SOCIO-ECONOMIC ASPECTS OF THE WASTEWATER PROBLEM IN THE SOUTH EAST PACIFIC

July, 2001
1 INTRODUCTION

The Permanent Commission of the South Pacific, (Comisión Permanente del Pacífico Sur - CPPS), as Regional Coordinating Unit for the Global Plan of Action for the Protection of the Marine Environment and Coastal Areas of the South East Pacific (SE/P), as per the recommendations made in 2000 at the IX Inter-Governmental Meeting on said Plan of Action, decided to continue actions that encourage member states to participate in preparatory and regional meetings on municipal wastewater. It is also working to develop a regional consensus for the Global Plan of Action for Protecting the Marine Environment in terms of land-based activities.

This report identifies wastewater action priorities that were reconfirmed by the VII Regional Technical Workshops with government-designated experts, convened by UNEP from 1996 to 1998 as part of the Regional Seas Program. The XX Meeting of the UNEP Governing Council asked the Executive Director to explore the possibility of having UNEP convene a world conference to analyse the issue of wastewater as a main land-based source of pollution that affects human health and ecosystems.

The UNEP/MPP Coordination Office developed, together with WHO, HABITAT and the Water Supply and Sanitation Collaborative Council (WSSCC), a Municipal Wastewater Action Plan to comply with the requests mentioned above. The inventory of wastewater-related socio-economic opportunities and the regional meetings for innovative cooperation are important components of this Action Plan. The UNEP Regional Coordination Units of the Regional Seas Programs will play an important role in implementing the Plan of Action.

This report discusses socio-economic aspects of the wastewater problem in the South East Pacific. It provides an overview of the potential for economic and social development in the region with regard to coastal marine and freshwater environments, and it shows the status of these developments in terms of the wastewater problem and potential pollution of the coastal environment. This review was mostly updated in 2000, and it is part of a consultancy contract reporting on the status of countries that participate in the SE/P Action Plan. It is one of the inputs for the UNEP regional meeting on this issue organised through the GPA office in The Hague.
Description of the SE/P Region

2.1 Physical Geography

2.1.1 Territory

For the purposes of the Action Plan for Protecting Marine Environments and Coastal Areas, the South East Pacific (SE/P) Region extends from 9° latitude north to 57° latitude south of Central and South America, and includes five countries with South East Pacific coasts. These are, from north to south: Panama, Colombia, Ecuador, Peru and Chile.

The region covers an area of 3,542,674 km², equivalent to 27% of the total continental area of South America. The coastal length of the five countries is 11,500 km (Figure 1).

The countries with the longest coastal areas are Chile and Peru, with approximately 35.5% and 26.7% of the total regional coast, respectively. The coastal regional profile presents few remarkable features, the most outstanding being the Gulf of Panama, the Gulf of Guayaquil and a large number of fjords, archipelagos, islands and bays on the Chilean coast. The continental shelf is narrow in some places and practically non-existent others; it is widest off Panama, southern Colombia and the Gulf of Guayaquil (López et al., 1996; Morales, 1995; Noboa, 1996).

The maritime areas claimed by the countries of the region represent substantially bigger areas than their continental territorial area (Table 1).
Table 1
Continental and Maritime Area of SE/P Countries, Administrative Divisions and International Borders

<table>
<thead>
<tr>
<th>Countries</th>
<th>Continental Area km²</th>
<th>Maritime Claims</th>
<th>Pacific Coast Length km*</th>
<th>Political borders</th>
<th>Administrative Division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>1,141,748</td>
<td>200 nm</td>
<td>1,392</td>
<td>North: Caribbean Sea East: Venezuela and Brazil West: Pacific Ocean Northwest: Panama South: Peru and Ecuador</td>
<td>5 natural regions-31 departments, 4 departments with Pacific coastline-1068 municipalities, and the indigenous territories</td>
</tr>
<tr>
<td>Chile</td>
<td>756,626</td>
<td>200 nm**</td>
<td>4,080</td>
<td>North: Peru Northeast: Bolivia East and South East: Argentina West: Pacific Ocean South: Drake Passage</td>
<td>13 regions, 51 provinces 342 municipalities</td>
</tr>
<tr>
<td>Ecuador</td>
<td>283,560</td>
<td>200 territorial waters</td>
<td>1,256</td>
<td>North: Colombia East and South: Peru West: Pacific Ocean</td>
<td>4 regions 22 provinces, 5 provinces with coastline</td>
</tr>
<tr>
<td>Panama</td>
<td>75,520</td>
<td>200 nm</td>
<td>1,697</td>
<td>North: Caribbean Sea East: Colombia West: Costa Rica South: Pacific Ocean</td>
<td>9 provinces, 4 indigenous regions 67 districts</td>
</tr>
<tr>
<td>Peru</td>
<td>1,285,220</td>
<td>200 nm</td>
<td>3,073</td>
<td>North: Ecuador and Colombia East: Brazil South East: Bolivia South: Chile West: Pacific Ocean</td>
<td>24 departments, 194 provinces 1,816 districts</td>
</tr>
</tbody>
</table>

*even coast, it does not include estuaries
** coastal area for exploitation
*** EEZ Area
2.1.2 Geomorphology

Most of the region's geomorphology is determined by the Andean mountain range, which extends north and south through four countries of the region, and which forms well-differentiated natural regions. In Chile, the Andes constitute the eastern border of the territory and, in some places, reach an altitude of more than 6,800 m (Ojos del Salado). They run lengthways through Peru, determining, as in Ecuador, three natural well-defined continental regions: the coastal or littoral region, the inter-Andean or sierra region, and the Amazonian or eastern region. Ecuador also has a fourth, insular region consisting of the Galapagos Archipelago. In Colombia, the Andes are divided into three branches that end in the north, in the Caribbean Sea. In Panama, the geomorphology is influenced by the coastal mountains that run along the Pacific coast.

Panama has highlands, mountains and massifs of volcanic origin; and lowlands, plains and hills of sedimentary origin. In addition there are small elevations of the orography system that form part of the mountain range that runs along the continent by the Pacific. The central region of Panama, known as the transit zone, consists of a narrow central plain with a mountain section in the middle. The country is criss-crossed by mountain chains; the central range is in the west (Coclé, Santiago and Chiriquí); the northeast is a region of mountains and dense forests; and in the south-west, Chiriquí has mountain slopes covered with fertile soils (UNEP, 1999).

Besides the Andes, Colombia has three separate mountain systems: the Sierra Nevada of Santa Marta, 30 km from the Caribbean coast; the Sierra de la Macarena, in the Llanos Orientales (Eastern Plains); and the Baudó mountain range, which runs parallel to the Pacific coast and forms the natural western border of Colombia's Pacific region.

In Colombia, Ecuador and Peru, the inter-Andean or sierra region is defined by the Andes mountain system. The inter-Andean or sierra region of Ecuador has peaks over 5,000 m high. In Peru, the Andean region or sierra consists of a steep mountain system that runs north and south through the country. There are three mountain ranges in this area: the Western, the Central and the Eastern; and the main snow-capped mountains are Huascarán (6,668 masl), Yerupaja (6,632 masl) and Coropuna (6,425 masl).

In Chile, there are four very well-defined lengthways zones: the Andes mountain range, the Coastal mountain range, the intermediate depression, and the coastal plains. The relief is framed by the Andean range, which extends north to south like a backbone; both its height and width decrease towards the south. The northern end is highly affected by volcanic activity that has filled the area with layers of rhyolite lava, volcanic tuff and conglomerates. To the South, fjords and channels dominate the geomorphology; these are former glaciers that have been taken over by the sea.

The Amazon region in Ecuador starts in the eastern mountain range towards the Amazon Basin and goes up to the borders with Colombia and Peru. In Colombia, the Amazon basin has an area of nearly 270,000 km². The eastern plains, which are good for livestock, extend up to Venezuela; they range over 400,000 km² in the Orinoco Basin. In Peru, the wild forest or Amazonian region covers nearly 58% of the national territory. This region's topography consists predominantly of plains, and it is located east of the Andes (UNESCO, 2000).
2.1.2.1 Coasts, Dunes and Cliffs

Panama has nearly 284 km of sandy coasts; the provinces of Chiriquí, Punta Burica and Coiba Island are attractive for tourism. There are rocky cliffs on the coasts of the Darien, Las Palmas or Sona, and Veraguas Provinces. There are also micro-cliffs in the area between Boca del Guanábaro and Punta Boca de Hacha (Álvarez and Manelia, 1996; López et al. 1996).

In Colombia, the steep rocky coast extends north from Cape Corrientes; south of the Cape, the cliffs appear as isolated formations in the mouths of the rivers (Cantera, 1994).

Ecuador has 423 km of steep rocky coast with cliff heights ranging from 10 to 50 m. There are 1,229 km of open coast (Noboa, 1996). The coastal region runs from sea level up to 1,200 masl, and is comprised of an alluvial plain delimited in the east by the Andean mountains. This is a flat region whose plains are relieved in the west by rolling hills some 800 m high. The Insular region of Galapagos has an ecosystem that is home to a rich and varied biodiversity.

In Peru, the coastal region is the lower part of the Andes mountains adjacent to the Pacific Ocean. It extends from the ocean to 500 masl, covering 11% of the total surface of the country. Its topography is moderate, highlighted by shallow coastal areas, alluvial fans, and dunes alternating with small hills. This region consists of the inter-Andean transversal valleys, inter-fluvial deserts, plains or pampas, hills and dry ravines, the dry forest of the coastal desert, and an ecosystem of mangroves almost on the Ecuadorian border (INEI, 2000).

In Chile, 700 km of coast in the north is comprised of large cliffs, with a rocky shallow coast predominating over nearly 580 km. In the central zone, littoral dunes were formed near the beaches, which are generally located north of the mouths of rivers. The main dune fields are located between 29° and 42° latitude S (Morales, 1995; Castro & Morales, 1989). The coastline is mostly straight, except in the south, where it breaks down into islands, gulfs, channels, and deep inlets. To the North, from Arica to Coquimbo, the coast is exposed and full of cliffs; nevertheless, it has several shallow bays that are appropriate for ports. The main features of the south Chile coast are the Chiloé Islands, the Chonos Archipelago, the Taitao Peninsula, the Gulf of Penas, and the Strait of Magellan.

2.2 Natural Environment

2.2.1 Hydrography

The South East Pacific region, is in general, rich in water resources, the majority of the hydrographic springs being linked to the Andes mountains. Nevertheless, there are zones poor in this resource in several of the countries in the region, including the north of Chile, the central and southern areas of Peru, and in the central arch of Panama, among others.

Panama has numerous rivers that discharge into the Pacific. There are 51 hydrographic basins, 18 on the Atlantic slope and 33 on the Pacific. Most of the rivers are short, have high, steep banks, and empty perpendicularly into the coastal waters. There are approximately 350 watercourses, of which eight have hydrographic basins of over 2,500 km².
The most important basins are the Santa María, Bayano and Tiura-Chucunaque (Kwiecinsky, 1981) rivers. The largest lakes are manmade and created through the damming of rivers; the most important are Gautún (423 km²) and Bayano Lake (360 km²).

Colombia has numerous watercourses due to the fact that it is mountainous and borders on two seas. The runoff waters in Colombia are divided into five systems determined orographically. These, in order of size, are the Amazon springs (22,185 m³/sec), the Orinoco (21,399 m³/sec), the Caribbean (15,430 m³/sec), the Pacific (6,903 m³/sec) and the Catatumbo (which empties into Lake Maracaibo).

The main Colombian basins on the Pacific slope are those of the rivers San Juan, Baudó, Patía, Mira and Micay. The San Juan River has the largest volume and over 130 tributaries. The Baudó River is 200 km long; the Patía River, south of the coast, is 360 km long. The Mira River basin lies on the border between Colombia and Ecuador (FAO, 2001).

In Ecuador, the hydrographic systems and the basins are also determined by the Andes mountains, which run north and south through Ecuador. The mountains are divided into two large sections, the Eastern and Western Ranges. These, together with the transversal mountains running from east to west, have given rise to inter-Andean valleys formed by important rivers. There is a smaller, fragmented branch of mountains to the east which gives a unique character to the eastern or Amazon region.

Ecuador has 31 hydrographic systems with 79 basins. These systems originate in two Andean springs, one of which drains into the Pacific Ocean through 24 basins over an area of 123,243 km². The other, with 7 basins, drains into the Eastern Region over an area of 131,802 km². The insular area adjacent to the continent is 1,325 km². The Galapagos Islands are considered an independent hydrographic unit that drains into the Pacific Ocean. Ecuador shares hydrographic basins with Colombia and Peru, in the north the San Miguel River basin of Putumayo, and in the south the Catamayo-Chira and Puyango-Tumbes river basins (UNESCO, 2000).

The total contribution of Ecuador's hydrographic network, with a margin of error of 30%, is 110 billion m³ per year on the Pacific slope and 290 billion m³ per year on the Amazon slope. A total of 79 rivers drain into the Pacific, most on permanent basis, but some of which dry up in summer (the Muisni River in Esmeraldas, and the Jama, Chone and Portoviejo Rivers in Manabí). These rivers carry more water during the winter and transport a high load of sediments. The northern rivers form part of the main fluvial systems, the Santiago and Esmeraldas Rivers. The Santiago joins the Cayapas River, forming a delta at its mouth. The Jubones River is the main hydrographic system of El Oro Province. The Guayas River is the main river of the Ecuadorian littoral, and is formed by the confluence of the Daule and Babahoyos Rivers; it has a slope of 0.2 to 0.5% (Solorzano, 1981).

Peru has three large hydrographic systems that also correspond to slope basins (the Pacific, Atlantic and Lake Titicaca). There are 106 catchment basins that carry surface and underground water. In terms of total water resources, there is abundant surface water available and this constitutes a major potential. Nevertheless, actual water availability varies greatly over time for climatic reasons. The result is a shortage of water resources on the Pacific and Lake Titicaca slopes, and an abundance of water on the Atlantic slope.

An important feature of Peruvian rivers is their temporary pattern, that is, unstable flows. There is a short three- to five-month period of abundance (December through May) followed by a long dry period with low water levels lasting seven to nine
months (May through December). This has a negative effect on the country's water needs. Water discharged by rivers on the Pacific slope are produced by snowmelt in the Andean mountains and rainfall in the Andes. The average flow is 1,161 m³/sec. The rivers with greatest average flows are the Santa, Tumbes and Chira. The Amazon River is the largest catchment for the Atlantic basin, with an average contribution of 119,518 m³/sec. Its main rivers are the Huallaga, Ucayali and the Marañón. Rivers that flow into the Titicaca have an average flow of 221.9 m³/sec, with the main ones being the Ramis and llave rivers. Only part of the basin belongs to Peru; the remainder is on Bolivian territory (UNESCO, 2000).

Chile is characterised by a hydrographic system of transversal valleys running east and west. Rivers start both in the Andes and in the coastal mountain range; they are fairly short and with low-volume flows. In the north of Chile, due to convective rains in the highlands in summer, certain rivers acquire an alluvial character, with a surface runoff estimated at 30,416 m³/sec (DGA, 1987). In the South, rivers run shorter courses since the contour of the land progressively sinks into the sea, penetrating numerous channels and transforming the system's western section into countless islands in southernmost Chile (UNESCO, 2000).

The Chilean hydrological system is divided into three major zones: the Dry Pacific area, Central Chile and Southern Pacific (CEPAL, 1990). The Dry Pacific system includes part of the northern portion of Chile as well as the entire western drainage from the Peruvian mountains and southern Ecuador. The Chilean section of this system is formed by the Norte Grande and the Norte Chico areas.

The Peruvian border (18° S) is the northern boundary of this area, which continues down to the Limari river basin in the south (31° S), running from the Andes Mountain watershed in the east to the Pacific Ocean in the west. This is the driest zone in Latin America, noted for its marginal coastal deserts. Total surface runoff is 32 m³/sec.

Central Chile's hydrographic system lies between 31° S and 37° 30' S, from the Choapa river basin in the north down to the Bio Bio river basin in the south, and from the Andes Mountain watershed in the east to the Pacific Ocean in the west. Total surface runoff is 2780 m³/sec.

The southern Pacific hydrographic system is comprised of both Chilean and Argentine territory. The Chilean portion runs from the Imperial river basin in the north (37° 30' S) to the tip of the continent at Cape Horn in the south (56° 30' S), and from the Andes Mountain watershed in the east to the Pacific Ocean in the west. Total surface runoff is 2780 m³/sec (UNESCO, 2000).

2.2.2 Oceanography

The region is under the influence of the following ocean currents: the Humboldt Current, the Equatorial Current, the Antarctic Circumpolar Current and others that originate in these currents. They are created by the anticyclonic activity of the Pacific Ocean (Gallardo, 1984). The South American continent is affected by the Equatorial Current and its derivatives, the North and South Equatorial Currents, as well as the Humboldt, Coastal Humboldt (or Coastal Peru) Currents and the Colombia Current.

In southern Chile, the Antarctic Circumpolar Current hits the continent at 40-45° S, giving rise to a complex system of currents toward the north. To the south it forms the Coastal Cape Horn Current,
which carries low-salinity waters from the Chilean channels to the Atlantic Ocean through Drake Passage. The northern component of the current thus originated splits up into a coastal and an oceanic branch, separated by a countercurrent. The coastal branch, or Humboldt Coastal Current, originates at 40-45° S. It follows the coast northward, losing significance at 5° S when it clashes with the Equatorial Front and veers off towards the west. This current is characterised by cyclonic and anticyclonic eddies and upwellings.

The Peru-Chile Countercurrent is a surface current that originates in the Equatorial Countercurrent in the south and penetrates throughout the length of the 80° Long. W meridian. It separates the oceanic countercurrent of Peru from the coastal current, and its waters are equatorial, subtropical and warm. The Equatorial Countercurrent reaches the region at 4° and 10° N. It flows eastward toward Central America, splitting as it arrives at the Costa Rica Dome. The eastern branch, which flows north parallel to the Colombian coast towards the Gulf of Panama —known as the Colombian current— has a surface width of 200 km. Its influence is exerted up to a depth of 250 m. In the Bay of Panama it flows northwards along the coast at a speed of 0.5 knots (Kwiecinsky, 1981), reaching a maximum of 1.5 knots during spring tide.

Figure 2
Main South Eastern Pacific Ocean Currents

![Diagram of Main South-Eastern Pacific Ocean Currents](image-url)
The oceanography of the Gulf of Panama differs from that of the Gulf of Chiriqui in that the latter has no seasonal upwellings during the dry season (Kwiecinski, 1981). Both areas are encompassed in masses of surface tropical waters with a permanently low salt content, the lowest in those latitudes, due to the fact that precipitation exceeds evaporation. The waters include a mixed layer with an almost constant temperature, a thermocline with a marked drop in temperature, and a subsurface layer with temperatures that drop gradually. The Gulf of Chiriqui is located in a variable circulation system within reach of the Equatorial Current, depending on the season.

Waters in the Colombian area of the Pacific are part of the Bay of Panama. Their salt content ranges from 20% close to the coast to 33.5% offshore. Relatively warm surface waters (25° to 26° C) are typical, except for the upwell area in the Gulf of Panama, which extends from 7°30' N to 9° N and whose influence affects the northern area of Colombian waters. The equatorial system of currents in the Pacific becomes less defined as it approaches the American continent, but it affects the water in the Bay of Panama (Rodríguez, 1981). Surface circulation in the bay is a complex system primarily determined by the global wind currents which, in turn, are closely related to latitudinal movements of converging intertropical waters. The direct effects of the equatorial countercurrent, whose movement, if projected eastward, would collide with the Colombian coast, disappear between 90° and 85° W. These effects are more intense from May through December, when they become partially integrated with the circulation system of the Bay of Panama and the Costa Rica Current. They disappear temporarily from February through April, thus allowing the northern trade winds to move the tropical waters in the Bay of Panama. This gives rise to the Panama Current, which becomes part of the Southern Equatorial Current. This southern shift in the Panama Current intensifies the cyclonic movements (counterclockwise in the Northern Hemisphere) of the Colombia Current, which carries low salt content water in a northerly and northeasterly direction.

Ocean circulation in Ecuador is dominated by the winds, and it is part of the northern and Southern Hemisphere gyres. It is formed primarily by the northern and southern Equatorial Currents, the Equatorial Countercurrent, the Humboldt Current and the Cromwell Subcurrent (Cedeño, 1996). Generally speaking, the Ecuadorian sea is located in a area of transition from a tropical to a subtropical system. It is bordered on the north by the Bay of Panama, an area of the Tropical Oriental Pacific with low salinity warm waters, which tends to move southwards beyond its limits when the El Niño phenomenon is present. The coastal area is strongly influenced by the circulation of these waters, which generally flow counterclockwise. In the eastern portion it is formed by a northbound flow of the Colombia current, and on the western side by a meridional flow of water from the Gulf of Panama.

The subtropical water mass of the Peru Current (Humboldt) is found southward, off the Peruvian coast. This consists of cold, high-salinity water modified by a horizontal mixture with upwellings of low temperature and low salinity water. The Equatorial Front is found between these two masses of water; the Front runs from the shore to the north of the Galapagos Islands and is marked by strong thermocline gradients.

The Peruvian Current system in Peru is formed by flows, circulating in different directions, which carry water from different sources (Guillén, 1981). Along the coast, the surface currents are formed by the Peruvian Coastal Current and the Peruvian Ocean Current. These are
separated by a weak and irregular flow, the Peruvian sub-surface countercurrent, which is formed by when an extension of the Cromwell Current joins with the southern Equatorial Countercurrent. This current occasionally reaches the ocean surface (Wyrtki, 1963). Flows in the Peruvian coastal current are subject to seasonal variations. They are more intense from April through September, with movements limited to 200 m. The Peruvian Ocean Current is more intense and reaches up to 700 m in depth and, from July through September, it forms a single flow with the coastal current to become integrated with the Southern Equatorial Current as part of the anticyclonic circulation of the Southern Pacific. The Peruvian countercurrent is more intense than the sub-surface Peruvian current, which reaches up to 500 m in depth (Wyrtki, 1963). The Chilean current penetrates these waters at a depth of 50 to 100 m along the southern shores of Peru. There are intense upwelling processes in the circulation system described, particularly in the areas off Paita, Chimbote, Callao and San Juan.

The Chilean sea is distributed into warm waters in the open Pacific area at the 75° meridian to the west and north of parallel 35°. It includes the archipelagos of Juan Fernández and San Félix and San Ambrosio. Surface temperatures are high, ranging from 15.5° C to 25° C, with salinity at 36%. The Antarctic Circumpolar Current, the largest of all oceanic currents, circulates around Antarctica between that landmass and approximately 40° S. It divides as it approaches the Chilean shoreline, thus giving origin to the Humboldt Current, which runs northwards, and another flow running southward. This southerly current, while it is actually part of the Antarctic Circumpolar Current, is known as the Cape Horn Current. The Humboldt Current flows northwards from approximately 42° S (near the island of Chiloé) along the Chilean and Peruvian coastlines before it turns west to join the Southern Equatorial Current.

The Antarctic Circumpolar Current is a cold water current; therefore, the Humboldt Current waters are also cold. The latter is noted for being a shallow, broad and slow current that transports a low volume of water. It abounds in both clockwise and counterclockwise eddies, as is common in the eastern portions of ocean currents.

Generally speaking, two currents flowing northward and parallel to the coastline can be identified: the Coastal and Oceanic branches of the Humboldt Current, separated by a southward counterflow, the Peruvian countercurrent. In addition to these surface currents, there is a southward subsurface coastal flow, the Peru-Chile subsurface current, which occasionally emerges to temporarily modify the features of the water’s surface layer.

The ocean branch of the Humboldt Current flows northward, and its nucleus is found at a distance ranging from 300 to 4000 nautical miles off the coast at speeds that fluctuate between 8 and 20 cm/sec. This current mainly carries relatively cold, low-salinity sub-Antarctic water to lower latitudes.

The Peruvian countercurrent, which transports water of subtropical origin, flows southward at variable speeds both seasonally and from year to year. Speeds higher than 20 cm/sec have been detected off the coast of Arica in winter; speeds decrease quickly as the current moves south. Thus, speeds of 5 cm/sec have been detected off the coast of Antofagasta (in winter) and 6 cm/sec off the coast of Huasco (in summer). Its extension toward the south also varies; it has sometimes been found beyond the region of Talcahuano, while on other occasions it has not even been detected as far south as Valparaiso. When this countercurrent weakens, it allows water
from the ocean branch to flow into the coastal branch.

The Coastal Branch of the Humboldt Current flows between this countercurrent and the coast. Like the Ocean Branch, this one also carries sub-Antarctic water. The Coastal Branch generally has a well-defined and almost continuous flow in its westernmost portion; it deepens as it moves northward at speeds higher than 10 cm/sec. Speeds of 26 cm/sec have been detected (Huasco in winter), which shows that it is subject to fluctuations seasonally, yearly and geographically.

Underneath this coastal current, whose nucleus is found at around 100 to 200 m deep and at varying distances from the shore—further offshore in the north and closer inland in the south—the sub-surface Peru-Chile current flows southward. This submarine current transports sub-surface equatorial water, which is characterised primarily by its low dissolved-oxygen content associated with a relative maximum of salinity. Dissolved oxygen off the coast of Peru and northern Chile reaches minimum levels, very nearly zero millilitres per litre (nearly anoxic water). As a result, the seabed of the continental shelf and slope bathed by this water, up to 400 m deep, have a very low rate of marine life. Furthermore, few fish can live in this type of water. Therefore, most of the species that make up the great fishery wealth of Peru and northern Chile are found in the upper layer, which is 30 to 50 m deep.

The Chilean Coastal Current, moving northwards at some 10 cm/sec, is the one closest to the coast. Although this flow, not being permanent, is not strictly speaking an ocean current, it has some features stemming from a mixture of sub-Antarctic and sub-surface Equatorial waters that distinguish it from the Coastal Branch, to which it belongs.

The relatively low temperature of the waters off the shores of Chile and Peru are the result of the sub-Antarctic origin of the surface waters and of the upwellings that occur along these coastlines. These upwellings are caused by the S and SW winds in central and southern Chile and by the trade winds, which are SE winds north of 30° latitude S, common in northern Chile and Peru. Due to the combined force of these winds and the Coriolis effect (rotation of the Earth), surface layers of water are shifted offshore, and this is accompanied by an upwelling of deeper waters, some of which even reach the surface. This relatively cold water that rises is, primarily, sub-surface Equatorial water which, although poor in dissolved oxygen, has a high concentration of such nutrients as phosphates, nitrates and silicates, which are essential to phytoplankton (Sievers, 2000).

2.2.3 Climate

The region has many different climates, ranging from the driest desert climate to very cold and rainy. There are broad variations in rainfall patterns. For instance, in Colombia, while some locations in the Guajira area to the north record the lowest annual rainfall averages (300 mm), other locations along the Pacific coast record the highest figures in the country and the world (over 9,000 mm per year).

In Colombia and Panama, the region's climate is influenced by the Inter-Tropical Convergence Zone (ITCZ) and by ocean currents. There are also a series of temperature zones determined by altitude in most of the countries. In
Colombia, Ecuador, Panama and part of northern Peru, there are warm zones at less than 2,500 masl, temperate zones in areas between 2,500 and 3,000 masl, cold zones between 3,000 and 4,500 masl and ice-caps above 4,500 masl. To the north, on the Pacific Ocean, the predominating climates are humid and very humid tropical (Panama, Colombia and Ecuador); there is a subtropical and tropical climate in Peru, and a desert climate in southern Peru and northern Chile. The climate in northern Chile is predominantly arid, with both deserts and steppes. The central and coastal areas in the south have a temperate climate, and the coastal north is dry. The extreme south has a polar climate. Between Panama and northern Ecuador, temperatures range from 23° to 28°C with high rainfall rates, as much as 10,000 mm/year in Choco, Colombia. Between southern Ecuador and northern Peru (10° S), temperatures average 20-25°C and rainfall is around 1,000 mm/year. At latitudes of 10° and 20° S (Peru and northern Chile), temperatures range from 15 to 20°C, while rainfall rarely exceeds 20 mm/year; some areas are totally lacking in rainfall. Chilean latitudes of 20° to 30° S have a desert climate, with rainfall of 160 mm/year. From 30° to 50° S, the climate is temperate. Temperatures drop gradually from 18 to 13°C, while rainfall increases up to 3,000 mm/year. At 50° S and further south, the climate is cold and rainy with average temperatures of 6° to 0°C and a rainfall of 5,000 mm/year (Escobar, 2000; Gallardo, 1984).

Panama averages a yearly rainfall of some 233.6 km³. The average surface runoff is 144.1 km³/year, 60% of which is provided by the Pacific slope and the remainder by the Atlantic.

Panama’s climate is tropical, hot and humid, with temperatures varying according to altitude. The average temperature in coastal areas is between 23° and 27°C and in the highest points it reaches 19°C. There are five types of climate. In the lowlands, the predominant climate includes very humid tropical, humid tropical and dry tropical. In the highlands the predominant climate includes humid temperate and very humid temperate. A very humid tropical climate is present in the western portion of the Caribbean slope (the Peninsula of Valiente in the Bocas del Toro province), where average annual rainfall is around 6,000 mm. The humid tropical climate is the most prevalent in the country; it includes both slopes and brings annual rainfall of 5000 mm. A dry tropical climate is present mainly in the coastal regions of the western area of the Gulf of Panama, with an annual rainfall of less than 1,500 mm. A very humid temperate climate occurs in the high regions of the provinces of Bocas del Toro and Chiriquí. Panama’s geographic location makes it prone to the effects of the atmospheric movements of the inter-tropical convergence zone (ITCZ) due to solar angles. Movements in the ITCZ determine the appearance of the north-east trade winds. Consequently, these movements also determine the dry and rainy seasons; the latter lasts from April through December (Franco, 2001; Álvarez et al., 1991).

Colombia has multiple climates distributed over different temperature zones: a rainy jungle equatorial climate, located in Amazonia and on the Pacific coast; a tropical forest climate in the high areas of Amazonia, the middle valley of the Magdalena river and in the lower mountains; a flat terrain tropical climate located in the Caribbean and eastern plains; a tropical steppe climate in the savannahs of Guajira and the eastern part of Bolivar; a high-altitude tropical climate in the Andes mountains; and a cold high-altitude climate in the highest peaks of the Andes.

The climate on the Pacific coast is primarily determined by the movements
of the ITCZ, the proximity of ocean masses and events related to the "El Niño" phenomenon. In its annual south-north movements, the ITCZ determines the amount of rainfall for the year in the region. It gives rise to two rainy seasons (April-June and September-November in the north and central areas, and October-December in the south) alternating with two drier periods (Eslava, 1994).

Colombia is among the richest countries in the world in terms of water resources, behind only Russia, Canada and Brazil in water availability. Its yearly runoff output is six times higher than the average global output and three times higher than the Latin American average. Its annual yearly rainfall is 3000 mm, twice as high as the Latin American average and three times as high as the world average (Marín, 1992).

The climate in Ecuador is varied. The coastal area has two well-defined seasons: a rainy season, running from January through April, marked by humidity, high temperatures, and heavy cloud cover. In the remaining eight months, the temperature drops and the rains disappear. The climate is strongly influenced by the oceanic conditions. In the rainy season, high temperatures correlate with increased ocean temperatures, while lower temperatures and the decrease in rains coincide with a colder ocean (Noboa, 1996).

Peru has varied subtropical and tropical climates due to such determining factors as the Andes mountains and the Humboldt Current. The Peruvian coastal climate is temperate and humid due to the cold ocean current. There are two types of climates: the subtropical climate, with average temperatures ranging from 18° to 21° C and excessive atmospheric humidity (between 90% and 98%), and a semitropical climate with high temperatures (average temperature of 24° C), periodic rains in summer and abundant humidity. In the mountains, the climate varies from temperate to polar, and in the trans-Andean jungle plains the climate is warm and humid, with abundant rain. In the mountains, temperatures range from 6° to 18° C. Mountain summits 4500 masl have a polar climate, and the climate in the highland plateau is cold. Temperatures in the low slopes are moderate while the deep valleys are warm (Teves et al., 1992).

The following types of climate are found in Chile from north to south: desert, Mediterranean steppe, rainy warm temperate, rainy temperate, cold steppe, tundra and polar. In the Andes, the climate is marked by altitude and ice (CONAMA, 1999). Temperatures vary according to latitude, proximity to the ocean and elevation. In general, temperatures decrease gradually from north to south, with a difference of 12.8° C in almost 37° of latitude (Errázuriz, 1996). Rainfall ranges from scarce to non-existent in the north to an area of high rainfall in the extreme south, with a transition zone in the central part of the country, which has dry summers and damp winters. In the north, the climate is predominantly arid, with desert and steppe subtypes. The climate in the highland plateau is cold, with an icy subclimate in the highest areas and a high-elevation dry climate in the high plateau. Temperatures along the coast are relatively low, ranging from 18.7° C in Arica to 14.9° C in La Serena, and are quite homogeneous due to the regulating effect of the ocean. In the central inland strip, annual mean temperatures are also low due to extreme variations in temperature (up to 30° C in winter). At altitudes of 3000 masl, averages drop to under 10° C.

In the central zone, the climate is marked by variations in altitude, both longitudinally and transversally. A temperate climate is found in the central and coastal areas of the south, with dry
areas in the central longitudinal valley and along the coast in the north. A high-elevation icy climate is found in the mountains. Air temperature decreases with latitude, although the decrease is delayed along the coastal strip due to the regulating effect of the ocean. The central valley also experiences major annual and daily temperature variations; this effect too is less marked nearer to the coast. In the south, the climate ranges from the chill of the high mountain ice to temperate towards the west and marine temperate towards the austral zone. The temperature drops from north to south due to latitude. Annual temperature variations are no more than 10°C due to the effect of the ocean, which penetrates right up to the Andes Mountains (UNESCO, 2000).

2.2.4 Ecosystems and Biodiversity

2.2.4.1 Forest Ecosystems

In 1996, the SE/P had 786,000 ha of mangrove forests concentrated primarily in the Pacific coastal areas of Colombia and Ecuador. The region also had a surface area of 75,636,000 ha of tropical forest. The neotropical forest area was 14,526,000 ha, and it was confined to Chile. Forest cover in the region in 1999 was 67,562,000 ha, of which 67,378 ha were natural forestlands; in 1990 there were 144,000 ha of forest plantations (WRI, 1999). [Tables 2 and 3].

Table 2
Forest Ecosystems of the SE/P, 1999

<table>
<thead>
<tr>
<th>Countries</th>
<th>Surface area (thousands of ha.)</th>
<th>Original forest as a % of surface area</th>
<th>Mangroves</th>
<th>Tropical forest</th>
<th>Neotropical forest</th>
<th>Other forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Area (thousands of ha.)</td>
<td>% protected</td>
<td>Area (thousands of ha.)</td>
<td>% protected</td>
</tr>
<tr>
<td>Colombia</td>
<td>103,870</td>
<td>92.2</td>
<td>368</td>
<td>22.2</td>
<td>53,186</td>
<td>10.8</td>
</tr>
<tr>
<td>Chile</td>
<td>74,880</td>
<td>39.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ecuador</td>
<td>27,684</td>
<td>78.8</td>
<td>283</td>
<td>14.2</td>
<td>13,508</td>
<td>23.9</td>
</tr>
<tr>
<td>Panama</td>
<td>7,443</td>
<td>97.2</td>
<td>180</td>
<td>2.1</td>
<td>3,744</td>
<td>30.9</td>
</tr>
<tr>
<td>Peru</td>
<td>128,000</td>
<td>74.4</td>
<td>6</td>
<td>100.0</td>
<td>75,636</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Source: WRI (1999), Biodiversity Data Tables, World Resources 1998-1999
Table 3
Forestry Cover SE/P, 1995

<table>
<thead>
<tr>
<th>Countries</th>
<th>1980 (thousands of has.)</th>
<th>1995 (thousands of has.)</th>
<th>Annual changes (%)</th>
<th>1990 (thousands of has.)</th>
<th>1995 (thousands of has.)</th>
<th>% of change in 1990-95</th>
<th>Extension 1990 (thousands of has.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>57,771</td>
<td>52,988</td>
<td>(0.5)</td>
<td>54,173</td>
<td>52,862</td>
<td>(0.5)</td>
<td>126</td>
</tr>
<tr>
<td>Chile</td>
<td>8,087</td>
<td>7,892</td>
<td>(0.4)</td>
<td>7,023</td>
<td>6,877</td>
<td>(0.4)</td>
<td>1,075</td>
</tr>
<tr>
<td>Ecuador</td>
<td>14,372</td>
<td>11,137</td>
<td>(1.6)</td>
<td>12,037</td>
<td>11,092</td>
<td>(1.6)</td>
<td>45</td>
</tr>
<tr>
<td>Panama</td>
<td>3,764</td>
<td>2,800</td>
<td>(2.2)</td>
<td>3,112</td>
<td>2,794</td>
<td>(2.2)</td>
<td>6</td>
</tr>
<tr>
<td>Peru</td>
<td>70,714</td>
<td>67,562</td>
<td>(0.3)</td>
<td>68,462</td>
<td>67,378</td>
<td>(0.3)</td>
<td>184</td>
</tr>
</tbody>
</table>


2.2.4.2 Coastal Ecosystems

The region is endowed with all known coastal ecosystems. The typical ecosystems of tropical environments can be found in Panama, Colombia and northern Ecuador. In southern Ecuador and northern Peru, there are subtropical and temperate environments, while Chile has the cold and very cold environments of the south and the Antarctic in the extreme south. A few mangrove forests are found in northern Peru, and are very common in Panama, Ecuador and southern Colombia (Escobar; 2000; Tuñon, 1995; Cantera, 1994). Coral ecosystems are also present to some extent: There are patches of coral in some zones of Colombia, the Galapagos Islands and in Panama (Zapata, 1994; Hurtado, 1995; Tuñon, 1995). There are also estuarine systems, the major ones being connected to gulfs and bays in Colombia, Ecuador, Panama and in some areas of Peru and Chile (Noboa, 1996; Morales, 1995; Cantera, 1994; Álvarez et al., 1991). Coastal dunes are found mainly in Chile and Peru and, to a lesser extent, in southern Ecuador. There are fjords and high cliffs in southern Chile and medium high cliffs in Panama, Colombia and Chile (Escobar 2000; Morales, 1995).

2.2.4.3 Mangroves

The mangrove-covered area on the Pacific side ranges from the border between Panama and Costa Rica to northern Peru, with the San Pedro mangroves in the Piura district. The main species of mangroves in the region are Rhizophora mangle, R. harrisoni and Avicennia germinans. In 1996, mangrove forests in the region covered an area of 435,735 hectares, equal to 66% of the total regional surface area estimated for the 1960s-1970s, which accounted for 2.9% of the world's mangrove forest area. Countries with the largest mangrove-covered areas are Colombia and Ecuador, followed by Panama and Peru (Escobar, 2000).
2.2.4.4 Corals

The coral ecosystem in the South East Pacific is confined to Panama, Colombia and Ecuador, close to the coast and to some oceanic islands such as the Galapagos in Ecuador and Gorgona in Colombia. Some hermatypic coral formations are also found in Easter Island, in Chile (Escobar, 1996; Hurtado, 1995 a and b).

Coral ecosystems in the region have a low number of species (8 to 12 per patch) with Pocillopora damicornis, which thrives in protected shallow waters, as the most prevalent. The main areas where coral is found in Panama are Isla Seca, Isla Ladrónes, Isla Contreras, Uva, Coiba, Honda Bay, Parita, Taboga and Taboguilla Islands, the Las Perlas Archipelago and the Gulf of Chiriquí. Most corals are sub-tidal, and Pocillopora prevails in almost 80% (Tuñon, 1995; Escobar, 2000). In Colombia there are basically three zones with substantial development of coral formations: Isla Gorgona, Ensenada de Utría and Isla Malpelo. There are coral patches on the northern coast of the Choco District, from Corrientes Cape up to the border with Panama, in the Gulf of Cupica, Octavia Bay, Cupica, Solano, Limón and Punta Araila (Zapata, 1994; Escobar, 2000). In Ecuador, there are small coral formations along the coast. In the Galapagos Islands there are ahermatypic corals and hermatypic corals (Hurtado, 1995; Escobar, 2000).

2.2.4.5 Biodiversity

The preservation of biodiversity is ranked as a priority activity in the region. Three of the five countries forming the region are so-called "Megadiverse" countries, that is, countries that as a whole possess over 70% of the biological diversity available on the planet. Colombia, Ecuador and Peru are on this list of 13 countries.

In Colombia, for instance, the Pacific region has a complex ecosystem evidenced by ecological heterogeneity ranging from tropical subxerophytic shrubs to humid rainforests. The Chocó houses the richest plant communities in terms of world species, and the area records the highest indices of continental endemism (Gentry, 1986). The area is also acknowledged as one of the regions with the greatest diversity of amphibians. Almost 11% of all known species of birds are present there, and 56% of Colombian birds are found in that area (Proyecto Biopacífico, 1999; Naranjo, 1994). In addition, 13% of the biogeographic world provinces are represented in Peru, 5% of which are protected. Regarding continental fauna, the region is home to 472 species of mammals (29% from the neotropical region), 1756 species of birds, 360 species of reptiles, 352 species of amphibians, 900 species of fish from continental waters and around 22 species of angiosperms. It contains 10% of the animals and plants found on Earth, as well as 11 out of the 21 world priority areas for the conservation of birds. It ranks third in the world in terms of the greatest diversity of amphibians, fourth in terms of the diversity of its birds, and sixth with regard to papilionidae butterflies.

According to the WRI (1999), 1214 species of land mammals are reported in the region with 132 endemic species and 142 in danger of extinction.
The density of mammals per 10,000 km² varies between a maximum of 112 in Panama to a low of 22 in Chile. Furthermore, there are 5,648 species of birds, 232 of which are endemic and 209 are in danger of becoming extinct. There also are 99,496 species of higher plants, of which 14,776 are endemic and 1981 are in danger of extinction [Table 4].

Table 4
Biodiversity in the SE/P Region

<table>
<thead>
<tr>
<th>Countries</th>
<th>No. of mammal species</th>
<th>No. of endemic species of mammals</th>
<th>Endangered mammal species</th>
<th>No. of bird species</th>
<th>No. of endemic bird species</th>
<th>Endangered bird species</th>
<th>No. of higher plants</th>
<th>No. of endemic species</th>
<th>No. of endangered plant species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>359</td>
<td>29</td>
<td>35</td>
<td>1,695</td>
<td>63</td>
<td>64</td>
<td>50,000</td>
<td>1,500</td>
<td>376</td>
</tr>
<tr>
<td>Chile</td>
<td>91</td>
<td>17</td>
<td>16</td>
<td>295</td>
<td>14</td>
<td>18</td>
<td>5,125</td>
<td>2,698</td>
<td>292</td>
</tr>
<tr>
<td>Ecuador</td>
<td>302</td>
<td>24</td>
<td>28</td>
<td>1,388</td>
<td>38</td>
<td>53</td>
<td>1,250</td>
<td>4,000</td>
<td>375</td>
</tr>
<tr>
<td>Panama</td>
<td>216</td>
<td>14</td>
<td>17</td>
<td>732</td>
<td>8</td>
<td>10</td>
<td>9,000</td>
<td>1,222</td>
<td>561</td>
</tr>
<tr>
<td>Peru</td>
<td>344</td>
<td>48</td>
<td>46</td>
<td>1,538</td>
<td>109</td>
<td>64</td>
<td>17,121</td>
<td>5,356</td>
<td>377</td>
</tr>
<tr>
<td>Total</td>
<td>1,314</td>
<td>132</td>
<td>142</td>
<td>5,648</td>
<td>232</td>
<td>209</td>
<td>99,496</td>
<td>14,776</td>
<td>1,981</td>
</tr>
</tbody>
</table>


The contribution marine biodiversity makes to the wealth of fauna in the region is not fully known, and it has not yet been determined to what extent the coastal marine biodiversity is represented in its different ecosystems. However, there is evidence that this contribution is substantial. Specific marine biodiversity is very high and influenced by oceanographic conditions that characterise the great Humboldt Ecosystem, as well as the influence of the Equatorial, Antarctic and California Currents. To the north, the region is tropical and highly oligotrophic. To the south the region is cold, with a high degree of biological production. There are species from the Panamanian, Peruvian, Chilean and Magellanic fauna provinces. There is a large number of species that are common to the Indo-Pacific. Many marine species of the region are currently under some protection status, particularly mammals, birds and turtles. Endemism is moderate; this condition applies to two species of molluscs, as well as to two crustacean, nine shark, 21 marine bird, two cetacean and two pinniped species. The diversity of marine prairies is low in the Colombian and Panamanian areas of the Pacific.
There is no endemic genus of hermatypic corals, and their diversity is also low. Sharks are a group with a high rate of endemism. The region abounds in molluscs, birds, cetaceans and sharks (WCMC, 1989).

The Colombian Pacific has 126 species that are exploited in the fishing industry. Fish are the most numerous among this group (Gutiérrez, 1997; Gutiérrez and Valderrama, 1997). In Ecuador, over 170 species of fish are exploited by artisan fishing, as are other species of molluscs and crustaceans (CAAM, 1996). The Peruvian sea is quite varied in terms of species with considerable economic significance. There are over 30 species of mammals (pinnipeds and cetaceans) and around 800 species of fish, in addition to a vast variety of birds and numerous marine invertebrates. There is a forest of Lessonia nigricens and of Macrocystis integrifolia where around 150 species of animals live on the rhizoids. These algae, together with Durvillaea antartica, extend from the waters off southern Peru to Tierra del Fuego in Chile. There are over 90 species associated with communities dominated by Semimytilus algosus and Perumytilus purpuratus (Teves et al., 1992). The Chilean fishing industry exploits 125 different species, including 70 species of fish, 24 species of molluscs, 17 species of crustaceans and 12 species of algae (Zúñiga and Benoit, 1995; Escobar, 2000). There also are four species of turtles common to the region, namely, Chelonia mydas, Lepidochelys olivacea, Eretmochelys imbricata and Dermochelys coriacea (Hurtado, 1995a and b).

2.2.4.6 Protected Areas

The measures adopted by the region to protect its biological diversity include, among others, the designation and establishment of protected areas. There were 211 conservation units in 1999 (categories I through V of the UICN), most of which were in Colombia and Chile (WRI, 1999). The total area reserved for conservation is close to 130 million hectares. Of the total conservation units, which include protected marine areas, 20.8% (44 units) are part of the International Conservation Systems [Table 5]. There are 60 coastal marine protected areas, 26 of which are Natural National Parks (NNP) (10,129,027 ha), 29 are nature reserve equivalents (NR) (15,603,060 ha) and 5 are Natural Monuments (386 ha) (Osorio, 1998; Tuñon, 1995; Zúñiga and Benoit, 1995; Hurtado, 1995a and b).

The total regional coastal marine surface area reserved for conservation is 25,732,432 ha, a figure that is less than 1% of the total protected area in the region. Of this total, approximately 25% is dedicated to protecting coastal ecosystems, and less than 2% protects marine ecosystems [Table 6].
### Table 5
Protected Areas in the SE/P Region (In Domestic and International Conservation Systems), 1999

<table>
<thead>
<tr>
<th>Countries</th>
<th>Total PA Categories I - V UICN</th>
<th>National Protected Area Systems</th>
<th>International Protected Area Systems</th>
<th>Wetlands of Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Thous. of ha.</td>
<td>% of Area</td>
<td>No.</td>
</tr>
<tr>
<td>Colombia</td>
<td>79</td>
<td>9,358</td>
<td>9.0</td>
<td>3</td>
</tr>
<tr>
<td>Chile</td>
<td>72</td>
<td>14,134</td>
<td>18.9</td>
<td>7</td>
</tr>
<tr>
<td>Ecuador</td>
<td>20</td>
<td>11,927</td>
<td>43.1</td>
<td>2</td>
</tr>
<tr>
<td>Panama</td>
<td>21</td>
<td>1,421</td>
<td>19.1</td>
<td>1</td>
</tr>
<tr>
<td>Peru</td>
<td>19</td>
<td>3,462</td>
<td>2.7</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Protected area, category and name</th>
<th>Surface area (has.)</th>
<th>Establishing Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>NNP Sanquianga</td>
<td>80,000</td>
<td>Res. Ejecutiva 161/77</td>
</tr>
<tr>
<td></td>
<td>NNP I. Gorgona</td>
<td>42,000</td>
<td>Res. Ejecutiva 141/84</td>
</tr>
<tr>
<td></td>
<td>NNP E. De Utria</td>
<td>53,400</td>
<td>Res. Ejecutiva 140/87</td>
</tr>
<tr>
<td></td>
<td>SFF I. Malpeño</td>
<td>350</td>
<td>Res. Ejecutiva 1292/95</td>
</tr>
<tr>
<td>Chile</td>
<td>NP Arch. Juan Fernández</td>
<td>9,109</td>
<td>DS 103/35</td>
</tr>
<tr>
<td></td>
<td>NP Rapa-Nui</td>
<td>6,886</td>
<td>DS 148/35</td>
</tr>
<tr>
<td></td>
<td>Malpelo</td>
<td>9,956</td>
<td>DS 148/35</td>
</tr>
<tr>
<td></td>
<td>NP Boque Fray Jorge</td>
<td>63,093</td>
<td>DS 995/45</td>
</tr>
<tr>
<td></td>
<td>NP Cabo de Hornos</td>
<td>10,625</td>
<td>DS 321/57</td>
</tr>
<tr>
<td></td>
<td>NP I Guamblin</td>
<td>1,742</td>
<td>DS 475/59</td>
</tr>
<tr>
<td></td>
<td>NP LS San Rafael</td>
<td>1,460,000</td>
<td>DS 80/65</td>
</tr>
<tr>
<td></td>
<td>NP de Agostini</td>
<td>3,525</td>
<td>DS 264/69</td>
</tr>
<tr>
<td></td>
<td>NP Bahia O’Higgins</td>
<td>43,057</td>
<td>DS 734/83</td>
</tr>
<tr>
<td></td>
<td>NP Chiloe</td>
<td>157,640</td>
<td>DS 301/83</td>
</tr>
<tr>
<td></td>
<td>NP I. Magdalena</td>
<td>43,745</td>
<td>DS 527/96</td>
</tr>
<tr>
<td></td>
<td>NR I Guamblin</td>
<td>45,708</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>NR Las Gualtecas</td>
<td>1,097,975</td>
<td>DS 2.612/38</td>
</tr>
<tr>
<td></td>
<td>NR Alacalufes</td>
<td>2,313,875</td>
<td>DS 263/69</td>
</tr>
<tr>
<td></td>
<td>NR Katalalixar</td>
<td>674,500</td>
<td>DS 780/84</td>
</tr>
<tr>
<td></td>
<td>NR L. Torca</td>
<td>604</td>
<td>DS 604/86</td>
</tr>
<tr>
<td></td>
<td>NR I. Mocha</td>
<td>2,368</td>
<td>DS 70/88</td>
</tr>
<tr>
<td></td>
<td>NR Pingüino de Humboldt</td>
<td>860</td>
<td>DS 490</td>
</tr>
<tr>
<td>Ecuador</td>
<td>NR Machalilla</td>
<td>55,059</td>
<td>AM of 979</td>
</tr>
<tr>
<td></td>
<td>NP Galapagos</td>
<td>691,200</td>
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<td>180</td>
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<td></td>
<td>NR Lanchay</td>
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<td>DS 310/77</td>
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</tbody>
</table>

Source: Escobar (2000), Hurtado (1995 a and b)
2.2.5 Freshwater Environments Linked to the Pacific

There are many diverse freshwater environments linked to the Pacific Ocean coasts.

In Colombia, most of these are located below 1,000 masl, and they contain about 62% of the national water supply (Ministry of Environment, 1999). There are over 1,000 permanent rivers and more than 6,000 marshes, lakes, water reservoirs and lagoons. Of the marshes, 1,900 occupy some 451,419 ha. There are also 13,334 non-identified bodies of water that occupy an area of 129,085 ha. The numerous lakes and lagoons -some of which are shared with Argentina- that store a significant volume of water (FAO, 2001).

In Ecuador, 5 to 9 km³/year of water resources flow into Colombia on the Pacific slope; 70 to 125 km³/year flow into the Pacific through coastal rivers; 5 to 9 km³/year run into Peru on the Pacific slope; 9 to 16 km³/year run towards the Colombian Amazon basin; and 200 to 300 km³/year flow towards the Peruvian Amazon basin.

In Peru, average rainfall is 1,738 mm/year, for an annual volume of 2,233 km³/year. Of this, 1,616 km³/year becomes renewable water resources; the rest is lost through evapo-transpiration and evaporation. In the Sierra, there are some 11 lakes, both permanent and temporary and of varying sizes. There are other surface water resources located between 4,000 and 6,000 masl in the Andes Mountains (PAHO/WHO, 2000; FAO; 2001).

Some of the water bodies identified in the SE/P countries have locations that make them economically feasible for hydroelectricity generation sites, with a potential of some 609,059,000 kilowatts (CEPAL, 1999) [Table 7].

In 1970, the region produced 28% of Latin American and Caribbean hydroelectricity; this increased to 52% in 1984 and then dropped to 34.6% in 1994. The countries with the highest hydroelectricity potential are Colombia and Peru. In Colombia there are 90 small and middle-sized reservoirs storing 3.4 km³ and 26 large reservoirs (with a capacity of over 25 Hm³) whose total capacity is about 9.1 km³. Chile’s large reservoirs can regulate 4,665 million m³, and the country has almost 0.5 million m³ in minor regulation works. In Ecuador, total reservoir capacity is 7.5 km³; of this, 83% is
provided by the Daule-Peripa reservoir, which supplies the coast. In Panama, there are five reservoirs with a total capacity near 9 km³. In practical terms, the country’s hydroelectric potential is calculated at 3,568 Mw (31,247 Gwh, with 56% on the Pacific slope). In Peru, total reservoir capacity is estimated at 2,680 million m³ (FAO 2001).

<table>
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</thead>
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<td>50,000</td>
<td>120,000</td>
<td>120,000</td>
<td>93,084</td>
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<td>17,000</td>
<td>12,000</td>
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<td>20,000</td>
<td>22,000</td>
<td>69,953</td>
<td>22,000</td>
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<tr>
<td>Panama</td>
<td>1,890</td>
<td>2,900</td>
<td>7,146</td>
<td>7,320</td>
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<tr>
<td>Peru</td>
<td>30,000</td>
<td>58,000</td>
<td>75,381</td>
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<tr>
<td><strong>Total</strong></td>
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<td>214,900</td>
<td>291,354</td>
<td>210,800</td>
</tr>
<tr>
<td><strong>Latin America &amp; the Caribbean</strong></td>
<td>419,469</td>
<td>617,500</td>
<td>805,792</td>
<td>609,059</td>
</tr>
<tr>
<td><strong>SE/P(%)</strong></td>
<td>28.3</td>
<td>34.8</td>
<td>35.5</td>
<td>34.6</td>
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</tbody>
</table>


*potential evaluated with a plant factor of 0.5 based on OLADE methodology, in the years indicated as per ECLAC notes (1999)

Strictly speaking, there are no natural lakes along the Pacific Coast. The coastal lakes on the Pacific slope of Panama are manmade; one example is Gatun Lake. The presence of real coastal swamps in the region depends on the length of the summer season and on the tides. Almost all the coastal swamps and wetlands are located in estuaries and mouths of rivers, especially in the river deltas of Panama, Colombia, Ecuador and the north of Peru. Many marshes are also found in southern Chile. Most Panamanian wetlands are located at the bays of Parita, Chame, Chorrera, Bique, and Panama, at the gulfs of San Miguel, Montijo, and Punta Patiño, and the intertidal plains in Serigua and Canas Island (Tuñon, 1995). In Colombia, there are wetlands in Sanquinga, the intertidal plains of Gorgona, Tumaco Inlet, the San Juan river delta, the mouths of the Cajambre, Yurumangui, Mica and Saya rivers, Sardinas Cove, and Tribuga Inlet (Cantera, 1994; Escobar 2000).

In Ecuador the wetlands are located on the Esmeraldas coast and at the estuaries of the Gulf of Guayaquil and at Caraquez, Cojimies, Churute, Cayapa-Mataje and Machilla Bays (Noboa, 1996; Noboa et al., 1996; Noboa and Robadue, 1995; Hurtado, 1995 a). Peruvian wetlands include, among others, Mejia Lagoon, Vila swamps and Paracas Natural Reserve (Teves et al., 1992; Escobar, 2000).

In Chile, most coastal marshes are located between the parallels of 40° and 43° S. in the estuaries and behind the sands and areas with loose rock. There are tidal marshes in the Gulf of Ancud (Morales, 1995).
2.3 Demography

2.3.1 Population and Urbanisation

Since the 1950s, Latin American and Caribbean countries have experienced a historically unprecedented rate of demographic growth: from 166.3 million inhabitants in 1950 to 359.3 million in 1980, and to more than 476.6 million in 1995 (United Nations, 1998). The average annual growth rate reached a high of 2.75% in the first half of the sixties, then declined to around 1.54% during 1995-2000. During this time, urban centres have become more densely populated, while rural populations have dropped. The urbanisation process is transforming Latin America and the Caribbean into one of the most urbanised regions, together with North America and Europe. Tables 8 and 9 show the population growth of the SE/P, Latin American and Caribbean countries, illustrating the great difference between urban and rural population growth.

Table 8

<table>
<thead>
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<td>128,266</td>
<td>128,862</td>
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<tr>
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<td>71</td>
<td>75</td>
<td>77</td>
<td>78</td>
<td>79</td>
<td></td>
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<tr>
<td>Total</td>
<td>11,147</td>
<td>13,100</td>
<td>15,211</td>
<td>16,136</td>
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<tr>
<td>Urban %</td>
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<td>83</td>
<td>86</td>
<td>87</td>
<td>88</td>
<td>89</td>
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</tr>
<tr>
<td>Total</td>
<td>28,447</td>
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<td>42,321</td>
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<td>49,665</td>
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<td>35,262</td>
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<tr>
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<td>69</td>
<td>74</td>
<td>77</td>
<td>78</td>
<td>80</td>
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<tr>
<td>Total</td>
<td>7,981</td>
<td>10,264</td>
<td>12,646</td>
<td>13,798</td>
<td>14,899</td>
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<tr>
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<td>63</td>
<td>66</td>
<td>68</td>
<td>71</td>
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</tr>
<tr>
<td>Total</td>
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<td>2,856</td>
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<tr>
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<td>1,646</td>
<td>1,824</td>
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<tr>
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<td>58</td>
<td>59</td>
<td>61</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td><strong>Peru</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17,324</td>
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<td>27,804</td>
<td>29,885</td>
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<td>14,814</td>
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<td>7,379</td>
<td>7,597</td>
<td>7,818</td>
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<tr>
<td>Urban %</td>
<td>64</td>
<td>69</td>
<td>72</td>
<td>73</td>
<td>75</td>
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</tr>
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</table>

Source: CEPAL, 2000
The rapid concentration of urban population and rural migration to urban areas have created huge marginal urban areas on the outskirts of the cities, with no infrastructure and service zoning. The urban poor arriving from rural areas settle in shantytowns on the outskirts. Many of these settlements are poorly located and exposed to external dangers (floods, landslides, etc.), as well as to such internal hazards as overcrowding, health hazards, pollution, poor housing, unsanitary conditions, and other problems that directly affect a population's quality of life. This creates a situation of "poverty sub-urbanisation" and a marked societal gap in the cities.

The next Table shows the demographic situation of the South Eastern Pacific countries according to the last official population census performed in each of the countries: Colombia (October 24, 1993), Chile (April 22, 1992), Ecuador (November 25, 1990), Panama (May 13, 1990) and Peru (July 11, 1993).
In 1999, the estimated population of the SE/P countries was 97,039,026 inhabitants, equivalent to 32.7% of the total population of South America. The annual growth rate was 1.64 between 1990-1999 (World Bank, 1999). The population rose from 82,307,000 inhabitants in 1985 to 90,375,000 in 1990, an increase of 9.8%. The population density in 1999 ranged from 19.6 inhab/km² to 43.8 inhab/km².

It is estimated that in the year 2015 the SE/P region will have a total population of 122,357,828 inhabitants (CEPAL, 2000). A high percentage of these inhabitants will live on the coast.

In general, the regional coastal population grows at a higher rate than the rest of the territory. For example, in Ecuador between 1950 and 1990 the total population tripled while the coastal population quadrupled (Olsen and Arriga, 1995).

As is true for the rest of South America, the SE/P region shows a strong trend toward urbanisation. In 1999, the urban population was 72% of the total (World Bank, 1999). In 1999, 74% of the coastal population was urban, located in more than 56 urban centres of which 22 are coastal cities with more than 100,000 inhabitants. There are also several hundred small, unhealthy towns with populations of fewer than 10,000.

On the regional coast, one of the main environmental problems is the increase of marginal urban settlements. In most of these countries this increase is due to the depletion of agricultural, low rates of productivity, low profitability in production, violence and insecurity, and an indiscriminate access to urban lands.

Uncultivated coastal space is taken over with makeshift dwellings, sometimes violently. This is seen in an increase in slum areas in the main coastal cities of Colombia, Ecuador, Panama and Peru (Escobar, 2000). Almost 80% of the region’s poor coastal population lives in these slums. In some cities, these marginal populations are larger than the formal urban population, while in other cities it is equal to more than fifty percent of the formal population, as is the case of Guayaquil, in Ecuador; Tumaco and Buenaventura, in Colombia; and Lima-Callao, in Peru. It is estimated that the urban coastal slums are growing much faster than is formal, planned urbanisation.

On the Pacific coast of Panama, there are 1,016 "population centres" with fewer than 10,000 inhabitants; 21% of these centres have sprung up near fishing companies or in areas with harbour activities, which attract these marginal populations (Barnett, 1990; Diaz, 1990).

In Colombia, innumerable palofito (houses supported on poles sunk into the water) villages and marinas have sprung up on the Pacific coast, in river outlets, and in swamps. Most of these villages are populated by small fishermen and other inhabitants working at primary activities. On the southern coast, near Buenaventura and Tumaco, there are some 260 settlements located mainly on river banks. In 1990, in the port of Tumaco, more than 60,000 of the 180,000 inhabitants were living in substandard urban areas. The majority of the buildings were palofito-type constructions (Gutiérrez, 1990; Corpes de Occidente, 1998; Machado, 1993).

In the province of El Oro in Ecuador, 2,000 hectares of mangrove forest were taken over by marginal settlements, and by 1990, 10,557 hectares of beaches were occupied by the poor in different sectors of the coast. In Guayaquil, El Guasmo, a palofito slum is a typical example of this phenomenon. During the 90s, this settlement housed a third of the total population of Guayaquil; in the 80s, 46% of the city's area was occupied by "poor neighbourhoods" (Arauz, 1990; Corrales et al., 1990).

During the 80s, a total of 1,045 new population settlements (young towns) were established on approximately 138,996 km² of the Peruvian coast. These shantytowns were home to 2,384,764 inhabitants, almost 66.3% of the poor population. Fifty-one percent were in Lima, while 35% were in the towns of Piura, Chiclayo, Trujillo, Lambayeque, Chimbote and Arequipa (Cespedes, 1990).

In Chile in 1990, there were 67 coastal communities whose populations living in extreme poverty was 12.47% above the national average. Among these communities, those associated with artisan fishing have a wider range of differentiation on the national coast and better living conditions than the rest of the small fishing populations of the region's coast. In Chile in 1990 there were 180 fishing villages; 98% of these villages were located on the beaches along the entire coastline (Canales et al., 1990).

With the exception of Colombia, most of the regional coastal population is concentrated in a narrow strip of coast of variable width that rarely surpasses 100 km (Escobar, 2000).

In Panama, the Pacific coast accommodates 80% of the total population, with 60% of the population concentrated in the metropolitan area. The rest is located in 7 coastal centres with over 10,000 inhabitants, with an average density of fewer than 18 inhabitants/ km² (Alvarez et al., 1996; López et al., 1996).

In Colombia, the Pacific coastal population is located in two main urban areas, Buenaventura with 30% and Tumaco with 14%. The rest of the coastal population is distributed among more than 147 towns with fewer than 12,000 inhabitants (Gutiérrrez, 1996; Ministry of Environment, 1998; CCO, 1999).

In Ecuador, almost 50% of the population lives in coastal provinces 22 urban centres, mainly in the cities of Guayaquil, Esmeraldas, Portoviejo, Manta and Machala (Hurtado, 1995 a; Noboa et al., 1996; Sánchez and Orozco, 1996, 1997; ODEPLAN, 2000).
Most of the Peruvian coastal population lives in the Lima metropolitan area. The rest is distributed among three cities of over 1,000,000 inhabitants (Talara, Trujillo and Chimbote) and in several urban centres of over 10,000 inhabitants (Tumbes, Paita, Huarney, Huacho, Chancay, etc.) (Sánchez and Orozco, 1996). In Chile, not including the Metropolitan Region, 21% of the population lives in 95 coastal communities, mainly in the large urban centres (Iquique, Antofagasta, Valparaiso, Viña del Mar, Concepción, Talcahuano and Punta Arenas).

Figure 3
MAP OF THE MAIN COASTAL CITIES IN THE SE/P
2.4 Economy

2.4.1 Introduction

In the year 2000 Latin American and the Caribbean have been gradually recovering from the recession that affected many economies during the second half of 1998 and 1999. While in 1999 the GNP of the SE/P countries declined by 2.0%, during the year 2000 it rose 4.0%, on average. In addition, there was an average inflation rate of approximately 8.9%—similar to that of 1997-1999, along with a slight improvement in the labour markets. The current account deficit was 3% of the GNP, very similar to that of 1999, but much lower than that of 1998.

These favourable perspectives are the result of the reversal of the international trends that caused the 1998-1999 recession. The price of the basic products exported by Latin American and Caribbean countries is increasing, Asian economies are recovering, and growth is resuming in Europe. Although the US economy began a slowdown, it is expected to continue to grow at a relatively high rate. The improvement that this situation brought to the business sector enabled the value of regional exports to increase by about 25% in the year 2000, versus a decrease in 1998 and an increase of less than 6% in 1999. In fact, the expansion of exports is what has made the greatest contribution to the GNP recovery. Imports will also rise, though they are expected to grow at a slightly slower pace than exports.

The flow of financial resources to the region will increase moderately, but it is unlikely that direct foreign investment, which will continue to be its most important component, will recover its unprecedented level of 1999. The issuance of bonds during the first quarter of 2000 was the highest recorded since mid-1997, before the onset of the Asian crisis, but was again reduced in the second quarter, which shows that it continues to be volatile.

Bank loans and portfolio equity are expected to increase in comparison with the previous year. In general, capital flow should be 3% to 3.5% of the GNP in 2000, versus 2.8% in 1999. However, the climate is still uncertain, and the upward tendency in these areas might be slowed under the influence of the US financial markets.

A considerable rise in interest rates or a partial reversal of capital flows towards the US economy, among other factors, might result in an abrupt drop in the stock market or a devaluation of the dollar and a forced "landing" of that economy.

In most of the countries of the region, macroeconomic management has benefited from the improved international economic situation. According to the estimates, the year 2000 fiscal policy will be a little more restrained than in 1999, a year in which the deficit grew to an average of 3%, the highest level of the last decade. This deficit reduction will be, in part, the result of an increase in income and the reduction in transfers, which allowed for a higher level of growth. The lower level of expenditures is also a factor.

Monetary policy seems to be less restrictive due to the fact that inflation has been brought under control. Exchange rate policies have also taken a new direction. Strict exchange rate ceilings became more and more expensive for those countries that were most affected by the international crisis. With the exception of Ecuador, the subsequent devaluation generally had satisfactory results, as it encouraged exports and limited imports, thus stimulating national economic growth. It seems that the
devaluation of the national currencies, together with the recovery in growth rates, did not affect inflation rates. The main exception to the positive evolution of inflation is the case of Ecuador, a country in which prices rose more than 100% in the twelve-month period ending in June 2000, and led to the dollarization of the economy in January 2000.

The fact the inflation has not increased in other countries after currency devaluations and the subsequent reactivation of GNP growth are clear signs that the region might be beginning a stage of stability after a long period of high inflation or, even, hyperinflation.

Having inflation under control has had positive effects on real salaries. In fact, in Chile and Colombia the average real salary in the formal sector rose in the first half of 2000.

Most South American countries were immersed in a recession, but in the first half of the year 2000 the tendency is reverting, with improvements in the performance of several countries whose economies are recovered due to the more auspicious economic trends in Europe and Asia, and in the regional market as well.

Estimates indicate that Chile, Peru and Panama will have a growth rate equal to or higher than the 4% average in Latin America and the Caribbean.

2.4.2 Internal Economic Performance

In the year 2000 the Latin American and Caribbean region experienced significant recovery in economic growth. The growth rate was 4% due to the positive results obtained by a significant number of countries in the region during the first semester and to a favourable international economy.

In 1999, for the second consecutive year, the regional economy showed a significant slowdown in activity, resulting in a virtual stagnation of the GNP (-2%) after an expansion of 1.7% in 1998 and 4.9% in 1997.

Investment recovered in 2000 after a marked declined in 1999. The recovery in the SE/P GNPs also implies a significant improvement in savings and investment.

Investment in the field of machinery and equipment was the most adversely affected in 1999, although investment in construction also declined. In general, the drop was higher in private investment, especially among small and medium-size companies, whose access to bank credits was abruptly reduced.

Decreased investment in 1999 was attributed to a number of factors, among which the following can be mentioned: the effect of the international crisis and the contraction of internal demand, the restrictive economic policies that affected internal demand and the end of the investment cycles. Decreased investments caused by internal demand especially affected Ecuador, Chile and Colombia, where a significantly lower demand immediately meant contractions in investment.

The region is seeing the lowest inflation rates in 50 years, falling from almost 900% in 1993 to around 5% in 1997. This huge drop resulted mainly from changes in economic policies in the 80’s, when stabilisation effectively became top priority. A slow pace of price increases has been maintained, even after the financial crisis started in the second half of 1997 in some regions of the world.
In the year 1999, three of the five SE/P countries had inflation rates of less than 5% per annum. Only in two countries was it higher than that figure: Colombia (8.2%) and Ecuador (60%); in the latter, prices increased a dramatic 17% over an already high inflation rate in the previous year (43%).

Several factors linked to demand influenced 1999 inflation. First, monetary policies continued to be austere, compensating for the clear deterioration of the fiscal accounts. The recession suffered in the region was an important element in controlling inflation, as in three economies the GNP retracted and in two others it showed a growth of less than 3%. In this recessionary environment, consumer prices were favoured by the reduction in the profit margins of imported products. The exchange rate was among the supply factors that influenced 1999 inflation, but in very different ways. In some countries it put pressure on inflation, as strict exchange rate policies have slowly been put aside due to difficulties in the external sector. As a result, the nominal exchange rate with the dollar increased 160% in Ecuador.

Wholesale prices had a marked increase due to the high participation of tradable goods. However, these higher costs did not result in increased consumer prices, as market conditions prevented the transfer of the total effect of devaluation to consumers. On the contrary, maintaining a stable or only slightly variable nominal exchange rate in other countries made it easier to control inflation.

Higher oil prices forced drastic adjustments to the internal prices of its derivatives, which were added to the adjustments made to reduce the effects of the devaluation of several currencies in the region. Prices were also affected by the increased cost of public services. The exception continues to be Ecuador, whose inflation was higher in the year 2000, exceeding 100% in the twelve-month period that ended in June.

In 1999, the low or negative economic growth resulted in a worsening of labour conditions and higher unemployment. The unemployment rate rose from 8.1% to 8.7%, which was not only the highest point in the 90’s, but also exceeded the levels of the early 80’s during the debt crisis. In 2000, the economic reactivation has had a favourable influence on the job markets, both in the creation of employment and in higher salaries. However, this has been a moderate impact due to the delay with which new employment opportunities are created as a result of a recovery in economic activity.

The financial crisis that affected economic growth, aggravated in some cases by internal events, resulted in a significant drop in job opportunities; this was the main reason for unemployment at the regional level and a clear reflection of the slowdown in economic activity. The employment rate dropped significantly, and the unemployment rate in Chile, Colombia and Ecuador rose by 2 percentage points or more; this figure was slightly lower in Peru.

The slowness in the creation of new jobs was also reflected in job quality indicators, especially the difficulties in obtaining full-time employment. The situation is more varied in terms of salaries, which improved in several countries.

However, the creation of new jobs was not reflected in lower unemployment rates; these increased in Colombia and Ecuador in 2000, and only Chile saw an improvement in this indicator.

In view of the upswing in economic activity and estimates of economic growth, which might reach 4% regionally, the creation of new jobs is expected to have a moderately positive impact on unemployment. Regional joblessness is
expected to drop from 8.7% in 1999 to 8.5% in 2000.

Available data also show a moderate growth in the average real salary in the formal sector throughout the region, due to its increase in Chile and Colombia.

Chile shows the best possibilities of recovery due to the fact that towards the end of 1999 it had experienced positive growth rates and a trade surplus. In addition the country has access to external loans at very reasonable rates. At the same time, interest rates have returned to levels similar to those prior to the crisis, and its fiscal condition is one of the most solid in the region. The 2000 growth rate was 5.5% and the current account deficit was some 1.1 billion dollars. This result was favoured by a recovery in mineral prices on the international market. Lower interest rates and a steady recovery of trust in the country's growth prospects also led to a recovery of consumption and private investment.

In 2000, Colombia and Ecuador saw a recovery over the significant drop in the GNP of the previous year; this was 2% in Ecuador and 3% in Colombia, approximately one third of the 1999 loss. The political and economic situations in these countries complement each other; consequently, an improvement in the political arena would be of great help to economic recovery. The rise in oil prices, which stayed relatively high in 2000, favoured these countries. A consolidation in the financial situation can be an element of vital importance for reactivation, especially in the case of Ecuador. This factor depends, in turn, on access to external financing. Thus, the SE/P region as a group achieved a growth rate of around 4.0% in the year 2000.

2.4.3 Colombia

2.4.3.1 Recent Trends

In 1999 the Colombian economy suffered the most severe recession of the century. A severe tightening in private sector expenditures resulted in a 4.5% fall in the GNP and in an urban unemployment rate of 20%. A reversion in capital flow generated an adjustment in the current account through devaluation and recession. The extent of the external adjustment was 4% of the GNP, and inflation showed its lowest variation in thirty years (9.2%).

The international financial crisis caught the Colombian economy with a considerable external and fiscal imbalance, a reflection of greater expenditures than income during the decade. The adjustment to alleviate these imbalances was caused by a strong speculative attack against the local currency that lasted more than a year and a half. The monetary authority's decision to defend the exchange rate band postponed external correction, thus prolonging the pressure. As a result, the cost of the correction to the real sector was six consecutive quarters of declining GNP. The prolonged crisis and the delay in taking corrective measures in the fiscal and external environments led qualification agencies to lower the national debt classification. This resulted in more expensive external financing. The exchange rate band was finally abandoned in September, when a free floatation exchange regime was adopted. The economic authorities were forced to resort to the International Monetary Fund (IMF) in the third quarter.
An earthquake that affected the coffee production area in January 1999 called for additional fiscal expenditures; this, together with the decrease in tax incomes due to the recession, caused the fiscal deficit to rise to 6% of the GNP.

The year 2000 brought relative quiet on the exchange front, reactivation in economic activity and significantly higher exports. However, the second half of the year was uncertain politically, which produced strong fluctuations in the exchange rate and raised the prices of Colombian debt securities in international markets. The GNP rose to 3%.

2.4.3.2 Trends in the Main Variables

In early 2000 the Colombian economy had already suffered through two quarters of negative growth. In 1999 the GNP had fallen a total of 4.5%. The adverse conditions in 1999 mainly affected the private sector since private investment was only half of that of the previous year, whereas public investment fell by 6%. Internal demand was down 9%. Given the decrease in imports (15.4%), aggregate demand contracted by 6.4%.

With the exception of mining and social, community and personal services, the remaining areas saw negative growth. The construction sector was the hardest hit, as it lost a fourth of the added value as compared to the previous year. The high interest rates hit the construction sector both in supply (costs) and demand (mortgage loans). The manufacturing sector declined less sharply (-12.8%). In the industrial sectors there were positive results only in sugar and tobacco production and in oil refining. The financial services declined for the second consecutive year (-7.3%), thus reflecting the seriousness of the financial crisis. The stagnation in agricultural activity (-0.4%) was the result of a significant drop in coffee production.

Inflation in 2000 was 8.8%, compared to 9.2% in 1999. Two factors enabled progress in this aspect. First, the acute recession tended to keep prices down and to weaken the indexation mechanisms. Thus, prices of housing, clothing, culture and recreation increased less than those of other consumer goods. On the other hand, an abundant harvest as a result of favourable climatic conditions kept food price increases down.

The labour market saw two opposite tendencies. Given the widespread indexation of collective contracts, industry salaries benefited from the low inflation rate. In real terms they rose 6% for white-collar and 3% for blue-collar workers. At the same time, the urban unemployment rate rose in seven metropolitan areas, from 15.2% in 1998 to 19.4% in 1999. The low rate of economic activity in the last four years has not allowed a vigorous creation of new jobs. In addition, the workforce, measured by the global rate of participation, continued to grow (more than 1 percentage point in 1999), among other factors, due to the growing number of women and students in the economically active population. Consequently, unemployment rose substantially and employment fell by 1.5%. The reactivation in economical activity in the first half of 2000 has only been able to soften these tendencies, and the unemployment rate has not fallen below 20%.
The current account deficit of the balance of payments went from 5.3% of the GNP to 1.5% (1.25 billion dollars), while the positive balance of the financial accounts fell from 4.5% of the GNP to 0.5% (460 million dollars) in the same period. This reduction in the net inflow of resources meant a reduction in the balance of net international reserves of some 600 million dollars.

The first half of 1999 saw negative monthly growth rates in the value of exports despite the higher volume of goods exported. This was the result of low prices of the two main export products, oil and coffee. However, as international oil prices increased, exports performed better. Imports went through a significant slump until the last months of the year and only started to recover with the first signs of increased economic activity. The fall in capital goods imports was the most acute (-34%), being closely tied to investment dynamics.

Besides a decline in imports, 1999 saw a minuscule rate of capital inflow (460 million dollars), a tenth of that in 1998. This was the result of a radical change in expectations as to the sustainability of the Colombian economy's external position.

Chart 1 – Colombia
Main Economic Indicators

- Gross Domestic Product
- Gross Domestic Income

Chart showing the annual rate of variation for Gross Domestic Product and Gross Domestic Income from 1990 to 2000.
2.4.4 Chile

2.4.4.1 Recent Trends

The GNP was 5.5% in 2000. In 1999, the Chilean economy underwent a 1.1% decline in the GNP and 9.9% drop in internal demand (17% in investment). Unemployment peaked in August, with an overall rate of 11.5% for the country. In response to decreased private expenditures the Government expanded public spending beyond what had been foreseen, causing a global deficit in the non-financial public sector of 1.6% of the GNP. However, 1999 ended with signs of reactivation, with a recovery in the external account balance and an inflation rate of 2.3%. High spending in the Chilean economy in 1997 was reflected in a 5.0% deficit of the GNP in the balance of payments current account. This situation caused vulnerability in the face of a worsening international crisis. In 1998, the Chilean economy saw a deterioration of 3.5% in the GNP in terms of trade versus the previous year and a significant decline in financial flows from abroad, which forced a strong tightening. This brought several speculative attacks against the peso and episodes of uncertainty, which led to periods of loan contraction and interruptions in credit channels. All of this, together with a drought that led to a crisis in the electrical supply during the first half of 1999, contributed to a negative outlook, which even produced an acute contraction in spending (-9.9%) and extremely cautious behaviour in the banking system. Negative expectations and the low prices of the principal export products
generated a scenario that delayed the effects of the expanded fiscal policy and of the relaxation in monetary policy. Reactivation began only in the fourth quarter of 1999. Reduced demand was the primary factor behind the low inflation rate, which as of December 1999, was 2.3% annually, the lowest in 60 years.

The uncertainty caused by a presidential election year (December 1999) the sub-utilisation of installed capacity, the banking sector's reluctance to provide financing and the high interest rates at the beginning of the year (in response to the attacks against the 1998 peso), all worked together to cause a reduction in fixed capital formation measured at constant 1986 prices. This reduction was 31.8% of the GNP in 1988 and 26.7% in 1999. The slump in economic activity and low copper prices affected the national income. This situation, plus the additional need to speed up intensive public investment in employment and compensate the decline in private expenditure, caused a deficit of 1.6% of the GNP in the non-financial public sector accounts.

The economic slowdown and a nearly 11% increase in the real exchange rate favoured the correction of the external imbalance, causing the current account deficit to go from 5.7% of the GNP in 1998 to almost 0% in 1999. An increase of almost 8% in exports and a 19% decline in imports contributed to this trend.

In 1999, the Chilean economy decreased its external vulnerability and recovered the trust of the international financial markets; after a difficult adjustment period, the year ended with a reactivation stage. However, it showed other imbalances, which are being corrected during 2000 and 2001. Particularly important are the recovery of private investment and unemployment to previous levels, and the recovery of account surpluses in the public sector. In an environment of higher economic dynamism internationally, especially in Asia, and after correcting the external imbalance and relaxing monetary policy, the economy had a positive outlook for 2000, with a GNP growth of 5.5%. Despite rising oil prices, which have a direct impact on domestic prices, the inflation rate was 4.7% in 2000. The trade balance recovered its equilibrium and had a current account with a slight deficit of approximately 2% of the GNP.

2.4.4.2 Structural Reforms

In 1999, a series of measures were taken to increase Chile's integration into the international market. Regulations on external loans that exporters may obtain directly abroad for financing operations were made more flexible, and prior authorisation from the Central Bank is no longer required for the sale of foreign currency, payment of benefits, technical assistance, foreign currency work contracts, rentals, expenses for promoting exports and other similar items. In connection with privatisation, the sale of sanitation companies was begun in 1999 due to the need for investment in wastewater treatment. A group made up of Aguas de Barcelona (50%) and Suez Lyonnaise des Eaux (50%) acquired 42% of EMOS stock (Empresa de Obras Sanitarias) at a cost of 960 million dollars. Other foreign consortiums purchased the Empresa de Obras Sanitarias de la Región de Valparaíso (ESVAL) and the Empresa de Servicios Sanitarios de los Lagos (ESSAL) for 138 and 94 million dollars, respectively. Also, the site concession process started in the ports of Valparaíso, San Antonio and San Vicente; these were
awarded to groups with Chilean and foreign capital. In road construction concessions, 1999 saw little activity in the bidding processes promoted by the Public Works Ministry; only at the end of the year was the Santiago – Talca section of Highway 5 awarded to the Spanish company Cintra Concesiones, which committed to an investment of 750 million dollars. This company was also awarded the concession of the Cerro Moreno Airport in Antofagasta, which involves an investment of 2 million dollars.

2.4.4.3 Trends in the Main Variables

The year 1999 was marked by a recessive cycle that started in November, 1998 and lasted until the third quarter of the following year, which caused a reduction of 1.1% in the GNP during 1999. The fourth quarter recovery was led by the supply sector, especially in the export of goods and services, which showed a growth of 7% while domestic consumption increased only slightly. The persistently low levels of fixed capital formation, liquidation of inventories, and low private consumption resulted in an almost 10% decline in internal demand. Consequently, the imports of goods and services dropped 14%. Due to the fact that for the second consecutive year there was a fall in the trade price ratio, real available national income fell by 1.5%, a 2.8% reduction in per capita income. At the same time, the contraction in fixed capital formation reduced the share of investment in the GNP, measured in common pesos, from 26.5% to 21.1%. Gross national savings financed 20.9 points and only 0.2 points were financed with external savings.

The first half of 1999 saw a complex set of sectorial phenomena which exacerbated the adverse impact of the macro-economic conditions on activity and employment. Particularly important were the following: electricity rationing, which affected the level of activity due to the partial immobilisation of industry and its negative repercussions on business activity; prohibitions on the exploitation of certain species used in the production of fishmeal and oil, which prevented a speedier recovery once the Niña and Niño currents (which caused a sharp drop in the 1998 fishing) were overcome; work on one of the road construction concessions was halted due to financial problems. The behaviour of the GNP was favoured by growth in the mining (17%) and fishing (18%) sectors, as well as in service sectors: transportation and communications (2.7%); electricity, gas and water (1.8%); and financial services (2.9%). Although in the last semester industry increased it production significantly, there was a 1% drop overall for the year; construction activity, down 10%, was the hardest hit.

In the year 2000, the consumer price index went up 4.7%. In 1999 inflation was below the Central Bank goal of 4.3%, reaching only 2.3%. At the same time, in 1999 inflation in wholesale prices was much higher than the consumer price index (CPI), showing an increase of 13.5%, which generates expectations for a gradual transfer of such costs to consumer prices once the economy is reactivated. The rise in oil prices, which was transferred to the cost of fuels only after the presidential elections, is another element that led to higher inflation in 2000. The unemployment rate measured by the Instituto Nacional de Estadísticas (INE, National Statistics Institute) rose from 6.5% in June 1998 to 11.5% in June 1999. In December it fell to 8.9%, signalling the beginning of the normalisation of the labour market. Actual salaries were
adjusted more slowly, with a real increase of 2.4%. The 2000 unemployment rate was 9.4 in June and 8.3% in December.

In the year 2000 there was a negative balance of 500 million dollars. In 1999 the balance of payments accumulated a negative balance of 748 million dollars; international reserves at the Central Bank were reduced from 16 to 14.7 billion dollars. The current account deficit was reduced in 1999 to 0.2% of the GNP, almost six points less than in 1998, due to the improvement in the trade balance, which showed a surplus of 1.7 billion dollars. The deficit in the current account as a percentage of the GNP reached 1.3% in the year 2000. Foreign trade figures show the intensity of the economic contraction based on the drop in spending, which led to a 19% drop in the value of imports. This decrease occurred in consumer, intermediate, and especially in capital goods. At the same time, the value of exports increased by 790 million dollars, despite lower prices for the main export products. Greater volumes of exports were seen mainly in copper and in forestry, paper and cellulose products.

Chart 3, Chile
Main Economic Indicators

<table>
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<th>Gross Domestic Product</th>
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<td>Gross Domestic Product</td>
<td>Gross Domestic Income</td>
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2.4.5   Ecuador

2.4.5.1   Recent Trends

In year 2000, the GNP grew by 2%. In 1999, Ecuador’s economy experienced a profound financial and currency exchange crisis. The GAP shrunk by more than 7%. Imports plummeted, unemployment rose to more than 14% and inflation soared to 60%. Towards the end of the year, the authorities suspended payments on the external public debt, due to the fiscal cost of the depreciation of the sucre.

Starting in 1994, a surge in foreign capital, attracted by a relatively stable exchange rate and high interest rates, favoured a marked expansion of the financial sector. But the liquidity of many banks was seriously threatened by three factors: the El Niño phenomenon, which reduced many companies’ debt payment capacity; decreased access to international loans as a consequence of the international financial crisis; and the drop in trading caused by the introduction of the capital circulation tax. With the interruption of international capital flows at the beginning of 1999, the exchange system became untenable, and the loss of confidence in the financial sector and in the national currency became more serious. This was reflected in an ever-greater preference for cash, particularly dollars. In view of the weakened situation of an increasing number of banks, the authorities attempted to protect the financial system from a massive run on funds by freezing...
most of the deposits. This measure affected the payments system and further weakened already depressed internal demand and possibilities for recovery in the productive sector, resulting in higher unemployment. Measures taken to stabilise the financial sector and the exchange rate did not accomplish their expected outcomes, and at the end of 1999, the Deposit Guarantee Agency (Agencia de Garantía de Dépósitos, AGD) intervened in 14 banks, including some of the country’s largest. At the same time, on average, the real exchange rate rose by 39% in the course of the year. The actions taken to come to the aid the banking sector and the depreciation of the sucre increased inflation, which was restrained on the other hand by the weak internal demand.

The fiscal accounts benefited from rising oil prices, but currency depreciation made it more difficult to pay the external public debt in dollars, and at the end of the year, the government did not make its interest payments to private creditors. A deteriorating standard of living and a loss of political confidence provoked a crisis that ended with the destitution of the President elected in 1998. Nevertheless, the new government maintained the dollarization project, approving important legal reforms to implement the project in the first quarter of 2000.

2.4.5.2 Structural Reforms

In 1999, a series of minor public entities were closed, and the Instituto Ecuatoriano de Electrificación (Ecuadorian Institute of Electricity, INECEL) was split up into several electricity generation, transmission and distribution companies for further privatisation. Political instability and the difficult economic situation in 1999 were obstacles to major structural reforms, although advances were made in privatisation and concessions in the electricity, telecommunications and port sectors.

2.4.5.3 Trends in the Main Variables

The financial crisis and actions taken in response to it resulted in a 7.3% drop in the GNP and a 9.0% GNP drop on a per capita basis. Internal demand decreased by 18.3% due to the fact that economic and political instability restrained private investment; high unemployment, a drop in real salaries, and reduced loan availability limited consumer purchasing power, and the public sector cut down its levels of spending. Fixed capital formation dropped by 35.5%, and public and private consumption went down by 15.5% and 9.7% respectively. The impact of the GNP was cushioned by a 39% drop in imports, while exportations stagnated. As a result, global supply and demand slumped by 13.4%. In 1998, the agricultural and livestock sector had poor results due to damage and destruction in the wake of the El Niño climatic phenomenon. Still, El Niño did bring some benefits by improving soil conditions. Thus, 1999 agricultural production was up 2.4%, mainly due to banana, coffee, cacao and corn production. Nevertheless, due to a lack of financing in the sector, it was impossible to fully benefit from the natural advantages, and the growth rate was not enough to offset the contraction of previous years. Additionally, livestock production was down and the fishing sector decreased by 10% due to problems with shrimp production (the white spot
virus). In all, the agricultural and livestock sector as a whole saw a moderate decrease of 1.3%. While the activities mentioned suffered mainly problems of supply, depressed internal demand was the main cause of difficulties in the manufacture, construction, business and transportation industries, which dropped from 8% to 12%. Also, financial and government services contracted seriously, and aside from agricultural activities, only the electricity, gas, water, oil and mining sectors were able to avoid a downturn. In the year 2000, total GNP growth was 2%.

During 2000, the CPI grew by 96.6%. In 1999, the CPI increased 60.7% as compared to 43.4% during the twelve previous months as a result of accelerated currency depreciation and high levels of money issuance. The low internal demand prevented greater price increases, but the huge gaps between the depreciation of the nominal exchange rate and the CPI, as well as between the Producer Price Index (PPI), which soared by 186.9%, and the CPI, reflected an accumulation of inflationary pressures. During the first six months of the year 2000, the CPI had jumped by 65%, which translated into a twelve-month inflation rate of 104%. The economic crisis had a serious impact on the labour market. The demand for labour was limited while the workforce grew due to the needs of households. Consequently, urban unemployment increased from 11.5% to 14.4%. In addition, employment quality suffered a marked deterioration, and underemployment in urban centres increased from 45.8% to 56.9%. In this context of low labour demand and high inflation, a drop of real salaries in formal companies has been observed since 1997: the minimum wage with benefits has dropped 10.7% in real terms. The deterioration of labour market conditions has caused poverty to rise from 46% to 69% at the national level; rural areas, with poverty levels of 88%, are in a critical situation.

The economic crisis was reflected in the balance of payments in several ways. Imports dropped by 50%, affecting consumer goods as well as raw materials and capital goods. On the contrary, exports, which had dropped abruptly in 1998, recovered slightly (+6%). This was not due to exporters taking advantage of the conditions generated by the depreciation of the sucre, but rather almost exclusively to the rise in oil prices. In fact, despite a drop in the volume exported, the higher price enabled oil to recover its position as the main export product, one that it had lost the previous year. In contrast, income from sales of almost all other export goods to foreign countries dropped sharply due to lower prices (banana and coffee) and to production problems (shrimp). Non-traditional products, which had seen dynamic growth until 1996, suffered a new drop.

In any case, the trade balance registered a significant surplus. This situation, plus the fact that the negative revenue balance increased only slightly and that remittances were up sharply, the current account showed a surplus of almost 1 billion dollars, which represented almost 7% of the GNP when expressed in dollars. On the other hand, with less capital coming from abroad and large amounts of short-term capital exiting the country, the financial account registered a deficit of 1.8 billion dollars. The only source that injected significant amounts into the financial account was – thanks to the oil sector – direct foreign investment, even though it also dropped from 830 million to 635 million dollars.

In all, the global balance showed a deficit of 850 million dollars, which implied a 400 million-dollar drop in the reserve assets. The depreciation of the sucre and problems in the balance of payments made it increasingly difficult to pay the public debt in dollars. Between 1998 and 1999, the interest payments increased from 22.5% to 36.8% of the government's
total expenses. With the GNP plunging in dollar terms, the external public debt came to represent 100% of the GNP. The government decided to stop the payment on the dollar debt held by private creditors (Brady bonds, Eurobonds, internal debt in US$). By the end of the year, past due debts amounted to US$925 million, most of which is held by the Paris Club.

Chart 5, Ecuador
Main Economic Indicators

Gross Domestic Product  Gross Domestic Income

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2.4.6. Panama

2.4.6.1 Recent Trends

In the year 2000, the GNP was 2.5%. In 1999, the growth rate of the Panamanian economy decelerated to 3.2% after having registered growth of over 4% during the two previous years. The slowdown was influenced, for the second consecutive year, by the drop in external demand, especially that of Latin America, causing a decrease in re-exportations from the Free Zone of Colon. The dynamism of internal demand was moderated, in part, by the electoral process and the change of government, which translated into a freezing of public expenditures and a brief period of uncertainty. The economy kept its traditionally low inflation level and the fiscal deficit was reduced, although the current account of the payment balance showed a marked deficit for the second year in a row. Especially important for the country’s modernisation plan was the December completion of delivery to the Panamanian government of Panama Canal assets and facilities by the United States government.

Re-exports from the Free Zone of Colon, one of Panama’s most important value-added activities, dropped significantly as a result of declining purchases on the part of Colombia, Ecuador and Venezuela. These countries, which had fallen on hard economic times, are among its main clients. This also weakened the external operations of the International Banking Centre, although this was offset by increased internal banking activity. The international service rendered by the Panama Canal exhibited slow growth; however, the port system’s container
transhipping operations. Latin America’s largest, continued its sustained growth.

Capital formation, which had grown remarkably in 1998 (15.8%), became more moderate when important public and private investment projects were completed, especially in the road network, communications and social infrastructure. Consumer spending also grew much more slowly than in previous years. This was due to fewer new jobs, as well as to the rate of increase of real incomes and consumer loans. Excluding fishery, agricultural sector production was up as a result of larger basic grain crops, especially rice, and the recovery of the banana industry, which had experienced a slump in the previous year. In contrast, fishery activity plunged due to a smaller fish and shrimp catch as a result of a virus among the species. Hydroelectricity generation saw remarkable growth after the drought of the previous year. Likewise, modern telecommunications services continued to grow. Construction activity doubled as a result of road and infrastructure works and construction in the port system and in the hotel and business industries. The transfer of the Panama Canal to the Panamanian government by the United States affected the country’s economy, as income was no longer generated through the sale of services to military contingents and their families settled in the Canal Zone. Instead, numerous projects financed with domestic and foreign investment will enable the country to make productive use of the canal facilities and areas recovered, reflecting the country’s potential as a provider of modern international services. The new government’s economic program includes continued efforts to balance the fiscal deficit, reduce external debt, and to continue with the selective privatisation process.

2.4.6.2 Structural Reforms

The new government ruled out the sale of the Instituto de Acueductos y Alcantarillados Nacional (National Aqueducts and Sewerage Institute); the only project that remains to be offered in concession is the Tocumen Airport. The possible sale of the government’s remaining shares (49%) of the Cable & Wireless company, as well as the generation and distribution of electric energy, are still being debated. The sale of the re-integrated assets of the Panama Canal by the Interocéanic Region Authority continued in 1999.
An especially salient feature of 1999 economic performance was the dynamism of internal demand, despite having dropped in comparison to the previous two-year period. The exportation of international services was weaker due to less demand in the South American economies. Increased consumption resulted from a rise in employment and in real salaries, income from personnel working on the military bases, and the increase in consumer loans. With regard to investment expenses, important infrastructure projects were completed with both public and private investment, while other projects continued to be developed in port and commercial areas.

1999 saw a drop in the growth rate of the services sector, which accounts for some 60% of the total GNP, partly due to the decreased level of activity in the Free Zone of Colon (-14.5%). The financial difficulties being faced by the main clients of the Latin American area (Colombia, Ecuador and Venezuela) resulted in lower demand in the Zone; this affected imports and re-exports and had an impact on commercial activities as well, which decreased approximately 3.4%.

Nevertheless, the transportation and communication industries registered sustained growth (10.8%) during the year. Even though the Canal operations increased only moderately (1%), the new national port system continued to expand its services in the consolidation, transhipment and redistribution of goods. Cargo traffic reached 19.3 million tons, an increase of 45% over the previous year.

Communications grew rapidly as a result of the expansion of mobile telephony and other related activities. Financial brokerage services also expanded quickly (10.4%), thanks to bank loan operations in the internal market. In contrast, tourism-related activities performed only modestly, affected by the drop in activity in the Free Zone of Colon. The GNP generated in the goods sector was practically stagnant. Fishery was down 29.3% due to a reduction in catch, and shrimp farm production plunged (-46.5%). Manufactured products dropped 4.6% as a result of problems in the food, garment and chemical industries; the improvement in other activities, such as oil refining and the production of construction materials, could not revert the downward trend.

The agricultural and livestock sector saw significant improvement (6.9%) thanks to the recovery (28.8%) in banana production and exports, the country's main agricultural product, after struggling in 1998 with a long strike and adverse climatic conditions. Cereals also performed better; rice production was up 9%, sorghum rose 4.2% and beans improved 5%. In addition, poultry subsector activities continued to grow (5.3%).

The construction industry was up 12% thanks to commercial, hotel and housing projects financed by the private sector, after the continuation and conclusion of works in the public health infrastructure, the urban road system and the Pan-American Highway. This industry was boosted by the government's decision to continue with a program of housing construction aimed at low and middle-income families through subsidised mortgage interest rates.

The electricity, gas and water sub-sectors registered an increase of 20.6%. The considerable rise in the generation of hydroelectricity, and the corresponding drop in thermally produced power, increased the added value of energy production after the serious drought of the previous year. The commercial consumption of energy rose 8.7%, while
residential and industrial consumption was up 4.2% and 7% respectively.

The inflation rate from December to December was 1.5% in 1999, similar to the 1.4% rate of the previous year. Wholesale prices rose faster than consumer prices: 2.7% for a yearly average and 6.8% from December to December. This was due to higher import prices (6%), including oil, whose price hike was partially passed on to the consumer.

The creation of new jobs grew steadily in 1999. According to a household survey, the number of jobs had risen 2.8% between August 1998 and 1999. The major increase was in the Metropolitan Region (3.2%), where unemployment fell from 16% to 13.8%.

Salaries increased significantly, with a 4.3% rise in nominal wages in wholesale business and 9.2% in retail. Other services, including several third industry services, exhibited an average increase of 10.5%. Since inflation is traditionally low in Panama, these salary hikes were significant.

The sale of goods had a negative balance of nearly 1.4 billion dollars, slightly higher than the previous year. In contrast, the service exchange balance, traditionally positive, was 585 million dollars, 11% higher than in 1998. Income transactions, determined to a large extent by the payment and reception of interest from the banking system, showed a negative net balance of US$684 million. A slowdown in foreign interest received was an influential factor here, reflecting fewer operations in the international banking system. The value of re-exports from the Free Zone of Colon decreased to US$4.85 billion, 18.7% less than the previous year. 1999 imports reached US$4.05 billion dollars, a decrease of 23.8% with respect to 1998. This was due both to lower prices of Asian products – because of the exchange rate devaluations that occurred during the year – as well as to the drop of the regional demand.

Exports of internal origin were practically stagnant in 1999 with a total of US$707 million, a mere 0.2% higher than 1998. There were setbacks in such important items as shrimp, fishmeal, sugar, coffee and tropical fruits. On the other hand, sales of bananas, leather and cowhide, and oil products were up (157.7%).

The CIF value of imports entering the national market grew by 2.9%, representing US$3.5 billion. There was a wide range of behaviour in the different lines of goods. On the one hand, foods and beverages, as well as mineral and chemical products, were up significantly, while imports of agricultural products, plastics and rubber, and textile products were considerably lower. Capital goods purchases, mainly in communications and transportation equipment, were down 5.8%. Crude oil purchases rose by 63.6%, partly due to higher international oil prices, but also because of increased refining activity.

Foreign investment, after reaching amounts of over US$1 billion in the previous two years as a result of privatisation of the state telecommunications and electric companies, had a balance of only US$22 million in 1999. This amount includes US$149 million from increased investment in various companies, US$328.6 million from reinvested returns, and US$-457.5 million from the accounting entries resulting from the transfer of Panama Canal assets.
Chart 7, Panama
Main Economic Indicators

- Gross Domestic Product
- Gross Domestic Income

Chart 8, Panama
Consumer Price Index 1983 - 2000

- Consumer Prices
2.4.7 Peru

2.4.7.1 Recent Trends

Economic trends in Peru during 1999 were determined to a large extent by repercussions from the external events that had affected the country during the previous year. The GNP resumed a moderate growth rate of 3.8% a year. In 2000, the GNP grew by 4.0%.

In 1999, inflation reached a historical low of 3.7%. In 2000, the CPI went up 4%. Nevertheless, the economic reactivation was focused in resource industries, while the rest of the economy continued to suffer from the effects of the 1998 recession. The credit austerity program that provoked the exit of short-term foreign capital in 1998, the financial difficulties faced by some of the sectors, and adverse expectations during a good part of the year caused a shrinkage in internal demand (-3%). This, in turn, brought on a reduction in employment (-6%) and a crisis in the financial sector. The privatisation process lost its momentum, and less than the half of the 1999 privatisation plan could be executed.

Macroeconomic policy became more flexible in order to alleviate the negative effects of these events. Government expenditures were not adjusted to the shrinking tax revenues, and the fiscal deficit rose to 2.6% of the GNP. Currency devaluation absorbed part of the external impact, while monetary policy was oriented towards re-establishing bank liquidity. This policy was complemented with a program to assist with the restructuring of the financial sector.

The dynamism of the raw materials export sector and a collapse in the demand for imported goods brought about a reduction in the balance of payments deficit (3.6% of the GNP), despite a new deterioration in the terms of trade. In spite of the balance of payments situation, the withdrawal of short-term capital had to be compensated with a new decrease in international reserves.

The internal economic outlook started to improve at the end of 1999, and the growth rate in the three first months of 2000 was quite high (8.6%). Nevertheless, during the first half of 2000, the financial and foreign currency exchange markets suffered from the uncertainty resulting from the presidential election, notwithstanding the reactivation of the privatisation and concessions program. Even so, national projections for 2000 predict a 5% growth rate and an inflation rate of between 3.5% and 4%. Likewise, a fiscal deficit of 1.9% of the GNP is foreseen, along with a negative current account balance of 3.8%.
1999 saw an improvement in economic activity, mainly due to exports, whose volume grew by 7.5%, particularly in raw materials and their products. The drop in internal demand (-3%) generated a recessive scenario for companies oriented towards the internal market. Gross private investment dropped 16%, and private consumption stagnated. Government spending supported the public demand, both in consumer goods and in investment, 3.2% and 7.2%, respectively.

As a result, the overall demand was down (-0.9%) after having been stagnant the year before (0.3%). The previous two years had seen a break in the overall demand growth rates of 6% seen between 1991 and 1997. Nevertheless, unlike the year before, the recession had varying effects on internal and external supply. While domestic production grew 3.8%, mainly in primary industries, imports plummeted (-17%). Internal savings remained at around 18% of the regular GNP, but its composition changed. Lethargic consumer spending meant that private savings increased two percentage points, while public savings dropped from 3.6% to 1.7% of the GNP. External savings shrunk nearly three percentage points, leaving it at 3.6% of the GNP.

The increased GNP (3.8%) was mainly explained by supply-side economics. The production of primary goods was favoured by the maturity of mining investments and by the recovery of agriculture and fishery from the effects of El Niño. The expansion in supply influenced, in turn, manufacturing and processing activities.

Thanks to favourable climatic conditions, increased areas of cultivation, and the effect of the modest base of comparison from the previous year, livestock and agricultural production grew by 15% during 1999. Nevertheless, agriculture and fishing prices were depressed, which negatively influenced the profitability of the sector. A program to support the agricultural sector was executed, since many of the companies hit by El Niño were not in a position to finance planting. There were two-digit growth rates both in the production of food (potatoes, rice) and in the industrial and export sector (cotton, coffee). This dynamism extended to some areas of the livestock sector, such as the ovine and poultry industries.

Ocean fishing almost doubled its production, more than making up for the abrupt setback of the previous year. Fishing activity also benefited from a support program aimed at restructuring a sector that had invested heavily during 1992 to 1997, only to find itself facing hardship as a result of the El Niño phenomenon and overfishing.

In mining, gold production increased (36%), and copper was back up at 11% after a shrinkage of 5% in 1998. In addition, a large investment project was embarked upon. Other non-ferrous metals also registered improved, but more modest, results. In contrast, iron collapsed, with a 20% drop in production, while performance in the hydrocarbon subsector was mediocre.

The construction sector, previously a very dynamic and important provider of employment activity, saw a deepening of the recessive trends already felt in 1998; this year it shrunk by 12%. The causes were threefold: a pessimistic outlook that reduced the demand for commercial construction, greater caution among homeowners and the scarcity of credit. On the other hand, the public works subsector benefited from sustained government investment, particularly in irrigation and road networks.

Decreased investment affected various industrial sectors that produce machinery
or construction supplies. In contrast, agroindustry and other transformation activities enjoyed favourable performance which enabled industrial production to grow by 7.6%. Services remained stagnant (0.9%) due to the recession and the crisis in the financial system. The only industry that grew was telecommunications, especially mobile telephony.

With a CPI of 3.7% at the end of 1999, inflation was at a 30-year low. In the year 2000, it was at 4%. This accomplishment was due to a drop in food prices, as food accounts for 58% of the products included in the index. Stagnating internal consumption probably influenced the moderation in inflation as well, but it was not a determining factor, given the fact that prices of non-tradable items increased far greater than the average (housing, 13.9%; health, 10.8%).

Currency devaluation and rising fuel prices influenced production costs, including transportation and communication; these increased 13.5%. Thus, prices on wholesale imported products increased more rapidly than prices of goods produced domestically (10.7% and 4.1%, respectively). The annual variation in the wholesale price index amounted to 5.5% in December 1999 (6.5% in 1998). The mediocre performance of some domestic market segments caused a setback in the trend towards increased formal employment observed since 1994. In companies that provide jobs to more than five workers, the employment rate decreased by 5.8% and the unemployment rate rose slightly to 8.2%, within a large underemployment context.

The minimum wage was up 3.1% between January and October 1999. In April, civil servant salaries were adjusted by 16%, the first increase since 1997. On average, the real minimum wage dropped 3% in the year, while salary purchasing power rose 7%.

In 1999, the current account deficit was reduced to 3.6% of the GNP, by re-establishing the balance of visibles, placing it at -1.1% of the GNP (-3.9% in 1998). Most of the improvement is due to the collapse in imports (-18%). The value of exports did not increase much (6.6%) despite higher volumes, due to lower international prices. In 1999, the terms of trade deteriorated (-7.1%), after suffering a considerable drop the previous year (-13%).

Traditional exports were up 12%. In particular, the volume of fishing industry exports recovered from the abrupt drop of 1998, but international prices remained very depressed (US$361 per ton of fishmeal, in comparison with US$588 in 1998). Mineral sales expanded, while non-traditional exports decreased 5% due to a downturn in the metal mechanics and iron and steel sectors (-20%). With a retraction in demand and currency devaluation, imports, which had already begun to fall off in 1998, plummeted 18%. The sectors hardest hit were durable consumer goods (-32%) and capital goods (-17%).

The financial account balance showed a 60% shrinkage compared with 1998, 80% down from that of 1997. This was due to the exit of short term capital (US$1.8 billion) to amortise interbank loans, a process that began in 1998, and was very significant in 1999. The balance remained positive thanks to direct investment income totalling US$1.85 billion. This was directed mainly at the mining and telecommunications sectors, and to the recapitalisation of a bank. Nevertheless, the global balance was negative with new net loss of US$775 million on international reserves.

The external debt decreased 5% as a result of the reduction in short-term obligations; public debt payments required outlays of US$1.8 billion.
Chart 9: Peru
Main Economic Indicators

- Gross Domestic Product
- Gross Domestic Income

Chart 10: Peru
Consumer Price Index 1983 - 2000

Consumer Prices
3 LAND-BASED ANTHROPOGENIC ACTIVITIES THAT AFFECT THE MARINE ENVIRONMENT

3.1 Agriculture

Agriculture is one of the main economic activities in the SE/P region; it has high social impact and contributes an important share to the Gross Domestic Product. In 1999, the average GNP share in the pertinent countries was 9.7% in constant prices of 1995. That same year, agriculture contributed 13.7% to the GNP in Colombia, 6.3% in Chile, 12.9% in Ecuador, 7% in Panama and 8.7% in Peru (ECLAC, 2000). [Table 11]. Agriculture, forestry, hunting and fishing contributed 7.5% of the GNP in 1999.

Table 11
Share of Agriculture, Forestry, Hunting and Fishing in the Gross Domestic Product of SE/P Countries (Percentage of the GNP in Constant Prices); 1980-1999

<table>
<thead>
<tr>
<th>Countries</th>
<th>In 1990 constant prices</th>
<th>In 1995 constant prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>17.4</td>
<td>16.5</td>
</tr>
<tr>
<td>Chile</td>
<td>6.2</td>
<td>7.3</td>
</tr>
<tr>
<td>Ecuador</td>
<td>10.5</td>
<td>11.0</td>
</tr>
<tr>
<td>Panama</td>
<td>8.2</td>
<td>8.8</td>
</tr>
<tr>
<td>Peru</td>
<td>5.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>7.5</td>
<td>8.3</td>
</tr>
</tbody>
</table>


In 1997, arable land in the region was 9,685,000 hectares (equal to 7.2% of the arable surface area in Latin America and the Caribbean) and 4,894,000 ha with permanent crops (18.9 % of the total in Latin America and the Caribbean). Agricultural land under irrigation covered 4,373,000 ha, (23.91% of the irrigated area in Latin America and the Caribbean) [Table 12].
Table 12
Agricultural Area in the SE/P Region, 1998

<table>
<thead>
<tr>
<th>Countries</th>
<th>Arable land in thousands of ha.</th>
<th>Permanent crops in thousands of ha.</th>
<th>Irrigated area in thousands of ha.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>1,929</td>
<td>2,501</td>
<td>1,061</td>
</tr>
<tr>
<td>Chile</td>
<td>1,982</td>
<td>315</td>
<td>1,270</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1,574</td>
<td>1,427</td>
<td>250</td>
</tr>
<tr>
<td>Panama</td>
<td>500</td>
<td>155</td>
<td>32</td>
</tr>
<tr>
<td>Peru</td>
<td>3,700</td>
<td>500</td>
<td>1,760</td>
</tr>
<tr>
<td>Total</td>
<td>9,685</td>
<td>4,898</td>
<td>4,373</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>133,634</td>
<td>25,935</td>
<td>18,287</td>
</tr>
<tr>
<td>SE/P (%)</td>
<td>7.25%</td>
<td>18.89%</td>
<td>23.91%</td>
</tr>
</tbody>
</table>


The distribution of the working population in the SE/P by area of activity is similar to that of Latin America and the Caribbean in 1980 and 1990, with a difference in agriculture, which was slightly higher in 1990 and industry, which recorded a slight drop. [Table 13].

Table 13
Distribution of Working Population by Area of Activity in the SE/P: 1980-1990 (% of the Total Workforce)

<table>
<thead>
<tr>
<th>Countries</th>
<th>Agriculture</th>
<th>Industry</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>34.2</td>
<td>26.9</td>
<td>23.5</td>
</tr>
<tr>
<td>Chile</td>
<td>16.5</td>
<td>16.2</td>
<td>25.2</td>
</tr>
<tr>
<td>Ecuador</td>
<td>38.6</td>
<td>32.7</td>
<td>19.8</td>
</tr>
<tr>
<td>Panama</td>
<td>31.8</td>
<td>29.7</td>
<td>18.2</td>
</tr>
<tr>
<td>Peru</td>
<td>40.0</td>
<td>31.1</td>
<td>18.3</td>
</tr>
<tr>
<td>Total</td>
<td>33.3</td>
<td>26.8</td>
<td>21.8</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>32.2</td>
<td>23.6</td>
<td>25.8</td>
</tr>
</tbody>
</table>

Source: CEPAL, 2000

The main crops are cotton, rice, coffee, sugarcane, corn, cassava, soy, sorghum, wheat, fruit trees, etc. In Latin America and the Caribbean, the area planted with coffee in 1999 was nearly 5.5 million hectares, while rice covered 6.6 million hectares. SE/P countries account for 22.5% and 18.3% of these areas, respectively [Table 14].

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Table 14
Harvested Area (in Thousands of ha) by Main Agricultural Products in the SE/P, 1999

<table>
<thead>
<tr>
<th>Products</th>
<th>Colombia</th>
<th>Chile</th>
<th>Ecuador</th>
<th>Panama</th>
<th>Peru</th>
<th>LA &amp; C</th>
<th>SE/P (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>52</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>79</td>
<td>1,845</td>
<td>7.5%</td>
</tr>
<tr>
<td>Rice</td>
<td>431</td>
<td>15</td>
<td>366</td>
<td>88</td>
<td>310</td>
<td>6,602</td>
<td>18.3%</td>
</tr>
<tr>
<td>Coffee</td>
<td>800</td>
<td>0</td>
<td>200</td>
<td>25</td>
<td>212</td>
<td>5,486</td>
<td>22.5%</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>389</td>
<td>0</td>
<td>130</td>
<td>35</td>
<td>60</td>
<td>8,392</td>
<td>7.3%</td>
</tr>
<tr>
<td>Beans</td>
<td>137</td>
<td>29</td>
<td>58</td>
<td>7</td>
<td>98</td>
<td>7,283</td>
<td>4.5%</td>
</tr>
<tr>
<td>Corn</td>
<td>556</td>
<td>73</td>
<td>438</td>
<td>30</td>
<td>458</td>
<td>26,499</td>
<td>5.9%</td>
</tr>
<tr>
<td>Cassava</td>
<td>211</td>
<td>0</td>
<td>45</td>
<td>5</td>
<td>80</td>
<td>2,457</td>
<td>13.9%</td>
</tr>
<tr>
<td>Soy</td>
<td>22</td>
<td>0</td>
<td>42</td>
<td>0</td>
<td>2</td>
<td>22,500</td>
<td>0.3%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>63</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>3,773</td>
<td>1.9%</td>
</tr>
<tr>
<td>Wheat</td>
<td>17</td>
<td>339</td>
<td>27</td>
<td>0</td>
<td>131</td>
<td>8,788</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

Source: CEPAL; 2000.

SE/P banana production accounts for 43.6% of the Latin America and Caribbean total; coffee and rice from the SE/P area is 23.3% of total production [Table 15].

Table 15
Agricultural Production in the SE/P in 1999 (In Thousands of Tons) by Main Agricultural Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Colombia</th>
<th>Chile</th>
<th>Ecuador</th>
<th>Panama</th>
<th>Peru</th>
<th>LA &amp; C</th>
<th>SE/P (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>109</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>136</td>
<td>3,144</td>
<td>8.0%</td>
</tr>
<tr>
<td>Rice</td>
<td>2,059</td>
<td>61</td>
<td>1,290</td>
<td>232</td>
<td>1,947</td>
<td>24,013</td>
<td>23.3%</td>
</tr>
<tr>
<td>Bananas</td>
<td>4,259</td>
<td>0</td>
<td>6,858</td>
<td>765</td>
<td>735</td>
<td>28,910</td>
<td>43.6%</td>
</tr>
<tr>
<td>Coffee</td>
<td>648</td>
<td>0</td>
<td>157</td>
<td>10</td>
<td>145</td>
<td>3,695</td>
<td>23.3%</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>36,900</td>
<td>0</td>
<td>7,000</td>
<td>2,050</td>
<td>6,900</td>
<td>547,822</td>
<td>9.6%</td>
</tr>
<tr>
<td>Beans</td>
<td>140</td>
<td>31</td>
<td>31</td>
<td>3</td>
<td>104</td>
<td>5,122</td>
<td>6.0%</td>
</tr>
<tr>
<td>Corn</td>
<td>975</td>
<td>624</td>
<td>512</td>
<td>90</td>
<td>1,058</td>
<td>72,838</td>
<td>4.5%</td>
</tr>
<tr>
<td>Cassava</td>
<td>1,956</td>
<td>0</td>
<td>319</td>
<td>30</td>
<td>862</td>
<td>29,681</td>
<td>10.7%</td>
</tr>
<tr>
<td>Soy</td>
<td>44</td>
<td>0</td>
<td>77</td>
<td>0</td>
<td>3</td>
<td>53,337</td>
<td>0.2%</td>
</tr>
<tr>
<td>Sorghum</td>
<td>201</td>
<td>0</td>
<td>2</td>
<td>17</td>
<td>0</td>
<td>11,498</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

Source: CEPAL (2000)

Consumption of agricultural inputs in the region is high, especially fertilisers, and some crops require significant amounts of pesticides, particularly rice, plantains, bananas, cotton, sugarcane and potatoes. Panama uses approximately 5000 MT/year of pesticides, most of which are applied on the Pacific side. The use of pesticides in Colombia is minimal on the Pacific side compared to national totals, around 1.5%; pesticides are used mainly to treat and preserve wood.
According to the Ministry of Agriculture and Rural Development (1998b), in 1996 Colombia imported 9,536 tons of pesticides and 478 tons of fertiliser, and in 1994-1995 the country produced a total of 34,300 kg, including pyrethroids, insecticides, herbicides, biological regulators, etc. In 1996, a total of 16,400 tons of phosphated pesticides were applied in Peru. In Ecuador, 2,400 tons of pesticides and nematocides are used to control pests that attack bananas (Solorzano, 1981). Consumption of fertilisers in the region was 1.1 million tons in 1995, and it increased to 1.3 million in 1997. Regional consumption accounts for around 13% of the total consumption of fertilisers in Latin America and the Caribbean for the same period. Three countries produce fertilisers in the region: Colombia, Chile and Peru. Average national production was around 6.7% of the total Latin American production of fertilisers from 1996 to 1998 (CEPAL: 2000) [Table 16].

Table 16
Total Consumption of Fertilisers in SE/P Agriculture: 1996-1998 (in Tons)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>485,000</td>
<td>582,400</td>
<td>627,000</td>
</tr>
<tr>
<td>Chile</td>
<td>423,000</td>
<td>453,800</td>
<td>446,400</td>
</tr>
<tr>
<td>Ecuador</td>
<td>118,000</td>
<td>160,600</td>
<td>172,511</td>
</tr>
<tr>
<td>Panama</td>
<td>44,300</td>
<td>36,387</td>
<td>32,236</td>
</tr>
<tr>
<td>Peru</td>
<td>162,870</td>
<td>191,100</td>
<td>190,700</td>
</tr>
<tr>
<td>Total SE/P</td>
<td>1,233,170</td>
<td>1,424,287</td>
<td>1,468,847</td>
</tr>
<tr>
<td>LA and C</td>
<td>10,208,300</td>
<td>11,087,756</td>
<td>11,221,516</td>
</tr>
<tr>
<td>SE/P (%)</td>
<td>12.1%</td>
<td>12.8%</td>
<td>13.1%</td>
</tr>
</tbody>
</table>

Source: CEPAL 2000

Coastal agriculture, together with fishing, is one of the traditional economic activities, with considerable economic and social significance in most of the coastal areas of the countries in the region, except for the Colombian coast on the Pacific side. The crops are typical of the different latitudes: coffee, cacao, bananas, sugarcane, rice and cotton in the tropical and subtropical valleys of Panama, Ecuador and northern Peru; and fruit trees in the cold climates in Chile and southern Peru.

Along Colombia's Pacific coast, due to certain environmental conditions, this activity is deemed to be marginal and is concentrated in water meadows and alluvial soils; subsistence agriculture is practised together with the harvesting of the African palm (Machado, 1993). In Chile and Peru, coastal agriculture is carried out in small valleys (Castilla, 1981; Guillen, 1981). In Panama and Ecuador, agricultural activities are mainly in the coastal areas (Franco, 2001; Álvarez et al., 1991); in Ecuador over 70% of agricultural activities are conducted in coastal areas (Vásconez, 1995).

Agricultural activities in the region are affected severely by acute events of the El Niño phenomenon. Consequently, according to the Peruvian Agricultural Information Agency, during the El Niño event of 1997/98, around 205,000 ha were affected in Peru. The harvest from 73,000 ha (17,000 ha in permanent crops) was...
completely lost, and the remainder was affected by significant drops in yield. The greatest losses affected annual crops (123,000 ha) such as potatoes, rice and corn, while the total affected area of permanent crops (bananas, lemons, sugarcane, asparagus, olives, etc.) was close to 31,000 ha (FAO, 2001).

3.2 Fishing and Aquaculture

The waters of the South Eastern Pacific Ocean are known as some of the most productive in the world due to their unique oceanographic conditions, which include cold surface areas, a shallow layer of mixed waters, a thermocline close to the surface, and the presence of strong upwellings which allow for an extraordinary abundance of phytoplankton which, in turn, is responsible for the high levels of biological productivity. These upwellings occur seasonally in Panama and Chile and constantly in Peru. Consequently, there are abundant fishing resources available for exploitation, some of which are currently under full exploitation (Escobar, 2000). The region ranks second in terms of world fishing production, after the north-western Pacific, with an average annual yield of 14.2 million tons in landed catches in 1988-92 (FAO; 1995). In 1994, Peru produced 11.6 million tons and was the second-largest world producer in fishing after China. Chilean production was 7.8 million tons, thus coming in third as a world producer in fishing (FAO, 1996). Total production is dominated by the anchovy in Peru, followed by sardines, jack mackerel and mackerel. Moreover, the region is one of the two world centres of trans-zonal population stocks, particularly demersal fish (FAO, 1997). The average share contributed by fishing (included in the agriculture sector) to the total regional GNP (in 1995 constant prices) for the period 1990-1998 was 9.4 %. Fishing was most relevant to the GNPs of Peru, Chile and Ecuador (CEPAL, 2000). It contributed 0.51% to the GNP of Colombia in 1992 and 0.43% in 1993 (Ministry of Agriculture, 1998, Villaneda and Beltrán, 2000).

To the north, in Panama, Colombia, Ecuador and northern Peru, there are inshore fisheries based on the exploitation of penaeid shrimp and highly valuable but scarcer demersal fish, as well as deep-sea fishing for tuna, shark and squid. To the south of Peru and northern Chile, notably influenced by the Humboldt Current, there are upwelling systems that support important anchovy (Engraulis rigens) and sardine (Sardinops sagax) fisheries. In the cold waters of southern Chile, there are major hake (Merluccius gayi) and hoki (Macrourus magallanicus) fisheries. Jack mackerel (Trachurus pincucarus murphy) is also becoming important in the fishing industry (Escobar, 2000). Fishing in Panama is aimed at penaeid shrimp, particularly white shrimp (Penaeus occidentalis, P stylirostris, P vannamei), red shrimp (Penaeus brevirrostris) and other types of shrimp. There are also activities exploiting herring (Ophistonema libertate) and several species of anchovy (Cetengraulis ssp, Anchao ssp) (López et al., 1996). Sixty percent of demersal stocks and 70 percent of pelagic species in the region are either under full exploitation or are over-exploited (FAO, 1995, 1996, 1998).

From 1990 to 1994, the region produced 78% of the total catch in Latin America and the Caribbean, around 20,407,831 MT. Ninety-eight percent was from ocean fishing. The biggest producers were Peru and Chile with 96% of the total regional catch. A significant portion of this catch was from artisan fishing. Inland fishing catches amounted to 206,175 MT. The
value of fishing products exported by the region was close to 40 billion U.S. dollars (OLDEPESCA; 1995).

Fishing and aquaculture are very important for the regional economy, and they occupy a key position in the economic policies of the regional states, particularly in Chile and Peru, where a special Ministry is dedicated to this industry. Fishing contributes notably to the exports of the five countries, which are highly dependent on events in the international market. Fishing is among the major export products of several regional countries. In Chile, it ranks high, right along with copper and fruit; in Ecuador it is just above bananas and slightly below oil; in Peru and Panama it is one of the main export items. The main exports are shrimp and fishmeal. Chile and Peru dominate the world fishmeal market, while Ecuador is one of the main exporters of shrimp. At present, in Colombia, tuna is the largest fishing export, followed by shrimp (Mejia, 1998). In general terms, industrial ocean fishing is export-oriented and most of the catch from small-scale fishing is goes for domestic consumption; still, in some places, a significant portion of the small-scale catch is exported (CPPS, 1999 a and b). From 1990 to 1994, total exports from Chile, Ecuador, Peru and Panama amounted to 15,753,000 MT, with a value of US$11.7 billion (OLDEPESCA, 1995).

Furthermore, fishing is an important source of jobs and income in SE/P coastal areas, perhaps the most traditional one. Industrial ocean fishing in the region employs some 221,254 workers (fishermen + plant workers), 73% of whom are fishermen; small scale ocean fishing is practised by around 163,532 reported fishermen, located in some 505 fishing sites (communities, villages, etc.); approximately 1,021,000 individuals are directly dependent on the income earned by these individual fishermen (CPPS, 1999).

3.3 Coastal Aquaculture

In the regional coast, aquaculture is a relatively recent development, one that has managed to secure an important economic position in exports. For example, in Ecuador, farm-bred shrimp is the third-ranking export after bananas and oil. Chile ranks as the world's second largest producer of salmon, above Norway and after Canada (Báez et al., 1998). In Panama, farm-bred shrimp is one of the main export items. The range of organisms currently cultivated under various methods includes algae, crustaceans, molluscs, fish and some invertebrates. Species cultivated include shrimp, white shrimp (Penaeus vannamei, Penaeus (Lithopenaeus) vannamei, Macrobachium rosebergii), Pacific and Atlantic salmon, coho salmon (Oncorhynchus kisutch), Chinook salmon (O. tschawytscha), Pacific oysters (Crassostrea gigas), scallops (Argopecten purpuratus), etc., as well as many others that are currently the subject of experimental studies. Aquaculture centres are located at different places along the coast, particularly in southern Chile's X and XI regions, where salmon and oysters are farmed successfully in the open or in cages (Báez et al.). In northern Peru, in Tumbes, shrimp are raised in tanks and scallops are cultivated along the central coast (Casma, Lima and Pisco) (Yepes and Cisneros, 1999). In Ecuador, shrimp is farmed in the Guayas River estuary, in mangrove forests as well as in estuaries in southern Colombia. In Panama, shrimp is farmed in tanks and pools (Lara, 1999; Arauz, 1999; Ormaza, 1999; Coello and Olsen, 1995; CPPS, 1999 a, 1998).

Shrimp farming represents almost 80% of the total value of the regional
aquaculture production. Regional coastal aquaculture is export-driven and there are very few examples of coastal aquaculture for social benefit. Aquaculture also creates jobs in coastal areas. In Panama, shrimp farming generates around 20,000 jobs (Arauz, 1999) and some 80,000 in Ecuador (Ormaza, 1999). In 1997, Pacific coast aquaculture in Colombia generated jobs for around 10,000 workers (Villaneda and Beltrán, 2000).

3.4 Tourism

The different ecosystems found in the region provide a large variety of environments suited for tourism, some of which are currently being used for this purpose. Possible destinations for tourism are many and varied. There are around 400 sites and beaches reported that are suitable for tourism and that are highly attractive in terms of natural beauty and different facilities.

Ecuador has over 107 beaches suitable for recreation. Thirty-four percent of these are located in the province of Guayas (the area around Salinas is especially appropriate). 45% are in Manabí, and 9% are in Esmeraldas (Olsen et al., 1995). In Panama, beaches suitable for tourism and recreation are located in a 75-km sector that runs from Punta Chame to Juan Hombre (Zone 4 on the Master Tourism Map of Panama for 1993-2002) (López, De León and Sánchez, 1996). On the Pacific side in Colombia, 16 sites are mentioned as having high scenic value and major tourism potential. These include Salahonda, the San Juan river delta, Juanchaco, La Bocana, Ladrilleros, Málaga Bay, the isthmus of Pichidio, Buenaventura Bay, Guapi, Gorgona Island, Solano Bay, Cupica Bay and Cape Marzo. These locations have countless beaches, some of which have been adapted for local tourism with unpretentious facilities (Rodríguez, 1994; CCO, 1999). Tourism development in Chile is based on the seashore. According to Chilean highway maps, there are over 85 tourist destinations along the coast, most of which are found in the sector between La Serena and Concepción.

According to the World Tourist Organisation, WTO, from 1995 to 1997, an average of 3,524,637 international tourists visited the region. It is estimated that 47.7% of these tourists stayed on or near the coast (WTO, 1997). Eighty percent of the tourists that arrived in Chile during the same period stayed on the coast at some point. In Ecuador, around 50% of international tourists in 1995-97 visited coastal areas, while in Panama, over 90% of international tourists visited the Pacific. In Peru, 60% of international tourists visit the coast. It is estimated that, in general, 35% of all tourists visiting the region who visit coastal areas, do so for relaxation and recreation. Tourism is an important line of business for generating foreign exchange in the region. In Colombia, in 1997, travel agencies, hotels, and tourist restaurants, as a sector, generated an income of 1.6 trillion pesos (DNP, 1999).

Ecotourism, or nature-based tourism, is a traditional regional activity in areas such as Ecuador (the Galapagos), and it is gaining strength in Colombia (Isla Gorgona) and in Peru (Paracas). Ecotourism has potential for generating foreign exchange. In Ecuador, the Galapagos National Park generates an annual income of approximately US$90 million (Escobar, 1996).
3.5 Coastal Mining

Chile and Peru are among the world's largest producers of copper and silver. Chile contributes around 19% of the world's copper production and 11% of the world's refined copper. Peru contributes 3.1% of the global copper production from mines and an average of 1.72% of the refined copper. In 1994, total silver production in Peru was 1,824 tons (CEPAL, 1997). In the rest of the SE/P region, Pacific-area mining focuses on the alluvial exploitation of gold and silver, together with modest mining activities on beaches and riverbeds for the construction industry.

Mining accounted for 9.6% of the Chilean GNP in 1990 and 8.2% in 1994. In Peru it was 2.4% in 1990 and 1.9% in 1994. In Colombia, mining contributed 9.3% to the GNP in 1990 and 4.3% in 1994 (INGEOMINAS, 1999). Copper mines in Chile in 1994 had a total output of 2.2 million tons, while Peru produced 253,000 tons of copper. Chilean refined copper output in 1994 was nearly 1.3 million tons (CEPAL, 1996).

3.6 Coastal Industry

The region is moving toward industrialisation, with varying degrees of development and automation of industry among the countries. Chile ranks as the most industrialised country, followed by Peru, which has more varied industries. The food industry is the most predominant, followed by textiles, chemicals, wood pulp and paper, etc. The share of industry in the regional GNP in 1999 was 15%, and it ranged from 7.8% in Panama to 23% in Ecuador. In 1990, it generated an average of 11.9% of the regional GNP, ranging from 20.9% in Ecuador to 8.6% in Panama [Table 17].
Table 17

Industry’s Share of the GNP in SE/P Countries (% of the Total GNP in Constant Prices)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>1990</td>
<td>1995</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>21.5</td>
<td>1.9</td>
<td>15.5</td>
<td>13.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Chile</td>
<td>19.3</td>
<td>18.5</td>
<td>20.0</td>
<td>17.6</td>
<td>17.5</td>
</tr>
<tr>
<td>Ecuador</td>
<td>20.0</td>
<td>15.6</td>
<td>20.9</td>
<td>23.8</td>
<td>23.0</td>
</tr>
<tr>
<td>Panama</td>
<td>10.1</td>
<td>9.5</td>
<td>8.6</td>
<td>8.5</td>
<td>7.8</td>
</tr>
<tr>
<td>Peru</td>
<td>29.3</td>
<td>27.3</td>
<td>15.4</td>
<td>14.5</td>
<td>14.4</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>24.1</td>
<td>21.8</td>
<td>15.4</td>
<td>18.9</td>
<td>18.6</td>
</tr>
<tr>
<td>Average percentage SE/P</td>
<td>20.0</td>
<td>15.0</td>
<td>11.9</td>
<td>15.6</td>
<td>15.0</td>
</tr>
</tbody>
</table>

Source: CEPAL, 2000

The GNP in the Colombian manufacturing industry ranged from US$13.5 billion in 1995 to US$11.56 billion in 1999 (in 1995 constant prices). In the same period in Chile, it ranged from US$12.6 billion in 1995 to US$13.4 billion in 1999. Variations in Panama for those same years went from US$694.2 million to US$713.4 million [Table 18]. Industry is an important source of jobs in the region, generating an average of 22% of the jobs held by the regional work force (1970/80/90). In Chile it creates approximately 30% of jobs, in Ecuador around 20%, in Peru around 19% and in Colombia 23% (ECLAC: 1999)

Table 18

Manufacturing Industry’s Share of the GNP in SE/P Countries, in Constant Market Prices of 1995 (Millions of US Dollars).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>13,506.3</td>
<td>13,256.6</td>
<td>13,312.1</td>
<td>13,201.7</td>
<td>11,560.1</td>
</tr>
<tr>
<td>Chile</td>
<td>12,616.0</td>
<td>13,021.5</td>
<td>13,745.3</td>
<td>13,536.6</td>
<td>13,440.0</td>
</tr>
<tr>
<td>Ecuador</td>
<td>4,151.3</td>
<td>4,263.7</td>
<td>4,522.5</td>
<td>4,575.1</td>
<td>4,015.3</td>
</tr>
<tr>
<td>Panama</td>
<td>694.2</td>
<td>685.5</td>
<td>729.1</td>
<td>757.7</td>
<td>713.4</td>
</tr>
<tr>
<td>Peru</td>
<td>8,238.3</td>
<td>8,359.4</td>
<td>8,804.0</td>
<td>8,491.4</td>
<td>8,520.2</td>
</tr>
</tbody>
</table>

Source: CEPAL, 2000

A significant portion of the regional industry has facilities located along the coast, where in terms of numbers, the predominant industries are processing plants and canneries for seafood and other food products. On Colombia’s Pacific coast, industrial activities are concentrated in the cities of Buenaventura and Tumaco, which host facilities for some 26 fishing companies, as well as several sawmills and unfinished lumber processing companies (Rodriguez,
1981; Gutiérrez, 1996). Along the Chilean coast, there are around 311 industrial facilities of different types; the highest concentration is found in the area of Talcahuano (VIII Region - Concepcion), where 67 industrial facilities are located. The remainder are distributed unevenly in different development centres, such as Valparaiso, Iquique, Antofagasta and Puerto Montt (Castilla, 1981; Zúñiga and Burgos, 1996; Cabrera, 1991, 1994, 1996). In Ecuador, 69% of industries reported are concentrated along the coast, especially in the province of Guayas. The food processing industry accounts for 68% of these facilities (Campana, 1989; Carrasco and Muñoz, 1995). In Peru, most industries are concentrated in the Lima metropolitan area (Conopuma, Sánchez and Ecchevarray, 1986; IMARPE, 1996). Panamanian industry is mostly located along the coast of the Bay of Panama; this includes food processing facilities, abattoirs and corrals, starch and glucose factories, and distilleries and other bottling facilities (Sánchez and Orozco; Álvarez and Manelia, 1996; Franco, 2001).

3.7 Oil-related Activities

Colombia, Chile, Ecuador and Peru are oil-producing countries. Their joint production in 1999 amounted to 72,898.9 m³ (in thousands of m³), representing 14% of total Latin America and Caribbean production [Table 19].

<table>
<thead>
<tr>
<th>Countries</th>
<th>1997</th>
<th>1998</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>37,841.9</td>
<td>43,791.9</td>
<td>47,317.1</td>
</tr>
<tr>
<td>Chile</td>
<td>490.0</td>
<td>468.8</td>
<td>445.9</td>
</tr>
<tr>
<td>Ecuador</td>
<td>19,856.9</td>
<td>18,995.8</td>
<td>18,989.6</td>
</tr>
<tr>
<td>Peru</td>
<td>6,860.6</td>
<td>6,707.1</td>
<td>6,146.3</td>
</tr>
<tr>
<td>Total SE/P</td>
<td>64,849.4</td>
<td>69,963.6</td>
<td>72,898.9</td>
</tr>
<tr>
<td>LA &amp; C</td>
<td>520,431.6</td>
<td>538,864.2</td>
<td>518,778.3</td>
</tr>
<tr>
<td>SE/P (%)</td>
<td>12.5%</td>
<td>13.0%</td>
<td>14.1%</td>
</tr>
</tbody>
</table>

Source: CEPAL, 2000

Colombia, Ecuador and Peru are oil-exporting countries. Chile and Peru both have offshore oil production, Chile in the Strait of Magellan and Peru in the north. Oil pipelines are found along the coast of all the countries in the region. There are also several coastal refineries and a significant amount of regional traffic in oil (Pizarro, 1985).
Average oil transported in the past 14 years in the region was around 70,850 million m³/year. In Panama, most of the oil transported by sea is connected to the trans-isthmus pipeline that can carry 700,000 barrels/day and with coastal traffic in the ports of Balboa and Vacamonte. At Vacamonte, oil is supplied to a fishing fleet of around 3,000 vessels (D'Croz, 1998; Kwiecinsky, 1981). An average of 2.5 million/ton/year of oil move through the Colombian port of Buenaventura, and crude oil from Orto is received through the trans-Andean pipeline and stored in Tumaco (CCCP, 1993). There is an underwater pipeline in Ecuador connecting the terminal at Balao with the La Libertad refinery located in the Santa Elena peninsula (Campaña, 1989). Peru has 84 oil-producing platforms offshore from Paita and Punta Aguja, as well as three coastal refineries (Sánchez and Solázi, 1988). Oil production in Chile is based on three oil platforms (Pizarro, et al., 1981).

3.8 Ports and Ocean Transport

Chile and Peru are the two countries in the region that are significantly involved in marine activities. This is reflected particularly in their port infrastructure. There are over 22 ports in the region that handle different types of cargo, including oil terminals (Lemay, 1998). There is also a modest merchant fleet consisting of cargo ships, reefers and tankers and a large fleet of bulk carriers in Latin America. The total gross registered tonnage in MT for cargo ships was 256,694, equal to 23.5% of registered cargo for Latin America and the Caribbean for this type of ship and 315,781 MT for bulk carriers, equal to 16.2% of the total registered tonnage for Latin America and the Caribbean (Table 20). Approximately 96% of the foreign trade cargo of the countries in the region is transported by sea. There are two international routes of global importance that communicate the Atlantic and the Pacific Oceans: the Panama Canal to the north and the Strait of Magellan in the extreme south (Escobar, 2000).

<table>
<thead>
<tr>
<th>Countries</th>
<th>Cargo Ships</th>
<th>Bulk Carriers</th>
<th>Reefers</th>
<th>Tankers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>79,961</td>
<td>1,561</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chile</td>
<td>134,974</td>
<td>283,626</td>
<td>-</td>
<td>61,220</td>
</tr>
<tr>
<td>Ecuador</td>
<td>25,375</td>
<td>-</td>
<td>9,932</td>
<td>-</td>
</tr>
<tr>
<td>Peru</td>
<td>16,384</td>
<td>30,594</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total SE/P</td>
<td>256,694</td>
<td>315,781</td>
<td>9,932</td>
<td>61,220</td>
</tr>
<tr>
<td>LAC</td>
<td>1,090,105</td>
<td>1,953,385</td>
<td>109,220</td>
<td>1,851,550</td>
</tr>
<tr>
<td>SE/P (%)</td>
<td>23.5%</td>
<td>16.2%</td>
<td>9.1%</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

Source: CEPAL, 2000
Regional port activities are concentrated primarily in the industrial ports of Valparaiso in Chile and Guayaquil in Ecuador. There is a marked trend towards port expansion and modernisation in the region. The most active ports on the Pacific side of Panama are the Charco Azul oil terminal, Puerto Armuelles, Aguadulce, Vacamonte and Balboa, and the south terminal of the Panama Canal (Ramorino, 1989, 1994; Sánchez and Orozco, 1997). In Colombia, Buenaventura is the main port, moving 78% of the bulk and liquid cargo exported. It has an annual movement of 72 ships, with a monthly docking rate of 5 to 7 vessels in the past two decades. In the same period, Tumaco has moved an average of approximately 27 to 30 ships per year, and it can dock vessels weighing up to a maximum of 100,000 tons of dead weight (Santiesteban, 1998; CCO, 1999).

In Esmeraldas, in northern Ecuador, oil is transported via the oil terminal at Balao; El Oro moves 90% of banana exports. Puerto Bolivar, a port used for artisan fishing, and Guayaquil move around 78% of the total cargo in Ecuador. There are 18 maritime terminals in Peru capable of handling cargo in excess of 10,000 MT; these ports include Callao, Chilibeny, Chimbote and Pisco. In Chile, there are more than 20 maritime terminals. Noteworthy among the ports are Valparaiso, Talcachuano, Antofagasta, Puerto Montt and Punta Arenas, with Valparaiso as the main industrial port in the region (Pizarro and Vergara, 1981).

### 3.9 Transportation of Toxic Waste and Radioactive Material

The South Eastern Pacific region has been exposed, on several occasions, to the transportation of different types of waste. From 1986 to 1989, there was a period in which most of the countries in the region appeared as importers, mostly from the United States. Radioactive waste from Japan has also been transported through the SE/P en route to processing plants in Salfeld (U.K.) and The Hague, under a transportation program that began in 1995 and that will last 10 years. It is estimated that, by 1989, up to 10 loads of burned fuel had been transported through the Panama Canal, equal to 90,000 kg of burned fuel. Average traffic of vessels with radioactive cargo through the Canal is 10 ships per month, and at least two of these have high-level cargo (Gibbs, 1987).

Usually, these ships carry 12-14 containers with nuclear fuel, and have a carrying capacity of 30-60 tons of fuel. Intermediate application radioactive material (I-131: H-3), material for industrial use in non-destructive tests (Ir-193; Co-60), non-radiated nuclear fuel (a mixture of highly enriched plutonium or uranium oxide) and depleted fuel are all transported through the region. In general, the radioactive cargoes transported via the Panama Canal are classified as type B, that is, packages with an intermediate, medium and high activity. Uranium hexa-fluoride (UF6) is the radioactive cargo that is most frequently transported across the Panama Canal (Gibbs, 1987; Escobar, 2000).
4 WATER AND SEWAGE

4.1 Colombia

4.1.1 Institutional Organisation

In Colombia, the first administratively and financially autonomous drinking water and sewage companies established in medium-sized and large cities were formed between the 1950s and the 1970s. Services in smaller municipalities were handled through two entities run by the Ministry of Health: The Institute of Municipal Development, INSFOPAL, and the Program for Basic Rural Sanitation, managed by the National Health Institute, (Instituto Nacional de Salud – INAS). The former oversaw the construction, administration and operation of systems in small and medium-sized municipalities, while the latter serviced communities with fewer than 2,500 inhabitants, promoting projects with community participation in works construction and providing comprehensive support to the administrative committees in charge of the services.

In 1987, government Decree Nº 77 ordered the liquidation of INSFOPAL and the transfereance of the subsidiaries providing services to departments and municipalities. Moreover, it ordered the transfer of the Basic Rural Sanitation Program (Programa Sanitario Básico Rural – PSBR), to the departments.

This decree also created the Drinking Water and Basic Sanitation Directorate of the Ministry of Public Works and Transportation. This office was placed in charge of standards, general coordination, technical assistance and sector information management, as well as the orientation of the Basic Rural and Small Urban Sanitation Program. Water quality control is the only function that remains in the hands of the Ministry of Health; rates are set by the National Rate Committee, which is a section of the Department of National Planning.

Since, 1989, the funding of the sector through loans has been assigned to the Financiera de Desarrollo Territorial, S.A. (Findeter) held by the Ministry of Finance and Public Credit. This entity went into operation in 1990, channelling resources to finance community infrastructure projects and providing technical assistance to strengthen the sector's institutions. The Technical Assistance Program of the Social Adjustment Plan, (Plan de Ajuste Social, PAS) was created under the National Planning Department to complement Findeter. Its activities include assisting and supporting communities in formulating integral drinking water and sewage programs in order to obtain loans.

The Drinking Water Directorate of the Ministry of Public Affairs was terminated through Decree 2,151 on 1992. It was replaced by a Directorate of the same name but under the Vice Ministry of Housing, Urban Development and Drinking Water, a section of the Ministry of Economic Development. The new Directorate went into operation in the second half of 1993. Subsequently, two new agencies were created: the Drinking Water and Basic Sanitation Regulatory Commission as a regulator entity, and the Superintendence of Public Services, responsible for inspecting and monitoring the lender companies. Finally, Law 388 of 1997 on Territorial Organisation reformed the Vice Ministry of Housing, Urban Development and Drinking Water, making it responsible for promoting the National Policy for the Urban Development Plan; four directorates were created, including Residential Public Services, responsible for
the drinking water and basic sanitation sector.

Although the residential services could be provided by public, industrial, or private or mixed commercial entities, public services are the responsibility of the State since, due to their nature, they are directly related to the exercise of the rights that are consecrated in the nation’s Political Constitution.

At national institutions fulfill the following functions, among others:

The Ministry of Economic Development, through the Directorate of Residential Public Services, has the task of elaborating every five years, at most, a plan for expanding public services. This plan will determine the public investments to be made and will look for ways to stimulate private investment; additionally, it identifies sources of financing, supports the necessary negotiations, and ensures that the service companies compete on equal terms for the funding raised. Another important task is to provide technical assistance to the service providers in order to improve their technical capacity both regionally and locally, either directly or through collaboration with other public or private entities.

The Department of National Planning designs the policy for providing residential services and promotes adoption of the policy by the companies providing the service. It also formulates policies and strategies for inspection and monitoring in order to ensure adequate service. In addition, through the Directorate of Urban Development and Special Regional Programs, it guides and promotes the formulation of policies, plans, programs, studies and investment projects in the sector, jointly with national entities. It monitors and supports the Drinking Water and Basic Sanitation Regulatory Commission and the Public Services Authority in matters of rendering residential services. In the macro planning area, it formulates the National Development Plan, co-ordinating the monitoring, execution and evaluation of the results of policies, plans, programs and projects, recommending the necessary modifications and adjustments.

The Ministry of Finance and Public Credit, in order to harmonise the expansion plans put forth by the Development Ministry with the sector investment programs registered in the Development Plan, makes viable and supports negotiations with multilateral organisms for funds that will be administered by the regional financial support entity and residential public service companies.

The main function of the Public Services Authority, an office of the National Planning Department, is to supervise and monitor all the service companies; in this task, it relies on external audits contracted by each company. It also ensures that the national, department, and city subsidies go to the neediest individuals, in accordance with the pertinent rules; it verifies that the companies’ works, equipment and procedures meet the technical requirements established by the Ministry of Economic Development. It takes possession of a service provider when the company cannot or will not provide the public service with due quality and continuity, when company managers do not provide accurate and complete information to the control agents, or when their administration consistently commits serious violations of the regulations that govern them.

The Drinking Water and Sanitation Regulatory Commission (Comisión Regulatoria de Aguas – CRA), is an office of the Ministry of Economic Development. It is comprised of the Minister of Development, who presides over it, the Ministers of Environment and Health, the Director of the National Planning Department and four experts who work exclusively on the commission. These
experts are appointed directly by the President of the Republic for a fixed term of four years. The Drinking Water, Sewage and Waste Superintendent or his/her delegate also participates on this commission but without a right to vote. The principal function of the CRA is to regulate both rates and company management, establishing efficiency criteria through models and indicators to evaluate the financial, technical and administrative management. It also issues the respective certifications so that the municipalities can change the allocations of Law 60/93 resources earmarked specifically for the sector.

The Health Ministry established technical standards on the quality of the water supplied to the users by the companies. The Ministry supervises and monitors urban areas through the Health Offices of each department. These Offices are responsible for collecting and delivering consolidated information to the Ministry for systematisation. It is also the authority in charge of modifying quality parameters of water for human consumption in the country. At the municipal level, water analysis can only be carried out by laboratories authorised by the Ministry and by the National Institute of Health, in coordination with the Industry and Trade Authority, an office of the Ministry of Development, who accredits them.

The Ministry of Environment is responsible for formulating the national natural resources policy and, with the advice of the National Planning Department, formulates plans, programs and projects for natural resources and the environmental system. Additionally, it establishes the maximum allowable limits of emissions and wastewater discharged to natural sources in order to prevent environmental damage.

The main function of Ingeominas, an office of the Ministry of Mines and Energy, is the exploration, quantification and qualification of the country's groundwater sources.

Corpes y Departments, a regional and local organisation, articulates national policy with the municipalities. Through the Departmental Water Units, it has focused on providing technical assistance to the companies, especially in system design and construction and in operational administration, loss minimisation, and commercial aspects. In addition, the public services law enables the departmental entities to channel their resources to subsidise rates for the lowest income sectors. There are 36 Regional Autonomous Corporations in the country, 32 in the departments, and 4 in the largest urban centres, those with more than one million inhabitants. These are environmental authorities empowered to grant concessions, water licenses and approval of environmental management plans. They also monitor and follow up on quality and quantity of effluents put out by the various water use sectors.

At the local level, the municipalities, as executor of the government's social policy, have special constitutional powers. The municipalities' ability to take action is key, as they are responsible for providing the services. Their functions include the following, among others:

To define a strategy for modernising the services rendered, choosing, as per Law 142 of 1994, the business method that best fits with local requirements, taking into account that once the service provider has been transformed, it must operate under efficient business criteria, based on being self-supporting and providing good coverage and quality.

To formulate an investment plan in water and sanitation as an integral part of the Territorial Organisation Plan, (Plan Organizacional Territorial – POT), which includes both rural and urban areas; using the resources available for designing, building and supervising, and for
enlarging and improving the quality of the services, taking expense focalisation into consideration.

The companies that provide public drinking water service are responsible for quality service maintenance up to the point at which the piping system enters private property or connects to a regulating or metering device, should such exist.

Finally, the local body is responsible for the correct administration, operation and maintenance of the systems through its rates.

The structure of governmental entities involved in Drinking Water and Sanitation Service.

The chart below presents the sector structure and the different players:

*Figure 4 - Colombia
Organisation Chart of the Institutional Sector*
4.1.2 Market Traits

Law N°142 authorises entering into contracts for the purposes of managing utility services. In consequence, the Drinking Water Regulatory Commission has acted on the idea that management, service, leasing or concessions contracts enable agents other than the traditional ones to participate, thus guaranteeing open participation in bid processes. Contracts may be granted for exclusive service areas, for some of the service operation’s activities, for purchases of volumes of water for residential distribution. Contracts are granted by means of tenders open to all agents that can meet the stipulated requirements. In addition, these procedures permit the free selection of partners, so that a private individual or an official enterprise may provide technical and financial support.

Within this dynamic transformation framework, entities can change over from public enterprises into industrial and commercial businesses, as well as into mixed and private companies. Equally, the municipalities, through central administration (direct provision of services), may render services in accordance with specific regulations, to organised communities, marginal producers, and self-producers.

In spite of the short time that has elapsed since the sector’s modernisation process began, with all its limitations, positive changes have taken place in the local and management context. For example, the municipal authorities, with full autonomy, initiated their transformation process and the creation of companies, all in a climate of intense political debate with local actors; those that were providing services have become interested in analysing and evaluating actual production costs; and it has been possible to spark the interest and participation of private agents and specialised operators in spite of the resistance to change within the local arena.

In 1995, there were 953 entities rendering drinking water, sewage and sanitation services registered with the Residential Public Services Authority; in 1996, there were 1,482; in 1997, 1,609; and in 1998, a total of 1,650 entities. Of these, 641 were companies (39%), 414 were municipalities as direct service providers (25%) and 595 (36%) were authorised organisations. (Table 21)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipality</td>
<td>281</td>
<td>404</td>
<td>411</td>
<td>414</td>
<td>25</td>
</tr>
<tr>
<td>Companies</td>
<td>392</td>
<td>535</td>
<td>618</td>
<td>641</td>
<td>39</td>
</tr>
<tr>
<td>Authorised Organisations</td>
<td>280</td>
<td>543</td>
<td>580</td>
<td>595</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>953</td>
<td>1,482</td>
<td>1,609</td>
<td>1,650</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Residential Services Authority, 1999
Of the 641 companies registered in 1998, 240 have fulfilled with the juridical proceeding. (149 state industrial and commercial, 41 private, 40 mixed and 10 official companies), 8 are currently in the process of doing so, and 393 have yet to do so. In the 414 municipalities that had been rendering services directly, 91 have changed over (79 took over directly, 9 have become service companies, and 3 transferred the service), 139 are still in process, and 184 have not yet changed over.

Table 22 - Colombia
Distribution of Transformed Companies in 1998

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of Companies</th>
<th>%</th>
<th>Urban Population</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official</td>
<td>10</td>
<td>4.2</td>
<td>650,501</td>
<td>3.0</td>
</tr>
<tr>
<td>Mixed</td>
<td>40</td>
<td>16.7</td>
<td>2,137,925</td>
<td>9.9</td>
</tr>
<tr>
<td>Private</td>
<td>41</td>
<td>17.1</td>
<td>5,855,666</td>
<td>27.0</td>
</tr>
<tr>
<td>State Industrial and Commercial</td>
<td>149</td>
<td>62.0</td>
<td>13,003,714</td>
<td>60.1</td>
</tr>
<tr>
<td>Total</td>
<td>240</td>
<td>100.0</td>
<td>21,647,806</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Residential Services Authority, 1999

4.1.2.1. Population Served

Projected population of Colombia as of 1998 was 40,768,721 inhabitants, with 28,719,052 inhabitants in the main cities and 12,049,669 inhabitants in rural areas, giving a distribution of 70.4% and 29.6% respectively.

In 1998, the nominal national average coverage of drinking water service in primary urban areas was 89.2%, benefiting an approximate population of 25,619,498 inhabitants. Sewage service was available for an average of 78.6% of the population nationwide, with 22,547,415 inhabitants receiving the service.

The number of rural inhabitants with residential connections to drinking water is 5,024,712. This covers approximately 41.7% of the population, of which only 10% have good quality water. Only 2,000,245 inhabitants had access to sewage service; that is, 16.6% of the population disposed of wastewater in acceptable sanitation conditions. Additionally, water service is available, on average, six hours or less a day.

These coverage indicators must be analysed carefully since, in general, hook-ups to conventional networks are on record for single families, without taking into account individual solutions to water supply and wastewater disposal that are common in these areas.

It is important to emphasise that while the difference in the national averages for drinking water and sewage is 10.6% when these figures are analysed by population ranges, it has been observed that the difference in some ranges is actually higher than 20%.
### Table 23 - Colombia
**URBAN COVERAGE OF DRINKING WATER AND SEWAGE SYSTEM BY MUNICIPAL RANGE**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan Areas</td>
<td>Centre</td>
<td>9</td>
<td>13,235,061</td>
<td>278,064</td>
<td>92.2%</td>
<td>87.3%</td>
</tr>
<tr>
<td></td>
<td>Outlying</td>
<td>37</td>
<td>2,576,712</td>
<td>314,297</td>
<td>88.9%</td>
<td>80.0%</td>
</tr>
<tr>
<td>Sub-total</td>
<td></td>
<td>46</td>
<td>15,811,773</td>
<td>592,361</td>
<td>91.7%</td>
<td>86.1%</td>
</tr>
<tr>
<td>0-2,500 Range</td>
<td></td>
<td>403</td>
<td>514,116</td>
<td>2,512,653</td>
<td>93.6%</td>
<td>80.2%</td>
</tr>
<tr>
<td>2,501-12,000 Range</td>
<td></td>
<td>463</td>
<td>2,740,486</td>
<td>5,382,079</td>
<td>88.9%</td>
<td>66.0%</td>
</tr>
<tr>
<td>12,001-30,000 Range</td>
<td></td>
<td>94</td>
<td>1,823,136</td>
<td>1,460,070</td>
<td>88.7%</td>
<td>64.0%</td>
</tr>
<tr>
<td>30,001-70,000 Range</td>
<td></td>
<td>46</td>
<td>2,059,164</td>
<td>1,053,896</td>
<td>89.0%</td>
<td>64.5%</td>
</tr>
<tr>
<td>&gt;70,000 Range</td>
<td></td>
<td>16</td>
<td>1,857,360</td>
<td>429,573</td>
<td>87.2%</td>
<td>73.1%</td>
</tr>
<tr>
<td>Capitals &lt;100,000 Range</td>
<td></td>
<td>11</td>
<td>366,074</td>
<td>205,290</td>
<td>63.8%</td>
<td>62.0%</td>
</tr>
<tr>
<td>Capitals &gt;100,000 Range</td>
<td></td>
<td>12</td>
<td>3,526,943</td>
<td>413,747</td>
<td>84.3%</td>
<td>74.5%</td>
</tr>
<tr>
<td>Sub-Total</td>
<td></td>
<td>1,045</td>
<td>12,907,279</td>
<td>11,457,308</td>
<td>86.2%</td>
<td>69.2%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,091</td>
<td>28,719,052</td>
<td>12,049,669</td>
<td>89.2%</td>
<td>78.6%</td>
</tr>
</tbody>
</table>

Source: Ministry of Development - 1998

### 4.1.2.2 Characteristics of Water Resources: Present and Potential Water Supply and its Geographical Distribution

Though Colombia has a medium-high precipitation indicator of 3,000 mm, rainfall varies through the countries, with averages ranging from 300 mm in La Guajira peninsula to 9,000 on the Pacific coast. The gross supply per inhabitant is 57,000 cubic meters per year, not including groundwater. When taking quality and regulation conditions into consideration, this supply might as low as 26,700 cubic meters per inhabitant per year. However, it is important to mention that the population density makes this indicator less favourable in some regions of the country.

According to the IDEAM, the water supply in the country exceeds 2,000 cubic kilometres per year, or 57,000 cubic meters per year per inhabitant. This is very high compared with the average availability in the world, which is some 7,700 cubic meters, excluding groundwater. The net available supply, taking into account reductions for quality and natural regulation, is 1,260 cubic meters per year, excluding underground reserves. It is important to mention that because of the irregular distribution of this resource, this average is much less favourable when considering only areas with the higher concentration of population and their economic activities.

Additionally, the demand and use of surface water by industrial, human and other water consumption sectors are producing alterations that limit the amount and quality of the water in many regions. This can be distributed as follows (Table 24).
TABLE 24 - COLOMBIA
DISTRIBUTION OF WATER RESOURCE DEMAND BY SECTOR

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage of natural surface water demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water for human consumption</td>
<td>5%</td>
</tr>
<tr>
<td>Agricultural</td>
<td>63%</td>
</tr>
<tr>
<td>Energy</td>
<td>31%</td>
</tr>
<tr>
<td>Industrial</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: Ministry of Development 1998

The cities have an adequate supply of water, in line with the conditions in most of the country, given the fact that approximately 12% of the population shows high and medium-high scarcity indexes. In the future this scenario may vary considerably and quickly, especially in densely populated areas, where not only will demand increase for different residential, agricultural and economic activities, but the available supply may also be reduced considerably if the tendency towards intervention and deforestation of watersheds continues. A scarcity index of over 20% for 38% of the population may be seen by 2016 (Ministry of Development).

4.1.3 Management indicators

4.1.3.1 Continuity, Water Quality, Losses

Despite major efforts and progress made with regard to increasing coverage of drinking water service, the progress in terms of water quality has been slower.

In a sample evaluated by the Ministry of Development for 971 cities, it was found that approximately 35% have higher coverage than the national average; but with difficulties in producing water safe for human consumption; of the sample, a mere 21% have treatment plants, but they are not working properly.

It is noteworthy that, despite the fact that there are urban centres without treatment infrastructure available, they carry out the process of purifying water for human consumption. Of the sample analysed by the Ministry of Health, it can be concluded that all cities with more than 700,000 inhabitants perform a purification process; on the contrary, for locations with fewer than 2,500 inhabitants the average is reduced to 79.6%.

As a complement to the information from the Ministry of Health, the Ministry of Development, in its sanitary inventory for the urban sector systemised in 1998, stated that processes of purification are performed in 772 urban centres, to the benefit of 22.6 million inhabitants.

From the sample of the Second National Inventory on Drinking Water Quality for Human Consumption and Domestic Use, carried out by the Ministry of Health, 595 urban areas submitted information on the continuity of water supply service. This information, organised according to the different municipal ranges, shows the number of hours that drinking water service is available, on average.
TABLE 25 - COLOMBIA
CONTINUITY OF DRINKING WATER SERVICE BY MUNICIPAL RANGES

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan Areas</td>
<td>Centre</td>
<td>9</td>
<td>12,202,726</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td>Outlying</td>
<td>37</td>
<td>2,290,697</td>
<td>21.7</td>
</tr>
<tr>
<td>Sub-Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Range 1</td>
<td>403</td>
<td>481,213</td>
<td>20.5</td>
</tr>
<tr>
<td></td>
<td>Range 2</td>
<td>463</td>
<td>2,436,292</td>
<td>16.6</td>
</tr>
<tr>
<td></td>
<td>Range 3</td>
<td>94</td>
<td>1,617,122</td>
<td>18.2</td>
</tr>
<tr>
<td></td>
<td>Range 4</td>
<td>46</td>
<td>1,832,656</td>
<td>18.4</td>
</tr>
<tr>
<td>&gt;70,000</td>
<td>Range 5</td>
<td>16</td>
<td>1,619,618</td>
<td>23.2</td>
</tr>
<tr>
<td>Capitals &lt;100,000</td>
<td>Range 6</td>
<td>11</td>
<td>246,315</td>
<td>13.0</td>
</tr>
<tr>
<td>Capitals &gt;100,000</td>
<td>Range 7</td>
<td>12</td>
<td>2,973,213</td>
<td>19.0</td>
</tr>
<tr>
<td>Sub-Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,045</td>
<td>11,126,074</td>
<td>18.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,091</td>
<td>25,619,498</td>
<td>21.3</td>
</tr>
</tbody>
</table>

Source: Ministry of Health 1998

The locations with the most problems with continuous supply are the department capitals with a population of under 100,000 and municipalities with population ranges between 2,501 and 12,000 people. These have a service continuity of 13 and 16.6 hours as a daily average. At the national level the average figure is 21.3 hours/day. This high figure is mainly due to service continuity in the metropolitan areas and cities with more than 70,000 inhabitants, which account for 63% of the urban population with drinking water service.

Dividing the nationwide drinking water supply by the average consumption per user of 24.3 m³/month equals a per capita consumption of 165 litres/inhabitant/day.

In terms of companies, the modernisation pace of the suppliers has not yet improved the efficiency and conditions of water services supply and coverage; an evaluation of the performance of the companies who submitted information in 1997 Management and Results Plans for approval by the Ministry of Development, shows that their performance has not improved in relation with their financial, operational and rate indicators.

In an evaluation of the sample, between 1995 and 1997, 91% of the operational income is earmarked for payment of operational costs; the collection rate is 78% and the index of water not accounted for amounts to 39%.

As a result of company modernisation programs, the incorporation of additional national funds, compliance with the requirements of maximisation in rate use, and the utilisation of the resources of Law 60, in accordance with Law 508 of 1999, it is expected that by the year 2002 drinking water coverage will be 96% and 48.8% in urban and rural areas, and sewage service coverage will be 86% and 30.4%.
TABLE 26 - COLOMBIA
COVERAGE GOALS OF THE 1999-2002 DEVELOPMENT PLAN

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking Water</td>
<td>94.67%</td>
<td>41.70%</td>
<td>95.41%</td>
<td>44.20%</td>
<td>95.90%</td>
<td>46.70%</td>
<td>96.02%</td>
<td>48.80%</td>
</tr>
<tr>
<td>Sewage System</td>
<td>81.76%</td>
<td>16.60%</td>
<td>83.54%</td>
<td>21.10%</td>
<td>84.92%</td>
<td>26.30%</td>
<td>85.97%</td>
<td>30.40%</td>
</tr>
</tbody>
</table>

Source: Department of National Planning - 1999

4.1.3.2 Sanitation and Treatment of Domestic Wastewater

There are 190 wastewater treatment plants in the country located in 131 urban centres in 12% of the country’s municipalities. The different technologies are applied as follows:

TABLE 27 - COLOMBIA
DISTRIBUTION OF WASTEWATER TREATMENT TECHNOLOGIES

<table>
<thead>
<tr>
<th>Process Technologies</th>
<th>Quantity</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponds (aerobic/anaerobic)</td>
<td>105</td>
<td>55.0</td>
</tr>
<tr>
<td>Activated Sludge (aerobic)</td>
<td>43</td>
<td>22.5</td>
</tr>
<tr>
<td>Percolating Filters (aerobic)</td>
<td>24</td>
<td>13.0</td>
</tr>
<tr>
<td>UASB Systems (anaerobic)</td>
<td>17</td>
<td>9.0</td>
</tr>
<tr>
<td>Primary Operating System</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>190</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Ministry of Environment 1998

It can be observed that stabilisation ponds have the most commonly used technology, with 105 units, followed on a lesser scale by the activated sludge, percolating filters and UASB systems.

Additionally, there are technologies for treating domestic wastewater, most of which are based on biological processes. The simplest treatment uses septic tanks, a system used in the rural areas and small villages with a population of under 300 inhabitants.
4.1.4 Rates, Investments

The sector's rate system designed and implemented in the country by the Drinking Water Regulatory Commission is basically ruled by the following criteria: (a) economic efficiency, to make it similar to competitive market prices, without putting the burden of inefficiency on the final user; (b) neutrality, to provide all service users the same treatment regarding rates; (c) solidarity and redistribution, to guarantee that the higher income, commercial and industrial users help those of low income to pay; (d) financial sufficiency, to guarantee that the rates recover the operating, administration and maintenance costs, including the expansion and replacement of the physical infrastructure; (e) simplicity, to enable all users to understand, apply and control the formulas easily; and (f) transparency, understood as an explicit and public system for all the parties involved in the service.

All these criteria will allow the companies to be fully self-sufficient, guaranteeing the expansion and upkeep required and achieving a fair system with solidarity.

The regulation system promoted by the Commission intends to adjust the rates to the conditions of the sector and demand, transforming them into a mechanism that ensures total operation of the systems and expansion of the services. The supplier entities will calculate a target rate to be reached not later than December 31, 2004, and they will be required to provide information on costs, target rates, adjustment plans and the rates to be charged every year.

From the information included in the Management and Results Plans submitted to the Ministry of Development in 1998, it can be stated that the average cost of production per cubic meter in urban sectors of the country amounts to US$0.22/m³, while sewage disposal costs US$0.11/m³. At the same time, the average rate charged per cubic meter of water is US$0.25/m³ and US$0.14/m³ for sewage service (Ministry of Development, 1998).

The price paid per inhabitant for treated water service is US$1.32, while the price of a residential connection to a sewage system with wastewater treatment is US$1.29 per person and US$0.70 without treatment (Table 28).
TABLE 28 - COLOMBIA
PER CAPITA INVESTMENT PARAMETERS FOR DRINKING WATER, SEWAGE SYSTEMS AND TREATMENT PLANTS

<table>
<thead>
<tr>
<th>Item</th>
<th>US$/inhabitant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment in Drinking Water Treatment Plants (Metropolitan Areas)</td>
<td>18.00</td>
</tr>
<tr>
<td>Investment in Drinking Water Treatment Plants (Capitals &gt; 100,000 Inhab.)</td>
<td>17.50</td>
</tr>
<tr>
<td>Investment in Drinking Water Treatment Plants (Capitals &lt; 100,000 Inhab.)</td>
<td>17.00</td>
</tr>
<tr>
<td>Investment in Drinking Water Treatment Plants (Capitals &gt; 70,000 Inhab.)</td>
<td>16.50</td>
</tr>
<tr>
<td>Investment in Drinking Water Treatment Plants (Other Cities)</td>
<td>16.50</td>
</tr>
<tr>
<td>Reconditioning of Treatment Plants</td>
<td>7.00</td>
</tr>
<tr>
<td>Drinking Water Coverage (Metropolitan Areas)</td>
<td>132.00</td>
</tr>
<tr>
<td>Drinking Water Coverage (Other Urban Areas)</td>
<td>133.50</td>
</tr>
<tr>
<td>Drinking Water Coverage (Rural Areas)</td>
<td>150.00</td>
</tr>
<tr>
<td>Sewage System Coverage (Metropolitan Areas)</td>
<td>180.00</td>
</tr>
<tr>
<td>Sewage Coverage (Other Urban Areas)</td>
<td>150.00</td>
</tr>
<tr>
<td>Sewage Coverage (Rural Areas)</td>
<td>100.00</td>
</tr>
<tr>
<td>Investment in Wastewater Treatment Plants (&gt; 250,000 Inhab.)</td>
<td>130.00</td>
</tr>
<tr>
<td>Investment in Wastewater Treatment Plants (&lt; 250,000 Inhab.)</td>
<td>30.00</td>
</tr>
</tbody>
</table>

Source: Ministry of Development - 1998

The resources assigned to the 1999-2000 development plan amount to 4.3 trillion 1998 pesos, equivalent to 3 billion dollars of the same year. These resources are divided between two large areas: transformation and institutional adjustment, and investments in drinking water and sewage systems. Investments as an area have been assigned independently, 56% to drinking water projects and 44% to sewage systems; these, in turn, have been broken down by municipal typology into large cities, department capitals and municipalities with more than 100,000 inhabitants, and rural areas of the country.

It is noteworthy that the combined drinking water and sewage resources assigned to municipalities of fewer than 100,000 inhabitants and rural areas account for 35% of total investment.

An analysis of the sources of financing shows clearly that 35% comes from different types of public monies, 7% from private sector investment, and the remaining 58% from companies' own resources and direct contributions from municipalities unrelated to the transfer resources (Table 29).
4.1.5 Commercial and Financial Information

Investments in the sector during the years 1994, 1995 and 1996 amounted to a yearly average of US$466,000. This amount was broken down as follows: non-reimbursable resources of the nation, 23%; on average: loans to municipalities or service entities, 20%; municipal resources from transfers made by the national government and municipalities' own resources, 30%; and companies' own resources for leverage of loans and investments in the privatisation process, 25%.

An analysis of the makeup of the sector's financing sources for this period show that:

Co-financing resources in 1994 amounted to 10.6% of the total invested in the sector; in 1996 they increased considerably to 34.1%.

In connection with the credit resources, despite the increase of disbursements between 1994 and 1996 (US$80 to US$115 million) this item's share in the annual investments was significantly reduced, going from 28.6% in 1994 to 15.3% in 1996.

Regarding Law 60 resources, despite the increase in the value of transfers (from US$86 million to US$143 million for 1994-1996), their share as a financing source dropped from 30.8% to 19.1%.

It is clear that the behaviour of the co-financing, credit and Law 60 resources have a direct relationship: when the first source increases the other two decrease.
making an evident substitution effect among the sources evident.

Total contributions through different national sources to ensure financial closing of projects in the national interest amounts to 75% on average for the three years.

The private sector was the financing source that developed least during this period, accounting for only 0.3% in 1996; this situation is a result of weaknesses in the regulatory, taxation and guarantee policies for this sector.

The service provider companies have made significant contributions to sector financing, accounting for an average of 25%; it is expected that in the short term, this source of funds will increase since the regulation framework includes replacement and service expansion expenses in the rate schedule.

4.1.6 Final Disposal of Wastewater in Coastal Cities

The principal coastal cities in Colombia are Buenaventura and Tumaco, whose

4.2 Chile

4.2.1 Institutional Organisation

The government's responsibility in drinking water and sewage systems was redefined in the 1980s; it ceased to be a service provider, and its activities were made those of subsidiser and regulator. In short, it was transformed from a state company to a regulatory entity. The drinking water and sanitation services had been mainly in the hands of the government and, in general, the services of drinking water production and distribution, and wastewater collection, treatment and final disposal had operated as a unit.

The new institutional model for providing drinking water and sewage services, in line with the Chilean economic reality, focused more on private initiative and the market as a mechanism for assigning resources. These were reforms that had already been applied in the electricity and telecommunications sectors.

Decree Law DFL 382, the Sanitation Services General Law of 1998, Decree Law DFL 70, the Law on Sanitation Services Rates, Law N°18.778, the Law of payment Subsidies for drinking water consumption and sewage services, and the creation of the Sanitation Services Authority (SISS); all of these, since 1990, had permitted sanitation services to be granted in concession to public, private or mixed companies, for the installation and operation of sanitation services on an indefinite basis, provided that the conditions of such concessions are fulfilled.

The public sanitation services awarded to companies were regulated by law. The service provider companies were required to become public corporations whose only activity could be providing services of drinking water production and distribution, and wastewater collection and disposal. The law defines the responsibilities of the different levels of government as to the provision of such services; it acknowledges that company
management should be guided by management and efficiency indicators, and that the following must be considered in the rate schedule: economic efficiency, neutrality, solidarity and income redistribution for low-income sectors, in accordance with principles of solidarity and fairness.

The following agencies are active in this sector:

The Superintendencia de Servicios Sanitarios, SISS, (Sanitation Services Authority) created as a decentralised public agency with regulatory, supervisory and sanctioning authority. Its purpose is to perform the government's regulation and monitoring activities in this sector, being responsible for inspecting sanitation services providers and monitoring liquid industrial waste, and for scheduling rates for the regulated services, which are then submitted for approval by the Ministry of Economy, Promotion and Reconstruction.

The Ministry of Economy, Development and Reconstruction promotes and inspects the activities in the various industrial, services and business sectors. Its main purpose in connection with the Sanitation sector is to establish regulated prices as proposed by the Sanitation Services Authority.

The Ministry of Public Works (MOP), apart from its inherent functions, works in the sanitation sector in administering legislation on water resources, assigning water rights and approving concession rights to establish, construct and exploit sanitation services. Urban sanitation system concessions are granted by the MOP after being proposed by the Sanitation Services Authority, SISS. Central planning takes place in the rural sector under the Department of Sanitation Programs, DPS, an office of the MOP.

The Ministry of Health oversees water quality in the sanitation services that are not within the jurisdiction of the SISS (those that are not public sanitation services) and certifies quality regulations studied under the provisions of the Instituto Nacional de Normalización (the National Standardisation Institute).

Also relevant are other regulating agencies that deal with general regulations in economic, environmental, and water resources, etc., such as the National Environmental Commission, an agency under the Ministry of the General Secretariat of the Presidency of the Republic, which co-ordinates and oversees compliance with environmental impact regulations, particularly in this case, with regard to the environmental impact studies that have to support the projects undertaken by these companies.

The Ministry of the Interior, through the Regional Development Secretary, channels public funds from the Regional Development National Fund Program (FNDR) to regional governments, for financing drinking water and sewage networks as well as latrines in poor communities, among other social projects and works.

The National Economic Inspector's Office and the Anti-Monopoly Commissions (Decisions and Preventive) work with regulations governing competition and in identifying monopoly-type activities.

The National Consumer Service, an agency that focuses on protecting consumer rights.

In December 1989, most urban drinking water and sewage system services were provided by the government. State companies operated as subsidiaries of the Corporación de Fomento (Production Development Corporation). This corporation is the principal shareholder and senior administrator of the companies through the State Companies Administration System (Sistema de Administración de Empresas Estatales, SAE), with two autonomous state companies that were created for the
Metropolitan and V Regions, EMOS and ESVAL. The incorporation of private capital to the main Chilean sanitation companies started in 1998, when the majority of their shares were sold. In 1999 the situation changed dramatically, as shown in the following table:

### TABLE 30 - CHILE
**INCORPORATION OF PRIVATE CAPITAL INTO THE MAIN CHILEAN SANITATION COMPANIES**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>SENDOS</td>
<td>39.7%</td>
<td>CORFO companies</td>
<td>36.9%</td>
</tr>
<tr>
<td></td>
<td>EMOS</td>
<td>42.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ESVAL</td>
<td>10.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State</td>
<td></td>
<td>92.6%</td>
<td></td>
<td>36.9%</td>
</tr>
<tr>
<td>Private</td>
<td>Private</td>
<td>2.7%</td>
<td>Private Companies</td>
<td>58.1%</td>
</tr>
<tr>
<td>Municipal</td>
<td>Municipal</td>
<td>3.6%</td>
<td>Municipal</td>
<td>4.5%</td>
</tr>
<tr>
<td>Other</td>
<td>Others</td>
<td>1.1%</td>
<td>Others</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Even when in full compliance with sanitation legislation, while the government is the largest shareholder, urban companies must submit their investment and budget programs for the approval of the Planning and Cooperation and Finance Ministries, through the SAE.

### FIGURE 5 - CHILE
**INSTITUTIONAL ORGANISATION - URBAN SECTOR**
Chile's Drinking Water Program has been in operation since 1964 serving rural populations, which are defined as areas with approximately 15 houses per km and with a minimum population of 150 inhabitants. The systems are operated and maintained by the same communities that they supply, organised into Rural Drinking Water Co-operatives or Committees. Specialised technical units are contracted to supervise the execution of works and to provide technical assistance to the Co-operatives or Committees.

FIGURE 6 - CHILE
INSTITUTIONAL ORGANISATION – RURAL SECTOR

4.2.2 Market Characteristics

4.2.2.1 Population Supplied

As of June 30, 1999, the population of Chile was estimated at 15,017,760 inhabitants, of which 85.4% lived in urban areas and the remaining 14.6% in rural areas (CEPAL, 2000). In 1998, 3.8% had access to adequate sanitation technology, mainly with septic tanks and drainage wells (OPS, 2000).

A description of the Chilean urban sanitation sector includes the 21 companies that service more than 99% of the country's total clients. A client is understood to be an individual or entity

(SISS, 2000).
that resides and/or lives on the property which receives drinking water or sewage service. The total number of buildings supplied with drinking water and/or sewage as of December 31st, 1999 was calculated in order to classify the companies by size.

The distribution of the companies by numbers of clients in the country versus the total population is according to country's administrative divisions, as follows (Table 31).

Table 31 - Chile
Population and Client Distribution Per Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Company</th>
<th>% clients 1999</th>
<th>% population 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Essat</td>
<td>2.9</td>
<td>2.6</td>
</tr>
<tr>
<td>II</td>
<td>Essan</td>
<td>3.2</td>
<td>3.1</td>
</tr>
<tr>
<td>III</td>
<td>Emssat</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>IV</td>
<td>Essco</td>
<td>4.0</td>
<td>3.8</td>
</tr>
<tr>
<td>V</td>
<td>Esval</td>
<td>11.2</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>A. Quinta</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Coopagua</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Total V Region</td>
<td></td>
<td>13.0</td>
<td>10.3</td>
</tr>
<tr>
<td>RM</td>
<td>Emos</td>
<td>36.8</td>
<td></td>
</tr>
<tr>
<td>RM</td>
<td>A. Cordillera</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>RM</td>
<td>Los Domínicos</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>RM</td>
<td>A. Manquehue</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>RM</td>
<td>Servicomunal</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>RM</td>
<td>Maipú</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>Total RM</td>
<td></td>
<td>40.0</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Essel</td>
<td>4.2</td>
<td>5.2</td>
</tr>
<tr>
<td>VII</td>
<td>Essam</td>
<td>4.5</td>
<td>6.0</td>
</tr>
<tr>
<td>VIII</td>
<td>Essbio</td>
<td>10.5</td>
<td>12.8</td>
</tr>
<tr>
<td>IX</td>
<td>Essar</td>
<td>4.3</td>
<td>5.8</td>
</tr>
<tr>
<td>X</td>
<td>Essal</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>A. Décima</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Total X Region</td>
<td></td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>XI</td>
<td>Emssa</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>XII</td>
<td>Esmag</td>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Others</td>
<td>25 companies</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Sanitation Services Authority and NSI, 2000.

Over 40% of both the overall population of the country and the public sanitation service clients are concentrated mainly in the Metropolitan Region, while more than 10% of each group resides in the Eighth and Fifth Regions. The companies servicing these three regions provide sanitation service to almost 60% of the country's clients, a situation which reflects the actual urban concentration.

Chilean legislation classifies sanitation companies according to their percentage of clients as compared to the total client population. The firms are
grouped into large companies (15% or more of the total clients), medium (4% or more, but less than 15%) and small (less than 4%). Eighty percent of the country's clients are supplied by eight companies classified as large (1) and medium (7). Consequently, the 38 remaining companies, classified as small, provide service to 20% of the country's clients.

Client distribution by company size is shown in the following table (Table 32):

### Table 32 – CHILE
**Client Distribution by Company Size**

<table>
<thead>
<tr>
<th>Category</th>
<th>1999 -Main Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>1 private (Emos)</td>
</tr>
<tr>
<td>Medium</td>
<td>6 state and 1 municipal</td>
</tr>
<tr>
<td>Small</td>
<td>6 state and 7 private</td>
</tr>
<tr>
<td>Total</td>
<td>22 companies</td>
</tr>
</tbody>
</table>

The only company that undoubtedly classifies as a large company is the EMOS sanitation company of the Metropolitan Region. Likewise, the two main medium enterprises are ESVAL and ESSBIO, of the Fifth and Eighth Regions, respectively.

Considering the 10 largest companies with more than 10,000 clients each, together with the large and medium sized enterprises, we can conclude that only 18 companies supply sanitation service to 99% of clients of the sector. This shows the service supply to be highly concentrated among the largest companies.

The community participates in Chilean sanitation services in several ways. In the urban sector, legislation requires the licensed enterprises to report the rates and any other important information to their clients on a regular basis, under a policy of client education and orientation regarding their rights, rates, subsidised rates, etc.

Rural users participate more actively. In effect, the communities operates the drinking water systems that supply the concentrated rural population through Rural Drinking Water Co-operatives or Committees, which manage the service and sets the rates to be paid by the cooperative or committee members.

In Chile, since 1990, the rural population has decreased from 16.9% to an estimated 14% in the year 2000 (14.6% in 1999) [Table 33].
TABLE 33 - CHILE
SERVICE LEVEL BY TYPE OF SANITATION TECHNOLOGY, 1999

<table>
<thead>
<tr>
<th>POPULATION</th>
<th>% URBAN</th>
<th>% RURAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population served with residential connection to the sewage network</td>
<td>92.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Without connection but with an adequate system*</td>
<td>3.8</td>
<td>90.9</td>
</tr>
<tr>
<td>Without an adequate system**</td>
<td>4.1</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Source: OPS, 2000
* type of individual sanitation solution (septic tank, latrines), public (sewer system), ** without solution (poverty)

4.2.2.2 Characteristics of Water Resources: Current and Potential Water Supply and its Geographic Distribution

The geographic and climatic characteristics of the country give origin to independent basins located between the Andes Mountains and the sea, varying in size and flow volume. Water resources are scarce in northern Chile and increase progressively toward the south. Several dams have been constructed in the different basins to regulate surface water resources inter-annually; some of them are operated by the drinking water suppliers. There are also valuable groundwater resources that have been exploited to a limited extent and that should be more developed in the future.

The country's 22 main sanitation companies service 319 urban localities, of which 169 are supplied mainly by groundwater by means of 681 catchments; 70 are supplied exclusively from surface resources by means of 148 catchments, and 80 are supplied with a mixture of underground and surface resources through 372 underground and 109 superficial catchments.

Total national production capacity under maximum conditions amounts to 77,201 l/s, of which 33,470 l/s (43% of the total) comes from groundwater and 43,730 l/s (56.6% of the total) is from surface waters.

It is noteworthy that of a total of 34 companies, 13 use only underground waters and six exploit only surface resources; the remaining companies use mixed sources.

Chilean sanitation companies' reliability level is high. Inter-annual regulation dams, required fulfillment of development plans, and the fact that regional companies normally manage several water resources in a basin all help guarantee drinking water supplies, even through serious droughts. The 1999 drought, which seriously affected Chilean electric companies which, after the privatisation process of the 80s, no longer operate as a unit, did not affect the integrated regional sanitation companies. Therefore, the continuity of the urban and rural systems in operation can be estimated in 100% except in situations of force-majeur, such as heavy rains and excessively turbid conditions that temporarily paralyse plant operations and affect to some degree the continuity of the water supply under the quality standards required.
4.2.3 Management Indicators

4.2.3.1 Continuity, Water Quality, Losses

Compliance with Chilean physicochemical and bacteriological standards requires complete water treatment in a large part of the surface water supply systems, as well as water purification in all the urban and rural systems supplied by both surface and underground waters.

In 1998, 99.4% of the drinking water samples of all the companies operating in the urban sector complied with Chilean bacteriological standards, and 99.9% of the samples complied with purification standards. For companies operating in the urban sector, 96.5% of the samples complied with physical parameters (in matters of turbidity, colour, odour and taste) and 98.8% complied with chemical parameters (21 elements are identified). Chilean drinking water standards have not been updated with respect to the WHO guidelines. Still, compliance with these standards is high, and the supervision of water quality, particularly of the urban system, can be classified as effective. Sanitation monitoring is not considered completely satisfactory in rural drinking water systems.

Lost drinking water is the percentage of water produced by sanitation enterprises that is not billed, but lost. This indicator is calculated starting from an estimation of the amount of drinking water produced, based on the statistics supplied by each company. These losses are due to broken pipes, filtration, and to commercial situations that have not been registered in accounts. Medium-sized companies are the group that suffered the largest losses in 1999, with an average of 32.6%. It should be noted that in this group, losses decreased by one percentage point during these years. EMOS, the only large company that supplies a large area of the Metropolitan Region, maintained a constant loss percentage of 25.7% during 1998 and 1999.

The supply amount, in litres, that is consumed per inhabitant on daily basis varied from an average of 218 litres per day in 1999. This is much higher than the average of the companies that supply the higher income sector of the country, who have houses on larger lots and use water primarily for watering lawns. In the middle-sized companies, its average supply is 174 litres per day per inhabitant, the lowest among the three groups. In 1999, EMOS had a supply of 210 litres per day per inhabitant.

4.2.3.2 Sanitation and Treatment of Domestic Wastewater

The investment program for treating wastewater collected in the sewage systems is in full development. Treatment coverage for 1998, calculated by the SISS, was 16.7%; in 1999, it reached 19.1%; and in the year 2000, it was 20.9%.

The coverage goals for the country are 26.6% for 2001, 77.9% for the year 2005 and 93.8 % for 2010. It will be a great challenge for the Chilean sanitation sector to reach these goals, and that is the focus of the incorporation of private investment into the state enterprises.

In the rural sector, wastewater treatment coverage is still very low, existing only in some rural systems in regions that have incorporated treatment plants for their wastewaters. These consist mainly of septic tanks and sewage wells (3.8%).

83
The urban population without drinking water service has been classified by the Social Economic Individualisation Survey, CASEN, which is published by MIDEPLAN (Ministry of Planning); "no system, carries water," or "no system" in reference to sewage systems. Nevertheless, this group includes part of the population that lives in precarious housing built on the site of a main standard home. This situation is known in Chile as a "homeless population living on the property of another family," and strictly speaking, these people have access to the service because they carry water from the main house or use the sanitation system of the main house. The urban population that can be more clearly classified as not having drinking water or sanitation service are those who live in the so-called "camps," temporary informal population settlements. The government's Chile Barrio program is working to eradicate these camps, replacing them with urbanised settlements. It should be pointed out that these camps receive water from municipal tank trucks, and they have some kind of system to separate the "excretion from human contact."

In the rural sector, 65.7% of the population has had access to drinking water connections since 1998, (including an on-site shut-off valve); 34.3% did not have service. In this respect, a distinction should be made between concentrated and sparse rural population. Concentrated rural populations are understood to be localities with more than 15 houses per kilometre that have received special attention from the Government since 1964. By 1999, 96% of the concentrated rural population had access to the so-called Rural Drinking Water Systems, (Sistemas de Agua Potable Rural, APR). The sparse rural population gets its water from wells, rivers and springs that do not guarantee 100% drinking quality water. Combining the concentrated rural population, with high coverage, and the sparse rural population, with zero coverage, could average out at 67% overall coverage for the rural sector.

<table>
<thead>
<tr>
<th>Table 34 - Chile Urban-Rural Water and Sanitation Coverage, 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>POPULATION</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>Urban</td>
</tr>
<tr>
<td>Rural</td>
</tr>
</tbody>
</table>

(*) Concentrated and sparse population
(1) Excludes cesspool
(2) Includes cesspool

The sector has 13 large service providers that handle a percentage of the country's service users. These started out as state companies, but have been transformed into mixed companies with private capital. In the year 2000, in eight of the companies, part of the property has been transferred into private hands. This was part of the government's policy for overcoming the resource deficit for special wastewater treatment. These treatments require large investments that need to take place promptly in order to overcome the contamination problems in the country's waters.
4.2.4 Rates, Investments

Legislation stipulates that the rates applied by drinking water and sewage companies must cover all the costs involved in producing and distributing drinking water, and in collecting wastewater and disposing of it in receptor tanks or treatment systems for reuse or elimination. Until the middle of 1999, the state was the principal owner.

The following table provides information on the average per capita costs for water and sanitation systems, both urban and rural. The average production/distribution costs of drinking water can be estimated at US$0.26 per m³. Average investment and annual population increases have been included in the per capita costs for the urban systems. Per capita costs for the rural systems are based on information issued directly by the DPS of the Ministry of Public Works (Table 35).

Table 35 - Chile
Cost Per Capita by Technology, 1998
(US$/m³)

<table>
<thead>
<tr>
<th>Costs and Rates of Urban Services</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average cost of drinking water production/distribution</td>
<td></td>
</tr>
<tr>
<td>Average drinking water rate</td>
<td>0.38</td>
</tr>
<tr>
<td>Average sewage rate</td>
<td>0.19</td>
</tr>
<tr>
<td>Basic monthly expenses paid per inhabitant for drinking water services:</td>
<td></td>
</tr>
<tr>
<td>Users served with residential hook-up</td>
<td>227</td>
</tr>
<tr>
<td>Basic monthly expenses paid per inhabitants for sanitation services:</td>
<td></td>
</tr>
<tr>
<td>Users served with residential hook-up without treatment</td>
<td>1.13</td>
</tr>
</tbody>
</table>

The high coverage rate of the Chilean sanitation system is in line with the growth in investment in the sanitation sector. These investments accumulated 9.8% of the public investment from 1995 to 1998 (excluding the investment of good-producing state companies). This is a high percentage by Latin-American standards.

The following table (Table 36) shows average investment and domestic and foreign contribution of the utility companies in new works for drinking water and sanitation facilities in the urban and rural sectors from 1990 to 1998:
Investments in 1999 amounted to US$152.7 million. This includes both investments in sanitation works (drinking water, sewage, and wastewater treatment) as well as in other investments other than sanitation works. Drinking water and sewage investment amounted to US$114.7 million in 1999, 75.1% of the total; US$21.6 million was invested in wastewater treatment, for 14.1% of the total. Other Investments, at US$6.3 million, accounted for 10.7%.

The largest company (EMOS) accounted for 24.9% of 1999 investments, the medium-sized companies accounted for 48.5% of the total, and the small companies, 26.6%.

Total investment projected for the decade 2000-2010 is estimated at US$2.66 billion. This includes both investments in sanitation works (drinking water, sewage, and wastewater treatment), as well as in investments other than sanitation works. Of this total, 44.6% was invested by the largest company (EMOS), 31.9% was from medium-sized companies, and small companies accounted for 23.5%.

### Table 36 - Chile
Average Annual Investment 1990-1998
(In Thousands of US$)

<table>
<thead>
<tr>
<th></th>
<th>NATIONAL RESOURCES</th>
<th>EXTERNAL RESOURCES</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Drinking Water Supply</td>
<td>81,600</td>
<td>6,000</td>
<td>87,600</td>
</tr>
<tr>
<td>Rural Drinking Water Supply</td>
<td>28,200</td>
<td>1,700</td>
<td>29,900</td>
</tr>
<tr>
<td>Urban Sewage Service</td>
<td>72,700</td>
<td>6,200</td>
<td>78,900</td>
</tr>
</tbody>
</table>

Source: MIDEPLAN, DSP MOP, SAE

### Table 37 - Chile
1999 Investments (In Millions of US$)

<table>
<thead>
<tr>
<th>Company</th>
<th>1999 Investments in Millions of US$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drinking Water and Sewage</td>
</tr>
<tr>
<td>Large Company</td>
<td>28.26</td>
</tr>
<tr>
<td>Medium Companies</td>
<td>60.90</td>
</tr>
<tr>
<td>Small Companies</td>
<td>25.59</td>
</tr>
<tr>
<td>Total:</td>
<td>114.76</td>
</tr>
</tbody>
</table>

Source: SISS, 1999
Table 38 - Chile
Investment Projected for 2000-2010 (In Millions of US$)

<table>
<thead>
<tr>
<th>Company</th>
<th>Projected Investment in Millions of US$ (1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Large Company</td>
<td>104.36</td>
</tr>
<tr>
<td>Medium Company</td>
<td>135.60</td>
</tr>
<tr>
<td>Small Company</td>
<td>85.58</td>
</tr>
<tr>
<td>Total</td>
<td>325.55</td>
</tr>
</tbody>
</table>

Of the total investment projected for the next decade (2000-2010), 50.1% is for investment in wastewater treatment, estimated at US$1.33 billion.

The largest company (EMOS) accounts for 61.9%, US$825 million of the total investment projected in wastewater treatment in 2000-2010, medium-sized companies account for 30.4% of the total, and the small companies, only 7.8% of the amount projected for treatment.

Table 39 - Chile
Projected Investment In Wastewater Treatment In Millions Of 1999 US$, 2000-2010

<table>
<thead>
<tr>
<th>No.</th>
<th>Company</th>
<th>Projected Investment in Treatment in Millions of 1999 US$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>1</td>
<td>Large Company</td>
<td>66.84</td>
</tr>
<tr>
<td>7</td>
<td>Medium Companies</td>
<td>72.90</td>
</tr>
<tr>
<td>13</td>
<td>Small Companies</td>
<td>25.11</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>164.84</td>
</tr>
</tbody>
</table>

4.2.5 Commercial and Financial Information

Total exploitation income (sales) of the sector during 1999 amounted in December, 1999 to approximately US$493 million; this was a 0.2% decrease in real terms with respect to 1998.

Of the exploitation income in 1999, EMOS accounted for 28.5%, and 41.8% went to the group of 7 medium-sized companies. Both percentages are smaller than these companies' share of the country's total clients, which is 37.5% and 42.7%, respectively.

In contrast, the group of small companies had a higher share in the total income (29.7%) than in the total number of clients (19.9%).

In other words, the annual mean income per client of the smaller companies (119,100 pesos) is, in general, higher than that of the medium-sized companies (76,000) and the large one (59,200); it almost doubles the overall average of the sector (78,100). This is consistent with another characteristic of the sector, in
which the larger companies have economies of scale in providing services that allow for lower rates.

The smaller companies show great differences in the average billing per client, with a maximum of 517,000 pesos per year and a minimum of 65,600 pesos a year.

The following are among the factors that account for these differences in the mean income per client among companies, whether it be their effect on rates (prices), and/or physical amounts invoiced (m³): client portfolio: residential, commercial, industrial; socio-economic level of the residential clients (high socio-economic levels consume more due to lawn watering, swimming pools, etc.); seasonal consumption (resorts and vacation areas); coverage differences in different areas of the services rendered (coverage in all or some of the areas, and wastewater disposal with or without treatment, all determine rate differences); and geographic location, which determines a higher or lower availability of raw water and, therefore, differences in the consumption cost.

Another important observation is that the medium-sized companies, as a group, have had stable average per client income, about 76,000 pesos during the last two years. In contrast, a drop in average income between 1998 and 1999 has been observed in small companies, even though four companies showed an increase in per-client income due to sales growth of more than 5% in actual terms. The only large company, EMOS, reported a drop in the mean income per client, from 64,600 to 59,200 pesos. This was due to a drop in its sales together with an increase in the number of clients.

An analysis of the geographic distribution of physical billing of drinking water (m³) includes the sample of 21 companies that provide services to more than 99% of the of the country's users.

In general, each region is mainly supplied by a single sanitation company that has exclusivity of service in practically all the urban zone. Exceptions to this rule are the Metropolitan and X Regions, where other smaller private sanitation companies provide service alongside a company that supplies 80% of the urban users - EMOS S.A. (78.3%), and ESSAL S.A. (79%). In these cases, the companies serve different geographic concession zones within the same region.

Total drinking water consumption in the country's urban areas was 905.6 million m³ during 1999, 2.2% less than the previous year, which was US$926.2 million per m³.

Of total 1999 consumption, 41.9% was supplied by EMOS and 37.3% by the group of 7 medium-sized companies. Both percentages are inverse to these companies' shares of total sector sales, which are 28.5% and 41.8%, respectively. Contrariwise, the group of smaller enterprises had a smaller share in the physical billing (20.8%) than in total sales (29.7%). This, again, is a reflection of the presence of economies of scale in the sector, that is, the larger companies have lower service costs, both per client and per m³.

With the total number of clients in the country estimated at approximately 3.35 million, average annual consumption is 272 m³ per client (per real estate property).

A higher rate of consumption per client is seen in the companies serving the Metropolitan Region, where it reaches an average of 272 m³. This, of course, is an important competitive advantage for these smaller companies whose unitary costs do not include the effect of the economies of scale inherent to larger size companies.

When the four companies with the highest average consumption per client are excluded, the sector average decreases 4.8%, from 272 m³ to 259 m³.
4.2.6 Final Disposal of Wastewater in Coastal Cities

The main Chilean coastal localities and their corresponding levels of final disposition of wastewater are the following:

Of 21 coastal localities with a total of 2,400,000 inhabitants, in 1999, a total of 57.5% of the urban population had wastewater treatment or with sanitation disposal in the sea. According to the country’s projections, by 2005, close to 100% of the population will have their wastewater collection system with treatment or with adequate ocean disposal. In 1999, the sanitation discharge to the sea was 567 m³/year, along with 45,834 m³/year of untreated sewage. According to projections for 2005, 141,319 m³/year will be discharged to the sea under adequate sanitation conditions.

In 1999, 9 million inhabitants lived in localities that discharge their wastewater into a body or course of freshwater. Of these, 12.42% of the population’s wastewater was treated; this percentage is expected to increase to 78.8% by the year 2005.

An analysis of the overall national situation, including all discharge sites, shows that 22.6% of the urban population had their wastewater treated in 1999. This percentage will increase to 70.8% in 2005 since a significant amount of investment in wastewater treatment is foreseen for the Metropolitan region (SISS, 2000).
Table 40 - Chile
Principal Coastal Localities and their Coverage of Treatment and Final Disposal of Wastewater Collected by Public Sanitation Services

<table>
<thead>
<tr>
<th>Localities</th>
<th>Estimated urban population as of 1999 in coastal localities</th>
<th>% coverage of wastewater treatment, 1999</th>
<th>% coverage of wastewater treatment, 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arica</td>
<td>180,923</td>
<td>99.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Iquique</td>
<td>169,950</td>
<td>84.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Antofagasta</td>
<td>251,306</td>
<td>91.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Tocopilla</td>
<td>28,880</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Chañaral</td>
<td>13,223</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>La Serena</td>
<td>132,549</td>
<td>98.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Coquimbo</td>
<td>136,232</td>
<td>96.3</td>
<td>99.0</td>
</tr>
<tr>
<td>Valparaiso</td>
<td>284,663</td>
<td>88.5</td>
<td>97.3</td>
</tr>
<tr>
<td>Viña del Mar</td>
<td>302,304</td>
<td>94.2</td>
<td>97.7</td>
</tr>
<tr>
<td>Quintero</td>
<td>18,524</td>
<td>0.0</td>
<td>95.1</td>
</tr>
<tr>
<td>San Antonio</td>
<td>84,508</td>
<td>0.0</td>
<td>97.0</td>
</tr>
<tr>
<td>Talcahuano</td>
<td>275,558</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Tomé</td>
<td>39,620</td>
<td>48.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Penco-Lirquén</td>
<td>45,096</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Lota</td>
<td>51,949</td>
<td>88.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Coronel</td>
<td>89,583</td>
<td>0.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Puerto Montt</td>
<td>126,045</td>
<td>0.0</td>
<td>99.7</td>
</tr>
<tr>
<td>Castro</td>
<td>24,070</td>
<td>0.0</td>
<td>96.3</td>
</tr>
<tr>
<td>Ancud</td>
<td>29,848</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Puerto Natales</td>
<td>15,781</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Punta Arenas</td>
<td>122,376</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Coastal cities population as of 1999</td>
<td>2,422,988</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: SISS, 1999

In 1999, the coastal city population with adequate waste disposal to the sea was 1,411,562 inhabitants; by the year 2005, this figure will be 2,531,927.

Finally, it can be said that in Chile, advancement has been made in domestic wastewater treatment at the urban level. This has been an improvement for the different economic groups, with the exception of the homeless population settlements.

There has been little progress in sanitation conditions in the clusters of artisan fishermen located along the coast. Therefore, they are socially and economically disadvantaged as compared to the rest of the rural population.

4.3 Ecuador
4.3.1 Institutional Organisation

Ecuador is ruled by a unitary system of government, and an autonomous sectional or decentralised regime that includes the Provincial Council and the Municipality. It has 22 provinces in which, until 1999, there were 214 cantons: two metropolitan cantons with populations of over one million inhabitants; 13 with between 100,000 and one million; 60 with 10,000 to 100,000; and 139 with fewer than 10,000 people.

Drinking water and sanitation services are ruled by the principles of efficiency and equity. On one hand, efficiency is maintained by means of optimum management of resources and institutional capabilities. This results in the lowest possible costs in providing services and the maximum recovery of costs, including all of the operational and maintenance expenses, and complete or partial recovery of investments. On the other hand, the social principle of having all users share the costs of the services equally is applied through a progressive rate schedule based on appropriate parameters.

The public water and sanitation system is structured to assume administrative powers in direction, planning, standardisation, supervision, execution, operation, and funding for the following institutions.

The directive authority of the sector is the Ministry of Urbanisation and Housing (MIDUVI), through the Undersecretary of Environmental Sanitation (SSA). This office establishes policies, plans, schedules and technical assistance.

The SSA is also the sector's technology authority, and is involved in technology transference in standardisation, management, environmental monitoring, technical assistance, engineering, construction, operation, maintenance, administration, research, information and training.

The standardisation authority for basic drinking water and sanitation services is the MIDUVI, through the SSA. This Undersecretariat works with the Ministry of Health, the Ministry of Environment, and with the regional environmental preservation entities.

The Ecuadorian Institute of Standardisation is the standardisation authority responsible for the quality of materials used in rendering services.

The regional environmental preservation entities are the authority in protecting and monitoring the water basins. These entities are responsible for the conservation activities of renewable and non-renewable natural resources, as well as for monitoring water, air and soil pollution that may result from the liquid, solid and gaseous wastes put out by of domestic, industrial, agricultural and vehicular sources.

Each municipality is the authority in charge of rendering public water and sanitation services, and they have legal power to concede service providing activities to other public or private entities and to approve the public rates of those services. The municipalities are responsible for monitoring the quality of water for domestic consumption, assessing the environmental impacts of industrial, domestic and agricultural pollutants, and proposing ways to mitigate those negative impacts to the regional environmental preservation entities.

The Ministry of Finance and Public Credit is the fiscal authority responsible for the timely transfer of general governmental budget resources for the development of the water and sanitation sector. It also approves the external credit allocated to investments.
The State Bank (Banco del Estado) is the lending authority that manages loans and grants enough credit to finance the pre-investment and investment projects for the sector's development.

It has been proposed that the Environmental Control Authority, or a similar entity which does not yet exist, be the regulatory and supervisory authority that watches over compliance with the law and that sanctions infractions based on the SSA auditing reports. This body would be autonomous with regard to executive powers.

The sector's institutional framework is still considered inadequate since there is duplication and overlapping of functions and powers. This results in insufficient coordination among the sector's public, private and international entities and disperses information.

4.3.2 Market Traits

Ecuador has an autonomous or decentralised regime that includes the Provincial Council and the Municipality.

Each municipality has the authority to provide public water and sanitation services. It has the legal power to concede the provision of services to other public or private entities and to approve the public rates of these services. There are municipal water and sanitation companies for the urban areas; in rural areas, the drinking water systems are operated by administrative committees.

There are an estimated 214 supply systems in the urban sector and approximately 3,500 systems in the rural sector.

Within the state's modernisation process, the possibility of transferring functions and responsibilities to regional and local entities has been considered, as well as having the private sector participate extensively in providing services and
managing the water and sanitation systems. However, it has not been possible to realise the schemes and conditions necessary for the private sector to become a full participant.

4.3.2.1 Population Served

The country is divided into four geographic regions: the Sierra or Mountain range, the Coast, the Eastern and the Insular Regions (Galapagos Archipelago). Population was estimated at 12,411,234 in 1999, of which 63.9% is located in the urban area (CEPAL, 2000).

The total number of inhabitants supplied with drinking water is 5,346,000 in the urban areas and 4,302,000 in the rural zones, for a national total of 9,648,000 inhabitants with access to drinking water and sewage services.

Table 41 - Ecuador
Population Distribution by Regions
1999 (in thousand of inhabitants)

<table>
<thead>
<tr>
<th>Region</th>
<th>Urban</th>
<th>%</th>
<th>Rural</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sierra</td>
<td>3,280</td>
<td>41.7</td>
<td>2,225</td>
<td>50.0</td>
<td>5,505</td>
<td>44.4</td>
</tr>
<tr>
<td>Coast</td>
<td>4,370</td>
<td>55.5</td>
<td>1,834</td>
<td>41.2</td>
<td>6,204</td>
<td>50.0</td>
</tr>
<tr>
<td>East</td>
<td>203</td>
<td>2.6</td>
<td>392</td>
<td>8.8</td>
<td>595</td>
<td>4.8</td>
</tr>
<tr>
<td>Insular</td>
<td>14</td>
<td>0.2</td>
<td>2</td>
<td>0.0</td>
<td>16</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>7,867</td>
<td>100.0</td>
<td>4,453</td>
<td>100.0</td>
<td>12,320</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Population Projections as of 1999. INEC - SSA.

Table 42 - Ecuador
Urban, Rural and Total Population
from 1990-1999 (in thousand of inhabitants)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>5,684</td>
<td>5,913</td>
<td>6,177</td>
<td>6,492</td>
<td>6,718</td>
<td>6,944</td>
<td>7,172</td>
<td>7,403</td>
<td>7,635</td>
<td>7,867</td>
</tr>
<tr>
<td>Rural</td>
<td>4,580</td>
<td>4,589</td>
<td>4,564</td>
<td>4,489</td>
<td>4,503</td>
<td>4,516</td>
<td>4,526</td>
<td>4,534</td>
<td>4,540</td>
<td>4,453</td>
</tr>
<tr>
<td>Total</td>
<td>10,264</td>
<td>10,502</td>
<td>10,741</td>
<td>10,981</td>
<td>11,221</td>
<td>11,460</td>
<td>11,698</td>
<td>11,937</td>
<td>12,175</td>
<td>12,320</td>
</tr>
</tbody>
</table>

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The following table shows the changes in water coverage (not necessarily drinking water) and sanitation in Ecuador during the 1990s.

### Table 43 - Ecuador
Changes in Water and Sanitation Coverage
(1990 - 1998)

<table>
<thead>
<tr>
<th>Year</th>
<th>Water</th>
<th>Sanitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Urban</td>
</tr>
<tr>
<td>1990</td>
<td>60.3</td>
<td>77.5</td>
</tr>
<tr>
<td>1991</td>
<td>62.5</td>
<td>78.6</td>
</tr>
<tr>
<td>1992</td>
<td>65.4</td>
<td>79.0</td>
</tr>
<tr>
<td>1993</td>
<td>66.8</td>
<td>79.0</td>
</tr>
<tr>
<td>1994</td>
<td>68.0</td>
<td>80.2</td>
</tr>
<tr>
<td>1995</td>
<td>69.3</td>
<td>81.4</td>
</tr>
<tr>
<td>1996</td>
<td>69.7</td>
<td>81.5</td>
</tr>
<tr>
<td>1997</td>
<td>69.9</td>
<td>81.4</td>
</tr>
<tr>
<td>1998</td>
<td>70.3</td>
<td>81.5</td>
</tr>
</tbody>
</table>

Source: SSA (1999)

It is interesting to note that the arithmetic median increase in total drinking water coverage was 1.11% per year, while in sanitation it was only 0.66% yearly. The rate of change in water is not uniform; there were leaps in service between 1990 and 1994, but then relative stagnation from 1995 to 1998. Sanitation progressed at a regular rate up to 1994, and then also stagnated from 1995 to 1998. A simple linear forecast indicates that if the annual median rate remains unchanged, water coverage could reach 100% in 26 years and full sanitation coverage could be obtained in 63 years.
**Table 44 - Ecuador**  
Population with Access to Water Systems Already Operating and/or in Operation:

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Urban Population (in thousands)</th>
<th>Rural Population (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population supplied with residential connection</td>
<td>5,872</td>
<td>1,907</td>
</tr>
<tr>
<td>Population without residential connection, but with access to a close public water source</td>
<td>348</td>
<td>428</td>
</tr>
<tr>
<td>Total population supplied</td>
<td>6,220</td>
<td>2,335</td>
</tr>
<tr>
<td>Total population without service</td>
<td>1,415</td>
<td>2,205</td>
</tr>
</tbody>
</table>

Date of the information: (year/month): 1998/December

**Table 45 - Ecuador**  
Distribution of Clients and Population by Type of Sanitation Technology: Individual, (Septic Tank, Latrines) Public (Sewage System) No Service (Poverty)

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Supplied Population (in thousands)</th>
<th>Definition Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitation</td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>1. Private sewage connection</td>
<td>3,196</td>
<td>359</td>
</tr>
<tr>
<td>2. Septic tank, domestic latrine</td>
<td>1,423</td>
<td>1,121</td>
</tr>
<tr>
<td>3. Other types</td>
<td>727</td>
<td>2,822</td>
</tr>
<tr>
<td>Total</td>
<td>5,346</td>
<td>4,302</td>
</tr>
</tbody>
</table>

**Table 46 - Ecuador**  
Population Supplied with Adequate Elimination of Excretions:

<table>
<thead>
<tr>
<th>Type of Technology</th>
<th>Urban population (in thousands)</th>
<th>Rural Population (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with residential connections to sewage network</td>
<td>4,887</td>
<td>473</td>
</tr>
<tr>
<td>Population without residential connections but with adequate &quot;in situ&quot; private or shared systems</td>
<td>694</td>
<td>1,208</td>
</tr>
<tr>
<td>Population fully supplied</td>
<td>5,381</td>
<td>1,681</td>
</tr>
<tr>
<td>Population without service</td>
<td>2,254</td>
<td>2,859</td>
</tr>
</tbody>
</table>
4.3.2.2 Characteristics of Water Resources: Actual and Potential Water Supply and its Geographic Distribution

Ecuador is amply supplied with water in the global context. Superficial and groundwater resources amount to some 432,000 hm³/year (432 km³/year), according to a study carried out for the National Water Resources Plan. With a total area of 256,370 km², this represents a "specific run-off" of about 1,680 mm/year, significantly higher than the world median of 300 mm/year. Thus, for the Ecuadorian population of 12.32 million, in 1999, the country had an average of 35,060 m³ per year per inhabitant in water resources.

According to projections, by 2005 Ecuador will be consuming some 41.5 m³ of fresh water, 9.62% of the total amount available. Of this, 3.2% will be put to domestic, industrial or commercial use, and 96.8% shall be for agricultural use.

<table>
<thead>
<tr>
<th>Administrative Models</th>
<th>Population (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct public supply (Municipality)</td>
<td>2,061</td>
</tr>
<tr>
<td>Public supply with service contract</td>
<td></td>
</tr>
<tr>
<td>Management Contract (Esmeraldas)</td>
<td>129</td>
</tr>
<tr>
<td>Rentals</td>
<td></td>
</tr>
<tr>
<td>Concessions (including construction, operation and transference, etc.)</td>
<td></td>
</tr>
<tr>
<td>Private enterprise (with private majority shareholding)</td>
<td></td>
</tr>
<tr>
<td>Other (specify): Drinking Water and Sanitation Companies</td>
<td>5,445</td>
</tr>
</tbody>
</table>

Ecuador has a national policy of community management of rural water and sanitation services. 3.3% of the rural communities manage their water and sanitation systems autonomously.

In either level of public management, central or sectional, the role of private initiative will be in the various components of policy application and in consulting, construction, supervision, management, technical assistance, training and funding, or in the administration of companies as contractors, concessionaires or entrepreneurial partners.

The participation alternatives of private corporations are service contracts, management costs, commercial rentals and concession contracts.
4.3.3.1 Continuity, Water Quality, Losses

Ninety-five percent of the water systems provide intermittent service, and average availability was estimated at 18.27 hours per day in 1999. The study indicates that 60% of the networks use purification systems on water delivered to the population in urban areas. In Guayaquil, the largest city with 2,100,000 inhabitants, only 76% of the water distributed has acceptable residual chlorine levels, and 24% of drinking water tests do not meet national standards. Although there is no information on the rural area, it is probable that the great majority of the inhabitants receive unpurified, and therefore unsafe, water.

4.3.3.2 Sanitation and Domestic Wastewater Treatment

Of the total residual waters collected by the sewage networks, only 5% is purified. The most widely used system is the oxidation ponds. The remaining 95% is dumped raw to the natural bodies of water.

4.3.4 Rates, Investments

There is clearly a strong state subsidy since, on average, the water rate, what the user actually pays per each cubic meter consumed (US$ 0.0362), covers only 26.2% of the median production and distribution costs. Even when water and sewage rates are combined and compared with only the water service cost, the income still covers no more than 36.2% of the cost. Therefore, around 1% of the water system’s operation and maintenance costs has to be covered, like it or not, by someone other than direct users, and this still does not even come close to paying the investment costs. This emphasises the lack of funding needed for major repairs and for replacement of works.

On the other hand, what each household (with a residential connection) pays per inhabitant monthly for water and sanitation is around US$1.00, much lower than the ceiling amount for this item mentioned internationally (5% of the monthly household income).

In poorer urban neighbourhoods, water is frequently available only by tank trucks, and the users pay nearly US$1.00 for a cubic meter of water of doubtful quality.

The following table shows urban costs and rates per type of service.
### Table 48 - Ecuador
**Costs and Rates**

| **Date of Information:** (year/month): 1999/09 |  
| 1. Costs and rates of urban services |  
| a. Average costs of water production/distribution | $0.138 US$/m$^3$  
| b. Average water rate | $0.0362 US$/m$^3$  
| c. Average sewage rate | $0.0138 US$/m$^3$  
| 2. Basic monthly expenses per inhabitant for water services |  
| Users supplied with residential connection | $0.145 US$/month  
| Users served with public systems (public fountains, etc.) | $0.145 US$/month  
| 3. Basic monthly expenses paid per inhabitant for sanitation services |  
| Users supplied with residential treatment connections | $0.0551 US$/month  
| Users supplied with residential connections without treatment |  
| Users supplied with sanitation “in situ” | $0.0551 US$/month  
| 4. Unitary costs |  
| National estimate of construction costs per person supplied | $US$/persona  
| (a) Water supply systems |  
| Conventional systems with distribution with: |  
| - Urban residential connections | $142  
| - rural residential connections | $125  
| - urban public sources |  
| - rural public sources |  
| Public sources: |  
| - wells with manual pumps | $30  
| - protected wells | $20  
| - rainwater collection |  
| (b) Sanitation system |  
| - Sewage system with urban residential connection | $155  
| - Sewage system with rural residential connection | $145  
| - Small diameter sewage with urban residential connection | $130  
| - Small diameter sewage with rural residential connection | $130  
| - Residential connection and septic tank | $100  
| - Latrine with water discharge | $100  
| - Dry latrine (improved ventilation) | $80  
| - Simple latrine over pit | $60  

Source: OPS, 2000

In the seventies, public investment in water and sanitation per person per year was an average of US$7.40, but it was reduced to US$3.50 between 1982 and 1987. From 1990 to 1999, such investment increased to US$11.30 (with 29.6% from external resources).

To meet projections on future investment requirements in different scenarios, to elevate coverage to 98% of the population, both in water and sanitation service, would require US$1,482.4 million in 10 years, or approximately US$11 per person (total population) per year. This seems financially feasible if the investment levels of the 1990s remain steady, but it would require approximately 2.5% per year in compared to the 1.11% of the
nineties, and 3.6% per year for sanitation compared to the 0.66% of the nineties. This does not include the requirements for wastewater treatment, with which the amount would reach US$44 per person (total population) per year.

4.3.5 Commercial and Financial Information

The infrastructure history of these and most other services demonstrates that, in general, there has always been a trend to favour investment over administration, cater to political situations, and not pre-invest adequately. Conservation and good operation of the works is overlooked, producing two problems: bad service is provided and the facilities are damaged. Thus, funding is misused and users become frustrated, some of whom are not in conditions of rational use and complete payment. An outcome of all these circumstances is inequity, inefficiency, and a lack of sustainability; municipal administrative and financial procedures do not allow for good billing systems and cost recovery.

The following are financial figures from 1998: operational income, 3.6 million pesos; operational costs, 7.8 million; and total profit (loss), -4.2 million pesos.

In general, small municipalities, which account for 71% of the total, do not have the human and financial resources necessary to provide adequate, dynamic services, and few have chosen the alternative of regional association to share costs and to benefit from economies of scale. In the rural environment, many systems halt their operations after a short term of service because the community was not involved soon enough, the Administrative Committees did not find support, or insufficient rates were set.

4.3.6 Final Disposal of Wastewater in Coastal Cities

The current situation of liquid effluents, both household and industrial, have a very negative impact on the environmental health of the country. At this time, some 15 cubic meters of raw municipal sewage may be dumped per second per day into the various bodies of water in the country, and the deterioration in sites where there is no natural dilution is much worse than the average.

The country's 19 coastal cities are located in the provinces of Esmeraldas, Manabi, Guayas and El Oro. These cities are:

- Esmeraldas Province: Esmeraldas, Eloy Alfaro and San Lorenzo.
- Manabi Province: Portoviejo, Jipijapa, Manta, Montecristi, Roca Fuerte and Bahía de Caráquez.
- Guayas Province: Guayaquil, Naranjal, Mangaralto, Salinas, La Libertad, Santa Elena and Playas.
- Oro Province: Machala, Arenillas and Santa Rosa.

The total population of the coastal localities is 3,173,984 inhabitants, with 75% drinking water and 58% sewage coverage. 12% of the population disposes of their wastewaters in septic tanks and 7% in latrines.
4.4 Panama

4.4.1 Institutional Organisation

In July of 1998, Panama passed the General Law on Environment and created the National Environmental Authority (Autoridad Nacional del Ambiente, or ANAM) as an autonomous state entity governing matters relating to natural resources and the environment.

As of 1999, the Government of Panama has given high priority to the health sector, which includes, among others, drinking water supply and sanitation services. Apart from making possible the privatisation of the Instituto de Acueductos y Alcantarillados Nacionales [the Institute of National Aqueducts and Sewers], the principal supplier of these services in the country, it also provided the decisive impulse for furnishing basic sanitation services to those communities which did not have them. It also aims to create the mechanisms for improving the existing services by strengthening the institutions in charge of the sector.

Despite having satisfactory levels on drinking water and sanitation service coverage and access, as compared with other Latin American countries, investments in this sector during the last decade were practically at a standstill, and the entities involved deteriorated both administratively and financially. This brought about the vulnerability of the urban systems in both the drinking water and the sewage systems due to increasing water losses, exceeding the design parameters, weakening of the commercial activities, and limited investment in new projects and attention to the existing systems.

In rural areas, investments in new aqueducts and sanitation installation programmes came to an almost complete halt, with the consequent deterioration of the systems managed by community committees with little significant support from the Ministry.

In January of 1996, as part of the state restructuring process, the Ente Regulator de los Servicios Públicos [Public Services Regulatory Entity] was created, whose attention was directed towards incorporating the private sector into the supply and management of the electrical power, telecommunications, drinking water and sanitation services. January 1997 saw the enactment of the Regulatory and Institutional Guidelines for the Supply of Drinking Water and Sanitation Sewer Services [" Marco Regulatorio e Institucional para la Prestación de los Servicios de Agua Potable y Alcantarillado Sanitario"] in Decree Law No. 2. Its purpose was to establish the following:

The regulatory framework governing all activities related to the providing of public services for supplying drinking water and sanitation sewers, which were considered as public utility services, with the goal of promoting the uninterrupted supply of these services to the entire population of the country, under conditions of high quality and at economic prices, while utilising natural resources in a sustainable way and protecting the environment.

The legal framework for regulating the rights, powers and obligations of the service suppliers and their customers, the rate structure, and payment of services. It also introduces the participation of the
public sector, the private sector, and mixed sectors in providing those services.

The principal organisations related to this sector are:

The Ministry of Health (Ministerio de Salud or "MINSA").

The executive branch of the Ministry of Health (MINSA) is in charge of formulating and co-ordinating policies, and long term planning. Among other functions are the following: to establish mechanisms which motivate the service providers to operate in an efficient and businesslike manner; to dictate technical standards; to formulate policies, programmes and mechanisms for the development and maintenance of services in rural areas, to co-ordinate programmes of technical co-operation and technical and administrative research, and to develop human resources in the sub-sector; to establish mechanisms of co-ordination with other non-governmental organisations for orientation, training, and consciousness-raising regarding the value and use of water resources.

As part of its function of preventative health, the Ministry of Health is assigned the task of monitoring the quality of drinking water which is supplied to the population, and monitoring the quality of the sewage discharged into receiving bodies, in co-ordination with the Ente Regulator de los Servicios Públicos [Public Services Regulatory Entity] and the service providers.

The Institute of National Aqueducts and Sewers (Instituto de Acueductos y Alcantarillados Nacionales or IDAAN) is an autonomous state entity whose purpose is to reduce the morbidity and mortality rates of illnesses originated by water in order to improve the level of health, wellbeing and progress in the country by providing safe drinking water and safe collection and disposal of wastewater from communities with populations of over 1,500 throughout the country.

In addition to regulating the sector, the Public Services Regulatory Entity also controls, supervises and inspects drinking water and sanitation supply services.

Specifically, it has the following functions and attributions: to comply with and to enforce Decree Law No. 2 and other complementary legal norms, including technical standards, instructions and resolutions related to the service providing; therefore, it must efficiently monitor and verify the suppliers and the services they provide to the customers; to dictate regulations for the formulation of investment programmes for the maintenance, renovation, and expansion of the service supply systems, and verification of compliance; to impose penalties on offenders in the area of standards under its jurisdiction; to recommend to the relevant authorities the approval of concessions for the extraction of water, and to approve and monitor the rate structure for the services sector.

A large part of the aforementioned Decree Law No. 2 focuses on the subject of incorporating the private sector into the services corresponding to this sector; forms of management, modes for participation by the private sector in these services, and the mechanisms and formalities for the tender and contracting process in the event that some of the modes are eventually adopted for incorporating this sector into the services currently provided by IDAAN.

Some of the modes mentioned in the Decree Law for participation are: short-term service contracts for certain defined functions related to the services, between the state company and private companies; limited time administration or management contracts for all or part of the functions of the state company or entity; long term concession contracts for all of the functions of the state company or entity; BOO (build - operate - own) contracts; BOT (build - operate - transfer)
contracts; and public sale of the shares of the State or Municipal company or entity, or parts of these transformed into corporations.

The Office of the General Comptroller of the Republic is responsible for controlling public funds.

The Public Ministry is in charge of defending the interests of the State.

The Office of the Public Defender defends the interests of citizens.

The Emergency Social Fund, which is an entity attached to the Ministry of the Office of the President, is a permanent social investment fund which includes the processes of design, formulation, and financing of projects, among which are those of installing latrines, sanitation sewers, wells and rural aqueducts, among others.

The National Environmental Authority (Autoridad Nacional del Ambiente or ANAM) is an autonomous state entity which governs matters relating to natural resources and the environment, whose function is to ensure compliance with and application of the laws, regulations and national policies regarding the environment.

There are many actors involved in the management of water resources, principally due to the various different uses to which these resources can be put: the supply of drinking water, the functioning of the Canal, recreational use, farming, fishing, shipping, industrial, and power generation. This has brought about the coexistence of conflicts of interests, overlaps, and duplication of functions, without taking into account any integral planning of the areas of jurisdiction of each of the institutions and organisms involved.

Figure 8 - Panama
Institutional Organisation - Urban Sector

Figure 9 - Panama
4.4.2 Market Characteristics

4.4.2.1 Population Served

In 1999, the population of the Republic of Panama stood at 2,811,278 (CEPAL, 2000), with a growth rate, between 1995 and 2000, of 16.4, of which 23.1 corresponds to the urban population. In 1996 it was estimated that drinking water coverage reached 87% of the population, while the figure for sewage was 35%.
### Table 49 - Panama

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with residential connection</td>
<td>1,281.1</td>
</tr>
<tr>
<td>Population with no residential connection, but with nearby access to drinking water</td>
<td>13.3</td>
</tr>
<tr>
<td>Total Population with service</td>
<td>1,294.4</td>
</tr>
<tr>
<td>Total Population without service</td>
<td>182.3</td>
</tr>
<tr>
<td>Total Population</td>
<td>1,476.7</td>
</tr>
</tbody>
</table>

Source: OPS, 2000

### Table 50 - Panama
**Urban Sanitation Coverage in 1996**

<table>
<thead>
<tr>
<th>Type of Technology</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with residential connections to the sewage system</td>
<td>946.0</td>
</tr>
<tr>
<td>Population with no residential connections, but provided with proper &quot;in situ&quot; services, either private or shared.</td>
<td>510.8</td>
</tr>
<tr>
<td>Total population with service</td>
<td>1,456.8</td>
</tr>
<tr>
<td>Total population without service</td>
<td>19.9</td>
</tr>
<tr>
<td>Total population</td>
<td>1,476.7</td>
</tr>
</tbody>
</table>

Source: OPS, 2000
Table 51 - Panama
Rural Drinking Water Coverage in 1996
Rural Population with Access to Drinking Water System
(In Thousands)

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with residential connection</td>
<td>912.1</td>
</tr>
<tr>
<td>Population with no residential connection but with access to a nearby public drinking water source</td>
<td>116.2</td>
</tr>
<tr>
<td>Total population with service</td>
<td>1,028.3</td>
</tr>
<tr>
<td>Total population without service</td>
<td>169.5</td>
</tr>
<tr>
<td>Total population</td>
<td>1,197.8</td>
</tr>
</tbody>
</table>

Source: OPS 2000

Table 52 - Panama
Rural Sanitation Coverage in 1996
Rural Population with Access to Proper Elimination of Excretions
(In Thousands)

<table>
<thead>
<tr>
<th>Type of Technology</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with residential connection to the sewage system</td>
<td>3.2</td>
</tr>
<tr>
<td>Population with no residential connection, but provided with proper &quot;in situ&quot; services, either private or shared</td>
<td>1,033.4</td>
</tr>
<tr>
<td>Total population with service</td>
<td>1,036.6</td>
</tr>
<tr>
<td>Total population without service</td>
<td>161.2</td>
</tr>
<tr>
<td>Total population</td>
<td>1,197.8</td>
</tr>
</tbody>
</table>

Source: OPS, 2000

The above tables present, by type of solution, the urban and rural populations provided with drinking water supply and sanitation services in 1996.
4.4.2.2 Characteristics of the Water Resources: Current and Potential Water Supply and Geographical Distribution

Due to the location of the country, the geographical configuration, and the predominance of rainy and very rainy tropical climate areas over the accentuated dry tropical climate, Panama has ample water resources.

Water is taken from Alajuela Lake, which was manmade through the damming of rivers, to provide drinking water to most of Panama City. Groundwater is abundant and of good chemical quality in most areas of the country, though there are regions where it is scarce, hard, or salty.

Surface water is abundant and also of good chemical quality. In most regions of the country and in cases such as Alajuela Lake, even untreated water has drinking water quality levels close to those recommended by international guideline standards. However, it should be emphasised that there are regions with water shortages and serious competition for the use of water.

4.4.3 Management Indicators

4.4.3.1 Continuity, Water Quality, Losses

In urban areas, deficiency in the drinking water supply occurs mainly in the peripheral areas of the big cities, where in some cases there are areas with no service at all, or where the service is intermittent.

Intermittent service occurs in 27.1% of the urban systems, and affects 25.4% of the population served by the systems. In urban areas, the drinking water supply is typically available for 20 hours per day.

Even when the water is largely treated in conventional treatment plants, and all the water provided is disinfected, there are risks of contamination at in the distribution system and in the home due to the intermittent nature of the service. In residences, water contamination is related to the proliferation of storage tanks, which are not maintained or handled correctly, and in the distribution system due to loss of pressure related to the discontinuation of the service.

With the current service system, a large percentage of the water is unaccounted for, due to the lack of metering both at the production stage (output of treatment plants) and in distribution (residential connections) (OPS, 2000).
4.4.3.2 Sanitation and Treatment of Household Sewage

The sanitation sub-sector has improved in coverage. Considering that in 1990 coverage was 86.9%, and according to the latest available data coverage is now at 93.2%, there has been an increase of 6.3%.

Coverage at the urban level has remained stable at 98.7%. However, the situation of these services is no different from that of the drinking water sub-sector. Although it is true that there are black water collection services in most parts of urban areas, these wastewaters are discharged into watercourses and creeks with only primary treatment even in the best of cases, thus contaminating them. In Panama City, all sewage system outlets feed directly into the Bay. The situation of the sewage systems is critical, as they have had hardly any maintenance. In many cases, there is insufficient capacity, as well as damage to both the primary and secondary sewage channels, and in some cases there is deterioration due to the systems having grossly exceeded their useful life.

Likewise, the treatment of black waters is considered inadequate, as only ponds and Imhoff tanks are used for treatment. Most city subdivisions rely on septic tanks, and maintenance of these is scarce.

Only 18.3% of the wastewater collected by the sewage systems is connected to an operating treatment facility.

It should be mentioned that IDAAN, the institution in charge of these systems, provides the services free of charge.

In rural areas, sanitation coverage increased from 61.9% in 1990 to 85.95% in 1996 (OPS, 2000).

The population served mainly uses latrines, which are built by the community itself with support from the Ministry of Health and FES.

This significant increase is also due to the investments made by FES and to the implementation of the Rural Health Programme carried out by MINSA (Ministry of Health).

It should be mentioned that, even where coverage is acceptable, there are marked differences in sanitation between rural populations. Those that are furthest away, where access is difficult, have the most serious problems, as is the case, for example, in Darién Province and in the District of Kuna Yala (San Blas).
Table 53 - Panama
Service Level: Urban and Rural (Type of Technology) 1996
Population Provided with Proper Disposal of Excretions (In thousands)

<table>
<thead>
<tr>
<th>Type of Technology</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with residential connections to the sewage system</td>
<td>946.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Population with no residential connections, but with adequate &quot;in situ&quot; systems, either private or shared</td>
<td>510.8</td>
<td>1,033.4</td>
</tr>
<tr>
<td>Total population with service</td>
<td>1,456.8</td>
<td>1,036.6</td>
</tr>
<tr>
<td>Total population without service</td>
<td>19.9</td>
<td>161.2</td>
</tr>
<tr>
<td>Total population</td>
<td>1,476.7</td>
<td>1,197.8</td>
</tr>
</tbody>
</table>

Source: OPS, 2000

4.4.4 Rates, Investments

The rating system has remained unchanged since 1982, as there are political difficulties in setting rates based on the economic cost of the service. There is also a lack of coverage of correct metering devices, with the consequent inadequate generation of resources destined to finance the investment programme in drinking water and sewage systems.

Just as in urban areas, even though the rates charged are minimal (from US$0.50 to US$2.00 per month, per family), the level of past due accounts reaches significant figures, limiting the resources available for performing maintenance on the systems.

So far this decade, the Institute of National Aqueducts and Sewers (Instituto de Acueductos y Alcantarillados Nacionales or IDAAN) has abandoned the developmental mindset for which it was known in the 70s and early 80s, when it focused on planning and building new works. Instead, during this decade its efforts and limited investments have been aimed at just maintaining the existing systems. In this period, these systems have suffered progressive damage since, in many cases, they have not been operated and maintained properly.

Even these efforts have not been enough; currently, the problems which have plagued this Institution have persisted, or rather have worsened, greatly limiting the development of this sector. The problems include: vulnerability of the systems due to lack of proper maintenance; imbalances between supply and demand due to high consumption; a lack of metering systems; a high percentages of "missing" water; inappropriate rates (current rates date from 1982); lack of proper business development; lack of technical management training programmes based on the systems' requirements; loss of specialised technical and professional personnel; lack of financial and functional autonomy; among others.

Investment in sewage systems in this decade, approximately US$4.6 million, has been practically null, if the needs are
taken into account. Currently, the Panama City and Bay Sanitation Master Plan is being implemented, financed by resources from the BID.

The process of restructuring the sector has had an effect on the condition of the Institute. It fell into administrative and executive lethargy in the final years of the decade due to the vision of including the private sector in the providing of services. A total of only around US$31 million was invested in the years after 1995, which represents about 33% of the total amount invested in urban aqueducts in the entire decade, estimated at US$93 million.

### Table 54 - Panama

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban Drinking Water</th>
<th>Urban Sanitation</th>
<th>Rural Drinking Water</th>
<th>Rural Sanitation</th>
<th>Foreign Drinking Water</th>
<th>Foreign Sanitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>5.16</td>
<td>0.25</td>
<td>0.32</td>
<td>0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1991</td>
<td>5.88</td>
<td>0.69</td>
<td>1.10</td>
<td>0.13</td>
<td>0.16</td>
<td>-</td>
</tr>
<tr>
<td>1992</td>
<td>7.42</td>
<td>0.49</td>
<td>2.17</td>
<td>0.17</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1993</td>
<td>6.78</td>
<td>0.90</td>
<td>1.02</td>
<td>0.09</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1994</td>
<td>11.06</td>
<td>0.97</td>
<td>1.30</td>
<td>0.20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1995</td>
<td>4.63</td>
<td>0.13</td>
<td>0.94</td>
<td>0.38</td>
<td>2.78</td>
<td>0.38</td>
</tr>
<tr>
<td>1996</td>
<td>3.28</td>
<td>0.13</td>
<td>1.15</td>
<td>0.34</td>
<td>0.94</td>
<td>0.19</td>
</tr>
<tr>
<td>1997</td>
<td>5.99</td>
<td>0.70</td>
<td>1.08</td>
<td>0.20</td>
<td>0.93</td>
<td>0.35</td>
</tr>
<tr>
<td>1998</td>
<td>3.44</td>
<td>0.32</td>
<td>2.08</td>
<td>0.37</td>
<td>0.91</td>
<td>0.12</td>
</tr>
<tr>
<td>1999</td>
<td>3.39</td>
<td>0.31</td>
<td>2.78</td>
<td>0.52</td>
<td>1.10</td>
<td>1.57</td>
</tr>
<tr>
<td>Average</td>
<td>5.70</td>
<td>0.49</td>
<td>1.40</td>
<td>0.25</td>
<td>0.88</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Source: OPS, 2000

Future investment needed over the next 30 years in the urban sector has been identified. The investment projection was performed within the context of the Character Study done for those systems where the responsibility for maintenance falls to IDAAN. It is estimated that the investment required to maintain the systems and/or to increase coverage over the next 30 years amounts to approximately US$516 million. A large percentage of this investment will be needed between the years 2000 and 2010, when it is estimated that an investment of US$103.43 million will be needed in drinking water systems, and US$207.89 million in sanitation sewage systems, for a total of US$311.32 million.

In the rural sector, where the responsibility does not fall to IDAAN, pragmatic mechanisms are required for the construction, operation and maintenance of these services, mainly in those areas of scarce resources.

It should be noted that the investment levels required for providing services in rural areas have not been identified. For
these purposes, progress is being made by means of the Character Study that is currently being performed for that area.

Due to the lack of this information, this analysis has made some projections regarding the investments which will be required. Based on the population (in thousands) served in 1996, and setting the horizon as the year 2010, by which time it is proposed to reach and serve a population of 1,244.3 with drinking water and 1,100.8 in 2000 with sanitation, the populations which will be served were established for each year in the period between 1996 and 2010.

The average investment indicator (expressed in US$ per person served, including both local and foreign investment, since MINSA and FES executed programmes with the support of foreign financial institutions) for the last six years in which investment was large and constant, was then applied to these figures for the population to be served, thus obtaining the investment required to maintain and/or increase the coverage for each year of the period. The average indicators calculated as described above turned out to be US$3.50 for drinking water and US$0.71 for sanitation; total investment for the period 2000-2010 was calculated to be nearly US$45.0 million for drinking water and US$9.2 million for sanitation. This would achieve drinking water coverage of 92.6% (population served: 1,244.3 / total population: 1,344.1) and sanitation coverage of 93.5% (population served: 1,256.6 / total population: 1,344.1).

The total figure of US$54.1 million (45.0 + 9.2) represents a first approximation, until better projections can be obtained after completing the relevant evaluations and diagnosis through the Character Study which is presently underway.

Based on this figure, total investment required for the next decade (2000 to 2010) would be US$365.42 million, with an annual average investment in the area of US$36.5 million, roughly equivalent to almost three times the annual average investment which has occurred in the present decade, at approximately US$13.1 million.

### Table 55 – Panama
**Financial Sources 1996-1998**

<table>
<thead>
<tr>
<th>FINANCIAL SOURCE</th>
<th>TOTAL INVESTMENTS (IN THOUSANDS OF BALBOAS)</th>
<th>1996</th>
<th>1997</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROGRAMMED INVESTMENTS</td>
<td></td>
<td>9,760,400</td>
<td>9,883,300</td>
<td>6,119,000</td>
</tr>
<tr>
<td>IDAAN</td>
<td></td>
<td>8,265.4</td>
<td>3,459,000</td>
<td>5,557,000</td>
</tr>
<tr>
<td>CENTRAL GOVERNMENT</td>
<td></td>
<td>1,495,000</td>
<td>6,273,300</td>
<td>562,000</td>
</tr>
<tr>
<td>EXTERNAL</td>
<td></td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>OTHER</td>
<td></td>
<td>0.0</td>
<td>151,000</td>
<td>0.0</td>
</tr>
<tr>
<td>EXECUTED INVESTMENTS</td>
<td></td>
<td>5,020,300</td>
<td>9,605,400</td>
<td>5,904,000</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td>51.4%</td>
<td>97.2%</td>
<td>99.5%</td>
</tr>
<tr>
<td>DIAN</td>
<td></td>
<td>4,877.6</td>
<td>2,902.5</td>
<td>5,342,000</td>
</tr>
<tr>
<td>CENTRAL GOVERNMENT</td>
<td></td>
<td>142,700</td>
<td>6,557,200</td>
<td>522,000</td>
</tr>
<tr>
<td>EXTERNAL</td>
<td></td>
<td>0.0</td>
<td>0.0</td>
<td>40,000</td>
</tr>
<tr>
<td>OTHER</td>
<td></td>
<td>0.0</td>
<td>145.7</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: annual investment closing, planning office
4.4.5 Commercial and Financial Information

The amounts which were invoiced and actually collected from the total sale of water within the sector during 1998, were approximately $6,424,500 and $5,677,500 balboas respectively, which means that collections were equivalent to just 88.4% of invoices. This is a decrease of 2.7% in real terms with respect to 1998.

4.4.6 Final Disposal of Wastewater in Coastal Cities

The main wastewater discharges on the coast are from Panama City and the Bay, which take place without any previous treatment. Currently, the Master Plan for the Sanitation of Panama City and the Bay is being prepared.

4.5 Peru

4.5.1 Institutional Organisation

Water resources in Peru are owned by the state, which sets forth, by law, the conditions for their use. The most recent Constitution (1993) establishes that renewable and non-renewable natural resources are part of the nation's legacy and that the state plays a sovereign role in determining how they are exploited. Conditions for using these resources are established by means of an Organic Law, as are concessions to the private sector. The concessions grant rights to the holder which are subject to the pertinent legal provisions.

The Ministry of the Presidency (PRES) is the regulatory agency for water and sanitation. It is responsible for policy making and for establishing the general standards for the sector. One of its tools is the National Drinking Water and Sewage Programme (PRONAP), which is responsible for implementing the Support Programme for Basic Sanitation (PASSB).

Government project planning and implementation is financed by the National Housing Fund (FONAVI) in urban areas. The National Compensation and Social Development Fund (FONCODES), attached to the Office of the President of the Republic, is responsible for funding and supervising works in rural areas.

The National Sanitation Services Authority (SUNASS), attached to the Ministry of Finance and Economic Affairs (MEF), is responsible for regulatory functions. The MEF is responsible for policy making, issuing supplementary regulations on sanitation services and rates, and for inspecting services rendered, in addition to applying penalties and promoting the development of service providers (EPS).

Provincial municipalities are responsible for providing sanitation services in areas under their jurisdiction, except for the Lima metropolitan area. The latter is entrusted to a company called SEDAPAL (Servicios de Agua Potable y Alcantarillado de Lima). Municipalities grant management rights to these services to EPS, which may be public, private or mixed, and with the capacity to exploit either totally or partially one or more sanitation services. EPS may be created with at least 1,000 residential hook ups, that is, in towns with populations of over 6,000. In rural areas, the services are exploited by the community through Sanitation Services Administration Boards, called JASS. The operations of the JASS are regulated by the SUNASS.

The Ministry of Health, through DIGESA, is responsible for supervising the quality of
water delivered to the public and the regulations on environmental sanitation. The Ministry of Agriculture grants the right to use water resources, while the Ministry of Finance and Economic Affairs regulates the financial activities of state-run companies.

Figure 10 - Peru
Institutional Organisation

There are currently no private EPS's in Peru, given that the privatisation initiatives of SEDAPAL and, to a lesser extent, of EPS-GRAU, responsible for the service in most provinces in the district of Piura, did not materialise. However, EPS's encourage private sector participation in the operation and maintenance of the systems and in commercial matters (billing, meter readings, etc.) which are carried out by private companies on behalf of many EPS's.

In rural areas the services are exploited by the communities through Sanitation Administration Boards (JASS).
4.5.2 Market Features

4.5.2.1 Population Covered

Estimates prepared by the National Information and Statistics Institute (INEI) show that Peru had a population of 24,800,700 inhabitants in December 1998, with a growth rate of 1.8%. The projected population for 2010 is 29,885,340 inhabitants, with 21,517,445 urban (72%) and 8,367,895 rural inhabitants.

There was considerable growth in the water and sanitation sector in the period 1988-1998. Drinking water coverage rose from 58.4% in 1988 to 70.6% in 1993 and to 75.4% in 1998, while sanitation went from 47% in 1988 to 63.5% in 1993 and to 73.7% in 1998.

Table 56 - Peru
Water and Sanitation Coverage (percentage)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water*</td>
<td>58.4</td>
<td>70.6</td>
<td>75.4</td>
</tr>
<tr>
<td>Sanitation**</td>
<td>47.0</td>
<td>63.5</td>
<td>73.7</td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water*</td>
<td>67.2</td>
<td>88.7</td>
<td>88.8</td>
</tr>
<tr>
<td>Sanitation**</td>
<td>54.3</td>
<td>82.5</td>
<td>89.5</td>
</tr>
<tr>
<td>Rural</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water*</td>
<td>22.3</td>
<td>36.2</td>
<td>50.6</td>
</tr>
<tr>
<td>Sanitation**</td>
<td>6</td>
<td>27.0</td>
<td>39.5</td>
</tr>
</tbody>
</table>

1993 - National Census - INEI
1996 - National Decade Evaluation Team

* Includes the public water pipeline inside and outside homes, public water fountains and wells
** Includes the public sewage system, latrines or "in situ" disposal

From the above table one can infer that Peru has seen a considerable increase in water and sanitation coverage over the previous decade, with a higher percentage in rural areas.

113
Table 57 - Peru
Water Supply Coverage by Type of Service in Urban and Rural Areas and Nationwide

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of the population with residential hook up</td>
<td>67.6%</td>
<td>76.3%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Percentage of the population without residential hook up, with access to water at nearby source</td>
<td>21.1%</td>
<td>10.6%</td>
<td>30.5%</td>
</tr>
<tr>
<td>Percentage of total population with hook up or nearby water source</td>
<td>88.7%</td>
<td>86.8%</td>
<td>36.2%</td>
</tr>
<tr>
<td>Total population without water service</td>
<td>11.3%</td>
<td>13.0%</td>
<td>64.0%</td>
</tr>
</tbody>
</table>

Source: OPS, 2000

Table 58 - Peru
Sanitation Coverage by Type of Service in Urban and Rural Areas and Nationwide

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of the population with residential hook up to sewage system</td>
<td>58.1%</td>
<td>67.0%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Percentage of the population without residential hook up but with a proper &quot;in situ&quot; system, either private or shared</td>
<td>24.4%</td>
<td>22.5%</td>
<td>25.2%</td>
</tr>
<tr>
<td>Total population hooked up to the sewage system or covered by an &quot;in situ&quot; system</td>
<td>82.5%</td>
<td>89.5%</td>
<td>27.0%</td>
</tr>
<tr>
<td>Total population lacking sewage service</td>
<td>17.5%</td>
<td>10.5%</td>
<td>33.0%</td>
</tr>
</tbody>
</table>

Sources: 1993 - National Census - INEI
1998 - Data processed by the National Decade Evaluation Team - PAHO / WHO

Sanitation companies operating in Peru are classified according to the percentage of clients in their portfolio. Companies are divided into four categories:
- Sedapal
- Large companies: From 40,000 to 160,000 hook ups
- Medium-sized companies: From 10,000 to 40,000 hook ups
- Small companies: Fewer than 10,000 hook ups.
Table 59 - Peru
Client Distribution According to Company Size and Population Serviced
with Drinking Water in 1998

<table>
<thead>
<tr>
<th>EPS</th>
<th>D.W. CLIENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEDAPAL</td>
<td>1,007,766</td>
</tr>
<tr>
<td>Large companies (7 in total)</td>
<td>650,089</td>
</tr>
<tr>
<td>Medium-sized companies (20 in total)</td>
<td>387,014</td>
</tr>
<tr>
<td>Small companies (17 in total)</td>
<td>79,022</td>
</tr>
</tbody>
</table>

4.5.2.2 Features of Water Resources: Current and Potential Water Supply and Geographic Distribution of Water

There are three major hydrographic systems in Peru which, in turn, correspond to three drainage basins: the Pacific Ocean, the Atlantic slope and Lake Titicaca. On a nationwide scale, there are 106 catchment basins with an annual production of 2,046,287.5 mm³ of surface and underground water. Nevertheless, the climate in Peru gives rise to a large variety and discontinuity in the availability of water over time. The result is a lack of water resources on the Pacific slope, primarily in the coastal area, which has 2,885 m³ of surface water per inhabitant. In contrast, water abounds on the Atlantic slope with an estimated availability of 800,000 m³ of surface water per inhabitant. An important feature of Peruvian rivers is their temporary nature, considering the irregularity of their flows. A short period of abundance or maximum spate lasts three to five months (December through May) followed by a long dry spell lasting seven to nine months (May to December). This has a negative effect on the water needs of the country.

Current supplies (exploitable reserves) of underground water are estimated at 2,739.3 mm³. In 1987, the exploited volume on the Pacific slope was estimated at 1,508 mm³, for human, cattle, agriculture and industry consumption. This volume was provided by 39 of the 53 watersheds by means of 8,009 open, tubular and mixed wells. The volume of underground water exploited on the Atlantic and Lake Titicaca slopes has not been determined and is deemed not to be significant.

There are three other sources of surface water, called lagoons, available on a national level. These are temporary or permanent water deposits of varying sizes located in the Andes Mountains at altitudes ranging from 4,000 to 6,000 masl.

The lack of seasonal surface water in the coastal and mountain areas is the reason why studies and works have been carried out to make use of the water available in lagoons, which has been determined to be 3,028 mm³. In addition to the above, there are 11,673 lagoons which have not been studied or tapped, as well as the possibility of making use of the Andes topography, which is suitable for dams and reservoirs.
4.5.3 Management Indicators

4.5.3.1 Continuity, Water Quality and Losses

According to SUNASS (1998 Annual Report) management of municipal EPS's is deficient. This is primarily due to political interference, which prevents the sector from operating adequately. In addition, the billing system has poor collection rates, there are major losses of water and low levels of continuity.

In general, water is produced in sufficient amounts to cover the population’s needs adequately. However, operational and maintenance deficiencies in the system, the high volumes of water lost, consumer waste, clandestine hook ups and low micrometer coverage have been identified as the main causes for an unsatisfactory water supply.

Moreover, the infrastructure is deteriorating at a fast pace due to the lack of preventive maintenance. This is partly due to the fact that this situation is not given the importance it deserves, in addition to the limitations posed by the lack of financial resources.

In urban areas almost all supply systems (99%) fail to provide uninterrupted service, with 13.7 hours of service being the average. In Lima, 70% of the population receives an intermittent supply. This creates a risk factor for domestic water supplies because the lack of continuity in service forces the population to build water storage facilities (cisterns and elevated tanks) which are not adequately protected or cleaned and disinfected on a regular basis. Supply in rural areas is also intermittent. PRONAP reports that, in a sample of 20 small and medium-sized communities, 75% received an intermittent water supply and 50% had less than 10 hours of running water per day (PRONAP, 1998).

Around 80% of the systems in urban areas use disinfect their water. However, it is estimated that the percentage in rural areas is minimal and that it is not sustainable due to the difficulties involved in obtaining chlorine. In the Lima metropolitan area, 99.1% of water distributed is disinfected. There are problems with the microbiological quality of surface sources in many cities in Peru (including Metropolitan Lima) due to low coverage in wastewater treatment; this puts the drinking water services at risk, given that full disinfecting coverage has not been achieved. Moreover, an assessment of 745 national drinking water systems, which was carried out by DIGESA predominantly in rural areas, found that 58.8% lack purification systems.

Water not accounted for is a serious problem for the EPS’s. Out of a total of 45 EPS’s acknowledged by SUNASS, 35 have loss rates of over 30%. Furthermore, national coverage of micrometering is 23.5%.

Despite all the problems described, it is acknowledged that the government has managed to increase water and sanitation coverage significantly, improving service levels in urban areas and providing coverage to extreme poverty sectors in rural areas. The joint efforts made by governmental and non-governmental organisations and by international aid to organise the sector are also acknowledged, and the same applies to the search for sustained strategies, primarily in rural areas.
4.5.3.2 Sanitation and Treatment of Domestic Sewage

Water discharged by homes and collected by the EPS's amounts to around 930 million m³ per year of sewage (1999). Only 133 million m³ (14% of the total) receives any kind of treatment.

Important efforts are being made to increase this coverage through projects for treatment plants in the more densely populated cities (Lima, Chiclayo, Trujillo and Arequipa, among others). Some of these plants have already been built, others are under construction and the remainder are being studied. If the building of the projected plants for the period 2001 - 2010 materialises, wastewater treatment coverage would increase by 70%. Increased treatment coverage will not only improve the quality of the receiving bodies of water. It will also allow for using treated water under sanitary conditions. This will expand the agricultural frontier, release volumes of surface waters for urban use and reduce current practices of using raw sewage for irrigation.

Some of the projects contemplated in this context are the following: Improvement of the Southern Lima Sewage System (MESIAS). This project involves building three treatment plants for residual waters with a total flow of 3.2 m³/s and a pipeline approximately 50 km long that will help reduce the amount of sewage discharged into Miraflores Bay. Seventy-five percent of the funding is provided by OECF and 25% by the Peruvian government.

There are also other important projects being developed. SEDAPAL expects to build the following works in the coming years: a water treatment plant for Lima’s North Cone, with a production capacity of 2 m³/s at a cost of US$ 80 million; Huachipa treatment plant with a production capacity of 5 m³/s; Stage II of the MESIAS Project, involving the installation of an advanced primary treatment plant with a capacity of 5 m³/s and a 2.4 m diameter offshore sewage outfall that is 3 km long and discharges sewage 60 m below sea level. The project also includes treating 1,555 m³/day of sludge, (the total cost of the MESIAS project will amount to US$270 million); a wastewater treatment plant for the Northern Zone of Lima, with 40 advanced primary treatment plants with a capacity of 13 m³/s discharged through an offshore sewage outfall and that treats 4,500 m³/day of sludge, (investment is estimated at US$230 million); five decentralised treatment plants for using treated residual waters for irrigation in public parks, at a cost of US$50 million.

Loss of water quality is critical in some areas in Peru. It is mainly due to pollution from effluents produced by industry, particularly mining and metallurgy, and from domestic and agrochemical waste which affects water supply sources and places the population's health at risk.

In addition to difficulties in controlling and monitoring water quality, particularly in the inland regions of the country, there is an indiscriminate use of raw sewage due to the lack of water in coastal cities and the seasonality of rain in the Andean region.
Table 60 - Peru
Wastewater Treatment Index – Percentages

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>With SEDAPAL</td>
<td>Estimated volume</td>
<td>Thousands of m³</td>
<td>901,424</td>
<td>889,794</td>
<td>933,493</td>
<td>32,069</td>
</tr>
<tr>
<td></td>
<td>Treated volume</td>
<td>Thousands of m³</td>
<td>94,338</td>
<td>111,957</td>
<td>130,596</td>
<td>36,258</td>
</tr>
<tr>
<td></td>
<td>Treatment index</td>
<td>%</td>
<td>10.5%</td>
<td>12.6%</td>
<td>14.0%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Without SEDAPAL</td>
<td>Estimated volume</td>
<td>Thousands of m³</td>
<td>358,384</td>
<td>375,384</td>
<td>369,231</td>
<td>10,847</td>
</tr>
<tr>
<td></td>
<td>Treated volume</td>
<td>Thousands of m³</td>
<td>83,300</td>
<td>93,036</td>
<td>111,197</td>
<td>27,897</td>
</tr>
<tr>
<td></td>
<td>Treatment index</td>
<td>%</td>
<td>23.2%</td>
<td>24.8%</td>
<td>30.1%</td>
<td>6.9%</td>
</tr>
</tbody>
</table>

Source: SUNASS

A matter worth mentioning is that it is mandatory to include treatment for residual waters in any sewage project in rural areas. This prerequisite is required by FONCODES and MINSA according to current regulations (Reglamento Nacional de Construcciones). However, admittedly, there are serious problems in the operation and maintenance of the systems built due to lack of adequate training in the population, of monitoring and follow up by a responsible organisation in rural areas, and because of the vacuum existing with regard to the enforcement of the JASS regulations.
In Authority Resolution No. 920-98, SUNASS issued a Directive on rate restructuring in EPS's in order to modify gradually the rate structure applied to date in sanitation companies, which are outdated, highly complex in nature and generally based on non-transparent criteria to calculate consumption and apply the rates. Rate structures will be changed in three stages, starting in April 1999 through 2001. Their goal is to apply a user classification table applicable on a nationwide level; elimination of sub-categories and classification of users based on hook up diameters and other considerations; elimination of billing based on “minimum consumption” or “minimum allocations” applied to users that have consumption meters installed; establishment of a new rate structure in which different rates will only apply to different categories of users as a starting point in the process of making rates converge towards a single pricing system.

Rates currently being charged by the EPS's are reasonable, even though they may be considered high compared to the quality of the service provided. Average EPS rates are 0.39 US$/m³ and production/distribution costs are 0.18 US$/m³.

In terms of investments, an average of US$228,910,000 per year was invested in water and sanitation infrastructure works from 1990 to 1998, and they recorded an increase from 1.1 US$/inhabitant in 1990 to 15 US$/inhabitant in 1998. These figures were supplied by the central, regional and local government, by the service providers (EPS's), and the private sector (NGOs and communities), and account for some 14% of the total investments.
made by the government during the same period.

In urban areas, the biggest investments in the sector in this decade have been made in strengthening the capabilities of the EPS's by renovating and expanding services, and by implementing institutional and operational improvements with the support of PRONAP and FONAVI.

PRONAP is currently completing the Programme to Support Basic Sanitation (PASSB), which is intended to strengthen the new legal and institutional guidelines for sanitation at a central level, help to strengthen 36 EPS’s on a nationwide level (with the exception of the Lima metropolitan area) and prepare a portfolio of projects for the future expansion of the services. The PASSB, involving a total cost of US$200 million, including financial expenses of US$25 million, will benefit a population of seven million inhabitants.

In addition, PRONAP has developed other programmes and projects: improvement and expansion of drinking water and sewage systems in the cities of Piura and Chimbote (credit contract OECF No. PE-P25) for US$132 million; technical co-operation with GTZ - drinking water and sewage programme in Ayacucho and Tumbes for US$29 million; improvement and expansion of infrastructure in the cities of Cusco, Huancavelica, Chiclayo and Bagua Chica - US$16.6 million.

In rural areas, the National Social Development Compensation Fund (FONCODES) has allocated and financed 11,960 water and sanitation projects in rural areas during the period 1991-1999. This has involved an investment of US$287.5 million.

In recent years, SEDAPAL has also made significant investments in improving and expanding its infrastructure.

The main projects implemented by SEDAPAL include the following, among others:

- Pomacocha Rio Blanco Bypass - MARCA II: This consists of catching and conducting surface waters from the basin of the Yanati River and the basins of the Pomacocha, Huallacocha Alto and Huallacocha Bajo lagoons. Flows of up to 6.5 m³/s are diverted to the Rimac River, which is the main water source for the Lima metropolitan area. It involves a total investment of US$117,816,514, financed by the Overseas Economic Co-operation of Japan (OECF) and local resources. By March 1999, access works for the trans-Andean tunnel had been completed and the international bidding process had begun.

- Consolidation of the Marcapomacocha – MARCA III System

- Improvement of the Sewage System in south Lima (MESIAS). This project involves building three wastewater treatment plants covering a total flow of 3.2 m³/s and a pipeline approximately 50 kilometres long. This will help decrease the sewage discharged into Miraflores Bay. It is estimated that the plants will start operating in February 2001. The project involves a total cost of 16.88 million Japanese yen. Funding is divided as follows: 75% is provided by the OECF and 25% by the Peruvian government.

- The Project to Control and Reduce Water Leaks. There are plans to recover, in the period 1997-2001, approximately 6% of the water
volumes produced (1.6 m³/s) by detecting and repairing non-visible leaks and developing a Visible and Non Visible Leak Control System. The project will have a total cost of US$4.4 million. By August 1999, 3,970 km of conduits had been inspected and 563 l/s had been recovered. An average of 5.02 leaks per km were found.

- Micrometering Project. This project, which should be completed by December 2000, involves two components: rehabilitation of 340,000 residential hook up boxes for US$17 million and installation of 750,000 micrometers for US$17 million.

The government has set itself the goal of raising drinking water and sanitation coverage to 100% in rural areas by 2010 and increasing coverage in urban areas to 90-95%. To reach this goal in the coming decade, it will need an investment of approximately US$326.9 million per year. These funds will be provided by the state, international co-operation organisations, the private sector, companies and communities.

The following table shows the historical evolution of investments in sanitation. These investments have increased notably, even though the results do not reflect an equivalent rate in the quality of the services (Ministry of the Presidency, 1999).

| Table 61 - Peru Historical Investment in Sanitation (in Thousands of U.S. Dollars) |
|----------------------------------|----------------|----------------|----------------|----------------|
| Central Government                |                |                |                |                |
| PRONAP                           | 66,155         | 12,464         |                |                |
| FONCODES                         | 79,260         | 24,679         |                |                |
| Others                           | 10,000         | 4,688          | 573            | 1,943          |
| Regional and local governments   |                |                |                |                |
| Regional government              | 8,000          | 8,001          | 5,000          | 14,000         |
| Local government                 | 4,500          | 1,783          |                |                |
| EPS's                            | 120,300        | 60,060         | 16,036         | 12,612         |
| PRIVATE INVESTMENT               |                |                |                |                |
| Population                       | 80,000         | 110,442        |                |                |
| NGOs                             | 3,500          | 2,500          | 989            | 200            |
| TOTAL                            | 371,715        | 224,617        | 22,598         | 28,755         |

Per Capita Investment (US$/inhabitant) 15.0 9.5 1.1 1.5

Source: SUNASS Source: Ministry of the Presidency, 1999

The following table shows the involvement of the different funding sources. The most significant financing is that provided by the Public Treasury and the loans granted by FONAVI.
Table 62 - Peru
Funding Sources for the Sector (in Thousands of U.S. Dollars)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Treasury</td>
<td>105,035</td>
<td></td>
<td>44,289</td>
<td>31,867</td>
</tr>
<tr>
<td>Local Funds</td>
<td>80,900</td>
<td>48,000</td>
<td>24,800</td>
<td>40,000</td>
</tr>
<tr>
<td>Internal Loans (*)</td>
<td>135,800</td>
<td>187,400</td>
<td>138,525</td>
<td>209,500</td>
</tr>
<tr>
<td>External Loans</td>
<td>65,325</td>
<td>44,456</td>
<td>19,727</td>
<td>7,013</td>
</tr>
<tr>
<td>Donations</td>
<td>3,000</td>
<td>2,750</td>
<td>2,500</td>
<td>2,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>390,060</td>
<td>354,623</td>
<td>229,621</td>
<td>290,380</td>
</tr>
</tbody>
</table>

(*) Funding provided by FONAVI
Source: Ministry of the Presidency, 1999

The disappearance of FONAVI in 1998 created a serious vacuum for the sector since this institution was the main source of funding both for the general works executed by the EPS's as well as for the secondary networks and residential hook-ups that were partly financed by community members.

In this context, an investment policy was proposed based on segments according to the size of the community (Policy Guidelines for Sanitation (Lineamientos de política para el sector saneamiento, PRES 1999). At present, this proposal is still under debate. Basically it divides the population of Peru into seven segments, with their pertinent investment sources and the channels for distributing the funds.

Segment I: Scattered population (fewer than 300 inhabitants; 69,470 communities with a total of 4.05 million people).

Segment II: Small population centres (300 to 2000 inhabitants; 7,420 population centres with a total of 3.75 million people).

Segment III: District capitals (from 2,000 to 30,000 inhabitants; 452 population centres with a total of 3.32 million people).

Segment IV: Provincial capitals (from 30,000 to 70,000 inhabitants; 26 cities with a total of 1.2 million people).

Segment V: Department capitals (from 70,000 to 300,000 inhabitants; 15 cities with a total of 2.3 million people).

Segment VI: Large cities (from 300,000 to 1,000,000 inhabitants; 7 cities with a total of 3.14 million people).

Segment VII: Lima (7.01 million people).

Initially, in the process of improving and discussing planning for the sector for the coming decade, and in view of the absence of a consolidated institutional framework, the proposal was to create a General Directorate at the PRES or a National Rural Sanitation Programme (PRONASAR). Such an organisation would be responsible for planning for segments I through III, and responsibility would be assigned to PRONAP. In segments IV and VI rate regulation would be limited, and in segments IV through VII it would be implemented through SUNASS.

In rural areas (Segments I and II), diagnoses and pre-investment studies would be conducted by FONCODES with municipal and community support. Definitive studies and the execution of the works would be entrusted to FONCODES and JASS, through third parties. Management, operations and maintenance would be in the hands of the communities in Segment I and of the JASS in Segment II, backed by technical assistance provided by the Municipality.
Funding of investments for the period 2001-2010 is estimated at US$118 million for Segment I and US$348 million for Segment II to achieve 100% water and sanitation coverage. The central government would provide around 70% of the necessary funds. Municipalities would provide 10% and the communities involved would provide 20% by supplying labour, local materials and even cash payments.

In Segment III, prioritisation of investments, diagnoses, studies and execution of the works would be the responsibility of municipalities with the support of the PRES. Services would be managed exclusively by municipal administration (with the possibility of promoting private sector involvement) and technical assistance would be provided by either the National Directorate or PRONAP. Investment for the period 2001-2010 is estimated at US$850 million to provide 100% water and sanitation coverage. Funding from the central government would cover 50% to 60%, while municipalities would provide 10% and the pertinent community would provide 30 to 40%.

In Segments IV through VI, project identification, prioritisation of investments, diagnoses, studies and execution of the works, management, operation and maintenance would be entrusted to the EPS’s. (It is possible that the private sector could be encouraged to participate in the management, operation and maintenance). Technical assistance would be provided by the National Directorate or PRONAP. To achieve 90% water and sanitation coverage, funding of investments for the period 2001-2010 is estimated at US$183 million for segment IV, US$338 million for segment V and US$318 million for segment VI. The central government will contribute 50% and 40% respectively for segments IV and V, subject to a management contract with the pertinent authority and SUNASS. The difference will be supplied by the EPS’s through loans guaranteed by the central government. No central government contribution is contemplated for segment VI, but the government will guarantee the loans required by the EPS’s. The rates in these segments are supposed to cover the recovery of the investments made by the EPS’s.

Segment VII is covered by SEDAPAL, a company which, to provide 95% coverage in drinking water and 85% in sanitation, requires an investment of US$1.11 billion from 2000 to 2010. The investment would be made by the company itself with a guarantee from the central government.

4.5.5 Business and Financial Data

The Ministry of the Presidency has determined that business management is virtually undeveloped in the EPS’s. Of the total water produced by the companies, they manage to bill for 55%, and only 50% of this is collected promptly. The EPS’s take an average of 140 days to make effective collection. The high percentage of water not accounted for has a considerable impact on the real income of the companies. Estimated losses for this factor amount to US$25.5 million per year. Around 90% of the amounts billed are collected; the difference becomes bad debts of approximately US$23.5 million per year, a fact that has a direct effect on cash flows and induces short-term indebtedness and a consequent rise in costs. Only 3 EPS’s (out of the 45 recognised by SUNASS) achieve a margin higher than 40% of their sales after deducting costs and disbursed expenses. The other EPS’s achieve minimal margins.
and four of them disburse costs in excess of their income. Consequently, there are very few EPS's capable of generating sufficient resources to service their debts, replace assets and make new investments. While there is no explicit subsidy policy, the state has been subsidising the companies by providing capital free of charge, and the current rate structures still allow for cross-subsidies among consumers. In addition to failing to provide clear signals on the cost of the service, this generates distortions and cost overruns for the economy. Practically all the EPS's are indebted far beyond their means for loan repayment (PRES, 1999).

The situation is similar or even more critical in service providers not recognised by UNASS, primarily in rural areas, where the system operates with inappropriate management methods. The Managing Boards lack adequate knowledge in service operation and management, and their duties with regard to drinking water and sewage services have not been clearly defined. Additional factors identified include the application of barely sustainable strategies and the lack of a consolidated institutional framework. This leads to distortions in the actions of state institutions and NGOs: management and technology efforts and proposals are duplicated, giving rise to discrepancies in terms of who is in charge of management. Other reported issues include:

- High rates of default due to the population's economic problems or because users do not value the service adequately. Occasionally, the intermittence of supply creates resistance in the population to pay for the service.

- Some maintenance and operating activities are not carried out promptly and with the necessary frequency; the financial resources of all the service providers evaluated are insufficient to provide the necessary infrastructure, hire qualified staff, and purchase materials, equipment and transportation needed to develop and maintain a suitable operational level.

- Very low rates, established without taking into account the need to ensure the sustainability of the service, with strong political interference because the population refuses to accept increases due to their personal financial situations.
4.5.6 Final Disposal of Wastewater in Coastal Cities

The sewage collection system in the Lima metropolitan area, made up of the provinces of Lima and Callao, was established in 1859; it is over 140 years old. At present, only 3% of the sewage collected is treated, and the remaining 97% is discharged with no treatment whatsoever into the Pacific Ocean and the Rimac River.

In north Lima, 14 m³/s of raw sewage is currently discharged into the Rimac River and the Pacific Ocean via five discharge points: the Colector Costanero (3.2 m³/s), the Colector Centenario (4 m³/s), the Colector Bocanegra (0.8 m³/s), the Colector Comas (3 m³/s) and the Colector No. 6 (1.7 m³/s).

In the southern area, the plan is to divert 3.2 m³/s of raw sewage from the Surco sewage area, which has been pouring sewage into the ocean at Punta La Chira, to other areas for treatment and reuse.

The project involves diverting 2.20 m³/s of sewage from the Circunvalación and Villa María del Triunfo collectors to the Villa El Salvador and Pampas San Bartolo de Lurín. It also involves treating 1.00 m³/s discharged from the Villa El Salvador and San Juan collectors towards the San Juan PTAR.

The main coastal cities are Tumbes, Piura, Lambayeque, La Libertad, Aucas, Lima, Callao, Ica, Moquegua and Tacna.
5. ANTHROPOGENIC EFFECTS ON THE ENVIRONMENT

5.1 Ecosystems

5.1.1 Mangrove Ecosystem

The mangrove ecosystem is a strategic regional ecosystem that, aside from its ecological importance, is especially important socially and economically; it is a source of natural products that provide incomes to coastal populations who live on the primary extraction of resources. It provides good quality timber for construction, tannins and vegetal coal; it is a place for growth and reproduction of species, and it effectively controls coastal erosion.

The mangrove is one of the places with the highest biological productivity. Its preservation and recovery is crucial to maintaining biological productivity in the coastal waters and for the social and economical meaning for the coastal populations.

Almost 223,450 hectares of mangroves have been lost in the region over the last 30 years, about 40% of the mangroves existing during the 70s. In Ecuador, the Manabi mangroves and those located between Esmeraldas and the south of Colombia are in critical condition, whereas in Panama, their conservation is stable (Dinerstein et al., 1995) [Table 63].

<table>
<thead>
<tr>
<th>Geographic unit of Mangroves</th>
<th>Preservation Status</th>
<th>Threats to the Preservation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Coast</td>
<td>Medium</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Pacific-Panama</td>
<td>Low</td>
<td>Relatively Stable</td>
</tr>
<tr>
<td>Gulf of Panama</td>
<td>Medium</td>
<td>Relatively Stable</td>
</tr>
<tr>
<td>Esmeraldas/Colombian Pacific</td>
<td>Medium</td>
<td>Relatively Stable</td>
</tr>
<tr>
<td>Manabi</td>
<td>High</td>
<td>Critical</td>
</tr>
<tr>
<td>G de Guayaquil/Tumbes</td>
<td>High</td>
<td>Endangered</td>
</tr>
<tr>
<td>Piura</td>
<td>High</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Galapagos Island</td>
<td>High</td>
<td>Vulnerable</td>
</tr>
</tbody>
</table>

Source: Dinerstein et al., 1995

Colombia has reduced 61.2% of its mangrove area in the Pacific; in Ecuador the figure is 20.4% and in Peru, 35.1% (Escobar, 2000; Cantera, 1994; Sánchez and Alvarez, 1998). The main cause for the destruction of the mangroves has been the claiming of its area for shrimp aquaculture and, to a lesser extent, for urban expansion, coastal cattle raising, wood production and tannin extraction. In Panama, Colombia, Ecuador and Peru, mangroves have been destroyed in order to cultivate shrimp, using large extensions for shrimp ponds (Arauz, 1999. López et al., 1996). A special case is Ecuador, in the province of El Oro; the pressure on the mangroves by poor population settlements amounted to 2,000 hectares, and 10,557 hectares of beach areas were used by the poor populations in different sections of the coast in 1990 (Arauz, 1990). In general, the mangroves near the large
urban centres in Panama, Colombia and Ecuador have been affected by the domestic waste produced by "invasion populations."

5.1.2 Coral Ecosystem

The coral ecosystem has a limited distribution in the SE/P region. Besides its renowned ecological importance, it plays a fundamental role in supporting important non-industrial local fisheries in Colombia, Panama and Peru. It is also a "high fragility" ecosystem. The warm El Niño phenomenon has been identified as the principal cause for massive destruction of this ecosystem in the South East Pacific region. It also causes turbidity in some areas near the coast due to the coastal runoff and the high rates of erosion in some areas, especially in Colombia and Panama. The effect of domestic waste on this ecosystem is not well defined for the South East Pacific.

5.2 Coastal Wetlands, Beaches and Cliffs

Apart from their renowned ecological importance, the coastal wetlands in the region are the "natural environments" that provide resources, especially fish, for the main economic activity of innumerable artisan fishing towns in the region.

It is estimated that nearly 30% of the region's wetlands have been affected to some degree. Some have been reduced in area by urban expansion (Escobar, 2000); others, such as those in Panama Bay in Panama, Tumaco Bay in Colombia, and those connected with the Daule-Babahoyos and Guayas system in the Gulf of Guayaquil, in Ecuador, receive water contaminated with domestic waste.

A high proportion of the rocky cliff coast in the north of the region, especially in Colombia, is affected by serious erosion, resulting from the loss of plant cover when forests are cleared. In Panama, the coast with low and medium-high cliffs suffers the effect of erosion mainly due to overgrazing (López et al., 1996). In Chile, some dune formations have lost stabilisation due to the elimination of vegetal coverings, which induce reactivation phenomena, produced, in some cases, by marginal populations (Castro et al., 1989). In Colombia, levelling coastal areas for agriculture has modified 25% of the Pacific coastline with a tendency to erosion (González and Escobar, 1989). Some of the region's tourist beaches are also affected, especially the sections located near coastal cities. There are several beach sectors with a high potential for tourism that are affected to varying degrees by irregular settlements and, principally, by contamination with organic waste, especially in Ecuador (Vasconez, 1995).
5.3 **Protected Areas and Biodiversity**

All the protected coastal areas are affected mainly by fishing activities, unorganised tourism, maritime transport and overuse of the resources by the human settlements inside such areas, where domestic waste is a major factor (Escobar, 1996; Hurtado 1995a).

The coastal biodiversity is affected by contamination from domestic waste, especially communities of sea organisms that populate certain areas, such as those with clear signs of eutrophication and high levels of chlorophyll, nitrates, phosphate, and other nutrients. The following are a few examples: Tumaco Bay, in Colombia (CCCP, 1993); Estero Salado and other areas of the estuary inside the Gulf of Guayaquil (Solorzano, 1981); in the mouth of the Rimac River in Lima-Callao (Guillen 1981); at San Vicente and Concepción Bays, and in the mouth of the Bio-Bio river, in Chile (Castilla, 1981). In these areas, the composition and space distribution of the sea organisms have changed; species that are key both for the fishing industry and for the ecosystem have disappeared. Waste discharges have been the cause, among others, of the azoic condition responsible for the absence of benthonic communities at Pisco and Chimbote Bays, and of the eutrophication in many local areas of the Peruvian coast.

5.4 **Activities Affecting the Marine Environment: Industry, Agriculture, Mining and Oil Exploitation**

Most industries dump their effluents either poorly treated or untreated on natural water bodies, directly or through sewerage systems. Consequently, a variety of substances of different physicochemical nature enter the wastewater, some of them with recognised as toxic and persistent in the environment.

Agriculture has become the main source of insecticides in SE/P waters. These reach the coastal areas mainly through runoff and, to a lesser extent, on air currents from the agricultural areas to the water bodies in the form of aerosols.

Despite the fact that during the 70s the countries of the region adopted restrictions and prohibitions on the use of certain insecticides (mainly DDT, aldrin, dieldrin, chlordane, heptachlor, mirex, toxaphene, paraquat, etc.), many of these compounds have been detected in sediments and in the muscle of some sea organisms in several coastal areas of the South East Pacific, where the contamination has been considered "serious." Many of the fertilisers are effectively washed away in agricultural areas, especially in those whose crops have little soil retention capacity and where erosion is common. The fertilisers reach the water currents, where they become a substantial source of nutrients which, when added to those from domestic waste, are responsible for the eutrophication of some areas, especially those with little water movement.

Tailings from mining also produce environmental effects on the coast. In Panama they are produced by metallic and non-metallic mining; the most affected are the Pacora and San Martín Rivers (López et al., 1996). In Colombia, alluvial mining activity is responsible for the destruction of large areas of forests and cultivable lands; the Colombian Pacific receives loads of sediments from mechanised and artisan mining activities.
and from deforestation in the high areas of its watershed (CCO, 1999). In Ecuador, most of the registered mining concessions are centred in the coastal provinces, of which Esmeraldas had the largest number (Noboa, 1996). In Peru, the mining activities connected with the Peruvian coastline are in Ancash, Arequipa, Ica, Moquegua, Piura, Tacna and Tumbes. Three of them, which are located in the southern coastline, discharge their effluents directly into the sea (Sánchez et al., 1996). Chile has mines between Regions I and III, only a few of which discharged into the sea.

Oil activity directly affects the maritime environment. Panama has the ports of Balboa, Armuelles and Vacamonte; Colombia suffers from chronic spills from the fishing boats; in Ecuador the most threatened areas are Esmeraldas, Manta, Santa Elena Peninsula, the Gulf of Guayaquil and the ports of Guayaquil and Bolivar; in Peru, problem areas are Chimbote, Pisco and Paita; and in Chile, Valparaiso, Concepción and the Strait of Magellan. Also important are accidents in maritime traffic and, occasionally, during improper loading and unloading of hydrocarbons. The effects of these oil spills have seriously damaged the ecosystems and the artisan fishing industry, which has had to halt for periods of two to three months. The costs in recovery and clean up and the estimated loss of earnings in artisan fishing activity are relevant (INDERENA, 1976).

5.5 Affected Areas: Tourism, Fishing and Coastal Agriculture

Beach areas with tourism potential have been affected to varying degrees by domestic waste contamination. A number of attractive beaches in the region are affected, at different levels, by disorganised, ill-planned settlements and, mainly, by sewage, solid waste and garbage, especially those located near coastal cities. There are numerous areas of excellent beaches that have been progressively deteriorating due to this kind of settlement. Enteric micro-organisms have been detected in several places in SE/P coastal waters P (Noboa et al., 1996).

The flow of tourism and its regional infrastructure on the coast are affected by the acute events of the El Niño, with damages to highways, airports, electrical power and water supply, apart from floods such as those that occurred in Peru and Ecuador in 1982-83 (Vos et al., 1999). This event caused several hundred millions of dollars in lost income among service providers (ECLAC, 1983).

The fishing industry is affected by contamination, especially that produced by domestic wastewater. The 1991 outbreak of cholera affected both the fishing resources and the fishermen located in areas near untreated domestic water discharges into the sea. The lack of sanitation and a safe supply of clean water encouraged the presence of Vibrio cholerae; there were significant economic losses in artisan fishing for fresh-refrigerated consumption, which affected the economic income of a large number of non-industrial fishermen for several months (CPPS, 1991).

Pathologies have also been detected at the microscopic and histological levels in some fish species due to contamination from domestic waste (Leonardo et al., 1996; Escobar, 2000).

As in the case of tourism, regional fishing activities are notoriously influenced by the El Niño phenomenon, the event of 1997-98 having the second-highest temperatures registered in the 20th
century. The rise in temperature and the weakening of the enrichment process of the upwellings caused great reductions in the biomass and in the total production of small gregarious pelagic species and of other coastal resources, which resulted in a considerable reduction of the region's total production during 1997 (FAO; 1998). During the 1982-83 El Niño event, its effects on fishing activities in Ecuador and Peru were estimated at hundreds of millions of dollars (ECLAC, 1983).

In Ecuador, shrimp cultivation is affected by contaminated water that, at certain levels, produces massive mortality of shrimp larvae. In addition, the larvae's growth rate is slower in some areas of cultivation. Another problem is the "Taura Syndrome," which weakens the shrimp larvae. This disease, which affected the cultures in Ecuador, has been attributed to the effect of pesticides applied to banana crops and that have reached the waters of the Taura River by runoff (Jiménez, 1992).

In Tumbes, prawn cultures also face potential danger from the discharges received by the Tumbes River (DIGESA, 1999). In the southernmost tip of Chile, salmon cultures have been affected on some occasions by flowering of harmful algae caused by an over-enrichment of the waters due to waste from the aquaculture activity. The damages reported have been estimated in tens of millions of dollars (Clement et al., 1994).
WASTEWATER AND QUALITY OF LIFE

There are different problems associated with wastewater, either as causes or consequences, that have to do with a country's overall development. The factors related to wastewater problems are, among others, the level of economic development, the general level of health and the educational background of the populations. The negative impact of wastewater on the environment, the health and welfare, are conditioned by these, and other, associated factors.

6.1 Development and Quality of Life

One of the criteria frequently analysed in this area is the level of poverty. The countries of the region have varying situations of poverty among their populations. Poverty not only has to do with income, but also with other social variables related to the "quality of life" and welfare of the population, such as health, access to services, education, employment, etc. The percentage of the regional population that lived below the National Poverty Line in Chile was close to 17% (1991-92) and 21% (1992-94); 35% in Ecuador (1994), 37% in Panama and over 51% in Peru (1994/97) (WRI, 1999). Most of those living below the National Poverty Line were rural inhabitants, ranging from 67% in Peru (1994) to 29% in Colombia (1991) [Table 64].

Table 64

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Rural (%)</th>
<th>Urban (%)</th>
<th>National Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>1991</td>
<td>29.0</td>
<td>7.8</td>
<td>16.9</td>
</tr>
<tr>
<td></td>
<td>1992</td>
<td>31.2</td>
<td>8.0</td>
<td>17.7</td>
</tr>
<tr>
<td>Chile</td>
<td>1992</td>
<td>-</td>
<td>-</td>
<td>21.6</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>-</td>
<td>-</td>
<td>20.5</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1994</td>
<td>47.0</td>
<td>25.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Panama</td>
<td>1997</td>
<td>64.9</td>
<td>15.3</td>
<td>37.3</td>
</tr>
<tr>
<td>Peru</td>
<td>1994</td>
<td>67.0</td>
<td>46.1</td>
<td>53.5</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>64.7</td>
<td>40.4</td>
<td>49.0</td>
</tr>
</tbody>
</table>

Source: WRI, 1999
Regarding the International Poverty Line, Peru had the largest percentage of population with incomes of less than US$1/day, with 15.5% (1996); Chile had the lowest, at 4.2% (1994). The percentage of population with incomes under US$1/day was lowest in Chile with 0.7% (1994); Ecuador had the highest, at 5.8% (1996).

The percentage of population with minimum incomes of US$2/day was 52.3% in Ecuador (1996), while 21.2% of its population lived below this income limit. In Peru in 1996, 41.4% of the population earned less than US$2/day, and 17.1% of the population lived in poverty with incomes of US$2/day [Table 65].

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Population below US$1/day</th>
<th>Poverty (minimum US$1/day)</th>
<th>Population below US$2/day</th>
<th>Poverty (minimum $2/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>1996</td>
<td>11.0</td>
<td>3.2</td>
<td>26.7</td>
<td>11.6</td>
</tr>
<tr>
<td>Chile</td>
<td>1994</td>
<td>4.2</td>
<td>0.7</td>
<td>20.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1996</td>
<td>20.2</td>
<td>5.8</td>
<td>52.3</td>
<td>21.2</td>
</tr>
<tr>
<td>Panama</td>
<td>1996</td>
<td>10.3</td>
<td>3.2</td>
<td>25.1</td>
<td>10.2</td>
</tr>
<tr>
<td>Peru</td>
<td>1996</td>
<td>15.5</td>
<td>5.4</td>
<td>41.4</td>
<td>17.1</td>
</tr>
</tbody>
</table>

Source: WRI, 1999

According to ECLAC, the percentage of households living in poverty in Colombia varied between 45% and 39% (1980-1997); most of these were located in rural areas (between 57% and 45%). Nearly a third of metropolitan area households were living in poverty. In Chile, the number of poor households dropped from 39% in 1987 to 20% in 1996, and the percentage of rural households living in poverty decreased from 45% in 1987 to 26% in 1996. In Ecuador, half of the households lived in poverty between 1990 and 1997. In Peru, the percentage of poor households increased between 1979 and 1986, rising from 46% to 52%, and then dropping to 37% in 1997. In the region, most households living in poverty were in rural areas [Table 66].
## Table 66
Percentage of SE/P Households Living in Poverty, 1999 (a)

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Total</th>
<th>Urban Total</th>
<th>Metropolitan Area</th>
<th>Remainder</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>1980</td>
<td>39</td>
<td>36</td>
<td>30</td>
<td>37</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>-</td>
<td>35</td>
<td>33</td>
<td>36</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>47</td>
<td>41</td>
<td>35</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>45</td>
<td>40</td>
<td>30</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>Chile</td>
<td>1987</td>
<td>39</td>
<td>38</td>
<td>33</td>
<td>41</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>33</td>
<td>33</td>
<td>28</td>
<td>37</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>23</td>
<td>23</td>
<td>17</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>20</td>
<td>19</td>
<td>12</td>
<td>22</td>
<td>26</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1990</td>
<td>-</td>
<td>56</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>-</td>
<td>52</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Panama</td>
<td>1979</td>
<td>36</td>
<td>31</td>
<td>27</td>
<td>42</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>1991</td>
<td>36</td>
<td>34</td>
<td>32</td>
<td>40</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>30</td>
<td>25</td>
<td>23</td>
<td>35</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>27</td>
<td>25</td>
<td>24</td>
<td>29</td>
<td>34</td>
</tr>
<tr>
<td>Peru</td>
<td>1979</td>
<td>46</td>
<td>35</td>
<td>29</td>
<td>41</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>1986</td>
<td>52</td>
<td>45</td>
<td>37</td>
<td>53</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>41</td>
<td>33</td>
<td>-</td>
<td>-</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>37</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>61</td>
</tr>
</tbody>
</table>

Source: CEPAL, 1999

(a) percentage of households with incomes lower than twice the cost of a basic food basket

Similarly, the percentage of indigent households in Colombia varied between 16% (1980) and 20% (1997), reaching a high of 25% in 1994. An average of 10.7% of metropolitan area households were indigent during the period considered. Between 1987 and 1996, Chile’s percentage of indigent households ranged from 14% to 5%, respectively, of which 11% (1987) to 2% (1996) were located in Santiago. The percentage of indigent households in rural Chile also showed a downward trend, dropping from 17% in 1987 to 8% in 1996. In Ecuador, an average of 21.3% of urban households were living in indigence between 1990 and 1997. Panama had an average of 14.2% of its households living in indigence from 1979 to 1997, with 10.5% on average, located in the Panama City metropolitan area. For the period 1979 – 1997, an average of 20.5% of Peruvian households were indigent, of which an average of 38.2% lived in rural areas [Table 67].
Another factor considered is the level of literacy. In 1998, an average of 4.16% of the region's population was illiterate. The number of illiterates varied from 3.0% in Chile to a maximum of 5.4% in Peru. Chile had the lowest percentages according to age groups considered. The over 45 age group had the highest number of illiterates in all the countries [Table 68].

Table 68
Illiterate Urban Population by Age Groups in the SE/P, 1998
(% of the population of each group)

<table>
<thead>
<tr>
<th>Country</th>
<th>Total</th>
<th>15-24</th>
<th>25-34</th>
<th>35-44</th>
<th>45-59</th>
<th>60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>3.7</td>
<td>1.2</td>
<td>1.5</td>
<td>2.3</td>
<td>5.8</td>
<td>13.9</td>
</tr>
<tr>
<td>Chile</td>
<td>3.0</td>
<td>0.9</td>
<td>1.3</td>
<td>1.9</td>
<td>3.9</td>
<td>9.8</td>
</tr>
<tr>
<td>Ecuador</td>
<td>4.8</td>
<td>1.5</td>
<td>1.6</td>
<td>3.4</td>
<td>7.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Panama</td>
<td>3.9</td>
<td>1.4</td>
<td>1.9</td>
<td>5.6</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>5.4</td>
<td>1.0</td>
<td>1.8</td>
<td>3.1</td>
<td>10.7</td>
<td>20.1</td>
</tr>
</tbody>
</table>

Source: CEPAL, 1999
Another way of expressing the quality of life in different countries is the Human Development Index (HDI) (PNUD, 2000). Since the United Nations Programme for Development published its Report on Human Development in 1990, several indices have been prepared to measure different aspects of human development. The most common, the Human Development Index, which has been prepared every year since 1990, measures average achievements in terms of basic human development using a single, simple index that allows for classification of countries. It is a compound index since it expresses a country’s mean progress in three basic aspects of human development: a long, healthy life; knowledge; and a decent standard of living.

The HDI comprises three variables: life expectancy at birth, level of education (adult literacy and overall rate of combined primary, secondary and higher enrolment), and the actual GNP per capita adjusted in purchasing power parity (PPP) in dollars. Income is considered in the HDI in representation of a decent standard of living, and substitutes all the human options that are not reflected in the other two dimensions. For the calculation of the HDI, minimum and maximum fixed values have been established regarding each of the following indicators:

- Life expectancy at birth: 25 years and 85 years.
- Adult literacy rate (15 years or older): 0 % and 100 %.
- Overall rate combined enrolment: 0 % and 100 %.
- GNP per capita (PPP in dollars): 100 dollars and 40,000 dollars.

The HDI value ranges from 0 to 1. Its value for a particular country indicates the distance (or its deficit) that the country has to overcome in order to achieve the maximum possible of 1. At the same time, it allows for comparison with other countries. The mission of each country is to find the way to reduce its deficit.

Countries have been classified into three groups according to their HDI score: high, with values of 0.800 or higher; middle, between 0.500 and 0.799; and low, with less than 0.500. The average HDI in 1998 was 0.908 for the first group; 0.673 for the second and 0.421 for the third. As a whole, developing countries had an HDI of 0.642 for 1998. Latin America and the Caribbean together had an HDI of 0.758 for the same year.

In the 1998 HDI for all five South East Pacific countries, Chile (0.826) qualifies among the countries with high human development, while Panama (0.776), Colombia (0.764), Peru (0.737) and Ecuador (0.722) are within the medium level of human development. An analysis of the HDI variables for 1998 for the South East Pacific countries shows that:

- Life expectancy at birth (years) fluctuates between 68.6 (Peru) and 75.1 (Chile).
- The adult literacy rate (% population of 15 years of age or older) varies between 89.2 (Peru) and 95 (Chile).
- The combined overall school enrolment (%) ranges between 71 (Colombia) and 79 (Peru).
- The GNP (US$) varies between 3,003 (Ecuador) and 8,787 (Chile).

Poverty variables are implicitly included within the components of the HDI, and it is possible to observe some level of correlation among them, as shown in the following table:
Table 69
HDI and Poverty Levels in SE/P Countries, 1998

<table>
<thead>
<tr>
<th>Country</th>
<th>HDI 1998</th>
<th>% population below the National Poverty Line (between 1992 and 1997)</th>
<th>% population below US$ 2/day (-1996)</th>
<th>% poor households (-1997)</th>
<th>% indigent households (-1997)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td>0.826</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Panama</td>
<td>0.776</td>
<td>37</td>
<td>25</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>Colombia</td>
<td>0.774</td>
<td>18</td>
<td>27</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>Peru</td>
<td>0.737</td>
<td>49</td>
<td>41</td>
<td>37</td>
<td>18</td>
</tr>
<tr>
<td>Ecuador</td>
<td>0.722</td>
<td>35</td>
<td>52</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

6.2 Water and Sewerage System: Management Indicators (Performance)

According to the Pan-American Health Organisation (1998) and as cited by ECLAC (1999), 74.2% of the regional population had access to drinking water services in 1995. On average, nearly 91% was urban population and 31% was rural. Likewise, an average 69% of the regional population had access to sanitation services and waste disposal in 1995; of these people, an average of 82% were urban dwellers. Table 70 shows the percentages of populations with access to drinking water and sanitation services [Table 70].

Table 70
Access to Drinking Water and Sanitation Services in the SE/P, 1995

<table>
<thead>
<tr>
<th>Country</th>
<th>% population with access to drinking water (a)</th>
<th>% population with access to sanitation (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Urban</td>
</tr>
<tr>
<td>Colombia</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td>Chile</td>
<td>91</td>
<td>99</td>
</tr>
<tr>
<td>Ecuador</td>
<td>55</td>
<td>84</td>
</tr>
<tr>
<td>Panama</td>
<td>84</td>
<td>99</td>
</tr>
<tr>
<td>Peru</td>
<td>66</td>
<td>81</td>
</tr>
</tbody>
</table>

Source: OPS, 1998
(a) population with residential hook up and/or easy access
(b) population with sewerage service and waste disposal
In Colombia, sewage coverage has changed in the last 13 years, increasing from 59.4% in 1985 to 86.1% in 1998; there are 6 to 10 million Colombians without access to water and sewage services. In rural areas, there are 5 to 8 million people who lack at least one of these services. Only 62% of the population receives water that is safe for human consumption. The sanitation situation on the Pacific coast is completely different from that of the rest of the country, and is critical. Water supply coverage in the coastal municipalities is 48%, and sewage coverage is only 10%, both figures below the national average. On the coast, rural aqueduct coverage is only 4.2%, and sewage system coverage is low in urban areas. In the coastal towns of Buenaventura and Tumaco, coverage is 35% and 7%, respectively. In the rural area it is below 1%.

Chile has the highest percentage of population in the region with access to drinking water (91%), where coverage is 99% for urban populations and 47% for rural.

Half of Ecuador's population (55%) had access to drinking water (84% of the urban population and 10% of the rural). Total water coverage for human consumption has had an average increase of 1.1% in the last decade, reaching a total coverage of 70.3% in 1998, with 81.5% urban and 51.4% rural.

Likewise, wastewater collection in Ecuador has grown an average of 0.66% per year during the last decade, reaching a coverage rate of 58% in 1998, with 70.5% urban and 37% rural. Only 5% of all the wastewater collected undergoes some form of treatment, oxidation ponds being the most commonly used technology.

In 1995, 84% of Panama's population had access to drinking water, of which 99% were urban inhabitants and 73% were rural dwellers. Coverage in the sanitation subsystem has improved; in 1990 it was 86% and towards the end of the decade it had reached 93.2%, an increase of 6.3%.

In the best of cases, the wastewater collected receives primary treatment before disposal into watercourses or streams, with the subsequent contamination of such water. In Panama City, water is disposed of directly to the bay without any kind of treatment.

In 1995, 66% of the Peruvian population had access to drinking water (81% urban and 31% rural). Between 1992 and 1996, a latrine construction programme was implemented to cover 9.1% of the urban population and 26.3% of the rural population (1,841,000 latrines) (OPS, 1999). The Peruvian coastal population's limited access to drinking water and sewerage system service is responsible for the poor sanitation conditions. Only 7.7% of the coastal population gets water from tank trucks; 3.7% gets it from wells and 20.4% draws it from natural sources. Only 21.9% of the population had latrines; this figure is 20% in urban areas and 24% in rural zones (OPS, 1999).
6.3 Vital Statistics

According to the PAHO, the overall mortality rate in the SE/P in 2000 was, on average, 6.0 per 1,000, with the lowest rate in Panama, at 5.1 per 1,000, and the highest in Peru, at 6.3 per 1000.

In the year 2000, the infant mortality rate varied widely in the region, with 44.8 deaths of children under the age of 1 per 1,000 live births in Ecuador at one extreme, and a rate of 10.4 in Chile on the other. Chile, Colombia and Panama stand out with infant mortality rates near 11 and Ecuador and Peru with rates close to 44.

The birth rate in the year 2000 was lowest in Chile (19 per 1,000) and highest in Ecuador (24.4 per 1000).

Chile had the highest life expectancy in 2000 (75.3 years), followed by Panama (74 years). Peru had the lowest life expectancy (69.1 years), followed by Colombia and Ecuador (71.2 and 70.0, respectively) [Table 71].

<table>
<thead>
<tr>
<th>Country</th>
<th>General mortality, rate per 1,000</th>
<th>Infant mortality, rate per 1,000 live births</th>
<th>Births, rate per 1,000</th>
<th>Life expectancy at birth, years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>5.6</td>
<td>11.2</td>
<td>23.4</td>
<td>71.2</td>
</tr>
<tr>
<td>Chile</td>
<td>5.7</td>
<td>10.4</td>
<td>19.0</td>
<td>75.3</td>
</tr>
<tr>
<td>Ecuador</td>
<td>5.9</td>
<td>44.8</td>
<td>24.4</td>
<td>70.0</td>
</tr>
<tr>
<td>Panama</td>
<td>5.1</td>
<td>11.2</td>
<td>21.4</td>
<td>74.0</td>
</tr>
<tr>
<td>Peru</td>
<td>6.3</td>
<td>43.0</td>
<td>27.3</td>
<td>69.1</td>
</tr>
</tbody>
</table>

Source: OPS, 2000

Poverty is one of the factors that foment the development of regional environmental problems, making them more evident and critical. Among these problems, wastewater contamination, especially of domestic origin, is always present among the poorer population. Its effects become more evident and severe among the poor, given the special vulnerability of this population, particularly the children.

Inadequate sanitation, which is prevalent to varying degrees in Latin American countries, is generally the cause of high infant morbidity and mortality rates, and the South East Pacific countries are no exception. Infant mortality is closely linked with diarrhetic diseases, caused to a great extent by the environmental contamination produced by untreated discharges of domestic wastewater.

In the South East Pacific, untreated domestic discharges, insufficient coverage of basic sanitation, and poverty are the main causes of infectious and parasitic digestive diseases such as diarrhea, amoebiasis, hepatitis, typhoid and paratyphoid fever and cholera. Additionally, there are natural environmental conditions in the region that favour the spreading of water-borne diseases, especially in Colombia.
Panama, Ecuador and northern Peru. In the first three countries, 60% to 80% of their territory is considered wet or extremely wet, which facilitates the incidence of diseases related with this type of contamination.

Another geo-demographic phenomenon of interest is the fact that human settlements in the South East Pacific tend to be located along watercourses into which they dump their generally untreated wastewater. Downstream communities, especially those located at the end of the rivers along the coast, are at high risk for developing digestive infectious diseases, as they are exposed under various circumstances to these polluted waters.

The 1991 cholera outbreak in the region was associated with these inadequate basic sanitation conditions, as well as with the poverty and eating habits of the populations in some of the countries at risk.

On the Ecuadorian coast, infant mortality and morbidity are caused mainly by sanitation deficiencies, in which contamination from domestic discharges plays a key role. Infant mortality in Ecuador has been estimated at 44.8 per 1,000 live births (OPS, 2000), although this varies greatly among the coastal provinces. Diarrhea is the main cause of morbidity, especially in children under 5 years old. In 1995, of a total of 1,330 deaths from enteritis and other diarrheic diseases, 31% occurred in infants under 1 year of age. Nearly 19% of the children suffer from some form of diarrhea that, together with other diseases, account for 60-70% of hospital admissions. Cholera and other digestive diseases have declined. During the period 1992-1996, the fatality rate remained below 1%. In 1991, 46,320 cases of cholera were reported in 17 of the country’s 21 provinces, most of them in the coastal provinces. In 1996, 1,066 more cases were reported. From 1992 to 1996, almost 193,352 cases of diarrheic diseases were reported. During 1996, the main cause of hospital admissions were intestinal infectious diseases, most of them due to poor sanitation conditions.

In 1992 in Peru, the main cause of death among infants under 1 year old was communicable diseases in general (39.8%). Among them, infectious intestinal diseases accounted for 25.1% of deaths in which environmental pollution from domestic waste played the most important role.

Deficits in basic infrastructure in Panama, especially in water treatment, have resulted in an increase in the morbidity level of diseases linked with environmental sanitation, such as diarrheic infections, typhoid fever, enteritis and cholera. As a result of this situation, diarrheic infections and other enteric diseases have become one of the principal causes of death in the rural population.

6.4 Food Safety

Food safety depends not only on the abundance and availability of food, but also on access to it and its quality and nutritional value. Food safety is also linked to the population’s eating habits and customs, and to a series of economic and social factors. Within the context of contamination, problems in food safety can be linked to the ingestion of contaminated food products and with the deterioration of food-producing zones. The region has an average dietary energy deficit of 200 kcal. This deficit among the undernourished is highest in Peru (240 kcal/day per capita), Panama (220 kcal/day per capita) and Colombia (220 kcal/day per capita; it is lowest in Chile (150 kcal/day per capita) and
Ecuador (160 kcal/day per capita) (FAO, 2000*). The calorie supply per capita/day in 1996 ranged from 2,784 in Chile to 2,437 in Peru. Similarly, the protein intake in grams per capita/day is 59.1 in Chile and 64.1 in Panama. In Ecuador it is 99.9; in Peru, 48.9; and in Colombia, 64.9 [Table 72]. Finally, the highest fat intake in gr/day per capita is in Ecuador, with 100.9, and the lowest is in Peru, with 48.9 (Table 72).

Table 72
Food Data of the SE/P Population in 1996

<table>
<thead>
<tr>
<th>Country</th>
<th>Calories per capita/day</th>
<th>Protein grams per capita/day</th>
<th>Fat Grams per capita/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,570</td>
<td>60.4</td>
<td>64.8</td>
</tr>
<tr>
<td>Vegetal products</td>
<td>2,131</td>
<td>32.3</td>
<td>35.8</td>
</tr>
<tr>
<td>Animal products</td>
<td>439</td>
<td>28.1</td>
<td>29.1</td>
</tr>
<tr>
<td>Chile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,784</td>
<td>79.0</td>
<td>81.0</td>
</tr>
<tr>
<td>Vegetal products</td>
<td>2,169</td>
<td>29.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Animal products</td>
<td>615</td>
<td>29.5</td>
<td>42.7</td>
</tr>
<tr>
<td>Ecuador</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,707</td>
<td>57.9</td>
<td>100.9</td>
</tr>
<tr>
<td>Vegetal products</td>
<td>2,226</td>
<td>30.8</td>
<td>67.8</td>
</tr>
<tr>
<td>Animal products</td>
<td>471</td>
<td>27.0</td>
<td>32.1</td>
</tr>
<tr>
<td>Panama</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,442</td>
<td>64.1</td>
<td>76.0</td>
</tr>
<tr>
<td>Vegetal products</td>
<td>1908</td>
<td>20.8</td>
<td>29.5</td>
</tr>
<tr>
<td>Animal products</td>
<td>524</td>
<td>25.4</td>
<td>26.5</td>
</tr>
<tr>
<td>Peru</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,437</td>
<td>60.4</td>
<td>48.9</td>
</tr>
<tr>
<td>Vegetal products</td>
<td>2,095</td>
<td>28.8</td>
<td>24.4</td>
</tr>
<tr>
<td>Animal products</td>
<td>342</td>
<td>21.6</td>
<td>24.5</td>
</tr>
</tbody>
</table>

Source: FAO, 2000*

Despite a sufficient availability of food, most of the regional intake is centred on rich sustained diets consisting mainly of carbohydrates (corn, potatoes, rice, wheat, cassava) which are high in energy; in general terms, the local diet is poor in foods that provide essential nutrients (legumes, dairy products, vegetables, meat and fish, fruit and oils) that are necessary for proper nutrition. According to the WRI, food production indices have increased noticeably between the periods 1984-1986 and 1994-1996 (WRI, 1999). In Chile the total index went from 78 to 125, and, similarly, the per capita index went from 83 to 116. Countries with the lowest indices in 1996 were Panama and Colombia [Table 73]. Although there are important protein-rich food sources available, these are not accessible to or are beyond the reach of certain sectors of the population, especially poor urban populations. In general, regional hunger is rooted in poverty; this deficiency is also connected to deeply ingrained eating habits in certain sectors of the population in all the SE/P countries.
According to the FAO, in the period 1996-1998, the countries with the best "non-hunger" conditions were Chile and Ecuador [Table 74].

Chile has a food availability, in terms of dietary energy supply (DES), of 2,850 kcal/person/day and an under-nutrition magnitude (minimal nutritional energy needs) of 1,910 kcal/person/day. The nutritional energy intake in undernourished people for the same period was 1,760 kcal/person/day, and the energy deficit in undernourished people was 150 kcal/person/day. The proportion of cereals, roots and tubers in the DES was 42%.

In Ecuador, the intake was 2,710 kcal/person/day, and the magnitude of under-nutrition was 1,810 kcal/person/day. The nutritional energy intake in undernourished people was 1,650 kcal/person/day, and the deficit was 160 kcal/person/day. The proportion of tubers, roots and cereals in the DES was 38%.

Peru had the lowest figure in food availability – 2,390 kcal/person/day – and its minimal nutritional energy needs were the same as those of Colombia, Ecuador and Panama, i.e. 1,810 kcal/person/day. The intake of nutritional energy in undernourished people was 1,570 kcal/person/day, with a deficit of 240 kcal/person/day. Cereals, tubers and roots accounted for 51% of the DES.
Table 74

<table>
<thead>
<tr>
<th>Country</th>
<th>Food availability; nourishing energy intake (kcal/person/day)</th>
<th>Nourishing energy intake in the undernourished (kcal/person/day)</th>
<th>Under-nutrition magnitude (minimal energy need) (kcal/person/day)</th>
<th>Food deficit in the undernourished (kcal/person/day)</th>
<th>Diet (% of cereals, roots and tubers in the DES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>2,580</td>
<td>1,540</td>
<td>1,810</td>
<td>220</td>
<td>40</td>
</tr>
<tr>
<td>Chile</td>
<td>2,850</td>
<td>1,760</td>
<td>1,910</td>
<td>150</td>
<td>42</td>
</tr>
<tr>
<td>Ecuador</td>
<td>2,710</td>
<td>1,650</td>
<td>1,810</td>
<td>160</td>
<td>38</td>
</tr>
<tr>
<td>Panama</td>
<td>2,450</td>
<td>1,590</td>
<td>1,820</td>
<td>230</td>
<td>40</td>
</tr>
<tr>
<td>Peru</td>
<td>2,390</td>
<td>1,570</td>
<td>1,810</td>
<td>240</td>
<td>51</td>
</tr>
</tbody>
</table>

Source: FAO, (2000b)

According to the FAO classification (op. cit.) Chile is classified with Group 2 countries, which have a low prevalence and severity of under-nutrition; the rest of the countries classify as Group 3, where both the prevalence and the severity of under-nutrition are moderate [Table 75].

Table 75
Prevalence of Under-Nutrition in the SE/P and % of Under-Nourished People in the Total Population – Various Periods

<table>
<thead>
<tr>
<th>Country</th>
<th>Prevalence Category</th>
<th>Total population 1997 (millions)</th>
<th>Number of people 1996-98 (millions)</th>
<th>% of population 1979-81</th>
<th>% of population 1990-92</th>
<th>% of population 1996-98</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>3</td>
<td>40.0</td>
<td>5.2</td>
<td>22</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Chile</td>
<td>2</td>
<td>14.6</td>
<td>0.6</td>
<td>7</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Ecuador</td>
<td>3</td>
<td>11.9</td>
<td>0.5</td>
<td>11</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Panama</td>
<td>3</td>
<td>2.7</td>
<td>0.4</td>
<td>21</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>Peru</td>
<td>3</td>
<td>24.4</td>
<td>4.4</td>
<td>29</td>
<td>40</td>
<td>18</td>
</tr>
</tbody>
</table>

Source: FAO (2000b)

According to the National Nutrition Profiles (FAO, 2000), in Colombia one out of every five children in rural areas suffers from chronic malnutrition, compared to one out of every eight in the urban sectors. The prevalence of chronic malnutrition is disproportionately high in the region of Cauca and Nariño, where children under five years of age are five times more likely to suffer growth retardation. Emaciation is particularly high in children of the Pacific coastline (5.6%). The two coastal regions (Atlantic and Pacific) and rural areas are the hardest hit by global malnutrition. In general, the Colombian diet is rich in calories with an average of 2,580 kcal/person/day.

In Chile, the nutritional condition of children under six years of age that receive health care through the National System of Public Health (70% of the total population) indicates that, in 1996, the incidence of chronic malnutrition was 2.3% and obesity was 6.9%. Regions IX, X and XI, which have the highest levels of... 142
poverty, have the highest figures in both chronic malnutrition and obesity, whereas Region XII, with a smaller proportion of poor population, had the lowest rate of chronic malnutrition and the highest of obesity. This obesity distribution suggests the existence of an obesity pattern linked with poverty and low stature (Regions IX, X and XI) and another pattern associated with economic well-being and normal stature (Region XII). The problem of overweight and obesity, which is apparently the most important at present, seems to be tied to factors such as poverty, urbanisation and climatic conditions, which determine both food consumption and levels of physical activity.

In 1986 in Ecuador, the nutritional condition of children under the age of five was characterised by a very high prevalence of global and chronic malnutrition, 37.5% and 49.4%, respectively, and a very low level of severe malnutrition (4%). In general, the problem is more serious in rural than in urban areas, and in the mountains more than on the coast. In the rural mountainous areas, there is a 51.9% rate of global malnutrition and 69.8% of chronic malnutrition, whereas at the provincial level the highest rates are found in Cotopaxi (50.7% and 67.4%), Chimborazo (48.3% and 65.1%) and Cañar (47.8 and 64.5%), all of which are located in the mountains.

In Panama, the areas most seriously affected by chronic and severe malnutrition are the provinces of Bocas del Toro, Chiriqui and Veraguas, inhabited by the indigenous population and the poorest and least densely populated.

In Peru, the nutritional condition of children under the age of five improved between 1984 and 1996, with a national decline in the chronic malnutrition rate from 37.8% to 25.8%. Although poverty levels have remained high, global malnutrition dropped from 13.4% to 7.8%, partly as a result of increased food availability and better access to food. Despite this progress, there are still pockets of severe poverty and malnutrition in the mountain region. The constantly high migration rate from rural areas towards the larger cities has resulted in an increase of population living in poor housing and lacking in basic services and jobs. There are urban areas, particularly in Lima, where the levels of poverty and malnutrition are high.

There is no data available on the effect of contamination on food safety in the region, but it is known that most cases of diarrhetic diseases are linked with the consumption of foods that have come in contact with contaminated water and account for a significant number of medical consultations. The consumption of raw or poorly handled fish and seafood, and vegetables irrigated with wastewater is especially relevant. Fishing is an important source of high-quality white proteins that play a significant role in the nutrition and feeding of the regional population. However, this source is particularly vulnerable to contamination. More than 50% of the fish extracted is destined for fresh consumption, while some 20% goes for canning and processing. In 1994, average regional consumption of fish in the SE/P region was 11.24 kg/year per capita, five times higher than the average for Latin America and the Caribbean, and slightly below the world average of 13 kg/year (OLDEPESCA, 1995). In addition to the problem of contaminated fishing products, the regional custom of consuming fish and seafood raw adds an extra risk factor. The cholera outbreak in 1991 clearly reflects the effect of this custom on the vulnerability of the population; this factor, together with the poor sanitation conditions in some regional coastline locations and the existence of adverse conditions, made it easy for the disease to spread rapidly beyond the region into areas as distant as
Mexico. The epidemic was effectively controlled in the region. This episode caused a real decline in artisan fishing activity and deprived a large number of people (nearly 150,000) of this nutritional food source for a prolonged period. Peru saw a 75% drop in the volume of fish caught by artisan fishermen for immediate consumption. Due to domestic waste contamination, there are several areas in the region applying for "fish extraction certification." some of them in areas near the mouths of rivers (Escobar, 2000).

6.5 Coastal Water Contamination and Human Health

In Latin America, a high percentage of urban domestic waste is collected by sewage systems. However, a high percentage does not receive sanitation treatment before its final disposal in water bodies such as canals, rivers, lakes and coastal seawater. Untreated effluents from businesses and industries are also discharged into the collection systems and bodies of water.

Thus, the water bodies contain a mixture of biological and chemical contaminating agents that affect the public health when the water is recycled for agricultural irrigation, untreated consumption, and for use in recreation and aquaculture. The health impact from recreation and aquaculture in coastal seawater has been an issue of concern relatively recently.

There is a wide range of risk factors associated with coastal activities. Although accidents (drownings and other), sunburn and sunstroke are traditionally the most evident, the magnitude of acute and chronic conditions caused by microbial and chemical seawater pollution is considerable, according to the results obtained from the growing attention given to this problem by researchers in recent years, especially in the 1990s.

The pouring of untreated waste into coastal seawater is its principal source of contamination by biological and chemical pathogenic agents. It causes significant potential risks to health, especially among bathers and seafood consumers. This statement was confirmed in connection with bathing only in the mid-80s after years of a lack of sound evidence in this respect (Shuval, 1986). Seawater baths and raw seafood consumption have later been confirmed as transmission routes of microbial diseases (Shuval, 1999; Harvell et al., 1999).

In addition to pathogenic microorganisms, variable amounts of substances from domestic, industrial and commercial activities are discharged into the sewage networks or watercourses that are then poured into the sea.

Variable and extreme contamination rates have been measured in seafood and seawater in the geographical zones that receive residual water with varying degrees of contamination.

Exposure to bacteria, viruses, parasites and fungi and to a diversity of hazardous substances may occur in the coastal environment through water intake, inhalation of water as aerosol or dewdrops, seafood consumption and dermal contact with water and sand. In general, the risk depends on the concentration level of the contaminating substance in the polluted environment and the duration of human contact with such an environment. Individuals with health problems and children are more susceptible to this type of exposure.

There is world-wide epidemiological evidence that enteric and respiratory diseases can be caused by bathing or
swimming in seawater contaminated with pathogenic microbes from untreated wastewaters (WHO, 1998; Kay et al., 1994; Pruss, 1998; Fleisher et al., 1998).

Contaminated seawater may increase the risk of falling ill or dying through activities such as bathing, water sports, recreation with or without contact with water, fishing, professional diving and consumption of seafood. Infectious diseases generally appear in the digestive and upper respiratory systems; eyes, ears and skin can also be affected. Digestive tract diseases that have traditionally been studied and linked with water or seafood contaminated by micro-organisms are acute gastroenteritis, typhoid and paratyphoid fevers, hepatitis A and cholera. Nose and pharynx diseases are those most frequently found in the upper respiratory system. Gastroenteritis is the most frequently detected and researched disease in published literature.

Significant incidence rates have been established for diseases linked to bathing and swimming in contaminated coastal water and to the consumption of contaminated seafood. Epidemiological studies have linked exposure to contaminated seawater with diseases; relative risk values* are frequently between 1.5 and 3. They are also consistent, as there are similar results obtained by different researchers in different countries. At the same time, they have shown a temporal cause-effect relationship, and most of them also show significant dose-response relationships. In addition, the studies are plausible as their results agree with the general information on the ingestion of infecting doses of pathogenic germs. Finally, they corroborate the analogy that similar agents cause similar illnesses in similar circumstances, when the widely demonstrated effect on health is reproduced through faecal contamination of drinking water.

There are at least twenty reliable studies, most of them of prospective design, that clearly support the conclusion that the frequency of infections and diseases in bathers increases constantly as faecal contamination in coastal water increases; all of them contribute to the establishment of an unquestionable dose-response relationship (Pruss, 1998). It has also been shown that the higher the recreational exposure time, the more frequently the disease appears. Micro-organisms indicating faecal contamination that have shown the closest correlation with health effects are the enterococcus, faecal streptococcus and faecal coliform.

It has been detected that, specifically, bathing in contaminated seawater generates a significant excess rate of enteric diseases, and their rates of incidence show a high correlation with the concentration of enterococcus and escherichia coli in the water (Shuval, 1986). In addition, based on the epidemiological studies, several authors have developed dose-response relationship models that show a tendency to increase the bathers' risks in falling ill as the concentration of bacteria such as enterococcus, faecal streptococcus and faecal coliforms increases in the water (WHO, 1998).

The studies also conclude that bathers face risks of developing digestive and respiratory illnesses in slightly contaminated coastal water, even at the levels of microbial contamination.

* Relative Risk is the ratio between the incidence of a disease in a group exposed to a specific causal factor and the incidence of the same disease in a control group not exposed to such factor.

The WHO also estimated that bathing in seawater classified as acceptable with an average *faecal streptococcus* level of 50 per 100 ml places an adult bather at a 5% risk of developing an infectious disease after a single exposure (WHO, 1998).

Volunteer-based studies have determined that in adults bathing in "acceptable" water that meets European Community or US Environmental Protection Agency standards, but with a slight level of wastewater contamination, including immersing their heads in the water and presumably taking in some water, 35% suffered gastroenteritis and 66% suffered an acute feverish respiratory disease and/or an ear infection (Kay et al., 1994; Fleisher et al., 1998).

Children are more sensitive than adults to exposure to pathogens in seawater. Contributing risk factors are their less-developed immune defenses, low level of acquired immunity, longer time spent in the water and greater amounts of water ingested. If, additionally, children are a high proportion of total beach users, all this puts them at especially high risk. It has been found that the morbidity rate in children is twice that of adults (Cabelli, 1983; Fattal et al., 1987).

Fish and seafood contaminated with bacteria and viruses – especially raw molluscs – is a common means of transmission of infectious diseases via the digestive system. Some evaluations conclude that contaminated fish and shellfish are responsible for a significant portion of food-transmitted diseases world-wide (Scoging, 1991). The pathogenic agents of domestic wastewater remain viable in seawater for days, weeks, or even years, as in the case of the hepatitis A virus; they remain inside fish and shellfish for months. Filtrating shellfish concentrate in their flesh very high contents of germs that are present in the water (Gerba, 1988). The vibrio cholerae apparently has its natural habitat in the marine environment, especially in warm coastal water and estuaries.

The origins of cholera, typhoid fever and hepatitis outbreaks (among others) are frequently identified as contaminated beach water, fish and seafood. Some studies have found that fish and shellfish are responsible for 11% to 70% of the outbreaks of food-borne diseases (Eyles, 1986). There are estimates of a 1% risk of acquiring infectious hepatitis A in individuals who eat raw shellfish only once, even when the shellfish was extracted from officially approved water for its culture (Rose and Sobsey, 1993). This is supported by the findings that 20% of the shellfish collected in water that complies with bacteriological guidelines for their culture is contaminated with enteric viruses (Rose and Sobsey, 1993).

A study in the U.S. concludes that 1% of the individuals that eat slightly contaminated raw shellfish will fall ill with a moderate viral intestinal illness. This risk increases to 50% if the viruses are highly infective. Studies conducted in the U.S. (Koff et al., 1967) and the United Kingdom (Scoging, 1991) estimate that 25% of infectious hepatitis sufferers acquired the disease through eating raw shellfish.

Latin American health services frequently identify outbreaks of infectious hepatitis and typhoid fever (and cholera in the 90s). When these outbreaks are studied, the transmission is found to be linked to the consumption of raw seafood and fish from coastal areas near wastewater discharges and contaminated river outflows.

By 1997, marine aquaculture world-wide was producing over 18 million MT per year of fish, molluscs, crustaceans and algae.
The challenge lies in assessing the potential risk that this production implies to the consumer, knowing the occurrence of diseases caused by these products coming from culture waters that comply with microbial contamination standards.

On the other hand, it would also be possible to infer the risk to the population from consuming fish and seafood. Assuming that a proportion of seafood has a variable degree of microbial contamination, a rough way to evaluate the risk is to analyse the yearly rate of marine food consumption expressed in kilograms of product consumed per inhabitant annually. This estimation would be more reliable if the calculation were based on the volume of marine products extracted by artisan fishermen in coastal water, where contamination is more evident.

The best information about the impact of the coastal environment on health, where most epidemiological research has been carried out, refers to exposure to seawaters and foods contaminated with microbes. The assessment of beach exposure, particularly to sand, is relatively poor, and the epidemiological research is almost null. Sand works as a reservoir; bacteria, viruses, fungi and parasites become isolated in it. Although the most frequently found micro-organisms are bacteria and fungi, there is not enough epidemiological evidence to assure that transmission takes place through this way; some research even concludes that sand is not an infection risk (Chabasse et al. 1986; Conseil Supérieur d'Hygiène Publique de France, 1990).

Information on biological contamination levels of beaches does not help to infer a certain degree of risk. It is difficult to determine exactly to what degree the contaminated seawater is responsible, and how much can be attributed to the beach users. The results do not coincide when comparing the levels and kinds of microbial contamination with dry and wet sand conditions, number of bathers, tides and seasons (WHO, 1998).

Outbreaks of infectious gastrointestinal diseases are just one visible part of the problem of coastal sea contamination. Studies show that the incidence of disease during outbreaks is just a small part of the actual total incidence. Frequently, it is calculated that the real rate is about 100 times greater. Infectious diseases linked to contact with seawater is a public health problem, with many people suffering from light to moderate clinical ailments and with very low fatality rates, except perhaps with cholera. This is not a problem where mortality plays a relevant role or becomes a major concern. However, recent evaluations are showing that, in addition to specific outbreaks, widespread microbial contamination in coastal areas is causing a generalised public health problem whose world-wide dimension may be critical (GESAMP, 2001).

Unspecific, acute, infectious gastroenteritis is of relatively short duration, no more than a few days. In contrast, typhoid fever and viral hepatitis type A, despite a very low fatality rate of about 0.1 to 1%, are highly incapacitating, the patient being confined for several weeks or even months. Cholera, on the other hand, is extremely serious and has a fatality rate of over 50% when untreated.

It is estimated that many people suffer from gastroenteritis or upper respiratory diseases due to seawater causes that do not form part of outbreaks (Shuval, 1999). It is known that few of them request medical attention (1 out of 1,000) and that it is probable that in these cases, likewise, the fatality rates are low.

With this background information, the economic impact that this kind of disease has world-wide was estimated, considering the world’s annual universe of
tourists as the exposed population. When the estimations of the number of tourists worldwide that swim in the sea are related with the relative risks of different levels of seawater contamination, and deriving a total number of "days of exposure to seawater," it is concluded that swimming in the sea would cause moderate gastroenteritis and upper respiratory ailments in about 250 million people annually. An estimate of the socio-economic impact from lost time among the sufferers can be added to this figure.

The economic impact was calculated on the basis of DALY (disability-adjusted life years) as an expression of the criteria of "global disease load/cost" developed by WHO and the World Bank. This expresses the life years missed due to premature death (in relation to life expectancy) and to incapacitation as a result of illness (World Development Report, 1993). The amount of US$4,000 was assumed as the mean socio-economic cost per year of missed productive life. Total annual world cases are about 400,000 DALYs, which represent an annual estimated expense of US$1.6 billion (Shuval, 1999).

It was also calculated that the consumption of contaminated raw seafood worldwide is responsible for 2.5 million infectious hepatitis cases annually. This figure, together with the fatality and chronic hepatic damage rates, each of which, according to the study, occur in 1% of the patients, account for 1.8 million DALYs per year and a social cost of about US$7.2 billion annually (Shuval, 1999).

The analysis of the impact of sea contamination on health has focused on the evaluation of the effects of microbial contamination. In recent years, there has been an increasing interest in learning the magnitude of the problems caused by the chemical contamination of coastal areas and beaches through the discharges into the sea of hazardous chemical wastes from coastal industry, inland industrial and agricultural activities and from domestic wastewater containing significant amounts of potentially toxic domestic substances.

The type and magnitude of chemical contamination of the sea from land-based sources depend on the degree of industrialisation and urbanisation as well as on the scope and intensity of agriculture. An evaluation of these variables could shed some light on the potential risks to the marine biota and human health.

Due to the harm to the marine environment and their impact on health, special attention has been given to metals, hydrocarbons, and persistent organic pollutants (POPs). Specifically, cadmium, mercury and lead have been studied, as well as pesticides from agricultural activity, and organic compounds associated with industry and oil.

Human exposure to anthropogenic contaminants in coastal waters implies risks of toxic effects, especially chronic, long run effects. This exposure usually occurs at low concentrations of substances in the water, marine water users are unlikely to be exposed to concentrations high enough to cause acute intoxication after a single exposure.

Microbial contamination produces the onset of acute infectious diseases within a short period; these illnesses can be easily linked to the marine exposure. In cases of repeated exposure to toxic substances in water or food, damage can appear months or years later. Without studies that show the dimension of this association and the frequency of the chronic damage, the actual impact of chemical contamination of the seas cannot be known.

Exposure to toxic substances in seawater occurs as described above for microbial agents. The information on dermal exposure to substances in the water and
sediments is not very conclusive; the possibilities of contracting illnesses are greatest through water intake, especially in children, and through inhaling water as spray.

However, the most relevant exposure occurs on a sustained basis through the consumption of fish and seafood, which concentrate and accumulate substances, particularly metals and organic compounds. The risk associated with hazardous substances in fish and seafood is greater among people who frequently incorporate them in their diets. Among the adverse effects linked to chronic exposure to toxic substances are damage to the nervous, endocrine, immune and reproductive systems, and cancer.

The carcinogenic risk of these chemical sea pollutants occurs through ingestion of a variety of organic compounds ubiquitously distributed in fish and seafood. Important among these are polychlorinated biphenyls (PCBs) DDT, hexachlorobenzene, chlordane, benzo-alpha-pyrene, dieldrin and dioxins.

Since substances in marine foods pose a long-term risk, the epidemiological evaluation is not conclusive as to the magnitude of the impact that the relative participation of such exposure has on health at the present levels of contamination. This is due to human communities’ multiple exposure to different non-marine environments (water, air, soil, non-marine foods, etc) contaminated with the same substances found in fish and seafood. For example, the main sources of exposure to PCBs in foods are fish, red meat and dairy products.

Especially important among contaminating metals in the sea are cadmium, mercury and lead. In the 1950s in Japan, an epidemiological assessment was made of an episode of harmful effects due to mercury among the general population, which was not occupationally exposed to this substance. The metal, in an inorganic compound (of relatively low toxicity), was poured into the sea by local industries, where, due to anaerobic bacterial action in the sediments, it turned into organic mercury (methylmercury, highly toxic for the nervous system). This subsequently entered the trophic chain and accumulated in fish caught for local consumption, generating an epidemic of severe brain damage in new-born babies.

Polycyclic aromatic hydrocarbons (PAHs) are important due to their incorporation into the marine food chain. The main source of anthropogenic PAH contamination in the sea is oil-related activity.

POPs include a series of pesticides (aldrin, chlordane, DDT, dieldrin, heptachlor, etc) and PCBs products and industrial by-products (dioxins and furans). They are organic compounds of the chlorinated kind, almost insoluble in water and highly liposoluble. Resistant to photochemical, chemical and biological decomposition, they become very stable in the environment. They tend to accumulate in sediments and in the fat tissues of live organisms; POPs easily concentrate in marine organisms, thus representing a risk when they are consumed by humans.

Another dimension of the substances in marine waters is the presence of natural biotoxins in marine algae. In the last few decades, there has been an increase in the occurrence of toxic algae world-wide, and it is strongly believed that this could be directly related to the growing impact of anthropogenic discharges into coastal waters that provide nutrients, particularly nitrates and phosphates, which encourages the growth of toxic algae (Smayda, 1989).
The presence in the sea of toxic species such as dinoflagellates, nanoflagellates, diatoms and cyanobacteria may produce severe dermatitis in swimmers who come in contact with the algae, particularly, cyanobacteria. But the most serious aspect is that severe poisoning with diarrhea, paralysis, amnesia and neurotoxicity can occur through the consumption of seafood and fish contaminated through the food chain with these toxic species. The fatality rate of the paralyzing variety can reach between 10 and 20% (WHO, 1990; WHO, 1994). It is estimated that between 100,000 and 200,000 cases of severe intoxication of this kind occur world-wide every year, resulting in 10,000 to 20,000 deaths and about 20,000 cases with severe neurological sequelae (Shuval, 1999).

The toxic episodes reported in the region are concentrated in the far south of Chile, where outbreaks were recorded in 1972, 1981, 1989, and continuously ever since. Episodes have also been recorded in Tumbes, Peru. In Chile in 1998, a spring blossoming affected the production of cultivated salmon, resulting in losses of approximately US$10 million (Clement and Lambeye, 1984). Intoxications reported in Chile have occurred mainly with diarrhetic poison and paralyzing poison; between 1972 and 1995, there were 310 reported cases of paralysis, of which 20 were fatal, and over 600 cases of diarrhetic intoxication. Diatoms have been reported in the southern region, with no recorded incidents of amnesia (COI, 1994).
7 TRENDS IN THE PUBLIC AND PRIVATE SECTOR PARTICIPATION IN URBAN WATER AND SEWAGE SERVICES

7.1 The Growing Water Shortage and the Need for Private Sector Involvement to Fulfil Demand

During the decades of the 80s and 90s, water supply did not keep pace with world urbanisation and population growth. The combination of the two caused sanitation services to deteriorate, which, in turn, generated economic, political and social conflicts. The inability of governments to resolve these problems was the main reason for encouraging the private sector to participate.

The greatest area of concern is the scarcity of water in the world, which affects agriculture production, economic development, and damages the environment. Water is a natural renewable resource, but its amount is fixed and finite, and it is not distributed equally in all countries. In addition, there are serious problems of water supply among households and industries, and among rural and urban sectors. Water scarcity is evident in two ways, both in absolute terms and in terms of supply; both problems are seen in urban areas.

The migration trend from the country to the cities is evident, especially in developing countries. This phenomenon brings along with it environmental and water resource degradation, and increased amounts of wastewater. In developing countries, 90% of wastewater is discharged to rivers and seas without being previously treated.

The issue of water in the urban sector has both political and economic difficulties. Traditionally, water and its services have been subsidised by governments, since it is considered a basic need; therefore, it has important social and political overtones. The fact that a realistic price has not been assigned to water consumption results in half the drinking water in developing countries being wasted before it reaches consumers.

Since 1960, while moderate increases have been seen in investments in water services, the private sector's participation has increased at a much faster pace. In general, there is a current trend in the world to increase the participation of the private sector. Investment in infrastructure in developing countries, which comprises approximately 50% of public expenditures, is being taken over by the private sector. The decreasing role of the public sector in water services is due to the problems governments face in funding. Most public spending is financed by tax monies, and the funds collected are not sufficient to carry out investments or improvements that are essential for a smoothly functioning water sector. Governments are currently looking for a way for the private sector to contribute in the areas of investment, technology and human capital. Private capital doubled in the decade of the 90s, and private investment in developing countries increased six-fold. This was the result of the public sector's poor performance in supplying, promoting and improving infrastructure, paving the way for the private sector to fulfil these limitations on funding and on supplying urban services. Together with the scarcity of funds, there is a lack of political will to change the distribution of resources available to face the problems of water scarcity and pollution.

In addition, the quality of utility services, as well as water supply, depends to a large
extent on how the decentralisation process is implemented. How responsibilities are divided at the local, provincial, and national levels is a decisive factor. In Latin America, the jurisdiction granted to local governments did not guarantee representation of all local interest groups.

To date, the most important challenge in the sanitation sector has been to maintain a balance between public and private participation in order to supply more efficient water and sewage services to local users. A crucial part of the system is that the government retains the responsibility to establish and reinforce the performance standards according to the norms, regardless of the private management model chosen.

Aside from the experiences and conditions in developed countries with respect to public-private management, a great deal of the debate on the roles of the private and public sectors is being carried out in developing countries for several reasons. It is worthwhile to point out the following:

- A decrease in public funds
- Deteriorated public water systems
- An opportunity to attract new investment and technological experience
- An improvement in water supply

It is crucial to choose the best available option for governments to improve on the operation and quality of sewage systems.

In some models the public sector remains in control, but at the same time improves incentives to the private sector. For example, the sector may remain in the hands of a state corporation, but with a corporate structure delegating the administration to the private sector. Thus, the corporation has full freedom in establishing rates, administering budgets and financing new projects. This type of structure offers better accountability and transparency as compared to traditional governmental operations.

Other options involve the private sector to a greater or lesser degree; the most important alternatives include:

- Private management and control, with public sector ownership and investment; contracts granted to the private sector;
- Private management and investment, with public supervision and property; concessions and contracts, transfers to the private sector;
- Public-private management and property; joint investment (joint ventures)
- Unregulated private service; small companies and community organisations.

Several of these models are derived from experience in industrialised countries, especially from the experience acquired in large multinational corporations.

Other funding alternatives are by means of municipal bonds or by complete privatisation of water companies (British model); Chile is currently using this method. In the United States and in Canada, local governments depend on the bond market to finance a major portion of the water services. This is because it has a very well developed capital market and macro-economic stability, which offers confidence to private investments. The confidence in laws, procedures and financial entities at the local level are also necessary to the development of a municipal bond market.

These conditions do not exist in many developing countries. Governments are viewed as high-risk investments, lacking autonomy to collect and make use of funds. Nevertheless, the municipal bond market is growing. In Latin America, 52 municipalities and provinces had access
to capital through bonds between 1991 and 1998.

The policy adopted in Chile has resulted in increased water availability, exploitation of new resources and minimal ecological damage due to new infrastructures. Chile has developed legal and administrative means to attract private capital, generating confidence to invest in the sector.

Water rights are tradable. The prevailing use of these rights is in proportion to the number of rights (shares) on a variable amount; in other words, the owner has the right to a specific number of rights (shares) per sector. Water is distributed by the market within and among the different sectors of the city, and the law ensures protection should non-desirable effects arise. Users and organisations are organised and have the power to resolve conflicts.

There are various viable options in the privatisation process. Through concessions, the government contracts a private firm to be in charge of one or more specific services for a period lasting from five to seven years. The government remains the main provider, only delegating some management activities. The private sector agrees to perform a specific task for a fixed amount previously agreed upon, and to maintain specific performance standards.

The service contract is one of the models that facilitates increased private competition. Under a service contract, the government pays the private sector a pre-determined amount that may consist of a single amount, a per-unit cost or shared funds, among others. Costs are set and the private sector participates in the profits. The private sector does not necessarily have direct communication with the users, and financial transactions are done directly by the government. In this model, the government is responsible for financing investment needs that may arise to expand or improve water systems.

Service contracts have the advantage of being one of the formulas that most encourages private competition. This is due to the fact that contracts are constantly renewed, making contractors aware of the need to maintain high standards and low costs. In addition, as contracts are renewable, entrance barriers are low.

The disadvantage of service contracts is that they do not generate sufficient private capital, nor do they lay the necessary groundwork to optimise water systems and sewage functions. Therefore, good performance depends to a large extent on governmental capacity to provide capital and proper management. Also, ambivalence may arise with respect to the private sector’s role in maintenance and the public sector’s in investment.

Service contracts leave the most sensitive political issues in the hands of the government; these include tax collection for services and expansion of the water network system. In summary, they do not resolve the political pressures that make up a major portion of the sector’s decisions: in the municipalities, for example, there are pressures to grant contracts to lower bidders without taking service quality into consideration.

When one of the main objectives of the government is to attract private capital, but it prefers to retain control and ownership of the water systems, one alternative available is BOT (Build, Operate, Transfer) contracts.

The BOT contract system facilitates the construction of new plants. Private corporations finance, build and administer the new plant for a period of not less than 10 to 20 years, in accord with regulatory governmental measures, while the government retains ownership of the plant and becomes client and regulator.
of the service. Under this type of agreement, the private sector grants the capital to construct new infrastructure. Meanwhile, the government agrees to buy a minimum amount of production, regardless of demand. In this manner, the private sector is assured the recovery of the invested cost during the period stipulated.

The system has the advantage of being an efficient way to attract private capital for the construction of new plants and drainage systems, or to renew substantially existing infrastructure. This type of agreement reduces market risk for the private investor, since the government is its main and sole client, reducing the risk of insufficient external demand or payment capacity. This model has been used for the construction of many plants in developing countries.

One disadvantage is that this sort of agreement, in general, is limited to one plant or to one specific infrastructure work, which does not allow for using resources in a generalised manner. A second problem is that the government guarantees the reimbursement of a percentage of the construction expenses incurred by the private sector, and, if the municipality does not fulfill its end of the bargain, the government is liable to the investors; the city is required to pay for a minimum and a maximum amount of water generated by the construction company.

With concessionaire contracts, the government turns full responsibility for water supplies and sewage systems over to a private contractor (concessionaire), including construction, management, maintenance and collection. The governmental role is transformed from service provider to regulator or enforcer of the quality and prices of the service.

During the life of the contract, the private sector manager is responsible for the capital and the operational costs, including infrastructure, energy, raw materials and repairs. In exchange, the private operator collects rates directly from the system's users. The rate schedule is generally established in the contract, which also includes provisions for future amendment.

The rate schedule and the regulatory plan that goes with it is the most complex component of the concessionaire agreement. Rates must allow the operator to generate reasonable earnings that will avoid political and social problems.

The debate on the rate system focuses on information. Does the regulator have enough information to judge accurately the financial state of the concessionaire during the license period? Is the private sector complying with the quality requirements, and are the clients well supplied? Information management among concessionaires, users and regulators is one of the biggest challenges that have to be closely examined when preparing concessionaire agreements.

As in the case of BOT agreements, funding through concessions involves two components: liquidity and external debt. The governmental guarantee to cover the concessionaires' losses if it fails to make a profit minimises the risk for the private sector. This is especially true when considering the changes in the value of the US$ dollar, since the profits are in local currency, but debts are usually held in foreign currency.

The advantage of the concession system is its effectiveness in attracting private capital for new plants and sewage systems, or renewal of existing ones. It is also advantageous to share responsibility both in investment and administration, which give the concessionaire additional incentives for investing and improving technology, since any gain in efficiency will translate into increased monetary profits. In some countries, concessions
have been successful in improving water services and in reducing costs to the users. In addition, concession systems are less prone to political interference as compared with services managed only by the government, since the licensed services remain with the same operator regardless of any changes in government.

One of the main disadvantages is that large concessions can be difficult to organise and can be politically controversial. Even though concessions clearly specify the performance, price adjustment and quality standards, they tend to lack planning and dialogue among the parties involved, thus affecting users and employees. Planning is a critical issue, one that requires the government to expand significantly its regulatory capacity.

Also, it is difficult to stipulate the licensing conditions since such contracts have a life service of 25 years or more. It is impossible to predict in advance the most efficient and effective way to provide a service for such a long period. There are several alternatives for solving this uncertainty that are being examined. One is for the bidder to offer the total amount that it is willing to invest, without specifying how the full amount will be allocated. Contracts might also include clauses allowing for future reviewing of programs to be carried out, and for scaling of rates during the period.

Finally, large concessions tend to create monopolistic practices, protecting the licensee from external competition during the re-negotiation of contracts.

Under the joint venture system, the public and private sectors share in the profits generated, as well as the tasks and responsibilities assumed. Under this model, both sectors are responsible for investments and risks. Each party must be willing to quantify the contributions of each one to the projects and the implementation process.

These joint ventures are a new way of acquiring and implementing different types of projects, where the government can grant the company a concession or a BOT contract. They create in a "real" way an association where the government, the entrepreneurial sector, the NGOs, and other stakeholders pool resources and generate profits together, resolving issues of local infrastructure. Under this system, the government continues to be the main regulator, but is also an active shareholder of the company. In this manner, the government benefits from profits generated and ensures political support. The private sector generally has the responsibility of daily operational management.

Joint ventures have the advantages of benefiting from the private sector's dynamism, having access to financing, technology and business efficiency, while taking into consideration social and environmental aspects and the local context. As both parties have invested, both have incentives to make sure things operate properly. This encourages them to make the best investment decisions, develop the best technology, and make any improvements that will result in profits for everyone. Lastly, it stimulates dialogue among all parties.

Nevertheless, there are disadvantages. One is the fact that the government continues to fulfil regulatory functions. This could create future conflicts of interest between maintaining accountability and maximisation of earnings, producing a risk of political intervention that would reduce the private sector's profit potential.

While the government explores traditional alternatives, there are less formal ways of involving the private sector. Some of them are through small businesses; some involve the public sector, others the private. Many of them concentrate on the poorest neighbourhoods of the cities and on peripheral areas. This is the de-regulated private scheme.
Recent studies indicate that in developing countries, more than half of the urban population receives basic water supply services from a private company. When governmental and private services are inadequate, the community can fill the gap. Community providers can be individuals, families or local communities. These can play a decisive role in organising collective solutions to difficulties; they can work through NGOs to organise and finance sanitation services.

For example, community providers can buy water in large amounts and sell it in small quantities. Small investment groups can serve a few families with a single water source. Another option includes community water services, whereby 20 to 30% of the households install house meters from the central system and regulate their own use, paying their accounts collectively.

An advantage of community agreements is that they reduce the initial investment by using local resources, such as labour force, local material, and supervision of construction materials, workers and supply, etc. Small and medium size companies can service the community according to their incomes, which can improve existing economic conditions.

An important disadvantage is coverage: While it may be successful in certain neighbourhoods, it would be difficult to expand it on a large scale or to duplicate it in other areas. Another disadvantage is that governments are sometimes reluctant to support this type of community effort since they perceive informal methods of service as unstable. In addition, maintaining infrastructures at a community level takes time, and to institutionalise and maintain this sort of project could result in difficulties over the long run.

7.2 Lessons Learned in Private Sector Investment in Urban Sanitation Services and Wastewater Treatment

As previously stated, governments worldwide are looking for ways of attracting private sector companies to water and sanitation services. The following are some of the lessons that could be identified in this process:

The involvement of the private sector does not release the government from its responsibility of ensuring basic services. Governments have the primary responsibility to make sure basic needs are met, and the private sector can help to do so. How this is accomplished will depend on what the government prefers. It might be a direct service supplier, retaining total control of all the different stages of the cycle; it might involve the private sector to a large or small extent if this is viable, thereby increasing efficiency and access to technology; or services can be left under entrepreneurial management or under the complete control of private investors. The success or failure of any alternative depends on many factors. In any case, the government has the ultimate responsibility for fulfilling basic needs. What is important is how the government bears this responsibility.

Satisfied users are loyal clients that avoid potential problems. When they are not satisfied, they can be a source of economic and social conflicts and problems. A system of water subsidies also satisfies users, but only until the system deteriorates due to water scarcity, high operational costs, inadequate maintenance, loss of profits and other problems. This is the situation facing most developing countries. Determining the actual long-run cost of water services and how much to charge the final user: This is
the key to success and to ensuring continuous water and sewage service.

Users have proved over and over that they are willing to pay as long as they receive good service. Governments must be aware of users' needs. When planning water projects, they have to take into consideration both users' needs and the technical aspects of water supply. In this respect, decentralised and differentiated services tend to be more successful at satisfying users' needs, since private companies are more updated than governments are on what the user needs.

If the government decides to involve the private sector, they must co-operate in the process, delegating managerial aspects to the private sector and focusing their efforts on enforcement and regulatory tasks, monitoring what the private companies are doing. This change of roles implies a balance that is sometimes difficult to achieve, one of not placing too much or too little surveillance on private companies. The changeover from provider to regulatory agent is an extremely difficult change for governments, even more so when the same entities that used to be in charge of management are now limited to an enforcement and regulatory role. Furthermore, it should be added that if a government's regulatory capacity is fragile, this can seriously affect the flow of foreign investment.

While governments are concerned about increasing private investments, major projects are being carried out through decentralising national activities to the municipalities. In this case, the decentralisation process has both advantages and disadvantages with regard to private investment. A positive aspect is that services are supplied to the users more directly, and this should give users the ability to express their opinion regarding quality of services and rate schedules.

The biggest problem is that of attracting direct foreign investment. If a company is willing to invest long-term, it needs a certain degree of certainty with respect to the terms stipulated in the negotiations. Many of the decentralisation processes lead to uncertainty as to how responsibilities will be shared among national, provincial and local authorities. This is even more acute in the case of water rights. Many municipalities have little experience with the private sector, loans and public relations. And lastly, depending on the type of decentralisation, it may be that the country is too small to assume the costs associated with the transition process and that private investment will be necessary.

The water sector has great opportunities for investors. Three characteristics make it attractive: a) the need to expand water services, b) the actual income created by a continuous demand for water, and c) the opportunity of increasing these profits through better performance in the supply and management of the sector. Where there are great needs, there are big opportunities. The scale of these needs world-wide is overwhelming. Currently, French and British companies are those most active in meeting these needs. There are new investors interested, such as those from the electric sector and other utility companies, in addition to direct private investors.

Water, being a basic need, has great value. Therefore, the majority of the urban population pays something for the water it uses. Even the poorest sectors can be attractive sources of income, since under certain conditions, they could even pay higher rates for drinking water than other more affluent areas.

Users pay. This is the foundation on which to improve service. This is true both in increasing the efficiency of its use and in attracting private capital. Public awareness should be increased on issues such as water use and cost-benefit ratios.
Users must be aware of this and be ready to pay, not only for drinking water, but also for wastewater treatment. Therefore, it is important that the public be better informed. Users are ready to pay more for a service when they are aware of the needs and benefits.

Difficulties in attracting investors lie in other part of the cycle, particularly in the collection and treatment of wastewater. This may continue as long as there is not a willingness to pay for wastewater treatment. People are more willing to pay a higher price to have access to drinking water than to treat wastewater. For this reason, it is extremely important that the real cost of the two services be analysed as a whole rather than separately.

Water is a basic need, and that is why government plays an important role. At the same time, water is seen as a commodity, since it has a value for the consumer. Therefore, it must have appropriate price and costs, combined with regulatory actions, and it must generate sufficient income to attract private investment. These two components are a source of heated debates and controversies on the value placed on water. These characteristics increase the risk for private investors. The risks are several: the amount of investment, the length of time needed to recover the investment, and government participation in prices, standards and exchange rate fluctuations. The price of water use and consumption is based more on political factors than on economic ones. Given the fact that it is highly political, public servants sometimes seek to gain additional votes during a political election by promising to keep the basic services at low prices.

The costs and risks are very high, since they imply high initial capital and country risks. Transition costs in the water sector are extremely high. Many governments do not know how the water system operates; this increases the risk for investors due to a lack of information on the current state of infrastructure when they calculate costs and participate in the bidding process. There is not much experience in the bidding processes and negotiation, making the transition and investment process even more difficult.

One of the secondary effects regarding high transition costs is the trend to concentrate investments only in large cities. In urban areas, there is a greater possibility of recovering investment and generating enough profits to justify the high initial costs and the inherent risks of this sector.

7.3 Project Risks

Country risk is also a factor when evaluating investments. In the water sector, many of the risks are directly related to how the government manages the project.

Will the water quality standards change during the life service of the contract?

Will the conditions under which the capital is invested change?

How will rates be adjusted over time?

Will the government fulfil its payment commitments?

The duration of the contract also plays an important role.

Other risks are related to users.

Will the users pay the costs of the services?

What type of political pressure could users exert on the government that could force it to make changes that have not been agreed to?
The country risk factor can be very high, depending on the magnitude of the investment. The macro-economic indicators and the political climate can be definitive factors in the decision of a foreign company to invest or not. In this case, it falls to the government to foster confidence and to minimise risks. The political will to do so or not depends on the country. This risk factor depends on the user and the government, and on their response.

One of the highest risks for the private sector is whether the government will fulfil its promises and goals during the stipulated period. It is essential that a solid attitude of confidence exist in political terms, along with a resolution mechanism to resolve controversies over the rate schedule. It is crucial to develop confidence in the country's laws and regulations based on a stable and transparent system, and to have a rate program that covers investment financing and operational expenditures and that assures profits.

International help also serves to minimise country risk, creating a climate of confidence for the private investor investing in specific projects.

As topics of reflection for governments, it should be mentioned that many governments have difficulties minimising these risks and satisfying the private investor, partly because they have to develop a new role as to assigned functions. The fact that water is considered a basic need justifies governmental intervention. At the same time, to attract private investment and to improve sector performance, governments need to transfer some of its functions to the private sector. It is difficult to find the right balance. Performance, quality, quantity, and price must be improved, and at the same time, weaker groups must be protected so that they do not lose out. Some governments are afraid that they are not able to generate great changes, sometimes due to political pressures or to political will. In addition, private sector participation requires that governments assume new functions, especially in the area of negotiations with private companies.

Many users see the participation of the private sector from a mixed point of view. On the one hand, they expect service to improve; on the other, they are afraid of having to pay more. They wonder why the government is unable to provide this service efficiently and without surcharges. Is it necessary to obtain profits from a basic need such as water?

Most investments in water services, especially in developing countries and in transition economies, have been made by private providers, be these large multinationals that offer these services or various small, informal entities. The great majority of governments participate with large international holdings, seeing them as a global solution for their various needs. At the same time, the large companies tend to concentrate in areas where greater opportunities for profits exist. This implies that investment in small and poorer areas need other alternatives to improve water supply services.

In sum, it is not a question of money; it is a question of business. This comment is made by many private investors the world over. To create attractive opportunities for investment, the following are needed: market studies, information and shared investment. Water must not be supplied free of charge. Water rates must reflect the cost of providing the service, including profits for the private investor.

Likewise, when private investors are involved, governments retain a high level of control over water and related services through the commitment to establish and exercise economic, social and environmental prudence. Involving users in the decision-making process can also help improve regulatory performance.
Their inputs can help the government meet quality standards, accepting the real prices for these services.

Some developing countries may not have any kind of wastewater treatment. The impact on the environment and on health can be very serious. Infectious diseases caused by untreated wastewaters, such as diarrhoea, are the fourth cause of mortality worldwide, and occur almost exclusively in developing countries. One of the ways for governments to approach this problem is to take care of it directly, paying for it through taxation. This was the method adopted by developed countries.

Fair sanitation prices cover not only drinking water costs, but also those of treating wastewater and obtaining recycled water of acceptable quality. With the increasing participation of the private sector in the drinking water field, it makes sense to incorporate wastewater treatment, if possible, into privatisation process initiatives. It is less costly to install drinking water networks and wastewater collectors simultaneously than separately. Given to the greater need to improve drinking water and wastewater treatment in the cities, these two components should be incorporated into the calculations and programme designs of water projects.

Government interest in encouraging private enterprises to participate in improving water quality and sewage systems is essential. There are many ways in which the private sector is participating in this process. There is no single correct formula. Nevertheless, it is a process in which governments, investors, and users need to develop schemes in which local needs and the local context are part of the reforms.

Bidding processes are useful in stimulating innovation in water system designs and water management alternatives using the experience that the private sector can contribute. For example, a bidding process can be based on the cost of guaranteeing specific standards of performance during a given period of time; the bidder presents the best design to accomplish this objective, instead of the government being the one to specify the design. In this case, the government evaluates the design. Its new role is to regulate, not provide water service.

As for expanding the access to the formal market for a greater number of bid processes, there is a limit that large companies can assume in terms of number and type of project. Small and medium-sized companies could participate in bidding on smaller projects in small cities. Their participation has the advantage of stimulating local business and generates local employment. Nevertheless, having one large company assume everything is very attractive for governments; thus, many bidding processes are set up in such a way as to prevent access of small companies. In addition, access to funding is only available to large companies.

Long term response for many countries could be to foster a common fund of local private providers that could compete in the contract bidding (this system was used in France). This system is effective with the bidding process open to everyone. Also, informal providers can be integrated into the formal service network in areas with few or deficient services.

Many cities in developing countries have two separate water systems: the formal system or network managed by the government, and the informal, decentralised network made up of community workers organisations in marginal neighbourhoods. A preferable solution would be to incorporate the services offered by informal entities and then offer them to the municipality.
7.4 Costs and Prices

It is extremely important to make information available to all water market stakeholders in order to increase the capability of both users and government, and for them to adapt to their new roles. This reduces the transition costs and increases competitiveness.

An important strategy to reduce transition costs is to share information: sharing knowledge, data bases, current status of the water system, and data on users' payment capability helps avoid study duplications. Household surveys could be done by NGOs and academic or research institutions. Workshops, symposiums, conferences and meetings are extremely important for transmitting information and for reaching as many people as possible. Groups of professionals, investors, lawyers, and engineers familiarised with the obstacles the private sector will have to face are also useful as government consultants. While international consultancy in these matters is important, local participation and consulting is also an important complement to the process; in addition, it reduces costs.

Some of the major transition costs for the private sector are unavoidable. The private sector has to incur high initial costs, and the government must support and review the bidding process.

It is also important to improve efficiency and competitiveness by monitoring progress and performance. Although it is difficult to introduce the concept of competitiveness into the network system, it is possible to encourage competition by comparing performance levels between different providers in different localities. No provider wants to be last on the scale; this not only increases complaints from the users, but the company also faces difficulties in obtaining capital in the future.

Since water is both a basic need and an economic good, both government and private sector must invest time and resources in it. Government must invest in regulatory systems to ensure that public goals are met and that private enterprises do invest in order to offer high-quality service. There are other types of joint investment that also can be appropriate for the main objective of reducing initial and transition costs, assuring, at the same time, that social aspects do not worsen.

A basic goal of all governments is to be sure that all citizens have access to drinking water, regardless of their ability to pay. The governments' commitment to subsidising the service can be resolved not through distorted prices that do not reflect the real cost of the water, but rather by means of some kind of "supplementary income payment." In Chile, this has been done by using "social certificates for water subsidies" (certificados sociales para los subsidios de agua). This is a new, effective system that separates business from social issues, and subsidies are more transparent and direct than in the system operating up until 1980.

The following is needed to attract more private investment:

- To set clear performance standards to be met: economic, environmental and social, at municipal, provincial and governmental levels;

- To negotiate the terms under which the private sector is to be involved, whether at the municipal, provincial and/or national levels;

- To regulate stages as they are completed, at municipal, provincial and/or governmental levels.
To find the ideal combination between the role of the private and public sectors in services and water treatment, the basic premises include:

Government controls the water sector;
Users pay;
Businesses need to generate profits;
Grantors can help.

How these basic principles can best be implemented depends on the local needs and context of each country. Government must not believe that private sector participation will decrease its responsibility; in fact, the role of the government throughout the process is a determinant and fundamental factor in attracting foreign capital and in guaranteeing that the private sector provides services efficiently.

Users must be ready to pay for the services that they receive, both water and sewage. At the same time, government and businesses must be informed as to the needs and preferences of the users, and include them within the regulatory structure. If there are investors participating in the process, governments must be aware of the need to generate profits to preserve those capitals.

Investors, in turn, should be aware that their profits must be reasonable over the long term; they must not attempt to obtain large short-term profits, which can bring risks and high political costs.

Donating agencies can help or hinder these efforts depending on their attitude. One of the best things they can do is to offer experience, contacts and information on the different methods governments all over the world have chosen to make this transition from the public to the private sector in matters of water services.

All the parties have an important role to play for this process to be successful, respecting, understanding and reflecting on the goals, achievements and needs of all. In summary, private investment can be a powerful, efficient alternative for improving water quality, supply and services, but it is a task in which everyone must participate.
8. CONCLUSIONS

The SE/P region is fortunate with respect to its morphology, determined to a large extent by the Andes mountains, its natural resources, diversity of climate and special ecosystems, in addition to its unquestionable economic potential. It has more than 11,500 km of coast, Chile and Peru having the longest coastlines.

The activities on the Pacific shore are of great importance in most of the countries in the region. They are important in Panama because of its capital city; in Ecuador because of the Guayas River and its importance to Guayaquil; in Peru, because of its capital and coastal cities; and in Chile, because of its numerous important coastal cities. Colombia has only two minor coastal development centres.

These five countries have highly diverse demographic, social, cultural and economic situations due to their respective national needs.

The wide variety of human activities, including agriculture, aquaculture, tourism, urban development, mining, industry and fuel transportation, have a direct, significant effect on the marine coastal environment of the South East Pacific. This is particularly true for domestic wastewater that finally arrives to the sea. In most cases, it has a negative effect on the health of the inhabitants, natural resources, economic development and the populations' quality of life.

At the end of the 90s, after the international economic crisis, the economic situation in Latin America and the Caribbean began to recover. In the year 2000, economic growth was at 4% due to the positive results registered in some of the countries and the positive outlook for the international economy. The expansion in exports also contributed significantly to the improved GNP in most of the countries. Investment was up, too, in 2000 after dropping sharply in 1999. The GNP recovery for all the SE/P countries also implies significant improvement in saving and investments.

In 1999, three of the five SE/P countries had annual inflation rates of less than 5%. The recession that the region experienced was an important factor in controlling inflation. The exchange rate was the supply factor that most affected 1999 inflation.

Oil price hikes forced drastic adjustment in prices of all oil products, on top of the adjustments made to cover the effects of devaluations in various regional currencies. Prices were also affected by increased utility rates.

The financial crisis that affected economic growth, made worse in some cases by internal events, led to a significant drop in the demand for labour, the main cause of unemployment in the region and a reflection of reduced economic activity. There was a significant drop in employment and an increase in the unemployment rate in Chile, Colombia, and Ecuador.

Chile has a good chance of recovery, since at the end of 1999 it was already experiencing a positive growth rate and a trade surplus. During 2000, Ecuador and Colombia recovered from the previous year's sharp drop in GNP, regaining almost one-third of what they lost during 1999. In these countries, the political and economic situations are closely tied, so that a political improvement will help economic recovery.

The rise in oil prices, which stayed at relatively high levels in the year 2000, favoured oil-producing countries. The consolidation of the financial situation may be an element of vital importance for reactivation. Thus, the SE/P region overall saw a growth rate of about 4.0% in 2000.
The water and sanitation sector is one of the socio-economic components that greatly affect the quality of life and environmental conditions.

In order to have favourable results in the public health sector and in the economic parameters related to the environment, the areas of drinking water distribution, wastewater collection and final disposal of wastewater must be handled together. In this respect, each SE/P country has its own organisations which do not usually integrate these areas.

SE/P countries’ water, sewage and sanitation providers are generally different in nature. State participation predominates in some countries, such as Peru and Panama. In Chile, the private sector is an important participant. The role of the municipalities varies in each country; it is important in Colombia, Ecuador and Peru.

It is difficult to compare quality, quantity and continuity of drinking water service in the different countries. There are marked differences among SE/P countries in such variables as the number of hours of service provided, purification and water quality, intra-domicile delivery or water carrying, all variables that fundamentally indicate that the population’s health is at risk.

Untreated wastewater has a significant negative impact on human, land and marine environments; this has been widely demonstrated by public health and environmental impact studies.

An important fact in SE/P countries has been the emphasis in extending wastewater collection coverage. In the second half of the 1990s, over 70% of the urban population had access to sewage service. On the other hand, treatment or sanitary disposal of wastewater has progressed more slowly in SE/P countries: by 2000, treatment coverage was between 5 and 21%, usually through the use of stabilisation ponds.

The rate schedule is an important factor holding back development in water and sanitation services. There is a wide range of subsidised services in the SE/P, with obsolete rates, while some have rate systems in the development process, and others with fair, realistic rates.

Governments world-wide are analysing ways of attracting private sector companies to supply drinking water and wastewater service, which is gaining in importance in SE/P countries. Since all the countries have the legal framework to allow the private sector to intervene in some way in urban water and sewage services, important factors will be an adequate rate system, incorporating state of the art technologies, and delivering service in accordance with technical standards and local administrative systems. Private sector participation does not release governments from their responsibility of ensuring that basic needs are met. Governments are primarily responsible for fulfilling basic needs, and the private sector is only one of the alternatives to do so. How these needs are met depends on each government.

In the SE/P region, there have been difficulties in attracting investment for the collection and treatment of wastewater due to the fact that the public is not willing to pay for wastewater treatment. It is more willing to pay a higher price for access to drinking water than to treat sewage.

Structuring rates and the regulatory regime to go along with them should be a high priority in the SE/P countries.

SE/P countries have not fully developed information systems in the sanitation sector. Information management among concessionaires, users and regulators is one of the most important challenges that must be analysed.

Anthropogenic effects on the coastal, beach and reef ecosystems and on the protected natural areas of the Pacific
coast have been due to the great variety human activities that take place in these areas. These activities have been undertaken without considering the intermediate and long-term costs that these may have. Industrial, agricultural, mining and oil exploitation activities are all carried out in the SE/P countries without the necessary measures being taken to avoid negative economic and social consequences.

These activities affect tourism, fishing and aquaculture, and, as a consequence, they have an impact on human health, the conservation and sustainability of marine resources, productive capacity, and the biodiversity of the marine environment.

There are numerous problems, both causes and effects, that are directly or indirectly associated with wastewater and that have to do with the comprehensive development of the countries. Among the related factors are level of economic development, the general level of health and the educational background of the populations.

The countries of the region have varying situations regarding population. The percentage of the regional population that lived under the National Poverty Line in the 1990s was very significant both in urban and in rural areas, although the poverty rate was much higher in the rural zones. The International Poverty Line, the percentage of indigent households and the illiteracy rate; these are indicators that describe the situation of the SE/P countries. Most of these factors are found in the rural households in the region.

One way of expressing the quality of life in different countries is the Human Development Index, or HDI. This index integrates the variables of life expectancy at birth, educational level, and GNP per capita. HDI values range from a minimum of 0 to a maximum of 1. In 1998, Latin America and the Caribbean overall had an HDI score of 0.758. In South East Pacific countries in 1998, Chile was at one extreme (0.826), and Ecuador was at the other (0.722). Poverty variables are implicitly included in the HDI, and it is possible to see a correlation among them in the SE/P countries.

The inadequate sanitation conditions that prevail to varying degrees in Latin American countries is responsible for the high rates of child mortality and morbidity in the South East Pacific countries. Child mortality is closely tied to diarrhetic diseases generated to large extent by the environmental contamination produced by discharges of untreated domestic wastewater.

In the South East Pacific region, untreated domestic waste, together with insufficient coverage of basic sanitation and the poverty rate, is one of the main causes of infectious and parasitic digestive diseases.

Population settlements in the South East Pacific countries are generally located along watercourses in which they dump their wastewater, generally untreated. Communities located downstream are at especially high risk of developing infectious digestive diseases, since they are exposed to contaminated waters.

In some countries, child mortality and morbidity are mainly associated with sanitation deficiencies, in which contamination from domestic waste plays a huge role. Because of this situation, diarrhetic infections and other enteric diseases have become one of the main causes of death in the rural population.

Food safety, which is very closely tied to the above, depends not only on the abundance and availability of foods, but also on their accessibility and their quality and nutritive value, as well as a series of other economic and social factors. The region has an average dietary energy deficit of 220 kcal.
It is well known that most cases of diarrhetic disease are caused by consuming food contaminated wastewaters. An important factor in the region is the fact that fish is frequently eaten raw, and fruits and vegetables are irrigated with wastewaters. Fishing is an important source of high quality protein, but it is vulnerable to contamination. In addition, seafood products are frequently eaten raw. The cholera outbreak in 1991 was a reflection of this habit and exposed the vulnerability of the population. Raw seafood, together with the poor sanitation conditions in some coastal areas, caused the disease to spread rapidly. Due to wastewater contamination, there are various areas in the region that are candidates for “fishery extraction certification,” among them, some areas close to the mouths of rivers.

A high percentage of urban domestic wastewaters in the region are collected in sewage systems, but most do not receive sanitation treatment before being disposed of in bodies of water. Industrial and commercial effluents are also discharged into collection systems and bodies of water without treatment. As a consequence, water bodies contain a mixture of chemical and biological pollutants that affect public health when the water is used for agricultural irrigation, recreational use, aquaculture, and for human consumption without being treated. These waters’ impact on health due to recreational activities and aquaculture in coastal waters is an issue that has received growing attention in the region recently.

The dumping of untreated domestic waste into the coastal waters is a main source of contamination with pathogenic biological and chemical agents. It is a source of major potential health risks, especially in swimmers and in consumers of seafood products.

Exposure to bacteria, viruses, parasites, fungi, and a variety of other harmful substances can occur in the coastal environment through water intake, water inhalation as aerosol or dew, consumption of seafood products, and dermal contact with waters and sand.

There is epidemiological evidence worldwide that digestive and respiratory tract diseases can be caused by bathing or swimming in marine waters contaminated with pathogens contained in untreated domestic waste. Contaminated marine waters can put populations at risk of disease and death through such activities as bathing, water sports, recreation with or without contact with water, fishing, professional diving, and consumption of fish and seafood. Infectious diseases mainly attack the digestive system and the upper respiratory tract; eyes, ears and skin can also be affected. The digestive system diseases that are traditionally associated with water and marine foods contaminated with micro-organisms are acute gastro-enteritis, typhoid and paratyphoid fever, infectious hepatitis A and cholera. Gastro-enteritis is the disease most frequently detected and researched in published works.

High incidence rates have been established in association with bathing and swimming in contaminated coastal waters, and with the consumption of contaminated fish and seafood. Children are more susceptible than adults to exposure to pathogens in seawater; they are a notoriously high-risk group. Morbidity rates in children have been found to double those of adults.

Eating seafood contaminated with bacteria and viruses, especially the consumption of raw molluscs, is a common cause of infectious digestive tract disease transmission. Contaminated seafood and fish are responsible worldwide for a major portion of food-transmitted diseases. Pathogens in domestic wastewaters remain viable in the sea for days and weeks, sometimes even for years, as in the case of the
hepatitis A virus. They can live for months inside fish and shellfish. Shellfish, as they filter the contaminated water, concentrate the germs in their flesh. Vibrio cholerae apparently has its natural habitat in the marine environment, especially in warm waters and estuaries.

Cholera, typhoid fever and hepatitis outbreaks, among others, are frequently found to originate in connection with beach waters and contaminated seafood. Studies indicate that 25% of those suffering from infectious hepatitis contracted the disease by eating raw shellfish.

Frequently, health services in the SE/P region studying outbreaks of infectious hepatitis and typhoid fever, and of cholera in the 1990's, found that the diseases were transmitted by raw shellfish and fish extracted from areas near domestic waste discharges or the mouths of contaminated rivers.

The outbreaks of infectious gastrointestinal disease are only one visible part of the problems of microbe contamination in the ocean. Studies show that the incidence of the disease in the initial outbreak is only a small part of the total; it is often estimated that the actual rate is 100 times greater.

In recent years, there is growing interest in learning about the magnitude of chemical pollution in coastal and beach waters due to the dumping of hazardous chemical residues from coastal industries, inland industrial and agricultural activities, and from domestic wastewater containing significant amounts of potentially toxic domestic substances.

The type and magnitude of marine chemical contamination from land related sources depends on the degree of industrialisation and urbanisation, as well as on the scope and intensity of agriculture, which, in the SE/P region countries, are generally quite high. Human exposure to toxic chemical pollutants in coastal waters implies a risk of long-term, chronic effects. Exposure is generally to low concentrations of substances in the water.

The most important exposure is that which occurs over long periods of time through the consumption of seafood, which concentrates and accumulates substances, particularly metals and organic compounds. The risk associated with hazardous substances found in fish and seafood is higher in populations for whom these foods are a dietary staple.

Finally, a major effect of inadequately treated and dumped wastewater in SE/P countries is the various economic losses incurred in different productive and services sectors associated with the coastal marine environment. Important among these are tourism, recreation, agriculture, and fishing. Deteriorating natural coastal resources can directly or indirectly affect the economic dimension.

In order to demonstrate more objectively these adverse economic effects and their related after-effects, it is highly advisable to recall the benefit of evaluating the economic impact through cost-benefit studies in this area, including as many players as possible that have benefited and or suffered from the problem.

One key strategy is to carry out case studies in the SE/P region on the socio-economic effects caused by the problem of wastewater in the marine environment.

In carrying out case studies, it is best to use the cost-benefit method, which allows for proposing a strategy and activity programme that can be an economic evaluation tool in the decision-making process.

A case study, despite the differences in scale in urban areas and, in particular, in wastewater discharges, is carried out within a common methodology based on fundamental economic principles for evaluating environmental impacts and future improvement projects, focusing on
the direct or indirect economic losses and gains to society.

A cost-benefit analysis focuses on the losses and profits to society, and not, as is the case in conventional financial analysis, on financial flows from the point of view of agency implementation.

The following are proposed for case studies on the socio-economic effects of domestic waste contamination in the SE/P region: Panama Bay, Panama; Tumaco Bay, Colombia; Gulf of Guayaquil, Guayaquil City, Ecuador; Callao and Miraflores Bays, Peru; and Concepción-Penco-Talcahuano, Chile.
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