector programs more effective. Communications need to be improved in order to facilitate the specialized intervention of sector representatives in community work. These interventions would provide for more accurate identification of the supply and sanitation needs that are put forward by natural community leaders;

- Lack of the material resources needed to develop and train community activists and communicators through workshops, seminars, book publishing, pamphlets, posters, etc.

- The health education messages related to the sector, which are broadcast by television and radio, are not systematic.

Following is a summary of the fundamental development aspects of the sector:

- The current foreign exchange resources in the country only ensure the most essential aspects of system operation, and provide for insufficient maintenance and small investments to address urgent situations;

Under current circumstances the Cuban economy cannot by itself cope with the demand for resources to resolve the cumulative problems that have resulted from the deterioration of the water and sanitation service infrastructure. Cuba consequently requires international cooperation;

The direct impact of water and sanitation quality levels on health and should constitute a warning regarding the sustainability of the health levels that Cuba has achieved, which are very different from the corresponding levels for developing countries and equated by many of them with the health levels of developed countries. Although the effects of the hygienic and sanitary problems caused by reduced water and sanitation service levels, including morbidity from waterborne diseases, have been attenuated by the Cuban health model, which has an extensive preventive care network and a rather extensive health education program, these levels have been maintained at a cost that is sometimes greater than current resources. In addition, these efforts do not achieve the same results when there are outbreaks or foci of communicable diseases, and specifically waterborne diseases. There is no doubt that, in order to achieve better levels of health indicators and maintain current indicator levels at a viable cost to the National Health Program, hygienic and sanitary conditions must be improved. Water and sanitation services will play a fundamental role in this improvement.

- The deterioration of water and sanitation services in the economic context of the country directly affects environmental conditions and the preservation of natural resources. In the context of Cuba's development conditions, water resources will be the most threatened, and are thus a priority for the National Program on Development and the Environment;

- The current institutional model of the sector is decentralized and completely separates the regulatory functions from system operations. However, the regulatory function needs to be strengthened, as well as the technical assistance provided to service entities. In addition, the community needs to take greater responsibility in the context of the sector development program;

  The internal economic transformations that are taking place in the country, and which affect the water and sanitation sector, are creating a favorable situation. Water and sewerage service fees (the residential sector beginning in October 1994 and the entire State sector) will allow the management of the service provider entities to begin a transition process from a subsidy model to a self-financed model beginning in 1995. This development will by itself create the conditions needed to achieve higher levels of management efficiency, independent of other actions that require resources to achieve such efficiencies, and of course, an increase in the quality of service;

- The country has the capacity for industrial production, especially in siderо-mechanics and construction materials, which can be used to address the needs of the sector. The use of these resources would provide for a reduction in the cost of foreign exchange to obtain certain finished products at the volumes required. In addition, because these industrial sectors are open to various forms of participation of external capital in order to utilize their capacities, not only can this benefit be achieved, but part of the production may be able to be exported to satisfy the demand in the region;

- The construction industry has the capacity to respond to a revived investment process within the sector;

- At the national level, there are many qualified staff available who, in the case of the water and sanitation sector, need both updated information on the use of modern techniques in managing these services, and managerial training.

9. STRATEGIES, POLICIES AND RECOMMENDED ACTIONS

The recommendations below follow from the process of analyzing the sectoral study within the context of Cuba's economic reality:

- Strongly promote external assistance at the governmental level, with the co-sponsorship of United Nations agencies (PAHO, UNDP and UNICEF), to governmental and regional institutions, bilateral agencies and within non-governmental agencies, within a broad cooperative framework that ranges from assistance in the financing of small projects, to credit cooperation;

- Establish various forms of participation of external capital in viable forms within the conditions of the Cuban economy, in construction and management activities (operations and maintenance) of drinking water and sanitation services;

- Strengthen the sector's development program that is designed to increase the quality of services, in order to supplement and extend them. Within this program, activities to repair the existing infrastructure should be accorded first priority. Among these activities, the following have highest priority:

  a) urgent activities directed to restoring the stability of the potable water supply;
  b) actions designed to raise the quality of operations and effective water management (the control and reduction of unmetered water), for which the reestablishment of measurement networks and censuses are essential;
  c) actions targeted to the largest cities (above all, the capital of the country), including the areas in these cities that experience the lowest service quality levels;

- Orient activities to increase coverage as provided in the National Action Plan to Fulfill the Goals of the World Summit for Children, as part of the sector development program, in order to serve:

  a) rural communities that lack water and sanitation services, beginning with those who receive public water service (transported by tank trucks) and whose maintenance has become untenable in the current circumstances because of a lack of fuel and other items required by motor vehicles;
  b) periurban areas that also depend on public service, for the same reasons, at the same time undertaking sanitation activities with appropriate solutions;
  c) cities with more than 20,000 inhabitants that lack these services.

In all cases, the application of appropriate, low-cost technologies is essential to

resolve both water supply and sanitation problems, as well as the participation of Cuban industry in the production of materials for the sector;

- Continue and improve the institutional development program that is targeted to water and sanitation providers, emphasizing the following aspects:

  a) credibility and image of the entities that deliver the services;
  b) cost recovery and the optimization of expenditures;
  c) increase in the capacity of administrative, technical, economic-financial and marketing management;

  Establish the regulatory and legal guidelines to implement and enhance the financial and control system, having been studied by the competent national bodies and enacted by the State, which will make it possible for the sector to obtain the resources necessary to cover current expenditures and investments;

- Design and implement a reasonable fee policy, beginning with the improvement of the cost and consumption control systems, which will not only generate a return on operating and maintenance expenses, but also cover the amortization of investments;

- Strengthen and develop the participation of Cuban industry in the production of material for the sector;.

- Undertake a micromeasurement development program, with phases and priorities that are set in accordance with the financial reality of the country;

- Implement and ensure, through the competent national bodies, a program to develop the human resources of the sector in order to provide them updated and complete information on the use of techniques and the introduction of modern managerial methods.

10. PROFILES OF PRIORITY PROJECTS

Thirteen project profiles have been developed, six of which are profile packages that are broken down into subprojects of related and interdependent activities, by jurisdictional location, in order to achieve a general objective. Altogether they provide 191 opportunities for external cooperation. These profiles are a first approximation to resolving the priority problems of the sector[1].

The financial value of this set of project profiles, which are basically directed to the repair and enhancement of the existing infrastructure, does not entirely cover the total estimated requirements to repair and restore the existing water supply and sanitation systems, which are estimated at US$ 643.08 million through the year 2004. This means that there are many more possibilities to identify projects to achieve this objective, a task that will continue to be worked on.

The identification and preparation of these profiles, which was carried out with the participation of working teams from various groups, regulatory agencies and extrasectoral entities, was performed on the basis of the comprehensive analysis in this report and taking into account policies, strategies and recommended actions. For each profile there is a brief description and definition of specific development problems that are addressed, the goals and the objectives, strategies, interested parties, geographical area and groups benefitted, the current and ultimate status of the project, and the estimated duration and investment.

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[1] In the project formulation phase, greater precision will be required with respect to the scope and content of the activities.

Table 10.1
Estimated investments for prioritized projects
(figures in thousands of US$)

Project Name		Identified subproj. No.	Estimated investments (contributions)		
			Total	National	External
a) Repair					
1.	Repair and enhancement of Water Supply Systems	25	20,555.0	999.0	10,565.0
2.	Improvements in the Maintenance and Enhancement of the Existing Sanitation Structures	52	51,401.5	41,133.0	10,268.5
3.	Restoration and improvement of the Water Quality Levels of the Water Provided to the Population	5	4,965.0	4,315.0	650.0
4.	Repair of the Vento Water Supply System Conduit	...	1,600.0	1,000.0	600.0
b) Extension					
5.	Drinking Water Supply and Sanitation to the Rural Population through the Use of Alternative Technologies	31	5,916.0	4,166.0	1,790.0
6.	Promotion of and Community Participation in Water and Sanitation Activities and their Impact on Health	...	8,000.0	4,550.0	3,450.0
c) Operational development					
7.	Optimization of the Operations of Principal Water Supply Systems through the Use of Modern Measurement, Diagnostic and Automation Techniques	36	10,217.0	6,985.0	3,232.0
d) Support					
8.	Program to Monitor and Control the Quality of Water for Human Consumption	42	3,829.2	3,012.5	816.8
9.	Managerial and Tech. Dev't. Program	...	1,310.0	200.0	1,110.0
10.	Improvement of the Sector's National Information System	...	120.0	60.0	60.0
11.	Implementation of Micromeasurement and Fees in the Principal Cities of the Country	...	120.0	70.0	50.0
12	Reorganization and Updating of the Sector's System of Standards	...	120.0	120.0	50.0
13.	Development of the Sector's Cost System within the Scope of Budget Unit	...	120.0	90.0	30.0
Total			**108,273.8**	**75,641.5**	**32,632.3**

Project 1. Repair and Enhancement of Water Supply Systems

Specific development problems that the project will address

The project is designed to repair and enhance the existing water supply infrastructure of the principal cities of the country, and the systems of a group of smaller cities that are facing an even more difficult situation. The following are the most important activities of the project, among others:

Increased control of leaks in conduits, networks and connections. It is estimated that current losses exceed 40% to 50% of the water generated by the sources, due to a large extent to the age of the pipes and the lack of technologies and materials to control the leaks. While in 1988 the systems were able to control 158,000 leaks, since then the situation has become more serious, and these activities have declined almost 40%. Consideration is being given to the use of internal repair technology with cement mortar for pipes between 100 and 300 mm with a capacity of 110 km/year, for which the country has the necessary technology and equipment (which require minor maintenance). However, the necessary materials and supplemental equipment are not available. In the case of the connections, molds have been obtained for the various plastic components, but the resources are not available to manufacture the units needed by these installations, estimated at some 30,000 units per year;

- Execution of general repair activities needed in the plants, whose production is impacted to a considerable extent by problems and breakdowns of the reagent dosing systems, automatic systems, valves and filters, among others. The technical condition of the plants is generally poor, primarily the result of their years of use and the financial difficulties that the country has had to face in recent years, which, together with the blockade, have reduced the opportunity to purchase the replacement parts needed to perform repairs. Cuba has 50 drinking water treatment plants of various capacities, with a capacity of 11.5 m^3/sec., which are connected to a population of close to 900,000 inhabitants. The most important of these plants are located in the central and eastern regions of the country, and Santa Clara, Cienfuegos, Sancti Spíritus, Camaguey, Holguín, Santiago de Cuba and Guantánamo are the most important cities that are served with surface water that is treated in these plants. The technology used comes from various sources, including Cuba, with technological equipment coming from abroad. The oldest of the plants are 45 years old, with a second group built in the 1960s, and finally, a third group built with French technology (Degremont) that entered into operations at the end of the seventies, and have now accumulated between 15 and 20 years of

service. In addition to this last group, during the last decade drinking water treatment plants were also constructed with Cuban technology with a capacity of 600 lps.

Enhancement of projects that are currently in construction or are partially suspended, in order to provide the inhabitants of Banes (50,000 people), Cabaiguán (approximately 40,000 people) and Cruces (25,000 people) with residential drinking water service, with the consequent improvement in the health conditions and standard of living of these populations. The cases of these three cities illustrate the situation of various cities that range from 20,000 to 50,000 inhabitants that are not connected to supply sources, and which depend on the supply of water to their populations through pipes, individual wells, and small networks that are connected to low volume wells;

- Installation of drinking water treatment plants for four cities or groups of cities. This will involve the construction of 2 plants with a capacity of 300 lps for Palma Soriano (60,000 inhabitants) and the northern development sector of Guantánamo (60,000 inhabitants), 1 plant with a capacity of 150 lps for Songo-La Maya (30,000 inhabitants), and 1 plant with a capacity of 100 lps (supplied by the same conduit) for the Tacajó-Nipe-Deleite group (25,000 inhabitants). These are urban areas whose populations are supplied from surface water sources whose water is not provided treatment, and which in general do not comply with drinking water standards, with the exception of disinfection.

Pertinence of the project to the country's health policy

Both the project and the subprojects included in it correspond to Government priorities and the priorities established by PAHO, given their direct impact on maintaining and increasing the coverage of drinking water supplied to the population, as well as the impact on the rational use of water resources and the project's positive impact on the standard of living of the population.

Goals

- Establish reliable, effective and economical techniques and methods to systematically reduce water losses from conduits, networks and connections, with a consequent increase in the efficient use of drinking water and an increase in the supply and coverage of this service, as well as a reduction of the over-use of water supply sources and networks;

- Gradually restore the capacities of surface drinking water treatment plants, which are currently impacted by equipment deficiencies and breakdowns, in

order to increase the supply to the population connected to these plants (close to 900,000 inhabitants), and consequently increase the health levels and standard of living of the population;

- Expand the supply of drinking water and residential service to a population of more than 100,000 inhabitants through the construction of new networks;

- Expand the drinking water installations that treat surface water in order to benefit a population of more than 175,000 inhabitants, ensuring a stable quality of treated water during the useful life of the treatment plant by attending to maintenance requirements. The use of Cuban technology is being considered in order to reduce the dependence on imported materials.

Objectives

- Reduce the losses or leaks of water supplied to the population and industry to a level of 25% to 30%;

- Repair and stabilize the capacity of drinking water plants using surface water that existed in the country at the end of 1993;

- Complete the works that are still in construction and are partially paralyzed in order to ensure household drinking water service to a population of 105,000 inhabitants grouped in 3 towns or cities;

- Consolidate the supply of drinking water, in accordance with Cuban standards, to a total of 175,000 inhabitants through the construction of 4 drinking water plants with various capacities (2 plants with a capacity of 300 lps, 1 plant with a capacity of 150 lps and 1 plant with a capacity of 100 lps).

Strategies

The project is structured into subprojects that complement each other in order to achieve the goal in each city selected.

Summary description

The projects will be directed and constructed by the respective provincial water supply and sewerage system agencies. These entities, which are administratively subordinate to the provincial governments, have the role and responsibility of managing the services. The National Institute of Water Resources is responsible for the technical supervision of these services.

Interested parties

The National Institute of Water Resources and the Ministry of Public Health, through their provincial agencies, together with the provincial water supply and sewerage system bureaus. For years these institutions have been identifying the problems resulting from water losses and the consequent impacts on potability and health, as well as the continuity and coverage of the service, which are all PAHO priorities.

Geographical area of the project and the beneficiary population

The project as a whole will benefit a population of almost 4.0 million people in 8 provincial capitals and a group of cities of between 20,000 and 50,000 inhabitants.

Current situation and situation upon completing the project

Current losses of water are estimated at levels higher than 40% to 50%, as a consequence of leaks in conduits and networks. Energy consumption is high not only because of the above, but also because of the condition of certain water supply sources. The water treatment capacity of a group of plants is impacted by their need for repairs. Certain urban centers that are supplied with surface water lack treatment facilities, with the exception of disinfection. In various cities (between 20,000 and 50,000 inhabitants) that are supplied with public services, individual wells and small networks linked to low-volume wells, the projects undertaken to provide them adequate service have been paralyzed.

The activities proposed for the subprojects are expected to raise the quality and efficiency of water supply services in each city.

Duration of the project

5 years

Estimated investments

The financing needed for this project is included in the analytical description of each subproject.

City: Havana
Province: Ciudad de la Habana (2,209,800 inhabitants)
Objective: Improve the quality and efficiency of water supply service.
Situation: 47 supply sources with 230 pumping stations, more than 30% of which require replacement because of their poor technical condition. Almost 4,000 km of networks and conduits, losses from leaks on the order of 50%. 174 GWH energy consumption.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.1	Repair the principal sources of supply (pumping equipment, electrical systems and hydraulic protector devices.	Improve the efficiency and stability of pumping.	Provide the principal sources of supply with the necessary replacement equipment, repair systems and electric protection.	1	5	800	2300
1.2	Repair conduits and networks with interior overlay mortar technology.	Reduction of losses from leaks	Enhance specialized inputs and other auxiliary resources for 6 existing injection machines (2/year) with a repair capacity of 10 km/machine/year.	1	3	1825	900
1.3	Repair of the Northern Havana Drinking Water Treatment Plant (500 l/s).	Restore the treatment capacity of the plant.	Replacement of obsolete components (pumps, valves and others) and repair of public works.	1	1	250	150
						2875	3350

City: Santa Clara. (197,200 inhabitants)
Province: Villa Clara
Objective: Improve the quality and efficiency of water supply service.
Situation: 3 principal sources of supply. Almost 340 km. of networks and conduits, stretches with more than 50 years of service, with losses from leaks greater than 30%; average time of service 8 hrs/day, although there are areas that receive service on alternate days or every several days.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.2	Rehabilitation of conduits and networks with interior overlay mortar technology	Reduction of losses from leaks.	Enhance specialized inputs and other auxiliary resources for 6 existing injection machines (2/year) with a repair capacity of 10 km/machine/year.	1	3	304	150

City: Cienfuegos. (102,800 inhabitants)
Province: Cienfuegos
Objective: Improve the quality and efficiency of water supply service.
Situation: 5 principal sources of supply. Almost 240 km of networks and conduits, water treatment plant that is operating with difficulty.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.3	Repair of the Cienfuegos water treatment plant (1 200 l/s, which also provides service to the city of Santa Clara.	Restoration of the treatment capacity of the plant.	Replacement of obsolete components (pumps, valves and others) and repair of public works.	1	1	175	105

City: Cruces. (20,000 inhabitants)
Province: Cienfuegos
Objective: Improve the quality and efficiency of water supply service.
Situation: Two sources of supply that need to be replace because they are insufficient. Most of the city receives public services (water trucks) because there is no water supply system.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.1	Recair of principal supply sources (pumping equipment, electrical systems and hydraulic protection devices.	Improve the efficiency and stability of pumping.	Provide the principal sources of supply with the necessary equipment.	1	5	15	80
1.4	Completion of infrastructure for the water supply system.	Extend water supply service to the entire population.	Extend the water supply system network to a population of 20,000 inhabitants.	1	5	420	980
						435	1060

City: Sancti Spíritus. (72,000 inhabitants)
Province: Sancti Spíritus.
Objective: Improve the quality and efficiency of water supply service.
Situation: 3 sources of supply with 17 pumping stations, 25% of which require replacement because of their poor technical condition. 230 km of networks and conduits, stretches of pipe with more than 50 years of service. Drinking water treatment plant with operating difficulties.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.1	Repair of principal supply sources (pumping equipment, electrical systems and hydraulic protection devices.	To improve the efficiency and stability of pumping	Provide the principal sources of supply with the necessary replacement equipment, repair systems and electric protection.	1	1	10	50
1.3	Repair of the Tuinicú Drinking Water Treatment Plant (500 l/s).	Restore the treatment capacity of the plant	Replacement of obsolete components (pumps, valves and others) and repair of public works.	1	1	250	150
						260	

200

City: Cabaiguán. (28,000 inhabitants)
Province: Sancti Spíritus.
Objective: Improve the quality and efficiency of water supply service.
Situation: Has no water supply system source. Has individual wells and small networks connected to low-volume wells. Does not have complete water supply networks.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.1	Repair of principal supply sources (pumping equipment, electrical systems and hydraulic protection devices.	To install a source of supply for the water supply system.	Provide the principal sources of supply with the necessary replacement equipment, repair systems and electric protection	1	2	20	150
1.4	Completion of the infrastructure for the water supply system	To extend water supply service to the entire population	Extend the water supply system network to a population of 20,000 inhabitants.	1	5	525	1225
						545	1375

City: Camaguey. (266,400 inhabitants)
Province: Camaguey.
Objective: Improve the quality and efficiency of water supply service.
Situation: 5 sources of supply with 21 pumping stations, 25% of which require replacement because of their poor technical condition. 400 km of networks and conduits with losses from important leaks. The treatment plant has problems. Average time of service is 10 hrs/day and there are areas that receive services on alternate days or every several days.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.1	Repair of principal supply sources (pumping equipment, electrical systems and hydraulic protection devices.	Improvement of efficiency and stability of pumping.	Provide the principal sources of supply with the necessary replacement equipment, repair systems and electric protection.	1	1	60	300
1.2	Repair of conduits and networks with interior overlay mortar technology	Reduction of losses from leaks.	Enhance specialized inputs and other auxiliary resources for 6 existing injection machines (2/year) with a repair capacity of 10 km/machine/year.	1	3	304	150
1.3	Repair of the Pontezuela Drinking Water Treatment Plant (700 l/s).	Restore the treatment capacity of the plant.	Replacement of obsolete components (pumps, valves and others) and repair of public works.	1	1	290	175
						654	625

City: Holguín. (232,700 inhabitants)
Province: Holguín.
Objective: Improve the quality and efficiency of water supply service.
Situation: 4 principal sources of supply: almost 200 km of networks and conduits, many of them in poor condition; drinking water treatment plant with operating difficulties. There are areas that receive water every four or five days.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.2	Repair of conduits and networks with interior overlay mortar technology.	Reduction of losses from leaks.	Enhance specialized inputs and other auxiliary resources for 6 existing injection machines (2/year) with a repair capacity of 10 km/machine/year.	1	3	304	150
1.3	Repair of the Drinking Water Treatment Plant (600 l/s).	Restore the treatment capacity of the plant	Replacement of obsolete components (pumps, valves and others) and repair of public works	1	1	250	150
						554	300

City: Banes (50,000 inhabitants)
Province: Holguín.
Objective: Improve the quality and efficiency of water supply service.
Situation: 2 insufficient sources of supply; public service in areas of the city, others receive water every several days through existing networks. Investment was initiated that is practically paralyzed.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.4	Completion of the infrastructure for the water supply system.	Water supply service extended to the entire population	To extend the water supply system network to a population of 50,000 inhabitants.	1	5	735	1715

City: Taguajó-Deleite-Antilla. (25,000 inhabitants)
Province: Holguín.
Objective: To raise the quality and the efficiency from the service of water supply.
Situation: Almost 80 km of networks and conduits. Receives untreated water except for disinfection.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.5	Design and construction of a drinking water treatment plant (100 lps)	Improved quality of the water supplied to the population	Design and construction of a drinking water treatment plant for a population of 20,000 thousand inhabitants.	1	2	280	120

City: Manzanillo. (96,700 inhabitants)
Province: Granma.
Objective: Improve the quality and efficiency of water supply service.
Situation: 8 sources of supply with 21 pumping stations, more than 30% of which require replacement because of their poor technical condition. Almost 150 km of networks and conduits; water service provided on alternate days.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.1	Repair of principal supply sources (pumping equipment, electrical systems and hydraulic protection devices.	Improved efficiency and stability of pumping.	Provide the principal sources of supply with the necessary replacement equipment, repair systems and electric protection	1	1	5	30

City: Palma Soriano. (56,400 inhabitants)
Province: Santiago de Cuba.
Objective: Improve the quality and efficiency of water supply service.
Situation: Receives water from a surface source with very poor treatment, with the exception of disinfection.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.5	Design and construction of a drinking water treatment plant (300 l/s).	Improved quality of the water supplied to the population.	Design and construction of a drinking water treatment plant for a population of 56,400 inhabitants.	1	2	1050	450

City: Songo-La Maya. (22,100 inhabitants)
Province: Santiago de Cuba.
Objective: Improve the quality and efficiency of water supply service.
Situation: 5 sources of supply with 4 pumping stations, almost 10 km of networks and conduits. Receives water that is untreated except for disinfection.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.5	Design and construction of a drinking water treatment plant (50 l/s).	Improved quality of the water supplied to the population	Design and construction of a drinking water treatment plant for a population of 22,100 inhabitants.	1	2	70	30

City: Santiago de Cuba. (418,700 inhabitants)
Province: Santiago de Cuba.
Objective: Improve the quality and efficiency of water supply service.
Situation: Almost 500 km of networks and conduits, losses from leaks greater than 30%. Stretches of the water supply system network with more than 50 years of use. Most of the areas of the city receive water every 3 days.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.2	Repair of conduits and networks with interior overlay mortar technology.	Reduction of losses from leaks.	Enhance specialized inputs and other auxiliary resources for 6 existing injection machines (2/year) with a repair capacity of 10 km/machine/year.	1	3	608	300
1.3	Repair of the water treatment plant (600 l/s).	Restoration of the treatment capacity of the plant.	Replacement of obsolete components (pumps, valves and others) and repair of public works.	1	1	125	75
						733	375

City: Santa Clara. (197,200 inhabitants)
Province: Villa Clara
Objective: Improve the quality and efficiency of water supply service.
Situation: 3 principal sources of supply. Almost 340 km. of networks and conduits, stretches with more than 50 years of service, with losses from leaks greater than 30%; average time of service 8 hrs/day, although there are areas that receive service on alternate days or every several days.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.2	Rehabilitation of conduits and networks with interior overlay mortar technology	Reduction of losses from leaks.	Enhance specialized inputs and other auxiliary resources for 6 existing injection machines (2/year) with a repair capacity of 10 km/machine/year.	1	3	304	190

City: Cienfuegos. (102,800 inhabitants)
Province: Cienfuegos
Objective: Improve the quality and efficiency of water supply service.
Situation: 5 principal sources of supply. Almost 240 km of networks and conduits, water treatment plant that is operating with difficulty.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (millions of US$)	
						national	external
1.3	Repair of the Cienfuegos water treatment plant (1,200 l/s, which also provides service to the city of Santa Clara.	Restoration of the treatment capacity of the plant.	Replacement of obsolete components (pumps, valves and others) and repair of public works.	1	1	175	105

Project 2. Improvements in Maintenance and Enhancement of Existing Sanitation Structures

Specific development problems that the project will address

The goal of the project is to improve the health conditions in a group of cities. The set of activities designed for this purpose includes the restoration and provision of appropriate resources to remove obstructions; the cleaning and maintenance of sewerage systems and septic tanks; the repair of a group of waste treatment plants and the introduction of simplified sewerage systems for collecting and disposing of wastes in the periurban areas of certain cities.

The current coverage of sewerage systems only extends to 40.4% of the urban population and 5.2% of the rural population. The construction of sewerage systems in existing cities involves difficulties and costs that are often practically insurmountable. Among other problems, these difficulties stem from the existence of technical networks, the need for deep excavations in narrow streets and traffic interruptions. In the existing systems there are an estimated 2,200 km of collectors and sewerage systems. In accordance with these figures, the density of these sewerage systems is approximately 1.2 m per person served.

The maintenance of sewerage installations has been progressively declining in recent years. The number of obstruction removal operations dropped from 106,900 in 1988 to 64,000 in 1993, basically because of the lack of materials and equipment that would have allowed the rate of this activity to continue. This situation aggravates even more the insufficient provision of this service to the population, and has had a negative impact on health and sanitation. Of the wastewater evacuated by sewerage systems, 21.6% (108.5 million) receives treatment from 5 purification plants and 564 stabilization ponds. The 5 plants have a capacity of 1.1 m^3/sec., although they have problems with maintenance, operations and capacity. The technology utilized is basically Cuban, and the largest work with percolator filters and primary and secondary sedimentators with open sludge digesters and drying beds.

The maintenance problems are actually minor, requiring the replacement of some pumping equipment and valves and the servicing of percolator filter seals and bearings. In addition, as an alternative form of waste disposal, there are more than 600,000 septic tanks available, which provide service to nearly 4 million people. The supply of equipment for the periodic cleaning of these facilities is 357 units, of which 52% is down for various reasons, among them the lack of accessories, spare parts and tires. However, during the prior year 136,000 cleaning operations were performed. Given that septic tanks require at least one annual cleaning, it is essential to at least triple the number of cleaning services performed, which will require a stock

of 500 pieces of equipment. This objective is fundamentally important, considering the impact of these services on health and environmental sanitation.

It is evidently necessary to reconcile the need for sanitation with the difficulties discussed above. In this regard, one alternative that tends to minimize the above difficulties is the use of simplified sewerage systems and the local treatment and eventual recycling of wastes. This strategy can be applied, especially in periurban areas.

Relevance of the project to the country's health policy

The project fully complies with the priorities of the Government and the policies established by PAHO, given its direct impact on maintenance, the increase in the coverage of water service and its positive impact on the standard of living of the population and environmental sanitation.

Goals

- To restore and stabilize the resources to ensure the maintenance of sewerage systems and septic tanks, with the consequent improvement in service and a reduction of the impacts on health and sanitation;

- To restore and stabilize a group of waste treatment plants with a view to ensuring that the dumping of effluents from these plants are within required parameters. This will make it possible to minimize their impact on receptor bodies and make possible their recycling where necessary;

- To assimilate the construction techniques and technologies for sewerage systems to simplified sewerage networks and to create conditions for the gradual extension of these networks to the areas where their application may be appropriate on the basis of experience with the design, construction and operation of three experimental systems.

Objectives

- Maintenance of the sewerage system in proper operating conditions and increase in the capacity to perform no less than 200,000 blockage removals per year;

- Completion and adjustment of the capacities of the existing waste treatment plants;

- Information on the technology of simplified sewerage networks and their application on an experimental basis in the periurban areas of certain cities.

Strategies

The project is structured into subprojects that are coordinated to achieve the goal in each city selected.

Summary description

The provincial water supply and sewerage system bureaus will be responsible for the project, with the technical advisory services of the National Institute of Water Resources and the participation of other industrial and construction companies.

Interested parties

The problems related to the need to increase the sanitation levels have been identified by the population, through the People's Councils and the council delegates, and by the municipal and provincial water supply and sewerage system entities. The solution of these problems corresponds to PAHO priorities.

Geographical area of the project and beneficiary population

The project will benefit approximately 7.3 million inhabitants of the urban sector. Of these, 3.3 million have sewerage service and 4.0 million have septic tanks as alternative waste disposal solutions.

Current situation and situation upon completing the project

The current decline in the level of blockage removal operations and the maintenance of collectors and water supply networks, as well as septic tank cleaning services and the deficient operations of waste treatment plants, threaten health and environmental sanitation.

With the execution of the proposed project, the level of sanitation should be restored in urban areas where the existing infrastructure permits.

Duration of the project

5 years (first stage)

Estimated investments

An account of the financing for each province's set of subprojects, basically for their capital cities, is included in the analytical description of each subproject.

Province: Isla de la Juventud Special Municipality (urban population: 71,200 inhabitants)
Situation: 80% of the population with sewerage service and 594 septic tanks with 4 tank cleaning trucks available, of which only 2 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	1	25	80
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 2 pieces of equipment through the purchase of components and spare parts.	I	1	10	40
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						185	270

Province: Guantánamo (urban population: 316,100 inhabitants)
Situation: 24% of the population with sewerage service and 20,760 septic tanks with 17 tank cleaning trucks available, of which only 12 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	1	25	80
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 5 pieces of equipment through the purchase of components and spare parts.	-	-	25	100
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						200	330

Province: Santiago de Cuba (urban population: 713,700 inhabitants.)
Situation: 38% of the population with sewerage service, 34,384 septic tanks with 18 tank cleaning trucks available, of which only 5 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 2 blockage removal modules, 1 pair of winches and wires, blockage removal augers and tools.	I	2	50	160,0
2.2	Repair of high pressure trucks.	Restore the level of blockage removal operations in the sewerage systems.	Purchase of components for 1 specialized high pressure truck (high pressure vacuum pumps, motors and high pressure suction pumps).	I	1	28	38,5
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 13 pieces of equipment (7 per year) through the purchase of components and spare parts.	I	2	65	260,0
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150,0
						293	608,5

Province: Granma (urban population: 484,000 inhabitants)
Situation: 26% of the population with sewerage service and 75,860 septic tanks with 28 tank cleaning trucks available, of which only 15 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 2 blockage removal modules, 1 pair of winches and wires, blockage removal augers and tools.	I	2	50	160
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 13 pieces of equipment (7 per year) through the purchase of components and spare parts.	I	2	65	260
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						265	570

Province: Holguín (urban population: 609,300 inhabitants)
Situation: 19% of the population with sewerage service and 55,416 septic tanks with 24 tank cleaning trucks available, of which only 16 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 2 blockage removal modules, 1 pair of winches and wires, blockage removal augers and tools.	I	2	50	160
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 13 pieces of equipment (7 per year) through the purchase of components and spare parts.	I	2	65	260
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						265	570

Province: Las Tunas (urban population: 313,800 inhabitants)
Situation: 15% of the population with sewerage service and 12,450 septic tanks with 20 tank cleaning trucks available, of which only 12 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	1	25	80
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 8 pieces of equipment (4 per year) through the purchase of components and spare parts.	I	2	40	160
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						215	390

Province: Camaguey (urban population: 682,900 inhabitants)
Situation: 33% of the population with sewerage service and 97,907 septic tanks with 33 tank cleaning trucks available, of which only 17 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 2 blockage removal modules, 1 pair of winches and wires, blockage removal augers and tools.	I	2	50	160
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 16 pieces of equipment 8 per year) through the purchase of components and spare parts.	I	2	80	320
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						280	630

Province: Ciego de Avila (urban population: 286,700 inhabitants)
Situation: 47% of the population with sewerage service and 13,489 septic tanks with 12 tank cleaning trucks available, of which only 7 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	2	50	100
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 5 pieces of equipment through the purchase of components and spare parts.	I	1	25	100
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						225	350

Province: Sancti Spíritus (urban population: 338,300 inhabitants)
Situation: 18% of the population with sewerage service and 55,416 septic tanks with 23 tank cleaning trucks available, of which only 11 are in operating condition.

Title del subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (US$ millions)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	1	25	80
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 12 pieces of equipment (6 per year) through the purchase of components and spare parts.	I	2	60	240
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						235	470

Province: Cienfuegos (urban population: 281,000 inhabitants)
Situation: 26% of the population with sewerage service and 29,954 septic tanks with 12 tank cleaning trucks available, of which only 8 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	1	25	80
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 4 pieces of equipment through the purchase of components and spare parts.	I	1	20	80
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						195	310

Province: Villa Clara (urban population: 660,300 inhabitants)
Situation: 12% of the population with sewerage service and 60,806 septic tanks with 20 tank cleaning trucks available, of which only 10 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	1	25	80
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 10 pieces of equipment through the purchase of components and spare parts.	I	1	50	200
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
2.5	Repair the Santa Clara treatment plant.	Restore the capacity of the plant.	Repair and enhancement of installations through the replacement of pumping equipment, valves and other items.		1	100	50
						325	480

Province: Matanzas (urban population: 505,400 inhabitants.)
Situation: 8% of the population with sewerage service and 60,500 septic tanks with 10 tank cleaning trucks available of which only 5 are in operating condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (US$ miles)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 1 blockage removal module, 1 pair of winches and wires, blockage removal augers and tools.	I	1	25	80
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 5 pieces of equipment through the purchase of components and spare parts.	I	1	25	100
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
						200	330

Province: Ciudad de la Havana (urban population: 2,209,800 inhabitants.)

Situation: 64% of the population with sewerage service. 156 km of sewerage conduits, 2 treatment plants and 9 stabilization ponds. 11,8474 septic tanks 39 tank cleaning trucks available, of which only 20 are in operating condition. 14 high-pressure specialized trucks with more than 10 years of use and in need of replacement parts.

	Title of the subproject	Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 10 blockage removal modules, 1 CV, 1 pair of winches and wires, blockage removal augers and tools.	I	5	250	800
2.2	Repair of high pressure trucks.	Restore the level of blockage removal operations in the sewerage systems.	Purchase of components for 14 specialized high pressure trucks (high pressure vacuum pumps, motors and high pressure suction pumps).	I	2	280	385
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 20 pieces of equipment (10 per year) through the purchase of components and spare parts.	I	2	100	400
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2000 inhabitants.	I	2	50	150
2.5.1	Repair of the María del Carmen treatment plant.	Restore the capacity of the plant.	Repair and enhance the installations by replacing pumping equipment, valves, and other items.	I	1	265	175
2.5.2	Repair of the Quibú treatment plant.	Restore the capacity of the plant.	Repair and enhance the installations by replacing pumping equipment, valves, and other items.	II	1	100	50
2.6	Completion of the María del Carmen sewerage system. Protection of the subterranean Vento watershed (Stages I and II).	Sanitation of the Vento watershed, one of the principal water sources of the capital.	Completion of water supply works that feed the María del Carmen plant (Stage I is 15 km of collectors and principal networks, Stage II is 300 km of secondary networks.	I (1st stage)	2	1500	250
				II (2nd stage)	10	35000	1600
						37645	3810

Province: La Habana (urban population: 532,800 inhabitants.)
Situation: 24% of the population with sewerage service, 1 treatment plant and 82,275 septic tanks with 43 tank cleaning trucks available, of which only 22 are in operational condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 2 blockage removal modules, 1 pair of winches and wires, blockage removal augers and tools.	I	2	50	150
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 21 pieces of equipment (11 per year) through the purchase of components and spare parts.	I	2	105	420
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2,000 inhabitants.	II	2	150	150
2.5	Repair of the Bejucal treatment plant.	Restore the capacity of the plant.	Repair and enhance the installations by replacing pumping equipment, valves, and other items.	I	1	100	50
						405	780

Province: Pinar del Río (urban population: 420,000 inhabitants)
Situation: 22% of the population with sewerage service and 21,138 septic tanks with 19 tank cleaning trucks available, of which only 5 are in operational condition.

Title of the subproject		Expected outcomes	Scope of the subproject	Priority	Execution (years)	Financing (thousands of US$)	
						national	external
2.1	Provision of mechanical resources to remove blockages from collectors and networks.	Restore the level of blockage removal operations in the sewerage systems.	Creation of 2 blockage removal modules, 1 pair of winches and wires, blockage removal augers and tools.	I	2	50	160
2.3	Repair of tank cleaning trucks.	Increased level of services provided to existing septic tanks.	Repair 5 pieces of equipment through the purchase of components and spare parts.	I	1	25	100
2.4	Introduction of alternative collection systems in periurban areas with community participation.	Introduction of alternative low-cost sanitation technologies.	Advisory services on the general design and external supplies needed to construct a pilot system in a periurban area with 2000 inhabitants.	II	2	150	150
						225	410

Project 3. Restoration and Extension of the Treatment Levels for the Water Provided to the Population

Specific development problems that the project will address

The health protection levels reached by the country are in particular danger as a result of the nation's financial situation, and drinking water treatment is one of the affected areas. This situation makes a considerable portion of the Cuban population vulnerable to outbreaks of waterborne diseases and removes one of the principal barriers to the introduction of cholera in the country.

Relevance of the project to health policy

The achievement of high levels of health indicators among the Cuban population is one of the important results of the Cuban program. Among its preventive measures is the assurance of access to drinking water in adequate quantities and quality; this service has been extended to practically the entire urban population and a considerable portion of the rural population.

The preservation of such sanitary protection is one of the most urgent concerns of the national health institutions.

There are 985 installations used to treat the water supplied to the population. Of these installations, 50 are drinking water treatment plants, 128 use chlorine gas, and the remaining 807 use hypochlorite. In addition, Cuban industry is available that has the capacity to manufacture the principal chemical products: chlorine gas, aluminum sulfate and sodium hypochlorite (of which some 12,000 tons per year are required). Moreover, a network of workshops and of laboratories completes the infrastructure that supports the treatment of drinking water.

Goals

The project is part of a program of activities designed to restore water potability, which suffered a sharp decline over the last three years.

- To strengthen water chlorination;
- To restore the manufacture of chemical products, repair treatment installations, implement the use of alternative products and restore technological discipline.

Objectives

The project should accomplish the following objectives within three years:

- Stabilization of the levels of supply of the necessary chemical products, starting with temporary importation and a restoration of the country's capacity to produce these products;

- Continuous operation of chlorine gas installations throughout the entire country and continuous operation of no less than 70% of hypochlorite installations;

- Establishment of a technological control system that ensures the proper operation of chlorination installations.

Strategies

The program will be undertaken along two principal lines of work:

- Progressive repair of the installations that are not currently functioning and establishment of a program for their systematic maintenance and control;

- Enhanced supply of materials, beginning with reduced importation of chemical products and their gradual replacement by Cuban production as the levels of production increase in factories under repair.

The National Institute of Water Resources, which will be responsible for the project, will be involved in it. The provincial water supply bureaus will implement project activities and provide workshop services and treatment control.

Summary description

- Repair or reequipping of the chlorination installations of the 30 principal cities of the country, in order to cover 70% of the urban population in the first year; expansion of repair efforts to another 80 population groups in order to cover 90% of the urban population; and finally, in the third stage, completion of the unfinished chlorine gas installations;

- Formulation and application of a control system to operate these installations, starting from the first year;

- Establishment of a set of measures to address the hypochlorite installations, which will seek to stabilize the supply of chemical products and the continuity of their operations;

- Study and introduction of products, parts and devices produced in Cuba in order to reduce expenditures on external materials and extend the coverage of chlorination beginning in the second year;

- Introduction and expansion of the use of alternative technologies and products that are available locally, in order to facilitate the extension of drinking water treatment to the rural sector, which includes 3,230 towns;

- Systematic training of the operations personnel of these installations.

Interested parties

The National Institute of Water Resources, the entity responsible for the drinking water and sanitation sector, accords priority importance to the execution of this project and to maintaining its outcomes. The Ministry of Public Health will provide support and coordination in order to achieve the objectives, because of the relationship of this project to its population protection programs. The jurisdictional governments and their water supply bureaus also agree on the high priority that should be given to the plan of activities contained in the project.

Geographical area and beneficiary populations

This project is national in scope; the population directly benefitting from the project is the 7.3 million inhabitants of the urban and rural sectors of the country.

Current situation and situation upon completing the project

The continuity in the operations of chlorine gas installations, expressed as a percentage of working days per year, has declined to 51%; the percentage for hypochlorite installations is even lower.

When the project is completed, the continuity of operations should exceed 90% in the largest installations (chlorine gas) and 70% for hypochlorite installations. Such levels will make it possible to protect the urban population that is supplied with drinking water (more than 6 million people) for more than 9 out of every 10 days, and will protect the residents of smaller towns (1.3 million people) for 7 out of every 10 days.

Duration of the project

The project is programmed to be implemented over three years. Beginning in the first year, the restoration of water potability will benefit 70% of the urban population of the country.

Estimated investments

The financing necessary for this project is included in the analytical description of each subproject.

10.3.1 *To ensure the continuity of water treatment for the City of Havana*

Objectives: To stabilize water treatment through the reequipping of installations, supply of products and treatment control.

Duration: 1 year.

Situation: The City of Havana has 33 chlorine gas installations, a drinking water treatment plant and 20 hypochlorite installations, which ensure the drinking water supply to 2.2 million people living in the capital of the country.
The reequipping of some of the installations has been carried out. This work should be completed and the control of its operation should be changed in order to ensure the reliable and continuous operation of this system of installations.

Activity		Expected outcomes	Priority	Execution (years)[2]	Financing (thousands of US$)	
					national	external
3.1	Reequip the chlorine gas installations.	Continuity of treatment.	I	1	105	50
3.2	Ensure the supply of chemical products: chlorine gas, aluminium sulfate and sodium hypochlorite.	Continuity of treatment.	I	ongoing	992	...
3.3	Reequip the sodium hypochlorite installations.	Continuity of treatment.	I	1	30	10
3.4	Establish a reliable system for the technological control of treatment installations.	Raise the level of technological knowledge.	II	2	30	15
3.5	Expand the production of replacement parts.	Stabilize operation.	II	2	100	30
					1185	105

10.3.2 ***Increase the continuity of drinking water treatment to 90% in 29 Cuban cities***

Objectives: Stabilize water treatment through the reequipping of installations, supply of products and treatment control.

Duration: 1 year.

Situation: The 29 principal cities of the country where 3.6 million people reside have an infrastructure of 18 drinking water treatment plants, 41 chlorine gas installations and 65 hypochlorite installations to treat the water in their water supply systems. Many of these installations have operating problems caused by equipment breakdowns and unstable supplies of chemical products, and also need to improve the qualifications of their workers.

Activity		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
3.1	To rehabilitate the treatment installations in Santiago de Cuba.	Ensure the supply of drinking water to 418 thousand people.	I	2	80	80
3.2	To ensure the supply of chemical products: chlorine gas, aluminum sulfate and sodium hypochlorite.	Continuity of treatment.	I	ongoing	890	...
3.3	To rehabilitate the treatment installations in 5 cities.	Ensure the supply of drinking water to 1.05 million people.	I	2	400	100
3.4	To establish a reliable system for the technological control of treatment installations in 29 cities.	Raise the technical operating capability	II	2	60	25
3.5	To expand the production of replacement parts.	Stabilize operations in 124 installations.	II	2	110	40
					1540	225

10.3.3 *To stabilize water treatment in a median urban population band*

Objectives: To stabilize water treatment through the reequipping of installations, supply of products and treatment control.

Duration: 2 years.

Situation: In the urban sector there are 67 medium and small towns where 1.2 million people live. Their water supply systems have 16 drinking water treatment plants and 54 chlorine gas installations. Most of these installations have problems with their operations caused by equipment breakdowns and unstable supplies of chemical products, which have worsened over the last 5 years. The retraining of the workers that staff these installations is also urgent.

Activity		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
3.1	To rehabilitate the chlorine gas installations in 54 urban towns.	Ensure the supply of drinking water to 860,000 people.	I	1	110	40
3.2	To ensure the supply of chemical products: chlorine gas, aluminum sulfate and sodium hypochlorite.	Continuity of treatment.	I	ongoing	650	---
3.3	To repair drinking water treatment plants in 16 towns.	Ensure the supply of drinking water to 240,000 people.	I	2	180	60
3.4	To establish a reliable system for the technological control of treatment installations in 67 towns.	Increase the level of technical operating capability	II	2	40	15
3.5	To expand the production of replacement parts.	Stabilize operations in 67 installations.	II	2	70	30
					1030	145

10.3.4 ***To establish an adequate system for the control of water treatment***

Objectives: To adapt treatment control techniques to situations of limited supplies and energy. To raise the technical capability of personnel.

Duration: 2 years.

Situation: The devices, machinery and equipment, as well as the techniques used to regulate the dosage and the operation of drinking water treatment plants and chlorination installations in the country require a high level of imports, for which sufficient financing is not available. To this can be added power outages and fuel shortages. For these reasons, most of the operations of the installations cannot be controlled. There is also an urgent need to retrain the workers in these installations in alternative techniques.

Activity		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
3.1	To change the techniques used in the technological control of drinking water treatment plants.	Simplify technological control in the plants.	I	2	30	10
3.2	To retrain the personnel who operate the drinking water treatment plants.	Develop human resources.	I	1	20	5
3.3	To modify and implement new technological control systems.	Ensure the proper technical operation of the installations.	I	2	60	...
					110	15

10.3.5 ***To expand water treatment to rural water supply systems through the use of alternative technologies***

Objectives: To extend the coverage of drinking water to the rural population; to provide locally attainable alternative procedures.

Duration: 2 years.

Situation: In the rural sector there are 3,234 towns, and the sanitary quality of their water supply is threatened by the small number of treatment installations and the unstable supply of chemical products. Current financial limitations make it impossible to ensure the drinking water supply using conventional procedures. This subproject seeks to develop a center in order to introduce alternative procedures and expand their use to communities, based on the experiences of a group that is already operating in the province of Guantánamo and a rural project in progress.

Activity		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
3.1	To complete the rural sanitation and treatment center of Guantánamo.	Develop alternative devices and procedures.	I	2	80	50
3.2	To train Cuban personnel in the use of alternative treatment technologies.	Develop technical capabilities.	II	1	50	10
3.3	To develop pilot programs in 10 provinces on the use of appropriate technologies.	Introduce and extend alternative solutions to the local level.	I	4	200	50
3.4	To introduce procedures and the use of alternative chemical products.	Provide adequate supplies of chemical products.	II	2	120	50
					450	160

Project 4. Repair of the Vento Water Supply Conduit

Specific development problems that the project will address

The objective of the project is to repair this conduit, which has been affected by interior coating problems, losses from leaks and critical problems with some intersections and watercourses.

The Vento conduit is one of the principal elements of the Albear Water Supply System, an engineering masterpiece from the colonial era. The city was supplied with water at the end of the last century through this conduit, with water collection and pipe systems that supplied water by gravity to the principal tanks. All of the works were constructed in the period from 1858 to 1893, the year when the conduit was completed that has an oval section 2.40 x 2.0 and a length of 9.6 km. The average volume of this closed conduit is 170,000 m³ per day, which represents nearly 15% of the total supply to the city, and it is the only source that provides water without some form of energy consumption.

Relevance of the project to the country's health policy

The project is in accordance with Government priorities and the priorities established by PAHO, given its direct impact on maintaining and increasing the coverage of the population supplied with drinking water, as well as its impact on the rational use of water resources and its positive effects on the standard of living of the population.

Goals

- To restore the hydraulic characteristics of the closed Vento conduit, and to incorporate and apply advanced technologies to repair large diameter gravity pipelines, also prolonging their useful lives.

Objectives

- To restore the water conduction capacity of the Vento conduit, ensuring the supply of 170,000 m³/day of groundwater without the use of electrical power.

Strategies

The following activities are included in the project:

- Preparation of a study to compare different repair alternatives, at the proposal level;
- Study and definition of a solution for the intersection with the Orengo watercourse;
- Study, design and execution of additional works;
- Execution of the restoration with the proper technology.

Summary description

The project will be directed by the City of Havana's Provincial Water Supply and Sewerage System Bureau (DPAA-CH), with advisory services provided by the National Institute of Water Resources and the Ministry of Construction (MICONS). The execution of the works will be carried out with the manpower and resources of the DPAA-CH and MICONS.

Interested parties

The project was identified jointly by the Provincial Water Supply and Sewerage System Bureau of the City of Havana and the National Institute of Water Resources. The project profile is within PAHO priorities because of its direct impact on coverage and the supply of drinking water, as well as its impact on the rational use of water resources and its positive effects on the standard of living of the population.

Geographical area of the project and the beneficiary population

The principal beneficiaries of the project will be the inhabitants of the municipalities of Centro Habana and Habana Vieja, ensuring the supply of water to the significant population that resides in these areas.

Current situation and situation upon completing the project

The Vento conduit, which has been in use for more than 100 years, has a critical problem in its intersection with the Orengo watercourse and serious problems along 4.5 to 5 km of its length as a result of collapses, leaks and structural difficulties. The possible failure of its structure would compromise approximately 15% of the total water supplied to the city.

The implementation of the project will restore the water conduction capacity of the conduit for a period of at least 50 years, thus ensuring the only source of supply to the city that does not require any electrical power.

Duration of the project

3 years

Estimated investments

Cuban resources	US$ 1.00 million
External resources	US$ 0.60 million
Total	*US$ 1.60 million*

Project 5. Drinking Water Supply and Sanitation to the Rural Population through the Use of Alternative Technologies

Specific development problems that the project will address

The rural population is behind the urban sector with respect to its levels of access to drinking water and sanitation. This includes problems of access, low per capita volumes, limited extension, unreliability of potability and uncertain disposal of excreta. These serious limitations affect 715,000 people, and half of the residents of the area lack adequate sanitation.

These sanitary infrastructure problems conspire against the health levels and the stability of these settlements, whose principal economic function is the production of food for the entire population of the country.

Although specific progress has been achieved in the rural environment since the 1980s through the implementation of a DIAPSA program, which made it possible to double the population supplied with drinking water, the size of the urban population (75.7%) makes it the sector that requires the greatest financial resources for water and sanitation.

Distribution of population settlements

Sector	Population (millions)	No. Settlements (> 200 inhabitants)
Urban	8.27	584
Rural	2.65	3,234

Relevance of the project to the country's health policy

The rural population is the most exposed to diseases associated with poor drinking water and inadequate sanitation. Its protection is addressed in the health programs of the Government.

Goals

- To expand the coverage of access to drinking water and adequate sanitation to the rural population sector;
- To extend the use of alternative technologies that reduce costs and are locally accessible.

Objectives

- Implementation of a rural potable water supply and adequate sanitation program in 30 municipalities of the country, where a large rural population resides;

- Training of the local personnel of these municipalities in the use of procedures, materials and alternative technologies to facilitate the extension of this program.

Strategies

The implementation of a water supply and sanitation program is dependent on the availability of financial and material resources, which are currently severely limited in the country. Therefore the project is based on the search for ways to reduce costs and use materials and devices that are within the reach of the local population.

In addition, two actions were identified that are essential to the provision of coherent support to rural programs: the introduction and development of alternative technologies and the national production of these devices and materials.

The local institutions lack sufficient information on and experience with alternative solutions that were developed or improved during the last decade. The training of local personnel in these procedures and devices is also necessary in order to modify technical profiles that are based on solutions that use mechanical equipment, electrical energy and imported materials.

In the location of the geographical areas of the project, those territories were selected that have the highest rural populations in the country. The selection also attempted to reduce the deficits in the sites experiencing the most critical situations and promote the extension of this experience to other settlements in these territories.

One of the most important experiences of the rural program implemented by DIAPSA was the recognition that rural populations have peculiarities that need to be taken into account when services are designed for them. The use of design and construction patterns that are different from those used in the urban sector, and a strong community participation component are basic requirements to undertaking such a program in a viable way within a population area with a number of settlements and a high degree of dispersion.

Summary description

The project is designed to be applied in a parallel way in each municipality and province, and participative subprojects have been structured.

The institutions in each locality organize their action plans and coordinate their support in terms of technical assistance and resources, of internal, jurisdictional or national origin, through the local governments. The provincial governments and their water supply bureaus coordinate the activities at the provincial level and with the INRH at the national level.

In order to provide drinking water and sanitation to each rural community, simplified designs are implemented that use plastic pipe (made in the country from imported raw material in order to reduce supply costs), catchments of available water sources with flexible volumes, and alternative devices for water collection and treatment (for example, windmills, rams, handpumps, manual feeders and small filters). The basic distribution within the community is carried out using public taps. The sanitation initiatives use improved latrines and, if appropriate, simple sewerage systems.

In order to make these alternative solutions accessible to the populations, local training is conducted and the use of available materials is promoted. Two rural technology centers that are being established in the provinces of Camagüey and Guantánamo provide special support to these activities. In addition, this support facilitates the operation and maintenance of the equipment, which is carried out by community organizations.

Interested parties

The National Institute of Water Resources promotes the application of potable water supply and sanitation programs for the population at the national level, within the sector's Ten Year Program.

These participative projects are of interest to the Governments of the provinces and participating localities, which have approved the jurisdictional versions of this Program, and coordinate the search for resources and community participation. The Ministry of Public Health, within its hygiene and prevention programs, provides support and participates in these rural programs.

Geographical area of the project and beneficiary population

The project is targeted to rural communities of the municipalities with the largest rural populations. In accordance with the urgent condition of their services,

subprojects were identified by province that altogether include 120 towns with a total population of 45,000 people.

Province	Total population (000s of inhabitants)	Municipalities with largest rural population
Holguín	404.7	Mayarí, C. García, Banes, Gibara, Báguanos
Granma	330.3	Bayamo, Guisa, Yara,B. Massó, Manzanillo
Santiago	304.0	Palma Soriano, Santiago, Songo-La Maya, Contramaestre, San Luis
Pine Wood River	287.2	Pinar, San Cristóbal, San Juan, San Luis
Town Clara	210.1	Camajuaní, Manicaragua
The Tunas	193.9	J. Menéndez, Jobabo, P. Padre, Las Tunas
Guantánamo	192.0	Salvador, Baracoa, Guantánamo
Camagüey	183.6	Santa Cruz del Sur, Florida

Current situation and situation upon completing the project

The populations of these 120 towns are suffering from critical difficulties with respect to their access to drinking water and sanitation, for the following reasons:

- Irregular supply for lack of public transport because of shortages of fuel and accessories for vehicles or because of breakdowns in their collection equipment; very low per capita volumes, for the above reasons or because of the distance to more productive water sources;

- Lack of potable water, for lack of treatment;

- Uncertain sanitation caused by the prolonged use of inadequate equipment.

Each subproject provides solutions to these situations in their particular towns. The subprojects also provide training to the community in order to maintain the water supply and adopt these alternative solutions.

Duration of the project

The project as a whole will last two years, with a staggered implementation by municipality.

Estimated investments

The structure of the operations plan, which proceeds in a parallel manner in each municipality, makes it possible to divide the plan into independent subprojects, with separate financing and material support. An estimate of the funds invested in each of these subprojects appears in the corresponding analytical tables.

Province: Holguín

Objectives: To provide adequate drinking water and sanitation to 20 rural towns, with a total population of 7,000 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Holguín has an area of 9,302 km^2 and a population of 1,027,300 inhabitants, of whom 38.5% reside in 472 rural towns or are dispersed throughout. The municipalities with the largest rural populations are: Mayarí, Calixto García, Banes, Gibara and Báguanos, where there are 224 towns.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
Mayarí	5 towns, with a population of 2,4 thousand	I	2	152	65
Calixto García	5 towns, with a population of 1,5 thousand.	I	2	130	56
Banes	4 rural towns with a total population of 1,1 thousand.	I	2	122	52
Gibara	3 rural towns with population of 1,0 thousand.	II	2	80	45
Báguanos	3 towns with a population of 1,0 thousand.	II	2	80	50
				564	268

Province: Granma.

Objectives: To provide adequate drinking water and sanitation to 20 rural towns, with a total population of 8,000 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Granma has an area of 8,362 km^2 and a population of 823,700 inhabitants, of whom 40.1% reside in 482 rural towns or are dispersed throughout. The rural population is distributed in mountainous areas or the Cauto plain. The municipalities with the largest rural populations are: Bayamo, Guisa, Yara, B. Masó and Manzanillo.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
Bayamo	5 towns, with a population of 2,7 thousand.	I	2	164	70
Guisa	5 towns, with a population of 1,6 thousand.	I	2	120	55
Yara	4 rural towns with a total population of 1,4 thousand.	I	2	100	40
Masó	3 rural towns with population of 1,2 thousand.	II	2	80	35
Báguanos	3 towns, with a population of 1,0 thousand.	II	2	80	50
Manzanillo	3 towns with a population of 1,1 thousand.	II	2	80	30
				544	230

Province: Santiago de Cuba.

Objectives: To provide adequate drinking water and sanitation to 20 rural towns, with a total population of 8,000 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Santiago has an area of 6,180.7 km^2 and a population of 1,030,600 inhabitants, of whom 29.5% reside in 295 rural towns are dispersed throughout. Most of the terrain of the province is mountainous. The municipalities with the largest rural populations are: Palma Soriano, Santiago, Songo-La Maya, Contramaestre and San Luis.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
Palma Soriano	5 towns, with a population of 3,0 thousand.	I	2	175	75
Santiago	5 towns, with a population of 1,2 thousand.	I	2	110	50
Songo-La Maya	4 rural towns with a total population of 1,5 thousand.	I	2	105	45
Contramaestre	3 rural towns with population of 1,3 thousand.	II	2	90	40
San Luis	3 towns, with a population of 1,0 thousand.	II	2	75	32
				555	242

Province: Pinar del Río.

Objectives: To provide adequate drinking water and sanitation to 10 rural towns, with a total population of 4,000 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Pinar del Río has an area of 10,921 km^2 and a population of 719,900 inhabitants, of whom 39.1% reside in rural towns or are dispersed throughout. The municipalities with the largest rural populations are: Pinar del Río, San Cristóbal, San Juan and San Luis.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
Pinar del Río	3 towns, with a population of 1,5 thousand.	I	2	95	40
San Cristóbal	3 towns, with a population of 1,0 thousand.	I	2	80	35
San Juan	2 rural towns with a total population of 1,0 thousand.	I	2	40	20
San Luis	2 rural towns with a population of 0,5 thousand.	II	2	40	20
				275	125

Province: Villa Clara.

Objectives: To provide adequate drinking water and sanitation to 10 rural towns, with a total population of 4,500 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Villa Clara has an area of 7,943 km^2 and a population of 827,300 inhabitants, of whom 25.4% reside in rural towns or are dispersed throughout. The municipalities with the largest rural populations are: Camajuaní, Manicaragua y Placetas.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
Camajuaní	4 towns, with a population of 2,0 thousand.	I	2	127	55
Manicaragua	4 towns, with a population of 1,6 thousand.	I	2	101	45
Placetas	2 rural towns with a total population of 1,0 thousand.	I	2	65	30
				293	130

Province: Las Tunas.

Objectives: To provide adequate drinking water and sanitation to 15 rural towns, with a total population of 15,000 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Las Tunas has an area of 6,591 km^2 and a population of 815,800 inhabitants, of whom 37.6% reside in rural towns or are dispersed throughout. The terrain is basically flat. The municipalities with the largest rural populations are: J. Menéndez, Jobabo, P. Padre and Las Tunas.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
J. Menéndez	5 towns, with a population of 5,5 thousand.	I	2	245	100
Jobabo	5 towns, with a population of 5,0 thousand.	I	2	231	100
P. Padre	3 rural towns with a total population of 3,0 thousand.	I	2	200	140
Las Tunas	2 rural towns with a population of 1,5 thousand.	II	2	110	70
				785	410

Province: Guantánamo.

Objectives: To provide adequate drinking water and sanitation to 15 rural towns, with a total population of 4,000 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Guantánamo has an area of 6,185 km^2 and a population of 512,000 inhabitants, of whom 37.5% reside in 137 rural towns or are dispersed throughout. 75% of the terrain is mountainous. The municipalities with the largest rural populations are: El Salvador, Baracoa and Guantánamo.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
El Salvador	5 towns, with a population of 1,6 thousand	I	2	124	54
Baracoa	5 towns, with a population of 1,1 thousand.	I	2	106	45
Guantánamo	5 rural towns with a total population of 1,4 thousand.	I	2	125	53
				355	152

Province: Camagüey.

Objectives: To provide adequate drinking water and sanitation to 10 rural towns, with a total population of 4,000 inhabitants.
To train local personnel in the use of these technologies and to extend these experiences to the rest of the provinces.

Situation: The province of Camagüey has an area of 15,974 km^2 and a population of 774,700 inhabitants, of whom 23.7% reside in rural towns or are dispersed throughout. The terrain of the province is essentially level. The municipalities with the largest rural populations are: Santa Cruz del Sur and Florida.

Municipalities	Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
				national	external
Santa Cruz del Sur	5 towns, with a population of 2,1 thousand	I	2	150	60
Florida	5 towns, with a population of 2,0 thousand.	I	2	145	60
				785	410

Project 6. Promotion of and Community Participation in Water and Sanitation Activities and their Incidence on Health

Specific development problems that the project will address

- Limited participation of the population in identifying the priority problems for the water and sanitation sector and the limited possibility of directly resolving these problems by taking advantage of local capacity;

- Lack of capacity to construct, repair, operate and maintain the water supply and sewerage systems, as a result of the current economic situation.

Relevance of the project to the country's health policy

The project contributes to the maintenance of water and sanitation services, which is one of the country's priorities for this sector, and strengthens the role of the community in society.

Goals

- To increase the coverage levels of the water and sanitation systems and increase active community participation in the solution of the sector's problems.

Objectives

- Construction or repair of water supply and sanitation systems with community participation in:

  a) 10 rural towns located in the five eastern provinces of the country, with a joint population of 4,000 people;

  b) Areas of five capital cities of these provinces, with a total population of 20,000 inhabitants;

  c) Selected peripheral areas of the city of Havana, with a total population of 16,000 inhabitants;

- Preparation and application of replicable participation models in drinking water and sanitation projects in rural and urban areas of the program;

- Design, development and utilization of communication materials to promote in the population (including schoolchild) the establishment of adequate habits and practices to resolve the problems of the water and sanitation sector.

Strategies

Based on the emergencies identified by the local population in the area of water and sanitation services, support will be given to their initiatives through agreements reached in councils and workshops in order to generate operating plans. In accordance with these plans, the initiatives will be supplemented with material and financial resources and information on the population, with other resources contributed by local governments and their administrations, as well as external support in the form of essential imported materials. The operating plans will be organized by the people of the community: in rural towns, the citizen and producer associations will direct the activities; in urban districts, the initiatives will be supported by the coordinating and mobilizing efforts of the people's councils.

The first stage of operations, which will last from 6 to 12 months, will mainly consist of identifying the needs in the projects' areas of operation, together with the communities, institutions and local associations, and preparing the informational materials and the operating plans. The subsequent years of the projects will be devoted to the activities of construction and repair of water and sanitation systems, aided by the use of educational materials based on the experience gained. The activities will be carried out in the rural and urban areas at the same time.

Summary description

The most pressing problems for the water supply and sanitation systems identified by the communities will be analyzed in workshops conducted in each locality. If advisory and technical services should be needed, they will be provided jointly with the local government. The local agencies involved primarily include those associated with water and sanitation, health and education.

The operating plan will be submitted for approval and will be promoted in the community, seeking real consensus in order to carry out the solutions to the problems identified, with the active participation of the population in their implementation. This operating plan will specify the resources, participants and implementation periods of the activities. It will be guided by a working group from local associations that participate in the control of the resources and expenditures that are incurred in this area.

A component that is implemented at the same time as the execution of the water supply and sanitation solutions is the design and preparation of mass communication modules. These activities are conducted while considering the communications media that are available to the locality; the development of a program to inculcate new habits, skills and practices in the population; and specific activities for the schools. The activities with school children will include the active participation of teachers, with meetings devoted to basic practical learning of elements of hygiene and techniques that are adapted to the culture and age of the children. The program will also promote the participation of these children in practical activities that can be related to sanitation and the drinking water supply.

Through periodic meetings of the plan management group with the people, the limitations or deficiencies will be identified and adjustments will be made to the implementation of the planned activities. Upon the conclusion of planned activities, an evaluation of the results will be performed and the transmission of the experiences to other communities will be promoted.

Interested parties

The National Institute of Water Resources is the national body that is responsible for this project. The INRH should promote, along with the localities involved and through the provincial and municipal governments, a consensus on the activities in order to support the initiatives of these communities.

The Ministries of Public Health and Education and the Institute of Physical Planning will provide additional support to the project through their local administrative agencies.

Geographical area of the project and beneficiary population

The five eastern provinces of the country are the areas with the most extensive problems with their drinking water and sanitation services. In this region, where half of the rural population of the country is concentrated, there are six cities with a total population of more than 100,000 inhabitants.

The rural population is well connected economically with the agricultural and livestock sector. The sugar cane economy predominates in the flat areas and, in the mountains, coffee groves and forests. The access to potable water is limited by the availability of ground water, and even if available, salinization is a serious problem in at least three of the provinces. The urban population of these cities and the peripheral urban areas of the City of Havana have access to surface water, and there are currently limitations with respect to its treatment and supply.

The beneficiary groups are part of the population that resides in the areas that are most vulnerable to water supply and sanitation problems: the small rural towns and the periphery of the cities. The implementation of this project seeks to address these vulnerabilities as identified by the people themselves and to improve the protection of their health conditions, with the active participation of the communities in the solution of the problems identified.

Current situation and situation upon completing the project

The project seeks to resolve the problems identified in these population settlements with respect to: volume of water and hours of delivery; quality of drinking water and elimination of excreta disposal problems; facilitation and establishment of positive sanitary practices among the populations.

The project activities will benefit 40,000 people, and the experience will also serve as model to be disseminated and extended.

Linkages to other programs

This community participation project is part of the National Drinking Water and Sanitation Plan, approved by the country in order to fulfill one of the objectives of the World Summit for Children. In addition, it strengthens the Cholera Prevention Plan that is sponsored by PAHO.

Estimated duration and cost

A period of five years is estimated for project implementation.

The total cost of the project will be US$ 8.00 million, with an external component of US$ 3.45 million.

Project 7. Optimization of the Operation of Principal Water Supply Systems through the Use of Modern Measurement, Diagnostic and Automation Techniques

Specific development problems that the project will address

This project is intended to create the conditions necessary to complete the census, provide diagnostic aids for mathematical modeling and conduct the macromeasurement of sources and principal conduits in selected cities of the country with the greatest relative share of these problems (Havana, Santiago de Cuba, Santa Clara, Camagüey, Holguín and Guantánamo). These cities represent the most important centers of the country and concentrate 42.2% of the urban population. Their systems have experienced a serious decline in their levels of service, significant losses from leaks (estimated between 30% and 50% of the water supplied) and an elevated consumption of energy and chemical products.

This situation is one of the primary factors impeding the development of moderately efficient water supply system operations. Although the survey and records of the most important water supply and sewerage installations were kept updated until the 1960s, and later attempts were made to update the information on the basis of project inventories of operational studies (in the principal cities, except for Havana, many extensive surveys are available), these efforts were carried out using rather imprecise methods. The pitometry committees are responsible for these activities, and the committees have been affected by the technical condition of various kinds of resources (detection equipment, pitometers, recorders, transportation and others). With regard to macromeasurement, basically of the water generated by the sources, and flows through principal conduits, over recent decades stationary equipment has not been acquired (nor conventional or up-to-date technology), and spot measurements have been performed with conventional equipment (pitometers) or by performing evaluations on the basis of the hours of operation of the existing pumping equipment.

It is evident that the implementation of techniques and advanced technologies is essential to the achievement of better management of the water supply systems. The following technologies are being considered: electronic detection and communications through a central command office for pump operations, flow and pressure measurement equipment, and tank operations; application of simulation techniques to optimize system operations; automated operation of the water supply system in real time; and the use of automated financial management. The implementation of these techniques and technologies requires that the system's infrastructure achieve a certain degree of consolidation, which means an updated census, an acceptable level of leaks in networks, adequate storage tank capacities, and consistent levels of micromeasurement.

Relevance of the project to the country's health policy

The project conforms to Government priorities and the priorities established by PAHO, given its direct impact on maintaining and increasing the coverage of the population supplied with drinking water, as well as its impact on the rational use of water resources and its positive effects on the standard of living of the population.

Goals

- To establish and consolidate techniques and reliable, effective and up-to-date methods for the census, diagnosis and optimization of the system operations of the principal cities of the country;

- To introduce and implement advance techniques and technologies for the operation and management of the water supply systems and their later use by other water supply systems of the country, as a way to achieve better financial management of these services, increase the coverage and supply with the same level of input from water sources, reduce energy consumption and optimize the use of the water supplied to the population.

Objectives

- Provide equipment and techniques to conduct a census, systematically update the census, diagnose the condition of conduits and networks, and perform the macromeasurement of flows from sources and through principal conduits, for the water supply system bureaus of the 6 principal cities of the country;

- Implement advanced techniques and technologies for the operation and management of the water supply systems with a view to optimizing the use of resources and existing installations.

Strategies

This operations program for each city is structured through the development of interrelated and interdependent subprojects to achieve the objectives. The division of the program into subprojects is a strategy that seeks to obtain national and external financial resources and is intended to help organize the sequence of activities.

Summary description

The project seeks to restore levels of water service in the 6 principal cities of the country in a relatively short period, by updating information on the water supply systems, establishing a system of systematic measurements of sources and pumps

that will make it possible to establish a more effective operation, stabilize the supply, balance distribution areas and reduce losses and overconsumption.

To this end, a set of successive and interdependent activities will be implemented to increase the operating capacity of the water supply system in each city, by providing reasonably indispensable tools and equipment and the training of personnel in operating techniques. In the most critical service areas of each city, a pilot program will be implemented to conserve water, which will help to increase the level of this service.

Interested parties

The project was identified jointly by the provincial water supply and sewerage systems bureau of each city and by the National Institute of Water Resources. The profile of the project falls within PAHO priorities given its direct impact on the coverage and provision of drinking water, as well as its positive impact on the health condition of the population.

Geographical area of the project and beneficiary groups

The principal beneficiaries of the project are the populations of 6 cities with more than 200,000 inhabitants, including the capital of the country, as well as the nationally important industrial complex of the city, which will be provided a stable water supply.

City	Inhabitants (thousands)
Havana	2,209.8
Santiago de Cuba	418.7
Camagüey	286.4
Holguín	232.7
Guantánamo	203.3
Santa Clara	197.2

Current situation and situation upon completing the project

These 6 cities currently receive a gross per capita volume of between 300 and 600 liters per person per day, although most of the population receives water on alternate days and for less than 6 hours. This situation is to a great extent the result of losses from leaks in conduits and the problems associated with network operations, including the lack of macro and micromeasurement, the lack of storage capacity and an inadequate water management policy.

The purpose of the implementation of this project is to stabilize the water supply at an average of 8 to 16 hours per day, provide an adequate supply, reduce administrative expenditures, define new investments, and store additional water in order to meet the demand.

Duration of the project

2 years

Estimated investments

An account of the financing of the package of subprojects for each city is included in the analytical description of each subproject.

City: Havana (2,209,800 inhabitants).

Objectives: To stabilize water service, increase the hours of supply and reduce emergency service in various areas of the city.

Situation: 98.7% with household connections. The supply system includes 47 sources of supply, 15 reservoirs, 330.5 km of conduits, and 3,584.6 km of distribution networks. It serves 550,000 residential nuclei, 34.8% of which are metered, and 18,000 state users (400 large consumers). It supplies 450 MM m^3 per year and consumes 174 GWh of energy. 54% of administrative expenditures are for wages and 35% for energy. Supply is discontinuous and at low pressure, varying between 3 and 16 hours per day or on alternate days; 8 hours per day on the average. It is estimated that 45% of the water in the supply system is lost.

Subproject title		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
7.1	Completion of the census of the water supply system. Use of software to continue to update the census.	Enable the implementation of 7.3	I	1	130	136
7.2	Design and implementation of the macromeasurement network. Use of a fixed and portable measurement system. Use of software in its implementation.	Enable the implementation of 7.3	I	1	220	315
7.3	Updating of the operations of the principal systems, improvement and evaluation of measures to optimize them. Use of software in the operations.	• Stabilize daily service • Increase continuity, schedules and supply • Reduce consumption and losses	II	2	250	50
7.4	Study, design and application of automation in sources and principal pumping stations.	Reliability of the supply	II	4	1500	300
7.5	Study and selection of critical areas (10 to 20 thousand inhabitants) and application of pilot project to conserve water (micromeasurements, control of leaks, introduction of low consumption fittings and equipment, possible reuse, community education), with community participation.	• Increase levels of service in these areas • Availability of significant volumes of recovered water	II	4	700	256
7.6	Development of human resources to implement the subprojects.	Reliability in the operating capacity of the water supply system.	I	1	50	20
					2850	1117

City: Santa Clara (197,200 inhabitants).
Objectives: To stabilize water service, increase the hours of supply and reduce emergency service in various areas of the city.
Situation: The water supply system includes 3 sources of supply; almost 340 km of networks and conduits and stretches that have been used for more than 50 years. Its average time of service is 10 hours per day, although there are areas that receive water on alternate days or every several days.

Subproject title		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
7.1	Completion of the census of the water supply system. Use of software to continue to update the census.	Enable the implementation of 7.3	I	1	10	24
7.2	Design and implementation of the macromeasurement network. Use of a fixed and portable measurement system. Use of software in its implementation.	Enable the implementation of 7.3	I	1	40	50
7.3	Updating of the operations of the principal systems, improvement and evaluation of measures to optimize them. Use of software in the operations.	• Stabilize daily service • Increase continuity, schedules and supply • Reduce consumption and losses	II	2	170	60
7.4	Study, design and application of automation in sources and principal pumping stations.	Reliability of the supply	II	4	80	15
7.5	Study and selection of critical areas (10 to 20 thousand inhabitants) and application of pilot project to conserve water (micromeasurements, control of leaks, introduction of low consumption fittings and equipment, possible reuse, community education), with community participation.	• Increase levels of service in these areas • Availability of significant volumes of recovered water	II	4	200	110
7.6	Development of human resources to implement the subprojects.	Reliability in the operating capacity of the water supply system.	I	1	30	20
					510	279

City: Camagüey (286,000 inhabitants).
Objectives: To stabilize water service, increase the hours of supply and reduce emergency service in various areas of the city.
Situation: The water supply system includes 5 sources of supply with 21 pumping stations, almost 400 km of networks and conduits, around 55,000 connections and more than 1,000 operating valves.

Subproject title		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
7.1	Completion of the census of the water supply system. Use of software to continue to update the census.	Enable the implementation of 7.3	I	1	20	24
7.2	Design and implementation of the macromeasurement network. Use of a fixed and portable measurement system. Use of software in its implementation.	Enable the implementation of 7.3	I	1	50	74
7.3	Updating of the operations of the principal systems, improvement and evaluation of measures to optimize them. Use of software in the operations.	• Stabilize daily service • Increase continuity, schedules and supply • Reduce consumption and losses	II	2	210	100
7.4	Study, design and application of automation in sources and principal pumping stations.	Reliability of the supply	II	4	50	10
7.5	Study and selection of critical areas (10 to 20 thousand inhabitants) and application of pilot project to conserve water (micromeasurements, control of leaks, introduction of low consumption fittings and equipment, possible reuse, community education), with community participation.	• Increase levels of service in these areas • Availability of significant volumes of recovered water	II	4	350	148
7.6	Development of human resources to implement the subprojects.	Reliability in the operating capacity of the water supply system.	I	1	50	20
					730	372

City: Holguín (232,700 inhabitants).
Objectives: To stabilize water service, increase the hours of supply and reduce emergency service in various areas of the city.
Situation: The water supply system includes 4 sources of supply; almost 200 km of networks and conduits and 100 operating valves. There are areas with large water needs with service every 4 or 5 days.

Subproject title		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
7.1	Completion of the census of the water supply system. Use of software to continue to update the census.	Enable the implementation of 7.3	I	11	20	24
7.2	Design and implementation of the macromeasurement network. Use of a fixed and portable measurement system. Use of software in its implementation.	Enable the implementation of 7.3	I	1	40	50
7.3	Updating of the operations of the principal systems, improvement and evaluation of measures to optimize them. Use of software in the operations.	• Stabilize daily service • Increase continuity, schedules and supply • Reduce consumption and losses	II	2	160	60
7.4	Study, design and application of automation in sources and principal pumping stations.	Reliability of the supply	II	4	40	8
7.5	Study and selection of critical areas (10 to 20 thousand inhabitants) and application of pilot project to conserve water (micromeasurements, control of leaks, introduction of low consumption fittings and equipment, possible reuse, community education), with community participation.	• Increase levels of service in these areas • Availability of significant volumes of recovered water	II	4	500	210
7.6	Development of human resources to implement the subprojects.	Reliability in the operating capacity of the water supply system.	I	1	40	20
					800	372

City: Santiago de Cuba (418,700 inhabitants).

Objectives: To stabilize water service, increase the hours of supply and reduce emergency service in various areas of the city.

Situation: There is a gap between supply and demand that exceeds 150 l/s. Some 50% of the population (14 areas) receives water every 4 days and 10% of the population receives water every 3 days. The networks are comprised of several hundred km of pipes that exceed 50 years of use.

Subproject title		Expected outcomes	Priority	Execution (years/2)	Financing (thousands of US$)	
					national	external
7.1	Completion of the census of the water supply system. Use of software to continue to update the census.	Enable the implementation of 7.3	I	1	50	48
7.2	Design and implementation of the macromeasurement network. Use of a fixed and portable measurement system. Use of software in its implementation.	Enable the implementation of 7.3	I	1	110	100
7.3	Updating of the operations of the principal systems, improvement and evaluation of measures to optimize them. Use of software in the operations.	• Stabilize daily service • Increase continuity, schedules and supply • Reduce consumption and losses	II	2	310	150
7.4	Study, design and application of automation in sources and principal pumping stations.	Reliability of the supply	II	4	140	50
7.5	Study and selection of critical areas (10 to 20 thousand inhabitants) and application of pilot project to conserve water (micromeasurements, control of leaks, introduction of low consumption fittings and equipment, possible reuse, community education), with community participation.	• Increase levels of service in these areas • Availability of significant volumes of recovered water	II	4	600	300
7.6	Development of human resources to implement the subprojects.	Reliability in the operating capacity of the water supply system.	I	1	70	40
					1280	688

City: Guantánamo (203,300 inhabitants).
Objectives: To stabilize water service, increase the hours of supply and reduce emergency service in various areas of the city.
Situation: The water supply system includes 4 sources and almost 200 km of networks and conduits. It loses more than 30% of its flow from leaks because sections of the network have been in use for more than 50 years.

Subproject title		Expected outcomes	Priority	Execution (years/Z)	Financing (thousands of US$)	
					national	external
7.1	Completion of the census of the water supply system. Use of software to continue to update the census.	Enable the implementation of 7.3	I	1	20	24
7.2	Design and implementation of the macromeasurement network. Use of a fixed and portable measurement system. Use of software in its implementation.	Enable the implementation of 7.3	I	1	45	60
7.3	Updating of the operations of the principal systems, improvement and evaluation of measures to optimize them. Use of software in the operations.	• Stabilize daily service • Increase continuity, schedules and supply • Reduce consumption and losses	II	2	210	100
7.4	Study, design and application of automation in sources and principal pumping stations.	Reliability of the supply	II	4	50	10
7.5	Study and selection of critical areas (10 to 20 thousand inhabitants) and application of pilot project to conserve water (micromeasurements, control of leaks, introduction of low consumption fittings and equipment, possible reuse, community education), with community participation.	• Increase levels of service in these areas • Availability of significant volumes of recovered water	II	4	450	190
7.6	Development of human resources to implement the subprojects.	Reliability in the operating capacity of the water supply system.	I	1	40	20
					815	404

Project 8. Program for the Monitoring and Control of Water Quality for Human Consumption

Specific development problem that the project will address

Cuba has problems with the quality of its drinking water services caused by intermittent service, the poor condition of networks, low pressure in the networks and difficulties in water treatment and disinfection processes. Beginning in 1990, Cuba's difficult situation in the international arena has had a negative impact on the national economy, particularly in the water and sanitation sector with respect to equipment and material resources. This situation has caused a deterioration in the quality of the water provided to the population, with the consequent increase in morbidity from waterborne diseases - both in absolute numbers and in rates - consuming large quantities of material resources and affecting the health of the population.

The National Institute of Water Resources, the agency that regulates the water and sanitation sector in the country, is responsible for the monitoring and control of water quality in the supply sources through the INRH's Water Quality Control Network (REDCAL). This Network includes 802 stations throughout the entire country, located at the supply sources, in their immediate surroundings and at wastewater discharge sites that involve risk of contamination. The Network's existence has permitted the implementation of specific plans to protect water resources in accordance with the provisions of *Legal Decree No. 138, On Terrestrial Waters*. In addition, the provincial water supply systems are subordinated to the local governments, and are responsible for the extraction of groundwater or the use of surface water and the determination of the kinds of treatment to which these waters will be subjected. As the entities that produce the water, they also control its quality at sources, treatment plants, conduits and key points in the networks, in order to take the necessary measures in case of contamination.

Cuba's Ministry of Public Health is the authority responsible for monitoring the sanitary quality of water for human consumption. To this end, MINSAP has established a monitoring network that encompasses more than 6,700 sampling points in sources, conduits, treatment plants, storage tanks and distribution networks throughout the entire country. The sampling should be carried out by the Provincial Hygiene and Epidemiology Centers (CPHE) at the intervals established in the following standards: *NC 93-02:92. Community Hygiene. Drinking water. Sanitary Requirements, and NC 93-03:92. Community Hygiene. Public Water Supply Systems*.

At the end of the 1980s, the monitoring and control system was consolidated. However, beginning in 1990 its operations have been seriously affected by the current limitations on laboratory cultures, equipment and reagents, as well as on transportation and the supply of fuel. Because of the above, 12.5% of the population

supplied in 1993 received water for which bacteriological control was not carried out. This figure reached more than 50% in 1994.

Relevance of the project to the country's health policy

The project is aligned with the National Institute of Water Resources' (INRH) guidelines for the protection of terrestrial waters and with the goals, objectives, and directives of the Ministry of Public Health to improve the health of the Cuban population through the year 2000. It also fully responds to the objectives of the Regional Plan for Investment in the Environment and Health (PIAS) formulated by PAHO.

The proposed program consists of three parts that encompass the water cycle from its sources through its delivery to the consumer, which will be carried out by each of the agencies involved in the activity.

- 8.1 Program for the Monitoring and Control of Water Quality at the Supply Sources

  Implementing agency: INRH

- 8.2 Program for the Control of Water Quality at Sources, Treatment Plants, Conduits and Key Points

  Implementing agency: Provincial water supply systems

- 8.3 Program to Monitor the Sanitary Quality of Water for Human Consumption

  Implementing agency: Ministry of Public Health

Program 8.1 Program for the Monitoring and Control of Water Quality at the Supply Sources

Goals

To strengthen the control, surveillance and preservation of water quality in the sources of supply.

Objectives

- Ongoing monitoring, control and preservation of water quality in sources for human consumption;
- Identification of sources with evident signs of contamination and recommendation of urgent corrective measures for the sources of the contamination;
- Improvement in the level of information on water quality that is provided to the individuals responsible for their use and management, through the systematic publication of the results obtained.

Strategies

The INRH will be responsible for implementing the project on the basis of the current organization of its system through its provincial bureaus and, at the line level, through its work on the hydraulic complexes constructed in areas where the sources are located that are considered in this project. A national coordinator will be appointed who will control and advise on the work of the provincial groups and those at the hydraulic complexes. The groups will be multidisciplinary in nature, and will have specialists in sanitary hydrology, chemistry, biology, microbiology and analysts. The provincial groups and the hydraulic complex groups should incorporate the municipality into the technical work, and will attempt to reach the community in order to provide greater credibility and more effective management to the project.

Summary description

Activities:

- Preparation of a document on strengthening REDCAL-SOURCE, indicating the current condition, prognoses for immediate implementation and needs for material resources;

- Formation of the groups at the national, provincial and local levels;

- Preparation, presentation and approval of the project;

- Mobilization of the financial resources needed to improve and modernize the network of existing laboratories and supply them;
- Implementation of the project.

Interested parties

- National Institute of Water Resources

- Ministry of Public Health

- Provincial Governments

Geographical area of the project and beneficiary groups

The project will be national in scope, and in its first stage the sources of supply and their environs at the level of provincial capitals will be accorded priority status. The covered population is equivalent to the population served by the water supply systems in these cities.

Current situation and situation upon completing the project

Currently the program to monitor, control, and preserve the quality of water for human consumption at its sources has shown a significant decline in its ability to fulfill its objectives, and this is generating a great deal of uncertainty and risk for the consumer.

When the project is completed, the REDCAL-SOURCE will have recovered its capacity and will have been strengthened in its conception and its ability to respond to its problems.

Duration of the project

3 years

Estimated investments

An estimate of the funds to be invested in each of the subprojects appears in the corresponding analytical tables.

Agenda 8.2 Program for the Control of Water Quality at Sources, Treatment Plants, Conduits and Key Points

Goals

To provide the population with water supply service at the level of quality required.

Objectives

- Ensure that all provincial water supply systems have the resources necessary to carry out their functions;
- Systematic control of water quality in the sources, treatment plants, conduits and key points;
- Ensure the proper treatment of water for human consumption.

Strategies

The provincial water supply systems will be the entities responsible for carrying out the project through the 14 provincial laboratories, with support from the plant laboratories and, in the specific case of residual chlorine control, from the water supply system bureaus.

Summary description

- Accreditation of the provincial water supply system laboratories in order to ensure that quality control is exercised over techniques, equipment and work instruments;
- Training of the technical teams that will carry out the program;
- Review of the inspection and sampling points;
- Preparation, presentation and approval of the program;
- Mobilization of financial resources to complete, modernize and provide the necessary supplies to the provincial water supply system laboratories;
- Implementation of the program.

Interested parties

Provincial water supply systems and the plant laboratories assigned to them.

Geographical area of the project and beneficiary groups

The project will be national in scope, with priority status accorded to the provincial capitals and, within them, the areas at high risk of contamination.

Current situation and situation upon completing the project

In some provinces, water quality control has deteriorated because of limitations on resources. The execution of the project would make it possible to carry out this control in a systematic and uniform manner, which would result in better service to the population.

Duration of the project

3 years

Estimated investments

An estimate of the funds to be invested in each of the subprojects appears in the corresponding analytical tables.

Agenda 8.3 Program to Monitor the Sanitary Quality of Water for Human Consumption

Goals

- To strengthen the system to monitor the sanitary quality of water and reduce the risk of waterborne diseases.

Objectives

- Organize the implementation of the monitoring program that has been established for the entire country;
- Systematic monitoring of the quality of water provided to the population at the key points of principal cities;
- Identification of the areas that have the highest risk of contamination within those population centers and proposed measures to mitigate these risks.

Strategies

The Ministry of Public Health will be the agency responsible for implementing the project through the provincial hygiene and epidemiology centers. The principal specialist or national coordinator will control and advise the work of the provincial groups.

Summary description

The following activities will be implemented:

- Analysis of the country's current information and the selection of areas where the system to monitor the sanitary quality of the water will be strengthened;
- Formation of the team that will carry out the program;
- Review of the number and location of inspection and sampling points;
- Preparation, presentation and approval of the program;
- Mobilization of financial resources to improve, modernize and provide supplies to the provincial hygiene and epidemiology centers;
- Implementation of the program.

Interested parties

Ministry of Public Health of Cuba

Geographical area of the project and beneficiary groups

The program will be national in scope, and the provincial capitals will be accorded priority status because they have the highest population density.

Current situation and situation upon completing the project

The Cuban standards for monitoring the sanitary quality of the water for human consumption cannot currently be complied with. As a result, part of the population is supplied water with no bacteriological control.

Given that this monitoring should be ongoing, the implementation of this project should in time generate better control over the quality of water supplied to the population. This improvement would in turn make it possible to take the necessary measures to reduce morbidity and mortality from waterborne diseases.

Duration of the project

3 years

Estimated investments

An estimate of the funds to be invested in each of the subprojects appears in the corresponding analytical tables.

City: Pinar del Rio

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is amebic dysentery, followed by hepatitis A.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
B.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	11.2	4.8
B.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	33.6	14.4
B.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	34.1	14.6
					78.9	33.8

City: Havana.

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. In several areas of the city water is supplied on alternate days. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAT-SOURCE	I	3	187.6	80.4
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	724.0	80.0
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	735.1	80.0
					1646.7	240.4

City: Matanzas.
Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.
Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL SOURCE	II	3	10.2	4.5
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	21.5	12.5
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	32.0	15.7
					73.7	31.7

City: Santa Clara

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. In several areas of the city the water is supplied on alternate days. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis, followed by amebic dysentery.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL SOURCE	II	3	17.5	7.5
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	52.5	22.5
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	53.3	22.8
					123.3	52.8

City: Cienfuegos

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is amebic dysentery, followed by type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAI-SOURCE	II	3	11.2	4.8
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	33.6	14.4
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	34.1	14.6
					78.9	33.8

City: Sancti Spíritus

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	6.2	2.7
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	23.1	9.9
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	23.4	10.0
					52.7	22.6

City: Ciego de Avila

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	6.2	2.6
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	23.1	9.9
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	23.4	10.0
					52.7	22.5

City: Camagüey

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is bacillary dysentery, followed by type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	20.2	8.6
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	75.6	32.4
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	76.6	32.8
					172.4	73.9

City: Las Tunas

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. Water is supplied every three days. The system to monitor and control water has been weakened by the lack of resources.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	10.5	4.5
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	31.5	13.5
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	31.9	13.7
					73.9	31.7

City: Holguín

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. Water is supplied every two days. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	20.3	8.7
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	50.9	25.1
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	61.7	26.5
					142.9	61.3

City: Bayamo

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	11.2	4.8
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	33.6	14.4
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	34.1	14.6
					78.9	33.8

City: Santiago de Cuba

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. Water is supplied every three days. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is bacillary dysentery, followed by type A viral hepatitis. Has had the largest number of typhoid fever cases in the country.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality at the sources of supply	Restoration of REDCAL-SOURCE	II	3	37.1	15.9
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	111.3	47.7
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	112.8	48.4
					260.9	112.0

City: Guantánamo

Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.

Situation: There are problems with the treatment and disinfection of the water supplied to the population. Water is supplied every two days. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	18.2	7.8
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population		3	54.6	23.4
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases		3	79.1	23.7
					151.9	54.9

City: New Gerona
Objectives: To strengthen the monitoring control of water quality and to reduce the risk of waterborne diseases.
Situation: There are problems with the treatment and disinfection of the water supplied to the population. The system to monitor and control water has been weakened by the lack of resources. The most common waterborne disease is type A viral hepatitis.

Subproject title		Expected outcomes	Priority	Execution (years)	Financing (thousands of US$)	
					national	external
8.1	Program to monitor and control water quality in the sources of supply	Restoration of REDCAL-SOURCE	II	3	3.5	1.5
8.2	Program to control water quality in sources, treatment plants, conduits and key points	Improvement of service to the population	I	3	10.5	4.5
8.3	Program to monitor the sanitary quality of water for human consumption	Reduction of morbidity and mortality from waterborne diseases	I	3	10.7	4.6
					24.7	11.6

Project 9. Managerial and Technical Development Program

Specific development problem that the project will address

In the sectoral study on drinking water and sanitation, a need was identified to increase the level of managerial preparation in modern managerial and administrative techniques and facilitate access to the current bibliography to supplement self-study in technical areas. The study also determined that there is an inadequate exchange of experience with other educational centers in the region in order to develop specializations in the field of sanitary engineering, and that there is little systematic training of technicians and workers.

Relevance of the project to sector policy

The training and development of human resources is vital to improving performance in the sector. Thus the project is fully in accordance with Government and PAHO priorities.

Goals

- To train the personnel of the sector entities in order to improve the efficiency of services, in accordance with the policy of the country and international experience.

Objective

- To develop a comprehensive and complete improvement program and ongoing and systematic training in the various occupational categories, in order to improve the qualifications of the personnel in charge of sector activities. This effort will have an impact on the management and performance of basic drinking water and sanitation services.

Strategy

Responsibility for project implementation will lie with the agencies that control the management, operations and maintenance of water supply and sewerage systems and the Hygiene and Epidemiology Network respectively. A group of professionals from these institutions will be formed with the support of specialized consulting services in order to develop the essential studies and implement the project itself.

Summary description

The project requires the implementation of the following phases:

- Creation of the group of professionals from the regulatory institutions and definition of the methodological bases for project implementation;
- Study and selection of staff to retrain;
- Development of program to obtain international cooperation;
- Coordination with specialized companies and international organizations to implement the program;

Interested parties

The National Institute of Water Resources, the Ministry of Public Health, the water supply and sewerage system bureaus and the local governments have included this project in their work plans.

Geographical area of the project and beneficiary groups

The project is national in scope, and benefits the service provider entities in particular, and in general, the entire sector.

Current situation and situation when the project is completed

Currently only isolated activities to train and develop human resources are being conducted, and they are insufficient.

When the project is completed, a larger number of people will be trained in the various work areas by occupational category.

Estimated duration

5 years

Estimated investments

The estimated cost for the external components is US$ 1.11 million over five years, at a rate of US$ 222,000 per year. The national component amounts to US$ 200,000 over 5 years.

Project 10. Enhancement of the Sector's National Information System

Specific development problems that the project will address

This project entails the improvement of the existing system in the sector, so that this system will be an effective tool and provide the elements necessary for decision-making at the various levels of sector management and the management of extrasectoral agencies that affect the sector.

Relevance of the project to the country's health policy

This project has a direct impact on the work of the sector given that it will facilitate improvement in its management. In addition, the project responds to national policy and PAHO priorities.

Goal

- To develop a reliable statistical information that will provide the institutions of the sector and other extrasectoral agencies with information on the indicator trends in order to facilitate planning, decision-making and the timely evaluation of management, among other activities.

Objective

- Preparation of a general information system that includes the necessary sector indicators, through the collection, evaluation, analysis and periodic updating of the data, in order to facilitate planning and timely and efficient decisions at all levels.

Strategies

The regulatory agencies (INRH, MINSAP), with the support of other national agencies, will be responsible for carrying out and coordinating project implementation. These agencies should also be supported by the provincial and municipal entities of the sector for the supply and processing of selected indicators that are required for system development and implementation.

Summary description

- Create a group of specialists to evaluate the initial studies and provide continuity to the results derived from them;

- Compile and analyze the information available in the provincial and municipal entities;

- Evaluate the existing information systems in the sector;

- Define the indicators that meet the needs of the sector in each of the various administrative levels;

  Define the enhancements needed to process the information;

- Establish the National Information System using a methodology that provides access for regulatory agencies and other extrasectoral agencies to processed and updated information in a systematic way.

Interested parties

- Provincial and municipal water supply and sewerage system bureaus;

- National Institute of Water Resources

- Ministry of Public Health

- Ministry of Economy and Planning

- Ministry of Finance and Prices

Geographical area of the project and beneficiary group

The project encompasses the entire country because it is a system that is national in scope. It will benefit the service provider entities, regulatory agencies and other agencies related to the sector by the very nature of the functions that it will perform.

Current situation and situation upon completing the project

There is currently a partial system with a limited number of indicators that make the precise evaluation of the activity impossible.

When a viable and uniform system is established to collect, record and process the indicators of the country's drinking water and sanitation sector, the analytical function will be improved, and with it the quality of decisions affecting the sector.

Estimated duration of the project

2 years

Estimated investments

Total	US$ 0.12 million
Of this:	US$ 0.06 million in external resources

Project 11. Implementation of Micromeasurement and Fees in the Principal Cities of the Country

Specific development problems that the project will address

Starting in October 1994, a fixed water consumption fee per resident per month was implemented in the country for the population sector that does not have stream gauges. This fee will coexist with structured fees in blocks for those family nuclei that have meters. The fundamental objective of these rates is to create a discipline of paying for the service received, and thus build the self-financing capacity of the sector. Another problem for the country is the definition and implementation of micromeasurement for users with household service.

Relevance of the project to the country's health policy

Once the parameters for water quality and coverage are achieved, the trend toward sector self-financing will ensure the maintenance of the levels reached and prevent the future deterioration of services.

Goals

- To strengthen the economic and financial self-sufficiency of the sector, in order to achieve its operational development and future growth;

- Provide meters to all drinking water users in the water supply systems with household connections.

Objectives

- Periodic (annual) setting of rates for the sector through the development of a method that will make it possible to determine the suitability of investments in stream gauges on the basis of economic profitability;

- Encourage water conservation through the reduction of consumption.

Strategies

The implementation of the project involves completion of the following phases:

a) Development of a cost analysis for the sector using the corresponding cost control methodology;

b) Analysis of the economic coverage of the current rates;

c) Design of a methodology to calculate rates that affect both the population with meters and those who receive service from unmetered pipe, which will be consistent with operating costs;

d) Review of the legislative framework that supports the rates.

The local water supply and sewerage system entities, which are subordinate to the regulatory agency, will undertake program activities for installing stream gauges, beginning with the largest cities and extending to the entire country.

Summary description

In the first phase, the project will be carried out in collaboration between the National Institute of Water Resources and the Ministry of Finance and Prices, up through the definition and establishment of the method to develop and approve the fee rates. In the second phase, the INRH will evaluate the priority status of the metered system on the basis of the criterion of economic profitability.

In addition, the implementation of micromeasurement will be carried out according to the following work plan:

- Creation of a working group;
- Prioritization of the principal cities to meter;
- Preparation of the detailed meter timetable for each city;
- Definition of the general plan of action with producers and providers.

Interested parties

The Ministry of Finance and Prices and the INRH are primarily responsible for promoting this project, which will make it possible to separate water supply and sanitation sector activities from the State budget. The water supply and sewerage system bureaus will also be involved at all administrative levels.

Geographical area of the project and beneficiary group

The fee that is established will affect more than 70% of the population, distinguishing between the users regulated by meters and those who receive service from unmetered pipe. Half of the country's population does not pay sewerage fees. However, a gradual increase in this coverage is anticipated.

The project is national in scope and is of interest to all agencies of the sector and the extrasectoral agencies that are concerned with the supply and conservation of water.

Current situation and situation upon completing the project

The current rates, for both water supply and sewerage, are not supported by a methodology that considers the costs incurred.

In the future, fee schedules should be devised that correspond to costs and charge users in accordance with their consumption, thus ensuring the financial viability of the sector.

Duration of the project

2 years

Estimated investments

Total	US$ 0.12 million
Of this:	US$ 0.05 million in external resources

Project 12. Reorganization and Updating of the Sector's System of Standards

Specific development problems that the project will address

State and lower level standards need to be updated in accordance with current economic circumstances that affect technological access.

Relevance of the project to the country's health policy

This project has direct repercussions for the work of the water and sanitation sector, basically for the principal agencies that comprise it: the National Institute of Water Resources and the Ministry of Public Health. Its implementation will make it possible to systematically regulate with a single criterion both the current work and possible future development, an approach that responds to Government policy for the sector.

Goal

- To reorder and to update the current system of standards and regulations of the sector, in accordance with the economic conditions of the country and international experience.

Objective

- To develop a system of State and jurisdictional standards that responds to the requirements of the sector.

Strategies

The National Institute of Water Resources and the Ministry of Public Health, as the principal agencies that govern sector policy, should assume responsibility for implementing the project, with the participation of other extrasectoral agencies and institutions that have expertise in the process of reorganizing and updating standards and regulations, through the creation of a working group.

Summary description

Creation of the working group;

- Collection of existing standards and regulations related to the sector;

- Review and evaluation of the country's current methodology for classifying

standards and regulations in accordance with a sectoral approach;

- Detailed study of recurrent elements in order to define sector standards and regulations;

- Definition of the scope and updating of the planned standards and regulations of the sector;

- Reorganization and classification of the State and jurisdictional standards;

- Definition of the work schedule;

- Updating and adaptation of the sector's standards and regulations;

- Definition of a system to implement and control the sector's standards and regulations;

Interested parties

The implementation of the project is of interest to the regulatory agencies of the sector.

Geographical area of the project and beneficiary group

The project is national in scope and its implementation is of interest to all of the agencies of the sector and to the extrasectoral entities concerned with water supply and sanitation.

Current situation and situation upon completing the project

Several systems of State and jurisdictional standards are currently available that should be organized and updated. When the project is completed, the sector will have a system of standards and regulations that will facilitate and improve the work from the design phase to implementation.

Duration of the project

18 months

Estimated investments

Total	US$ 0.12 million
Of this:	US$ 0.05 million in external resources

Project 13. Development of a Cost System for the Sector that Can be Used by Service Entities

Specific development problems that the project will address

Those responsible for the comprehensive management of water supply and sanitation systems need to know, as an essential component of economic analysis, the composition of costs related to the various activities, in order to be able to make decisions that result in greater efficiency.

The project is intended to undertake a detailed analysis of the cost of each sector activity through the establishment of an operational methodology in all service entities.

Relevance of the project to the country's health policy

More effective control of operating costs will make it possible to optimize the use of limited resources in order to improve the quality of water supply and sanitation services and increase the coverage of the population supplied.

Goal

- Provide the directors of the service entities with the elements of financial management that will assist them in their decision-making.

Objective

- To define and implement a system to record, classify and control costs by activity in the water supply and sanitation system service entities.

Strategies

The planned implementation of the project includes the following phases:

- Identification of the principal activities and their associated costs;
- Definition of the cost analysis system, budget and control methodology, forms and implementation schedule;
- Establishment of the accounting relationships necessary to feed the cost control system;

- Establishment of the activity cycle of the expenditure control procedure, including preparation, analysis and decision-making at each management level of the sector.

Summary description

Project development will be the responsibility of the National Institute of Water Resources and of the Ministry of Finance and Prices. The implementation of the methodology will be carried out through the provincial bureaus.

Interested parties

The National Institute of Water Resources, the provincial bureaus and the Ministry of Finance and Prices are the three institutional elements that will guide the decisions of the sector toward an improved use of its resources, both allocated and self generated.

Geographical area of the project and beneficiary group

The project will encompass the entire sector, and therefore make it possible to address the needs of all managers whose responsibilities include the financial area.

Current situation and situation upon completing the project

Beginning in 1994, only the Ministry of Finance and Prices has had the authority generate a preliminary classification of the sector's expenditures. The implementation of the project will allow sector and service entity managers, as well as the Ministry of Finance and Prices itself, to propose and make decisions with information on the evolution of significant costs of activities.

Duration of the project

2 years

Estimated investments

Total	US$ 0.12 million
Of this:	US$ 0.03 million in external resources

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ANNEX A: INSTITUTIONS AND PARTICIPATING TECHNICAL PERSONNEL

Collaborators

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Ms. Patricia Schroeder
Mr. Cecilio Mingo
Mr. Josep Bagué Prats
Mr. Mauro Tartaglia
Ms. Gabricla Solís

National Union of Cuban Architects and Engineers

Mr. Julio A. Salgado

1. Support Industries

Participating industries and annual production capacities	*Unit of measurement*	*Quantity*
Ministry of the Construction Materials Industry (MIMC)		
Asbestos cement tanks	**MU**	**31**
• Armando Mestre Martínez Factory, Ciudad Habana		20
• Asbestos cement compound, Santiago de Cuba		11
Asbestos cement pipes for water supply system	**Km**	**1991**
• Artemisa asbestos cement compound, Ciudad Habana		1550
• Asbesto cement compound, Santiago de Cuba		441
Cast iron pipes for water supply system	**Km**	**329**
• Casio Martínez Foundry, Ciudad Habana		329
Centrifuged concrete pipes for water supply system	**Km**	**187**
• Centrifuged concrete compound, Villa Clara		72
• Centrifuged concrete compound, Camagüey		43
• Centrifuged concrete compound, Holguín		72
Steel-lined concrete pipes	**Km**	**212**
• Comandante Pinares Factory, Ciudad Habana		70
• G. Abreu Fontán Concrete Pipe Factory, Ciudad Habana		97
• Comandante Pinares Remodeling Factory, Ciudad Habana		45
Asbestos cement sanitation pipes	**Km**	**480**
• Asbestos cement compound, Ciudad Habana		480
Clay pipes	**MU**	**1768**
• G. Lache Tile Works, Pinar del Río		200
• Raúl González Tile Works, Ciudad Habana		545
• Ciro Redondo Tile Works, Sancti Spíritus		187
• Clay compound, Camagüey		460
• Clay compound, Granma		460
• Floro Vistel Tile Works, Guantánamo		55
• Renato Guitart Tile Works, Isla de la Juventud		60

Cast iron sanitation pipes	**MU**	**438**
• San José Foundry Company, Habana		438
Plastic sanitation pipes	**Km**	**1340**
• Quang Tri Factory, Ciudad Habana		1340
Cement pipes for sewer system	**Km**	**674**
• Cement pipes for sewer system, Pinar del Río		37
• Gerardo Abreu Fontán Factory, Ciudad Habana		177
• Eladio Rodríguez Factory, Villa Clara		84
• Quintín Bandera Factory, Cienfuegos		26
• Roberto Elías Concrete Block Factory, Ciego de Ávila		4
• Concrete compound pipes, Camagüey		84
• Pipe factory, Las Tunas		34
• Compound pipes, Holguín		84
• Concrete pipe factory, Granma		22
• Eugenio Nogues Vera Pipe Factory, Santiago de Cuba		33
• Ramón López Peña Pipe Factory, Guantánamo		45
Calcium hydrate	**Ton**	**81200**
• Mártires de Corinthia Lime Factory, Ciudad Habana		24500
• José Martí Lime Factory, Matanzas		36000
• Cepero Bonilla Hydrator and Packing Factory, V. Clara		20700

Ministry of the Siderurgical-Mechanical and Electronics Industry (MINSIME)

• Julio Pérez Factory, San Antonio, Habana	Ton	1200
Production of wet connections and regulators		
• 9th of April Factory of the Mechanical Production Company, Villa Clara	Un	6000
Production of deep well pumps, gear heads for diesel engines		
• Amistad Cubano Soviética Factory, Ciudad Habana	Un	3700
Production of motors for motorized pumps		
• Cajimaya Plastic Pipe Factory, Holguín	Km	20000
Production of plastic pipe of up to 200 mm		
• Alejandro Arias Factory, Camagüey		
Production of manual water pumps, pump-jack motorized pumps, centrifugal pumps, electrical pumps	Un	25000
Windmills	Un	5000

- Vasyl Levsky Plastic Pipe Factory, Cienfuegos — Km — 20000
  Production of plastic pipe of up to 160 mm

- Miguel Suárez, Ciudad Habana — Un — 143000
  Non-ferrous foundry, production of wet connections and regulators

- Guaso Compound, Guantánamo — Un — 500000
  Production of gray and malleable iron connections

- Valve and pump factory, Guantánamo
  Production of industrial valves — Un — 40000
  Horizontal centrifugal pumps — Un — 5000

- Empresa de Instrumentación y Control Industrial, Ciudad Habana
  Production of stream gauges — Un — 100000

Ministry of Basic Industry
(MINBAS)

- MINBAS prototype workshop, Habana
  Production of polyester pipe with fiberglass

- Conrado Benitez Factory, Habana
  Production of wire for motor coils

- Orlando Cuellar Chlorine Soda Plant, Villa Clara
  Production of aluminum sulfate, chlorine gas, sodium hypochlorite, sodium silicate

Ministry of Construction
(MICONS)

- Equipment repair company, Villa Clara
  Production of HoFo venting valves — Ton — 300
  Production of aluminum venting valves — Ton — 100

2. Standards

Standards concerning water supply and sanitation are broad and varied, and include practically all aspects of this area. The standards can be divided into state standards (national or extrasectoral in scope) and area standards (requiring compliance by the sector).

2.1 *State standards*

These are the technical specifications that entail mandatory compliance for all activities for all areas of the national economy.

2.1.1 *Community Hygiene*

- NC 93-02 Drinking Water. Sanitary requirements and sampling.
- NC 93-03 Public Water Supply System. Sanitary requirements.
- NC 93-11 Public Water Supply Source. Sanitary quality and protection.
- NC 93-12 Water Treatment Installations. Sanitary requirements.
- NC 93-21 Determination of Color in Water for Human Consumption and for Waste Water. Testing method.
- NC 93-24 Determination of the Chemical Demand for Oxygen in Wastewater. Method of analysis.
- NC 93-25 Determination of Active Anionic Surface Agents in Water for Human Consumption and Wastewater. Testing method.

2.1.2 *Standards for the Environmental Protection System. Hydrosphere (SNPMA)*

- NC 93-01-102 Classification of Water-related Objects.
- NC 93-01-103. Classification of Domestic Waters.
- NC 93-01-105. Specifications and Procedures for the Evaluation of Water-related Objects for Fishing Purposes.
- NC 93-01-111. Sampling of Sediments for Pollution Analysis
- NC 93-01-112. Drinking Water. Determination of Monoaromatic Hydrocarbons.
- NC 93-01-113. Determination of Nitrates.
- NC 93-01-115. Determination of Nitrites.
- NC 93-01-116. Determination of Oils and Grease.
- NC 93-01-117. Determination of Total Sulfur.
- NC 93-01-118. Determination of Sulfates.
- NC 93-01-119. Determination of the Most Probable Number of Salmonella.
- NC 93-01-120. Determination of Organic and Ammoniacal Nitrogen.
- NC 93-01-121. Determination of Hexavalent Chromium.
- NC 93-01-125. Determination of the Most Probable Number of Total and Fecal Coliforms.
- NC 93-01-129. Determination of Aerogenous Pseudomonas.
- NC 93-01-130. Determination of Fecal Streptococci.
- NC 93-01-134. Determination of Phenols.
- NC 93-01-135. Determination of Chloroforms.
- NC 93-01-206. Forest Strips as Protection Areas for Reservoirs and Fluvial Channels.
- NC 93-01-208. Requirements for the Protection of Groundwater.
- NC 93-01-209. Requirements for the Calculation of Sanitary Protection Areas for Groundwater Sources.
- NC 93-01-210. General Requirements for the Protection of Surface and Groundwater from Contamination by Petroleum and its Derivatives.
- NC 93-01-215. Drinking Water. Determination of Metamidophos
- NC 93-01-216. Drinking Water. Determination of the Permanganate Index.

- NC 93-01-217. Drinking Water. Determination of Total Iron in Water for Human Consumption and Wastewater.
- NC 93-01-301. Recognition and On-board Inspection of Ships.
- NC 93-01-305. Sea Water. Use of Reducing Equipment and Floating Barriers.
- NC 93-01-307. Sea Water. Determination of Sources of Pollution by Hydrocarbons and their Derivatives. Procedures.
- NC 93-01. Final Disposal of Liquid Wastes in Domestic Water Bodies. Authorization Procedure. (In proposal stage).
- NC 93-01. Requirements for the Selection and Assessment of the Sources of Supply of Potable Ground Water to Communities and Industries (in proposal stage).
- NC 93-01-216. Determination of the Permanganate Index (in proposal stage).

2.1.3 *Design Standards*

- NC 48-09. Adjusted Flange. Principal types and dimensions.
- NC 48-13. Water Supply, Sewerage, and Rainwater Drainage System. Documentation and project.
- NC 48-14. Rainwater Drainage from Roofs. Project specifications.
- NC 48-15. Interior Water and Sanitary Networks of Industrial Buildings. Project specifications.
- NC 48-17. Drainage. River Rectification. Project specifications.
- NC 50-16. Pumping Stations. Publication and dimensions.
- NC 51-22. Exterior Hydraulic Installations. Symbology.
- NC 48-34. Pumping Stations. Contents of project documentation.
- NC 48-32. Collector Channels and Rivers. Classification and categories.
- NC 48-35. Determination of Maximum Daily Assistance.
- NC 53-91. Development of Construction Projects for Water Supply Systems. Drinking Water in Towns. Determination of demand.
- NC 53-121. Water Supply System. Project specifications.
- NC 53-125. Bridges and Sewers. Project specifications. Calculation method.

2.1.4 *Construction standards*

- NC 52-43. Asphalt macadam by penetration. Road mending. Construction specifications.
- NC 52-50. Glazed Clay and Cast Iron Pipes. Sanitary installation.
- NC 52-16. Earthmoving. Excavation for grading.
- NC 52-17. Earthmoving. Clearing the land.
- NC 52-19. Cast Iron Pipes and Connections for Water Supply Systems. Installation.
- NC 52-20. Iron-lined Concrete Pipes and Connections. Installation.
- NC 52-21. Shoring up of excavations. Construction specifications.
- NC 52 30. Underground Drainage. Construction specifications.
- NC 52-32. Refilling of Ditches for Pipes.
- NC 52-47. Rigid PVC Sanitary Pipes. Placement and installation.

2.1.5 *Product and Material Standards*

- NC 48-04. Taps. General quality specifications.
- NC 48-05. Taps. Principal types and dimensions.

- NC 48-07. Valves. Principal types and dimensions.
- NC 48-08. Two-screw flange. Principal types and dimensions.
- NC 48-19. Goose neck. Quality specifications.
- NC 48-20. Aluminum stoppers. Quality specifications.
- NC 48-06. Hydraulic Engineering. Valves. Quality specifications.
- NC 54-100. Asbestos Cement Tanks. Quality specifications.
- NC 54-199. Asbestos Cement Tanks. Handling, transportation, and storage.
- NC 54-233. Hydraulic Pressure Connections (unplasticized polyvinyl chloride). Quality specifications.
- NC 54-237. Asbestos Cement Sanitary Connections. Quality specifications.
- NC 54-202. Red Ceramic. Sanitary Pipes. Specifications.
- NC 54-211. Construction Materials and Products. Iron-lined Concrete Pipes for Water Supply Systems. Quality specifications.
- NC 54-260. Rubber-ringed Concrete Pipes for Drainage Systems. Quality specifications.
- NC 54-228. Asbestos Cement Sanitary Pipes. Quality specifications.
- NC 54-271. Concrete Pipes for Drainage Systems. Testing for cracking, breakage, or crushing using the three edge method.
- NC 54-189. Red Ceramic. Sanitary Pipes. Basic standard.
- NC 54-237. Asbestos Cement Sanitary Connections. Quality specifications.
- NC 54-254. Sanitary Connections of unplasticized polyvinyl chloride with adhesive seal. Quality specifications.
- NC 51-17. Technical Drafting for Construction. Graphic representation of pipe installations.
- NC 51-22. Exterior Hydraulic Installations. Symbology.
- NC 51-15. Surface Drainage. Project methodology.

2.2 Area Standards

These are the technical specifications that pertain to the area in questions and are mandatory.

2.2.1 *Design standards*

- RC 1009. Water Works. Water Supply Systems.
- RC 1010. Water Works. Sewerage and Drainage Systems.
- RC 1011. Water Works. Drinking Water and Water Purification Plants.
- RC 1021. Projects. Water Sanitation Installations in Buildings.
- RC 1031. Projects. Organization of Production. Water Works. Projected tasks. Scope and contents (pending approval).
- RC 1040. Stone roofing. Project requirements.
- RC 1041. Cover Welding. Project requirements.
- RC 1105. Urbanization. Rural Settlements. Level of network coverage.
- RC 3107. Sanitary and Rainwater Installations. Illustrations in buildings.

2.2.2 *Construction and installation standards*

- RC 3001. Earthmoving. Clearing. Disposal of brush and trees.
- RC 3004. Earthmoving. Excavations in wells.
- RC 3003. Earthmoving. Injection of cement into the rocky foundations of hydrotechnical works.
- RC 3005. Earthmoving. Excavation of ditches.
- RC 3006. Earthmoving. Excavations for grading.
- RC 3010. Refill. Ditches for conduits and cementing.
- RC 3011. General Refill.
- RC 3012. Earth Works for Core Walls and Dikes of Dams.
- RC 3027. Simple Containment and Comprehensive Culvert. Construction specifications.
- RC 3028. Hydraulic Concrete Sidewalks. Construction specifications.
- RC 3087. Prefabricated Bridges. Installation of slabs to support foundations.
- RC 3088. Prefabricated Bridges. Installation of cement basins.
- RC 3089. Prefabricated Bridges. Installation of columns.
- RC 3090. Prefabricated Bridges. Installation of frames for piles and abutments.
- RC 3097. Prefabricated Bridges. Installation of sewerage pipes and caissons.
- RC 3100. Construction of Water Supply Systems.
- RC 3101. Sewerage and Rainwater Drainage Pipes. Test.
- RC 3102. Asbestos Cement Pipes. Placement.
- RC 3103. Final Test of Water Supply System.
- RC 3104. Partial Tests for Pipe Pressure and Leaks in Water Works.
- RC 3105. Hydraulic Installations. Weldable Copper Pipe.
- RC 3106. Hydraulic Installations. Galvanized Steel Pipe.
- RC 3107. Sanitary and Rainwater Installations. Installations in buildings.
- RC 3108. Sanitary Installations. Fixtures.
- RC 3151. Earthmoving. Excavations in ditches. Explosives.
- RC 3152. Prestressed Pressurized Concrete Pipe. Installation.
- RC 4019. Water Pumps with Internal Combustion Engine.
- RC 5015. Industrial and Mechanical Installation. Test of technological pipe.
- RC 5026. Industrial and Mechanical Installation. Installation of vertical pumps.
- RC 5203. Industrial Installation. Instrumentation. Installation of plastic (PVC) signal pipes.
- RC 5206. Industrial Installation. Instrumentation. Tests of Airtightness and of the quality of impulse and signal pipes.

2.3 Construction regulations

- NRMC 060. Construction Materials and Products. Ceramic urinals. Types. Principal parameters and dimensions.
- RC 051. Construction Materials and Products. Ceramic Cup. Principal types, parameters, and dimensions.
- RC 062. Sands. Determination of the clay content for the control of the process.

- RC 1012. Road Projects. Instructions for the development of organizational techniques for public works projects.
- RC 1105. Urbanization. Rural Settlements. Level of provision with networks.
- RC 3018. Coverage of Slopes with Vegetation.

The trend to this point has been to develop and approve standards for water for human consumption and control the quality of wastewater, water supply sources, and systems--in particular, with respect to their sanitary health characteristics; as well as standards for the design and construction of hydrotechnical works, for hydraulic engineering (operations and maintenance), and for environmental protection. In addition, there are also a large number of standards governing the quality specifications of materials, products, and items related to the sector.

3. Scientific research

The country has seven basic research centers connected with the sector and distributed among various state institutions and agencies.

- National Center for Hydrology and Water Quality /INRH.
  Research on water quality, water resources management, and protection.

- Center for Research in Construction Materials /MIMC.
  Research related to water consumption by toilets and other devices.

- National Institute for Hygiene, Epidemiology, and Microbiology /MINSAP.
  Research on water quality, epidemiological control, and health surveillance of water sources, *inter alia*.

- Center for Hydraulic Research of the José Antonio Echeverría Advanced Polytechnic Institute /MES.
  Research into technological improvements water treatment plants and the production of drinking water.

- National Center for Scientific Research /MES.
  Research on ozone for the treatment of water and wastewater.

- Center for Research into Appropriate Technology /INRH.
  Develops prototypes and carries out the small-scale production of equipment and installations to collect water in rural areas that are difficult to access.

- Center for Chemical Research /MINBAS.
  Develops prototypes for the measurement of organic and other pollutants.

During the 5-year period from 1986 to 1990, research studies on 17 topics related to the sector were performed that resulted in improvements in water treatment, the introduction of evaluation methods, the financial savings, *inter alia*.

- Development of program packages for the design of water supply and sewerage systems, open irrigation networks, and rainwater drainage systems: CIH-ISPJAE.

- More efficient use of technologies already employed in the country for the cleaning of residential septic tanks: CIH-ISPJAE.

- New analytical methods for classifying water and wastewater and the evaluation of treatment processes: CENIC-MES.

- Characteristics of the hydraulic behavior of lakes with various entry and exit devices: CENHICA-INRH.

- Evaluation of the efficiency and design of stabilization ponds: CENHICA-INRH.

- Hydrobiological evaluation of selected stabilization ponds: CNIC-MES.

- Study and control of water quality in representative watersheds with karstic conditions: CNIC-MES.

- Effects of residual mercury from the chlorine plant on the Sagua la Grande River: CENHICA-INRH.

- Removal of organic matter and bacteria in surface water: CENHICA-INRH.

- Water quality of the main supply sources for human consumption: CENHICA-INRH.

- Study of the behavior of physical, chemical, and microbiological quality indicators of the water in supply sources in order to develop a warning system: INHEM-MINSAP

- Evaluation of the health risks to population groups from exposure to nitrates through water for human consumption: INHEM-MINSAP.

- Evaluation in supply sources of organic substances that may have chronic effects on health: INHEM-MINSAP.

- Sanitary evaluation of arsenic, cadmium, lead, and mercury in water for human consumption: INHEM-MINSAP.

- Automated program for the sanitary surveillance of water supply sources in water supply systems: INHEM-MINSAP

- Relationship between the concentrations of residual chlorine, turbidity, and the level of fecal coliforms in water for human consumption: INHEM-MINSAP.

- Criteria for improving sanitary quality standards in waters used for recreational purposes: INHEM-MINSAP.

- Evaluation of exposure to toxic metals in the locality of Moa, Holguín: INHEM-MINSAP.

- Evaluation of the effects of pesticides on the child population residing in areas where they are used intensively: INHEM-MINSAP.

During the 5-year period from 1991 to 1995, the following research areas will be pursued:

- Development, implementation, and evaluation of technologies for water disinfection in small communities and for socioeconomic objectives: CIH-ISPJAE.

- Program packages for the design of water distribution networks, sanitary sewerage systems, and drainage systems: CIH-ISPJAE.

- Treatment of the water supply using zeolites and activated carbon: CIQ (CNIC).

- Use of ozone to disinfect water: CNIC.

- Development of prototypes to measure organic contaminants using advanced methods: CNIC.

- Research on the role of trace elements in the environment and their relationship to cardiovascular diseases and cancer: INHEM-MINSAP.

- Evaluation of the impact of preventive measures on the health of the population: INHEM-MINSAP.

- Increase in information on the health effects of risk factors in the school environment and their relationship to the growth and development of children and adolescents: INHEM-MINSAP.

ANNEX C: MASS COMMUNICATION AND COMMUNITY PARTICIPATION

1. Radio Stations in the Republic of Cuba

Station	Daily broadcast hours	Founding Date
National radio stations		
Radio Habana Cuba	31.5	1-05-61
Radio Rebelde	24.0	24-02-58
Radio Progreso	20.0	15-12-29
Radio Reloj	24.0	1-07-47
Radio Taino	24.0	7-11-62
Radio Enciclopedia	24.0	25-04-48
Radio Musical Nacional	17.0	
Provincial radio stations		
Radio Guamá (Pinar del Río)	19.0	21-02-31
Radio Cadena Habana (Marianao, Ciudad Habana)	19.0	11-11-40
Radio Ciudad de la Habana (Ciudad Habana)	19.0	26-07-78
Radio Metropolitana (Ciudad Habana)	19.0	1-01-75
COCO (Ciudad Habana)	19.0	16-12-33
Radio 26 (Matanzas)	19.0	23-12-59
Radio CNHW (Villa Clara)	19.0	15-07-53
Radio Ciudad del Mar (Cienfuegos)	19.0	19-07-36
Radio Sancti Spíritus (Sancti Spíritus)	19.0	17-07-45
Radio Surco (C. de Avila)	19.0	10-10-52
Radio Cadena Agramonte (Camagüey)	19.0	9-06-57
Radio Victoria (Las Tunas)	19.0	24-02-52
Radio Angulo (Holguín)	19.0	10-10-37
Radio Bayamo (Granma)	19.0	1-07-33
Radio Revolución (Santiago de Cuba)	19.0	24-06-37
Radio Trinchera (Guantánamo)	19.0	
Municipal radio stations		
Radio Sandino (P. del Río)	8.0	10-10-81
Radio Artemisa (La Habana)	14.0	1-04-41
Radio Ariguanabo (San A.de los Baños)	14.0	08-10-71
Radio Camoa (San J. de las Lajas)	14.0	17-02 72
Radio Jaruco (La Habana)	14.0	13-03-90
Radio Güines (La Habana)	14.0	19-04-69
Radio Ciudad Bandera (Matanzas)	12.0	25-12-27
Radio Llanura de Colón (Matanzas)	11.0	24-07-74
Radio Victoria de Girón (Jagüey Grande, Matanzas)	7.0	08-08-77
Radio Sagua (S.la Grande) (Villa Clara)	18.0	09-04-83
Radio Caibarién (Villa Clara	18.0	27-08-85

Station	Daily broadcast hours	Founding Date
Radio Morón (Ciego de Avila)		
Radio Cubitas (Sola, Camagüey)	19.0	19-11-49
Radio Florida (Camagüey)	6.3	04-06-81
Radio Nuevitas (Camagüey)	8.0	02-11-69
Radio Rectángulo(Guáimaro, Camagüey)	8.0	01-08-39
Radio Santa Cruz (Camagüey)	8.0	13-03-59
Radio Libertad (Puerto Padre,Tunas)	10.3	01-05-69
Radio Maboas (Amancio,Tunas)	11.0	24-02-40
Radio Juvenil(Buena Ventura, Holguín)	11.0	04-04-70
Radio Banes (Banes, Holguín)	8.0	25-07-86
Radio Mayarí (Mayarí, Holguín)	8.3	25-06-69
Radio La Voz del Níquel(Moa, Holguín)	12.0	28-08-68
Radio Granma (Manzanillo, Granma)	13.0	24-07-79
Radio Portada de la Libertad (Niquero)	19.0	27-11-32
Radio Grito de Baire (Contramaestre)	8.0	
Radio Baraguá (Palma, Santiago de Cuba)	8.0	24-02-90
Radio Majaguabo (San Luis, Santiago de Cuba)	12.0	02-04-34
Radio 8 SF (Mayarí Arriba, S. Cuba)	8.0	05-07-82
Radio Mambí (Santiago de Cuba)	12.0	11-03-78
Radio Siboney (Santiago de Cuba)	19.0	03-07 75
La Voz del Toa (Baracoa, Guantánamo)	19.0	09-08-68
Radio Caribe (Nueva Gerona, I.Juventud)	12.0	
	19.0	15-12-82

2. Institutional Structure of a Municipality

Definitions:

- *Municipal Assembly:* Constitutes the organ of political representation.

- *Administrative Council:* Comprised of the president and vice president of local government and representatives from the service and financial entities located in the municipality. The Council is responsible for regulating service and financial activities at the local level.

- *People's Councils:* Bodies subordinate to the municipal government and whose purpose is to promote development, the mobilization of resources, and community participation in areas under their jurisdiction.

- *Communist Party of Cuba (P.C.C.):* Highest political authority for an entire municipality; the P.C.C.'s managerial function exercises a considerable influence on institutional coordination.

- *National and provincial companies and agencies:* This category includes a wide range of companies, budgeted units, and other agencies in the country.

- *Local Administrative Organizations:* These are the administrative, sectoral, and functional organizations; companies responsible to local authorities; and budgeted entities.

- *Community and mass organizations:* This category is comprised of all nongovernmental organizations in the country.

- *District:* A geographical unit represented by a delegate to the municipal government and the People's Council. The jurisdiction of a People's Council includes several of these units.

- *Deputies:* Citizens who reside in a municipality and are elected to the National People's Assembly.

Table D.1
Expenditures on Water Supply Systems
(figures in thousands of Cuban pesos)

Province	1990	1991	1992
Pinar del Río	4,150.4	3,457.7	4,090.0
La Habana	5,947.2	5,067.2	4,915.8
Ciudad de la Habana	15,566.9	16,507.4	17,026.5
Matanzas	3,455.5	3,366.4	3,509.6
Villa Clara	2,267.0	2,199.2	2,048.6
Cienfuegos	1,809.2	1,864.4	1,961.1
Sancti Spíritus	2,315.2	2,263.5	2,234.5
Ciego de Avila	1,412.0	1,306.0	1,497.1
Camagüey	3,575.7	3,634.0	3,725.7
Las Tunas	1,150.5	1,086.4	1,028.1
Holguín	2,836.2	2,870.5	2,657.2
Granma	2,351.1	2,260.0	2,589.8
Santiago de Cuba	4,518.6	3,781.4	4,091.0
Guantánamo	2,026.0	2,099.2	1,793.6
Isla de la Juventud	872.2	788.9	663.7
Total	**54,257.7**	**52,532.2**	**53,834.3**

Source: National Budget Reports, 1990, 1991, and 1992.

The water supply system group includes expenditures on the supply of water to the population, industry, and social services. Included in these services are the care, conservation, maintenance, and repair of conduits and connections in order to provide this service in an efficient manner.

Table D.2
Expenditures on Pipe
(figures in thousands of Cuban pesos)

Province	1990	1991	1992
Pinar del Río	422.7	516.6	159.1
La Habana	401.2	281.0	203.2
Ciudad de la Habana	577.7	571.8	555.1
Matanzas	297.3	89.2	57.0
Villa Clara	261.3	230.3	164.6
Cienfuegos	257.4	349.5	402.2
Sancti Spíritus	167.4	99.5	100.4
Ciego de Avila	201.2	151.7	178.3
Camagüey	130.5	105.1	91.7
Las Tunas	264.1	172.3	112.1
Holguín	3,506.6	3,397.9	2,397.8
Granma	627.6	750.0	990.9
Santiago de Cuba	1,097.4	769.0	509.9
Guantánamo	284.0	161.1	99.7
Isla de la Juventud	54.9	23.3	16.9
Total	**8,551.0**	**7,662.3**	**6,035.9**

Source: National Budget Reports, 1990, 1991, and 1992.

This group includes expenditures on water supply service to the population, industry, and social services on pipe.

Table D.3
Expenditures on Sewerage Systems
(figures in thousands of Cuban pesos)

Province	1990	1991	1992
Pinar del Río	105.7	128.7	139.4
La Habana	270.4	235.4	201.1
Ciudad de la Habana	1,680.8	1,850.7	1,875.6
Matanzas	150.7	135.1	136.1
Villa Clara	169.8	163.5	141.3
Cienfuegos	137.3	134.7	127.6
Sancti Spíritus	124.2	141.1	112.5
Ciego de Avila	528.2	219.0	208.9
Camagüey	165.8	169.5	165.5
Las Tunas	104.1	100.7	83.6
Holguín	146.5	150.5	149.5
Granma	166.9	167.2	197.4
Santiago de Cuba	295.9	330.0	265.6
Guantánamo	92.9	86.1	90.5
Isla de la Juventud	89.4	73.2	90.3
Total	**3,958.6**	**4,085.4**	**3,982.9**

Source: National Budget Reports, 1990, 1991, and 1992.

Includes expenditures for the care, maintenance, preservation, and repair of existing sewerage systems and networks.

Table D.4
Expenditures on Septic Tank Cleaning [a]
(figures in thousands of Cuban pesos)

Province	1990	1991	1992
Pinar del Río	139.9	116.9	...
La Habana	258.4	191.6	...
Ciudad de la Habana	630.2	473.6	450.7
Matanzas	288.6	247.9	...
Villa Clara	231.2	183.5	...
Cienfuegos	95.0	77.6	67.6
Sancti Spíritus	158.0	139.5	28.8
Ciego de Avila	107.1	100.1	...
Camagüey	184.0	144.9	131.1
Las Tunas	178.7	143.6	...
Holguín	297.3	268.8	...
Granma	230.0	206.9	203.0
Santiago de Cuba	166.7	141.6	124.4
Guantánamo	132.2	122.4	101.7
Isla de la Juventud	44.1	37.3	...
Total	**3,141.3**	**2,596.2**	**1,108.3**

Source: National Budget Reports, 1990, 1991, and 1992.

[a] The information lacking is not available in the accounts of some provinces for 1992.

This group includes expenditures for cleaning, repair, obstruction removal, and maintenance of septic tanks.

Table D.5
Expenditures on maintenance of urban drainage systems
(figures in thousands of Cuban pesos)

Province	1990	1991	1992
Pinar del Río	165.1	172.2	152.7
La Habana	313.1	290.6	269.4
Ciudad de la Habana	...	...	...
Matanzas	254.3	256.7	258.9
Villa Clara	455.3	440.9	411.2
Cienfuegos	193.0	81.0	66.8
Sancti Spíritus	166.5	171.9	165.6
Ciego de Avila	284.6	163.5	119.3
Camagüey	274.5	211.3	251.1
Las Tunas	258.3	263.3	251.2
Holguín	299.8	291.5	291.3
Granma	292.9	299.6	293.0
Santiago de Cuba	338.7	325.8	196.9
Guantánamo	95.7	89.9	86.6
Isla de la Juventud	17.3	20.1	18.9
Total	**3,409.1**	**3,078.3**	**2,832.9**

Source: National Budget Reports, 1990, 1991, and 1992.

[a] The information on this province does not appear here, because it has been included in the expenditures of another budget group.

This group includes expenditures for the care, maintenance, preservation, and repair of rainwater drainage networks.

Table D.6
Projections of regular sector operations
(figures in thousands of Cuban pesos)

Item	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fixed fee water revenues	20.2	82.8	84.9	87.0	89.1	91.2	93.3	95.4	97.5	99.6	101.8
Water meter revenues	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Total water revenues	35.9	98.5	100.6	102.7	104.9	107.0	109.1	111.2	113.3	115.4	117.5
Sewerage revenues	3.1	12.6	13.0	13.3	13.7	14.0	14.4	14.8	15.1	15.5	15.8
Other revenues	1.3	18.9	19.1	19.3	19.5	19.7	19.9	20.1	20.3	20.5	20.7
Total Revenues	**40.3**	**130.0**	**132.7**	**135.4**	**138.0**	**140.7**	**143.4**	**146.0**	**148.7**	**151.4**	**154.0**
Water: fixed costs	-26.6	-26.9	-27.1	-27.4	-27.7	28.0	-28.2	-28.5	-28.8	-29.1	-29.4
Water: variable costs	-27.3	-28.0	-28.6	29.2	-29.8	-30.4	-31.0	-31.6	-32.2	-32.8	-33.4
Sewerage costs	-4.9	-5.1	-5.1	-5.3	-5.4	-5.6	-5.7	5.8	-6.0	-6.1	-6.3
Fee collection costs	1.6	-6.8	-6.8	-7.0	-7.1	-7.3	-7.5	-7.6	-7.8	-8.0	-8.1
Other costs	-9.7	-9.9	-9.9	-10.0	10.1	-10.2	-10.3	-10.4	-10.5	-10.6	-10.7
Total operating costs	**-70.1**	**-76.3**	**-77.6**	**-78.8**	**-80.1**	**-81.4**	**-82.7**	**-84.0**	**-85.3**	**-86.6**	**-87.9**
Operating margin	-29.8	53.7	55.1	56.5	57.9	59.3	60.6	62.0	63.4	64.8	66.1
Depreciation	-13.3	-13.3	16.2	-19.1	22.2	-24.4	-26.5	30.0	-32.8	-35.4	-38.2
Total margin	43.1	40.4	38.9	37.4	35.7	34.8	34.1	32.0	30.6	29.3	27.9

Table D.7.1
Investments and total estimated financing needs for the sector
(figures in millions of US$)

Item	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Repair Program	111.4	107.8	116.3	72.6	63.1	75.0	30.1	21.2	22.3	23.4	643.1
National Action Program	34.0	35.7	37.5	39.4	41.3	101.2	106.3	111.6	117.2	123.1	747.3
Total Investments	**145.4**	**143.5**	**153.8**	**112.0**	**104.4**	**176.2**	**136.4**	**132.8**	**139.5**	**146.4**	**1390.4**

Note: ($) 1 Peso = 1 US$
Estimated annual inflation rate: 5.0%

Table D.7.2
Per capita rates used for investments in the National Program of Action

Item	US$/per.
Residential water supply connections in urban areas	190.00
Urban sewerage	190.00
Water supply to rural settlement areas	125.00
Sanitary latrines and pits in rural settlement areas	75.00
Residential water supply to areas with dispersed rural populations	80.00
Public and easy access service in rural settlement and dispersed population areas	55.00
Sanitary latrines in dispersed rural population areas	30.00

Note: $1 = 1 US$

Table D.8
Detail on investments in the National Health Program

Item in table 7.5 and 7.6	Item	Unit	Estimated annual investments (millions of US$)										Total investment in period
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
	Water supply												
1.1	Urban Sector, household connection:												
	Per capita cost	US$/per.	190.0	199.5	209.5	219.9	230.9	242.5	254.6	267.3	280.7	294.8	250.6
	Inhabitants	000s	90.0	90.0	90.0	90.0	90.0	210.0	210.0	210.2	210.0	210.0	1500.0
	Investment	000s US$	17.1	18.0	18.9	19.8	20.8	50.9	53.6	56.1	58.0	61.9	375.9
2.1	Rural sector, settlement population, household connection:												
	Per capita cost	US$/per.	125.0	131.3	137.8	144.7	151.9	159.5	167.5	175.9	184.7	193.9	164.9
	Inhabitants	000s	15.6	15.6	15.6	15.6	15.6	36.4	36.4	36.4	36.4	36.4	260.0
	Investment	000s US$	2.0	2.0	2.1	2.3	2.4	5.8	6.1	6.4	6.7	7.1	42.9
2.2	Rural sector, settlement population, public service:												
	Per capita cost	US$/per.	65.0	68.3	71.7	75.2	79.0	83.0	87.1	91.5	96.0	100.8	85.7
	Inhabitants	000s	4.6	4.6	4.6	4.6	4.6	10.8	10.8	10.8	10.8	10.8	76.0
	Investment	000s US$	0.3	0.3	0.3	0.3	0.4	0.9	0.9	1.30	1.0	1.1	6.5
2.3	Rural sector, dispersed population, household connection:												
	Per capita cost	US$/per.	80.0	84.0	88.2	92.6	97.2	102.1	107.2	112.6	118.2	124.1	105.5
	Inhabitants	000s	7.5	7.5	7.5	7.5	7.5	17.5	17.5	17.5	17.5	17.5	125.0
	Investment	000s US$	0.6	0.6	0.7	0.7	0.7	1.8	1.9	2.0	2.1	2.2	13.2
2.4	Rural sector, dispersed population, public service:												
	Per capita cost	US$/per.	55.0	57.8	60.6	63.7	66.9	70.2	73.7	77.4	81.3	85.3	72.5
	Inhabitants	000s	35.4	35.4	35.4	35.4	35.4	82.6	82.6	82.6	82.6	82.6	590.0
	Investment	000s US$	1.9	2.0	2.1	2.3	2.4	5.8	6.1	6.4	6.7	7.0	42.8

Notes: 1 peso = US$ Estimated annual inflation rate: 5%

Table D.8.1
Detail of investments in the National Program of Action

Item in table 7.5 and 7.6	Item	Unit	Estimated annual investments (millions of US$)										Total investment in period
			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
	Sanitation:												
1.1	Urban Sector, sewerage:												
	Per capita cost	US$/per.	180.0	199.5	209.5	219.9	230.9	242.5	254.6	267.3	280.7	294.8	250.8
	Inhabitants	000s	54.0	54.0	54.0	54.0	54.0	126.0	126.0	126.0	126.0	126.0	900.0
	Investment	000s US$	10.3	10.8	11.3	11.9	12.5	30.6	32.1	33.7	35.4	37.1	225.5
2.1	Rural sector, settlement population, sewerage												
	Per capita cost	US$/per.	125.0	131.3	137.8	144.7	151.9	159.5	167.5	175.9	184.7	193.9	164.9
	Inhabitants	000s	6.0	6.0	6.0	6.0	6.0	14.0	14.0	14.0	14.0	14.0	100.0
	Investment	000s US$	0.8	0.8	0.8	0.9	0.9	2.2	2.3	2.5	2.6	0.7	6.5
2.2	Rural sector, settlement population, pits-latrines												
	Per capita cost	US$/per.	75.0	78.8	82.7	86.8	91.2	95.7	100.5	105.5	110.8	116.3	98.9
	Inhabitants	000s	6.3	6.3	6.3	6.3	6.3	14.7	14.7	14.7	14.7	14.7	105.0
	Investment	000s US$	0.5	0.5	0.5	0.5	0.6	1.4	1.5	1.5	1.6	1.7	10.4
2.3	Rural sector, dispersed population, latrines:												
	Per capita cost	US$/per.	30.0	31.5	33.1	34.7	36.5	38.3	40.2	42.2	44.3	46.5	39.6
	Inhabitants	000s	20.7	20.7	20.7	20.7	20.7	48.3	120.7	48.3	48.3	48.3	345.0
	Investment	000s US$	0.6	0.7	0.7	0.7	0.8	1.8	1.9	2.0	2.1	2.2	13.7
	Total Investments	**000s US$**	**34.0**	**35.7**	**37.5**	**39.4**	**41.3**	**101.2**	**106.3**	**111.6**	**117.2**	**123.1**	**747.3**

Notes: 1 peso = 1 US$
Estimated annual inflation rate: 5%