MINISTRY OF AGRICULTURE

NATIONAL INSTITUTE OF NATURAL RESOURCES - INRENA

DIRECTORATE GENERAL OF WATERS AND SOILS - DGAS

INRENA

ASSESSMENT OF WATER RESOURCES AND THEIR USE BY DIFFERENT PRODUCTIVE SECTORS IN PERU

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NATIONAL INSTITUTE OF NATURAL RESOURCES
INRENA

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Lima-Peru, June 1995

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NATIONAL CONSULTANTS AND PROFESSIONALS OF THE GOVERNMENT

PARTICIPANTS

-	Eng.	Julio Salcedo Vargas	:	Chapters I, II and X
-	Eco.	Guillermo Moreno Chinga	:	Chapter III
-	Dr.	Gastón Galdos Román	:	Chapter IV
-	Eng.	Abraham Maraví Gutiérrez	:	Chapter V
-	Eng.	Rosario Fukuda Suzuki	:	Chapter VI
-	Eng.	German Li Hoyos	:	Chapter VII
-	Eng.	Efraín Sorados Albarracín	:	Chapter VIII
-	Eng.	Edgardo Ezcurra Cabrera	:	Chapter IX
-	Eng.	Raúl Roca Pinto	:	Chapter XI and XII

INTRODUCTION

There is concern all over the world about the inoperative and inefficient policies of management and exploitation of the water resource vis a vis its increasing demand and as compared to its limited and unvariable availability.

The Peruvian State and the policy of the current Government, in its new role, are oriented to fulfill governing, regulating, and supervising functions in order to promote the efficiency, rentability, and competitiveness of the productive sectors together with the exploitation and best management of natural resources.

In this new context, thus conceived, the General Directorate of Water and Soil of the National Institute of Natural Resources (INRENA), organism responsible for the promotion of the sustainable exploitation of water resource, supported by the United Nations Development Program (UNDP) started the study entitled **"Asseasment of the Water Resources and their Use by the Different Productive Sectors in Peru."** This will make it possible to establish institutional coordinations at the central level with the different water user sectors like: Agriculture, Mining, Industry, Energy, Drinking Water, etc. The purpose was to analyze the current situation of management and exploitation of water resources by each sector within their corresponding competence.

Likewise, in this Study, you will find a historical summary of the evolution of the mentioned sectors and sub-sectors, the institutional characteristics, the human resources, the policy outlines and strategies considered by each sector, as well as the action plans in the field of short, medium and long term investments.

Finally, we indicate the defficiencies and/or limitations that such sectors are having as well as the intersector conflicts for the use of water resource.

In this sense, the current Study considers the efforts made by the different sectors involved in the management of water resource with the final objective of knowing the situation of the management and exploitation of the water resource by the different productive sectors, as well as their intersector competences in order to establish policy outlines and strategies that will allow the promotion of an adequate management of water resource in the country with the aim of achieving economic development without any conflict in the exploitation of this basic resource.

Eng. Miguel Ventura Napa
Chief

PREFACE

Professionals from the National Institute of Natural Resources (INRENA) and national consultants participated in the elaboration of this Study. Dr. Orlando Olcese, consultant to the United Nations Development Program (UNDP) and to the United Nations Department for Development Support and Management Services (UNDDSMS), participated in the coordination, support and unvaluable advisory missions during the development process of the Study. In March 1995, there was a technical meeting for consulting and debating with the different productive sectors of Peru. Its subsequent observations and suggestions have been included in this publication.

Mr. Daryl Brehm, Agricultural Attaché of the American Embassy channeled the request for financial support made by the Ministry of Agriculture in order to publish this Study. By means of Section 416 USDA, the Co-financing Agreement between INRENA and CARE-Peru, as the financial and executing mediator of Section 416 USDA, was possible.

Ms. Liliana Núñez, a professional translator and English teacher, was in charge of the translation of the Study into English.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

BACKGROUND

Several international meetings in the last years have dealt with the matter of water as a resource subject to multiple uses, pollution, and to competition among different users. Some of these meetings are: the World Conference on Water, held in New Delhi in 1990; the UNDP Symposium about A Strategy for Water Resources Capacity Building, held in Delft in 1991; the International Conference on Water Resources and Environmens, held in Dublin in 1992; and the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992.

One of the most important agreements reached in these meetings was to deal with the water resource as a whole regarding its use and management planning. In the Delft meeting, strategies to be taken by the countries in order to develop institutional and human capacities in the Water Resource Sector were discussed. It was agreed, as a first step, that the countries should carry out a preliminary assessment of the water resource use in all sectors. This study meets that objective, since it has intended to cover the different sectors that use the water resource in the country.

CONTENTS OF THE STUDY

In Chapter I, the studies on rainfall and water availability in the country, according to geographical divisions and river systems, are analyzed. Likewise, a summary of the storage capacity, underground water availability and climatic anomalies is made.

In Chapter II, the use of water for different purposes as well as the interrelation of its use is analyzed; the existence of conflicts and the base for their solution are also discussed.

In Chapter III, water in Perú's economy is dealt with. First, a review of the country's population and the social aspects related to it is made; the distribution of the urban and rural population in the country, the growth rate and the population density, the levels of instruction, the gainfully employed population, and the living standards are especially examined. Next, a review of the country's economy, regarding its recent historic evolution as well as the present situation and future perspectives, is made. Finally, an analysis of water with regard to its potential in the country's economy is also presented in this chapter.

In Chapter IV, a brief description of water policies as well as institutional and legal aspects is made. An important point examined is the Proposed General Law on Waters which is at present object of an intense analysis by many users. In addition, a brief review of the policies for water use in each hydrographical basin is made.

In Chapter V, an analysis of the use of water by the agricultural sector is made. This analysis begins with a historic review followed by a study of water demand by the sector. When dealing with efficiency of water use, it is concluded that this efficiency is, in general, low. The agricultural production and productivity with relation to the efficient water use and the competitiveness of the Peruvian agriculture are also reviewed. This aspect is important considering that Perú needs new export products in the Agricultural Sector.

With regard to the effect of the agricultural sector on the quality of water, it is evident that there are serious pollution problems. It is also true that more systematical studies about the real situation of pollution by agricultural inputs in the country are needed.

In relation to the areas in conflict regarding water use, the country's situation is analyzed, and the basins where this situation is most serious are identified.

Finally, the institutional structure of the sector, the scope in which the different institutions carry out their activities, and the policies followed by them are also reviewed in this chapter.

Chapter VI deals with Drinking Water and Drainage.

In this chapter, a summary of the historical evolution of the drinking water and drainage in the country has been made. It also analyzes the coverage and characteristics of such services. The conclusion of this analysis is that the quality of water is not appropriately controlled in the country. On the other hand, the fact that there is a high percentage of leakages in the system and an enormous waste in the household connections originate apparently a deficit in the water system, although the water production levels exceed the necessary amount to cover the demand. With regard to the effluents, one of the principal problems in the country is the pollution through sewage and its final disposal in rivers or cultivation fields.

In relation to the institutional situation, the chapter shows a clear vision of the current situation and of the institutional changes introduced in the last years. An important aspect also emphasized is the promulgation of the General Law of Drainage Services, which establishes the norms that rule the rendering of sanitation services, declaring them as public need and use services and of primary national interest. Foreign and domestic financial resources are assessed as well, presenting an analysis of the tariff systems, their regulations and criteria used for their establishment.

Likewise, this chapter is devoted to the analysis of conflicts with other water user sectors and the harmful impact over the environment. Finally, the policies and strategies of the sector are also assessed.

Chapter VII deals with the use of water resource by mining in Peru. It starts with the description of the institutional organization of the mining sub-sector. In such organization, given by the current Government, one of the most important facts is the creation of the General Directorate of Environment, as a organism depending from the Vice-Minister of Mines, with a series of specific functions related to the protection and preservation of Environment in the Energy and Mining Sector.

After that, the chapter makes a historical description of Mining in Peru and its importance in the domestic economy.

When dealing with the competence for the use of water with other sub-sectors, the future water demand by mining is stressed by virtue of the 7,985 mining petitions made in the last 18 months which represented 5,868,820 ha.

Also, the water demand by the sub-sector in different mining operations as well as the impact on pollution are analyzed.

An assessment of the mining legislation in Peru and the policies and action strategies of the sub-sector is made. Finally, this chapter lists the mining projects in portfolio and presents an evaluation of information programs.

In Chapter VIII, an analysis of the use of water resources by industry in Peru is made. The first part contains a description of the historical evolution of the industrial sector in the country. Then, an estimate of water consumption by industry and of pollution as a result of such activity is made. With regard to this last point, the Study arrives to the conclusion that there is not yet an account of the sub-sector's performance in relation to pre-treatment of effluents and/or solid or gaseous wastes before leaving the industrial plants.

Following this, there is a description of the institutional organization of the sub-sector, ending with more observations about the preservation of environmental and natural resources as well as basic outlines of policies and strategies for environmental health.

Chapter IX deals with the use of water by the hydroenergy sector. It starts with a historical description of the electricity sector, including a summary of the use of water resource in the generation of energy.

The institutional organization of the Vice-Ministry of Energy as well as the policies, objectives, and strategies of the Energy Sector are analyzed.

With regard to the hydroenergetic potential of Peru, there is a summary of such potential in the assessment made by Lahmeyer-Salzgitter Consortium in 1974, according to the agreement signed between the Government of Peru and the Government of the Federal Republic of Germany.

In relation to the hydroelectric generation, a brief description of the law for electric concessions is made. Then, the chapter also considers an estimate of the national demand of electric energy, the evolution of hydroelectric energy generation in the country, the water resources used in the generation of electric energy, the hydrometeorologic infrastructure of the sector, the expansion plans for hydroelectric generation, and the financing of their power plants.

The Study finally reports the programs of institutional support and the information limitations in the electricity sub-sector, and makes a brief diagnosis of the institutional situation and of the human resources.

In Chapter X, other water uses are dealt with, being three specific uses emphasized: use of water for navigation purposes, use of water for tourist purposes, and acuiculture.

In Chapter XI, water use and environment are analyzed. First of all, a study of the environmental supply of the water resource in Perú, as well as the use of water in the country, is made.

When dealing with water pollution in Perú, the main causes of water pollution in Perú are examined. Among these causes are pollution by discharges of the mining-metallurgical industry, pollution by domestic discharges, pollution by agrichemicals, and pollution by hydrocarbons. Likewise, the impacts and consequences of mining spillings are analyzed, and the environmental impact of hydraulic projects is described.

Finally, in Chapter XII, the population problem and the development of awareness regarding water matters are analyzed. First, an environmental education related to water resource is discussed, and some proposals for the development of human resources are presented. Community participation in drinking water, sanitation and irrigation projects is considered; and non-governmental organizations related to water resource management are also mentioned.

CONCLUSION

The importance of this unique Study is that, for the first time, the multiple problems related to the use of water by the most diverse sectors in the country have been gathered in a single document. All efforts have been made to show the most acute problems related to the use of water resource. It is expected that, based on this general view of the use of water resource, the Government will make an analysis of the problems to be faced in the use of water and formulate a strategy oriented to the development of capacities for the management of water resource in the country.

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CHAPTER I

RAINFALL AND WATER AVAILABILITY

1.1 GEOGRAPHICAL DIVISION

Peru is situated in the Southern Hemisphere being part of the American Continent. From the point of view of its geographical coordinates, the national territory lies between the parallels 0 01'48" and 18 20'50.8" in the Southern latitude, and the meridians 68 39' 27" and 81 19' 34.5"in the Western longitude. On the North, Peru is bordered by Ecuador and Colombia, on the East by Brazil and Bolivia, on the South by Chile, and on the West by the Pacific Ocean. (Figure 1.1)

The total area of the country, including her isles and the Peruvian part of the Lake Titicaca, is 1,285,216 km².

Because of the Cordillera Range of the Andes, the country is divided into three major geographical regions: the Coast, the Highland, and the Jungle.

1.1.1 The Coast

The Coast is the belt comprised between the Pacific Ocean and the Western flank of the Andes (up to 2,000 m above sea-level approximately); it covers 10.61% (136,361 km²) of the total area of the country. The Coast is an arid strip of a variable width, reaching its maximum width in Sechura (160 km) and its minimum in Arequipa (5 km). The rivers flow down the Western Cordillera running perpendicular to the Coast, except the upper part of the Santa river. Very meteorized rocky elevations, hills and vast camps of dunes are dominant over the littoral undulate plains. In this region, life has been concentrated in the river valleys.

1.1.2 The Highland

The Highland lies approximately between 2,000 m above sea-level of the Western flank of the Eastern Range and 2,000 m above sea-level of the Eastern flank of this Range. This region covers 30.50% (391,991km²) of the country's total area; 70% of this area is found above 3,000 m high. There are the so-called High Plateaus in this region; the Andean Cordilleras rise up from these plateaus. In the Inter-Andean valleys agriculture constitutes the principal activity of the population.

1.1.3 The Jungle

This region runs from 2,000 m above sea-level of the Western flank of the Eastern Cordillera up to the Amazonian plain and extends as far as the frontiers with Ecuador, Colombia, Brazil and Bolivia. It covers 58.89% (756,864 km²) of the total area of the country. This region is subdivided into three regions: the top jungle located between 2,000m and 800 m above sea- level, the upper jungle located between 800m and 400 m above sea-level, and the lower jungle located between 400 and 80 m above sea-level.

Peru is politically divided into 24 departments, and a constitutional province, which, in turn, are grouped in 12 regions, as it is shown in Table 1.1.

TABLE 1.1
POLITICAL REGIONS OF PERU

REGION		DEPARTAMENT
I	GRAU	Tumbes and Piura
II	AMAZONAS	Loreto
III	NOR ORIENTAL DEL MARAÑON	Lambayeque, Cajamarca and
IV	UCAYALI	Amazonas
V	INCA	Apurimac,Cuzco and Madre de Dios
VI	SAN MARTIN LA LIBERTAD	San Martín and La Libertad
VII	LOS LIBERTADORES WARI	Ica, Huancavelica and Ayacucho
VIII	ANDRES AVELINO CACERES	Huánuco, Pasco and Junín
IX	CHAVIN	Ancash
X	AREQUIPA	Arequipa
XI	LIMA CALLAO	Lima and Callao *
XII	JOSE CARLOS MARIATEGUI	Moquegua, Tacna and Puno

* Constitutional Province

1.2 FLUVIAL SYSTEM

The studies carried out by Electroperu, Senamhi and ONERN consider three major hydrographical systems corresponding to watershed basins.

1.2.1 System of the Pacific Watershed

This system is formed by a great number of rivers mostly running perpendicular to the Pacific Coast. These studies consider 53 basins or hydrographical units the area of which represents 21.70% (278,892 km²) of the total area of the country.

1.2.2 System of the Atlantic Watershed

It is formed by such watercourses that flow into the Amazon which, in turn, disgorges into the Atlantic Ocean. They represent 74.50% (957,486 km²) of the total area of the country. This system is divided into three subsystems: the subsystem of the Marañon river composed of 18 basins, the subsystem of the Ucayali river composed of 9 basins, and the subsystem of other rivers of the Peruvian East which directly flow into the Amazon river. These rivers are the Yurua, the Purus, and the Madre de Dios. Besides, there are two rivers that are direct tributaries of the Amazon and serve as a frontier between Peru and Colombia and between Peru and Brazil; these are the Putumayo and the Yavari, respectively. All these rivers have a series of tributaries.

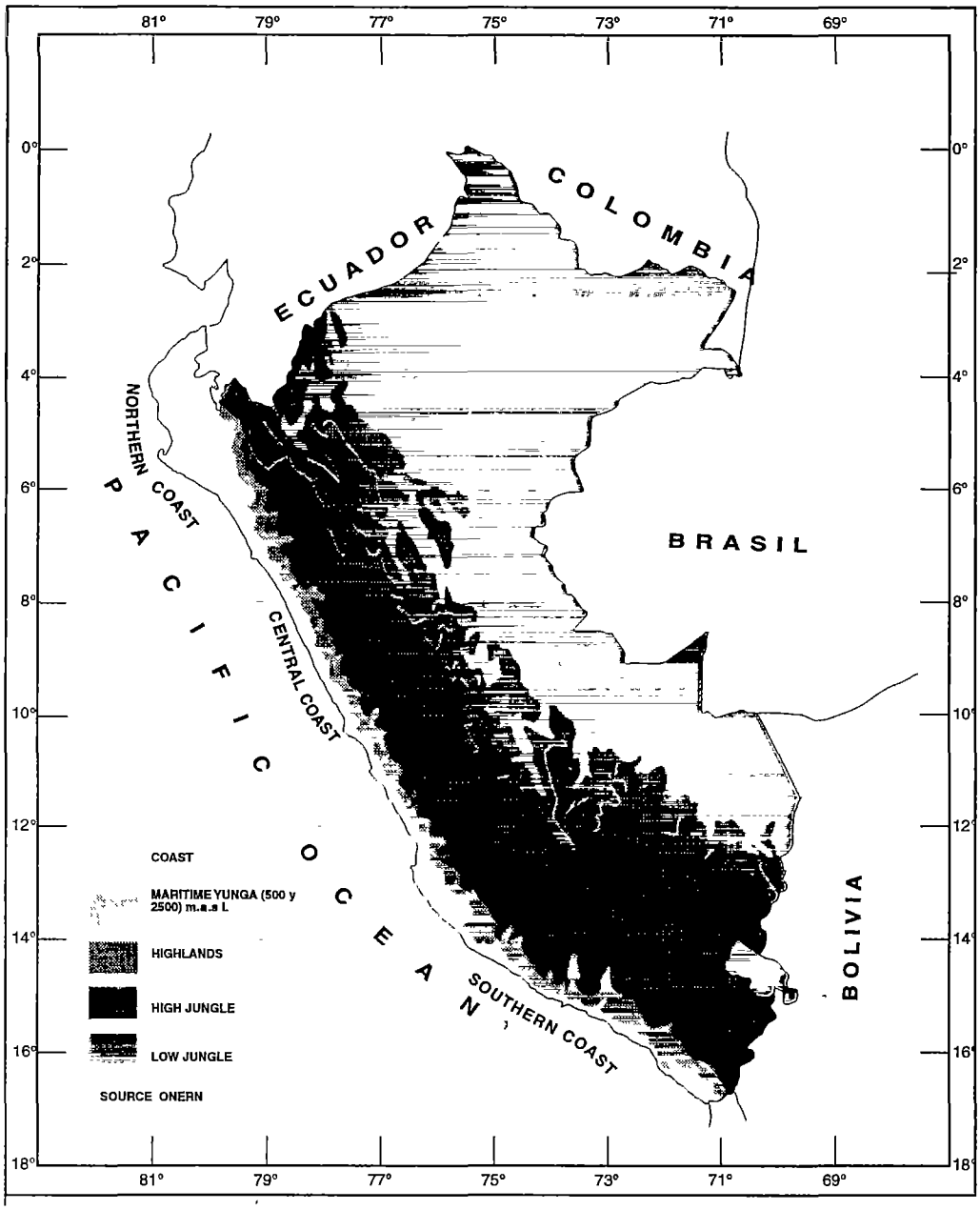
1.2.3 System of the Titicaca Watershed

It is formed by those rivers that disgorge their waters into the Lake Titicaca. The studies have considered 10 basins which represent a 3.8% (48,838 km²) of the total area of the country.

In Figure 1.2, the systems, subsystems, and hydrographic basins, as well as their codification, are presented.

FIGURE 1.1

NATURAL REGIONS OF PERU



TRANSVERSAL SECTION OF THE COUNTRY

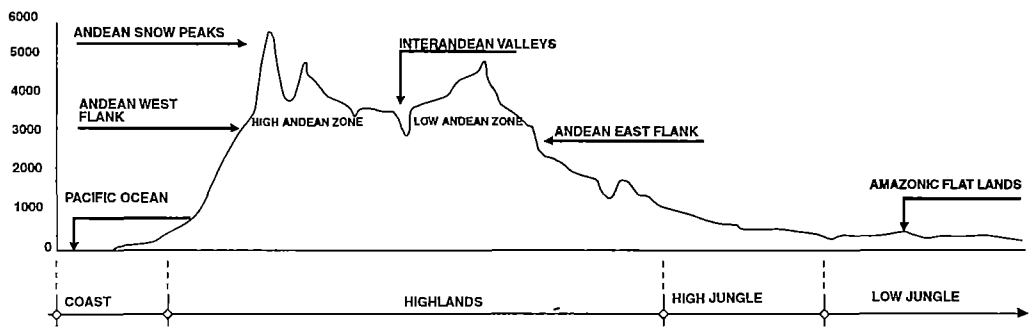
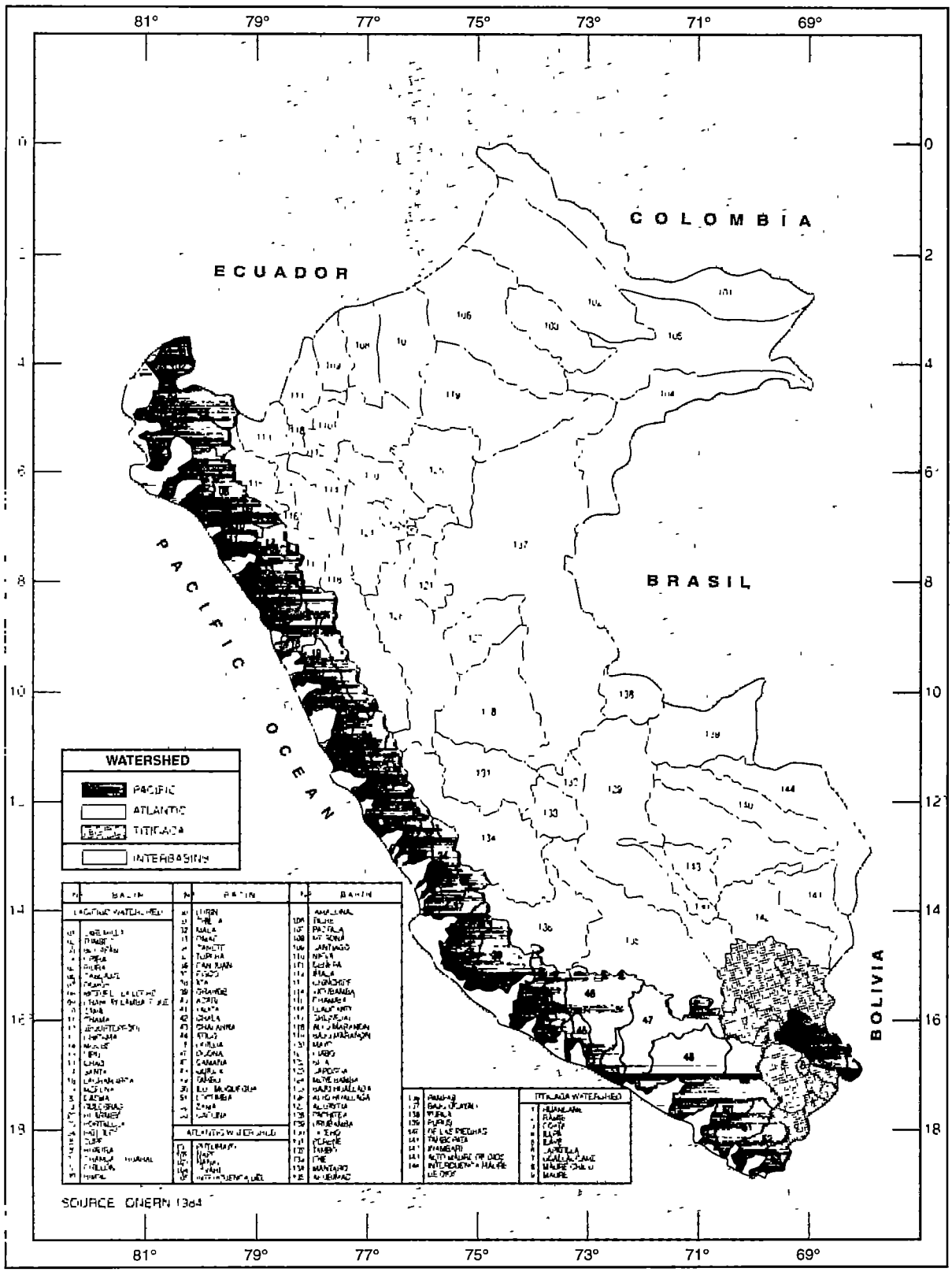


FIGURE 1.2

HIDROGRAPHICAL BASINS AND WATERSHEDS OF PERU



1.2.4 Hydrometeorological Network

According to the study "Assessment of the National Hydroelectric Potential", carried out by Electroperu in 1979, the hydrometrical network in Peru was composed of 396 hydrometrical stations and 1,189 meteorological stations (such as pluviometric, climatological or synoptical stations). These stations, that were operative, paralized, and/or closed at that time, were under the control of different public institutions (Senamhi, Electroperu, Ministry of Agriculture, among others), and of private enterprises that controlled stations in zones according to their interests.

By virtue of the study made in 1991 by the Planir-Cedex (Ministry of Agriculture and the Technical Cooperation of the Spanish Government), "Water Resources in Peru", most of the metereological stations are under the control of the Senamhi (National Meteorology and Hydrology Service) and have a variable period of operation, being the 1960-1980 period the one when the largest number of meteorological stations were in operation. At present, a considerable number of stations are paralysed, in general due to the lack of financial resources.

Regarding the hydrometrical stations, these are mostly controlled by the General Directorate of Waters and Soils of the National Institute of Natural Resources INRENA-Ministry of Agriculture. The stations located in the Coast started operating in 1910, and the stations located in the other regions of the country started at different times. Today, due to the decentralizing policies of the last governments, the hydrometrical stations are under the control of different departments of the Ministry of Agriculture located in various parts of the country.

The Coast of the country has 53 hydrographical basins, and 90% of these generally have one hydrometrical station, except those basins that, because they are regulated and have runoffs liable to be used to generate electricity, have a larger number of stations. At present many of the hydrometrical stations under the control of the Government are found abandoned and/or paralysed, usually for the lack of human and financial resources. Since this is a very important problem for the country, a solution should be found, because the information these stations provide about river flows is essentially significant and basic to carry out any kind of study on water resource.

1.3 RAINFALL

The rainfall along the Coast region is very slight reaching annual averages below the 150 mm in the central and southern belt (from Chimbote to Tacna); in the extreme north (Tumbes) the average reaches around 400 mm annually. Along the Coast, as a result of the condensation of the atmospheric humidity, a dense cloud (mist) is formed which is pushed some 20 km inland by the sea breeze which is caused by the Humboldt Current coming from the cold seas of the Antarctic; finally a scarce fine rain (drizzle) occurs during the year. The very little rainfall in the Coast region permits an agriculture only under irrigation.

Rains in the Highland region are not abundant either, and occur in the October-March period (austral summer); they are related to the maximum rise of the rivers in the Coast region. This rain has an annual mean of 300 mm in the Southern zone, and 900 mm in the Northern zone; above the 3,500 m above sea-level the rainfall occurs in snow form. In this region, agriculture is developed as dry farming and under complementary irrigation.

The Highland region experiences heavy rainfall with annual averages ranging from 3,000 to 4,000 mm reaching its highest value in March. In Figure 1.3 the isohyet curves nationwide are shown which give an approximation of the rainfall occurring in the country.

The mean rainfall in the Pacific Watershed, that includes the Coast region and part of the Highlands, is 600 mm annually, about 95% of these corresponds to the Highland region. The Atlantic Watershed experiences a rainfall of around 2,400 mm annually, and the Titicaca Watershed of 700 mm.

The rainfall distribution in the Pacific and Titicaca Watersheds is very irregular, while in the Atlantic Watershed it is better distributed. The three watersheds experience the lowest rainfall in the June-August period and the highest ones in March, except the Southern part of the country including the Titicaca Watershed where this rainfall occurs in January. Figure 1.4 shows the rainfall distribution in the Watersheds.

1.4 WATER AVAILABILITY

1.4.1 Surface Water

In terms of total water resources, the available surface water is abundant constituting a great potential. There are 106 hydrographical basins throughout the country that produce 2,046,287.5 mcm of water resource proceeding from surface and underground sources. There is no detailed information about underground water sources regarding the Atlantic and the Titicaca Watersheds. The factors affecting the country's climate, however, produce a great variety and discontinuity of the water resource with time. This results in a watershed of scarce water resources (the Pacific Watershed), principally in the Coast region where there are 2,885 m^3 of surface waters per inhabitant way below the world average of 8,500 m^3 of surface waters per inhabitant, and, also, in a watershed of abundant resources (the Atlantic Watershed) with an estimated availability of 800,000 m^3 of surface waters per inhabitant.

An important characteristic of the rivers in the country is their temporary regime considering the irregularity of their flows, the short period of abundance or maximum freshet, from 3 to 5 months (December to May), and a prolonged low water period, from 7 to 9 months (May to December); being this an unfavorable situation to satisfy the country's water needs for different purposes.

The rivers of the Pacific Watershed, that are formed by the thaw of the Cordillera of the Andes and the Andean rainfall, cross the Coast region to flow into the Pacific Ocean. These rivers have a short course, a variable flow, torrential nature and maximum freshet in the summer (60-70% of the annual mass) having, most of them, an irregular regime. The rivers that mostly contribute to the surface runoff with their mean annual flow are: Santa (158.20 m^3/s), Tumbes (196.10 m^3/s) and Chira (117.20 m^3/s) whose flows are lower than those of the rivers of the Atlantic Watershed.

The Atlantic Watershed is constituted by a great continental collector, the Amazon which receives the waters of the Yurua river, the Purus river and the Madre de Dios river, with a total mean surface contribution of 63,379.50 m^3/s annually. The Huallaga river with 3,796.4 m^3/s disgorging into the Marañon river, the Ucayali river with 13,375.2 m^3/s and the Marañon river with 15,436 m^3/s are clearly distinguishable in the Atlantic Watershed.

FIGURE 1.3

MAP OF ISOHYETS
(m.m.)

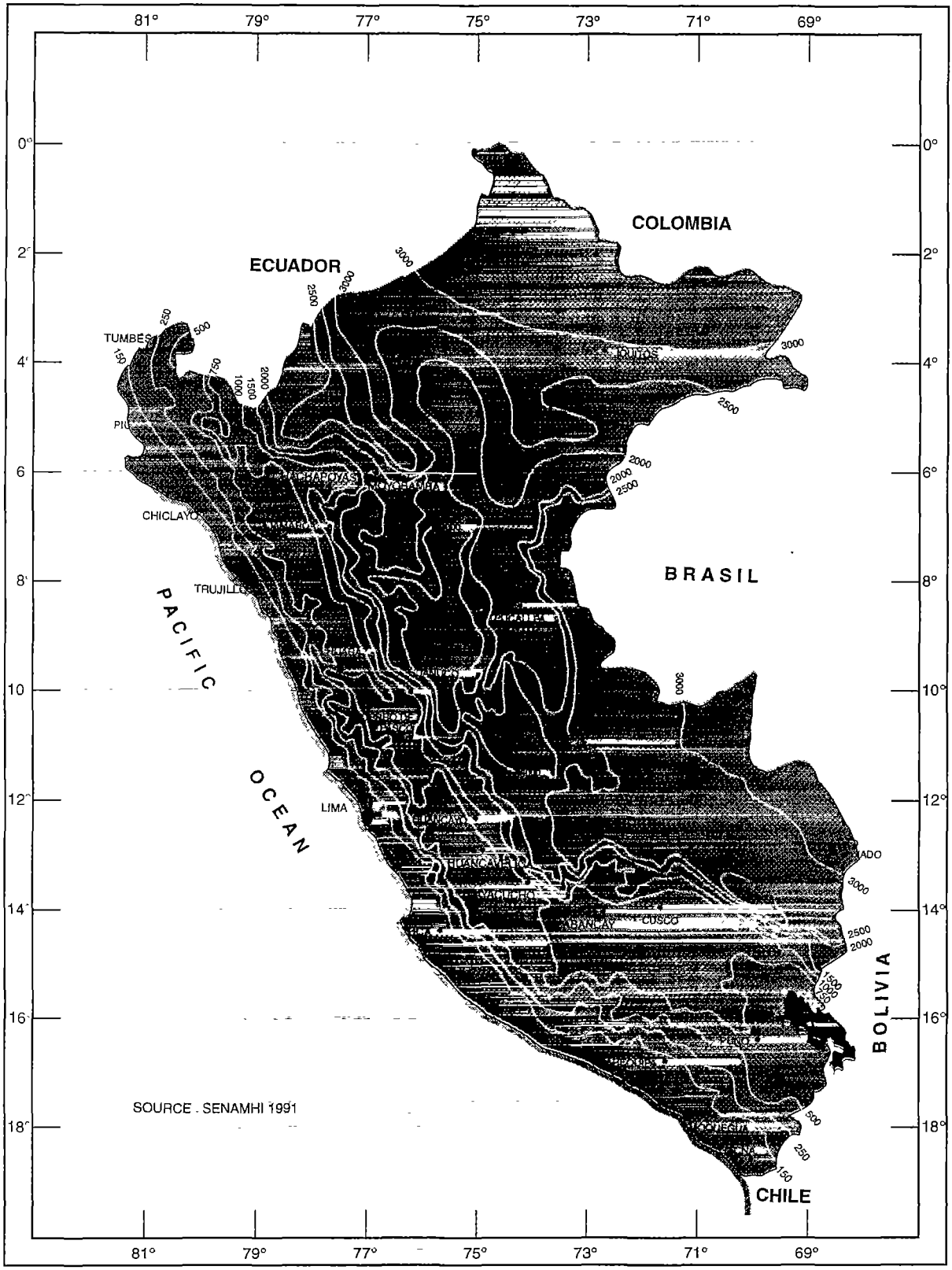
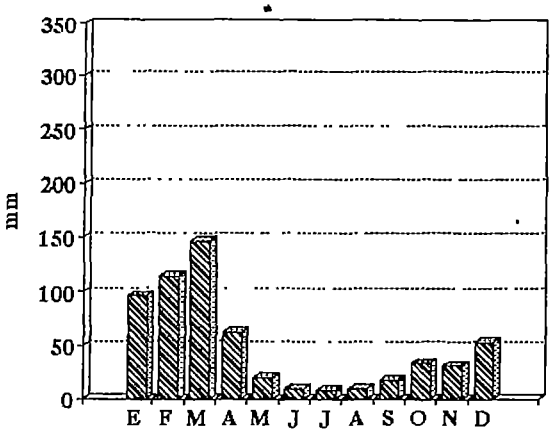


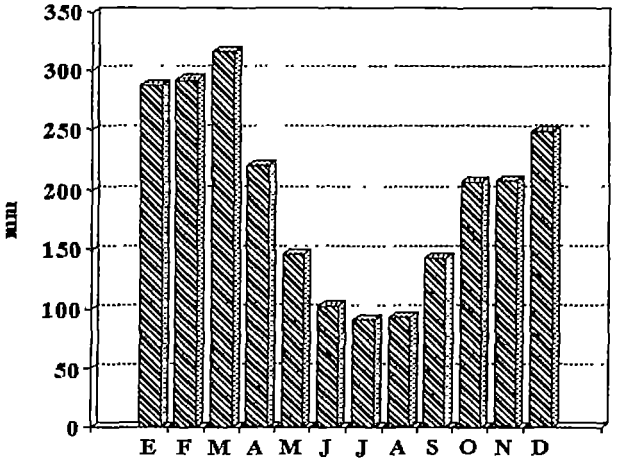
FIGURE 1.4

RAINFALL DISTRIBUTION

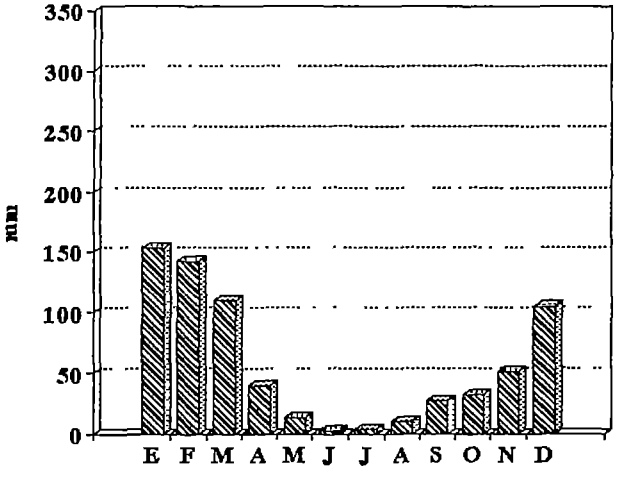
PACIFIC WATERSHED



ATLANTIC WATERSHED



TITICACA WATERSHED



The Ucayali and Marañon rivers, when they join near Nauta, form the Amazon which runs some 550 km in the country. The rivers in this Watershed are plentiful and have a permanent regime.

The rivers belonging to the Titicaca Watershed have a flow equivalent to 221.9 m^3/s; some of the most important are the Ramis (88.2 m^3/s) and the Ilave (40.1 m^3/s). Just a part of the basin and of the Lake Titicaca (60%) belongs to Peru, the rest to Bolivia. Table 1.2 presents the average flows of rivers by watersheds, calculated on the basis of studies carried out by Electroperu (1975), ONERN (1980), and CEDEX (1992).

1.4.2 Underground Water

The actual underground water availability (exploitable reserves) has been estimated in 2,739.3 mcm. In 1987 PLANIR elaborated the first approximation based on the surface and underground water resources. To this end, they assessed the exploitation of the underground waters nationwide, calculating in 1,508 mcm the annually exploited volume in the Pacific Watershed, whether for population, livestok, agricultural and industrial uses. This estimate corresponds to 39 of the 53 basins where this resource is used by means of 8,009 wells among driven, open cut, and mixed wells.

The underground water exploitation in the Atlantic and Titicaca Watersheds is unknow, and it is estimated as insignificant. The underground water exploitation by basin in the Pacific Watershed, whether it be for agricultural, domestic, livestock and industrial uses, is presented in Table 1.3

The aquifers in the Coast region are mainly constituted by alluvial formations corresponding to recent quaternary period and are, in general, predominantly free. It is estimated that in some sectors, the foundation is at 400-500 m deep. The aquifers overload is basically the result of the surface runoff through rivers and channels that irrigate the valleys, of the underground overload through the filtrations from the Andes, and, to a lesser degree, of the rainfall, since it hardly rains. The driven wells built in the arid regions of the Coast generally have depths ranging from 40 to 100 meters with a depth of water table between 10 and 30 meters and the resulting flows varying between 12 and 100 l/s.

TABLE 1.2

WATER AVAILABILITY

Pacific Watershed

BASIN	ELECTROPERU m3/s	ONERN m3/s	CEDEX m3/s	AVERAGE m3/s
ZARUMILLA	48	54	47	50
TUMBES	921	1158	805	981
CHIRA	962	1145	1408	1172
PIURA	298	202	372	291
CASCAJAL	94	44	12	50
OLMOS	37	17	07	20
MOTUPE	151	37	34	74
LA LECHE	8.1	50	72	68
CHAN.-LAMBAYEQUE	323	258	422	334
ZANA	91	80	74	82
CHAMAN	4.5	11	04	20
JEQUETEPEQUE	398	377	290	355
CHICAMA	299	225	240	255
MOCHE	11.2	103	82	99
VIRU	78	86	40	68
CHAO	38	33	28	33
SANTA	1502	143.7	1808	158.2
LACRAMARCA	08	03	01	04
NEPENA	3.8	2.0	28	29
CASMA	84	46	73	68
CULEBRAS	0.9	05	05	06
HUARMEY	66	33	21	40
FORTALEZA	51	58	48	52
PATIVILCA	521	480	473	491
SUPE	33	11	18	21
HUAURA	36.3	313	358	345
CHAN -HUARAL	202	19.1	156	183
CHILLON	125	110	84	106
RIMAC	290	25.9	240	283
LURIN	90	6.6	45	67
CHILCA	14	04	02	07
MALA	175	180	169	175
OMAS	38	15	0.8	20
CANETE	57.1	630	549	583
TOPARA	12	00	04	05
SAN JUAN	284	138	141	188
PISCO	262	23.5	24.8	248
ICA	131	113	83	109
GRANDE	171	194	133	166
ACARI	227	206	136	19.0
YAUCA	211	76	200	162
CHALA	17	01	02	07
CHAPARRA	26	03	05	11
ATICO	16	01	01	06
CARAVELI	32	08	02	14
OCONA	900	66.6	983	850
MAJES-CAMANA	900	825	977	901
QUILCA CHILI	387	232	156	258
TAMBO	399	397	391	39.6
OSMORE	43	2.9	18	30
LOCUMBA	42	82	42	55
SAMA	24	15	18	19
CAPLINA	18	31	13	21
TOTAL	12258	10993	11574	11608

Source · CEDEX 1990

Atlantic Watershed

BASIN	ELECTROPERU m3/s	ONERN m3/s	CEDEX m3/s	AVERAGE m3/s
CHIRIACO	810	1090	967	889
HUALLAGA	26790	37680	49422	37984
MARANON MEDIO	52910	88170	8049.3	73858
BAJO MARANON	114110	173710	175267	154362
AMAZONAS	31130.0	481310	414538	402383
ACRE	1200	770	2538	1503
URUBAMBA	1194.0	28900	26180	22340
VILCANOTA	1120	6.0	5830	2337
CHOTANO	200	200	226	209
HUANCABAMBA	34.0	420	352	37.1
TABACONAS	860	410	479	583
PUTUMAYO	19400	–	16000	17700
NAPO	45550	89360	47260	60723
YAVARI	34000	–	34000	34000
TIGRE	22970	33260	2562.2	27284
PASTAZA	18880	27690	2214.2	22904
SANTIAGO	17770	12380	1913.1	16427
NIEVA	340	3230	2439	2003
CENEPA	1040	5060	3275	3125
CHICHINPE	2150	2040	2058	2083
UTCUBAMBA	1220	1130	1166	1172
CHAMAYA	1150	980	1066	1065
LLAUCANO	530	290	383	401
CRISNEJAS	370	480	445	425
ALTO MARANON	7430	7310	7789	7510
AGUAYTIA	4590	11580	1033.6	8835
PACHITEA	12000	24120	18989	18370
PERENE	4550	7490	5825	595.5
MANTARO	4140	4570	4187	4299
APURIMAC	9240	11480	10781	10500
PAMPAS	2420	2290	2140	2283
UCAYALI	75000	176850	149406	133752
YURUA	2910	807.0	8109	6383
PURUS	5200	7870	1719.3	1002.1
DE LAS PIEDRAS	4720	9280	22232	12077
TAMBOPATA	415.0	11680	18147	1132.6
INAMBARI	9340	17100	9573	12004
MADRE DE DIOS	39870	74130	83338	65779
TOTAL	872310	1382220	1299324	1195185

Titicaca Watershed

BASIN	ELECTROPERU m3/s	ONERN m3/s	CEDEX m3/s	AVERAGE m3/s
SUCHES	90	93	69	84
HUANCANE	268	239	203	237
RAMIS	839	1031	77.5	882
COATA	408	312	480	393
ILLPA	7.5	80	70	75
ILAVE	348	416	440	401
MAURE	36	35	3.9	37
ZAPATILLA	39	25	31	32
CCALLACCANE	83	81	70	78
TOTAL	2186	2312	2157	2218

Source: CEDEX, 1990

TABLE 1.3

EXPLOITATION OF UNDER GROUND WATER FOR DIFFERENT USES PACIFIC WATERSHED (thousands m^3)

BASIN	POPULATION	AGRICULTURAL	LIVESTOCK	INDUSTRIAL
Zarumilla	336	10, 618	—	—
Tumbes	60	3, 499	—	—
Bocapan	—	—	—	—
Chira	—	—	—	—
Piura	22, 907	84, 886	837	504
Cascajal	1, 032	15, 528	—	—
Olmos	468	2, 472	—	—
Motupe – La Leche	768	54, 353	—	—
Chancay–Lambayeque	10, 826	141, 033	108	4, 969
Zana	—	36, 837	—	—
Chaman	2, 516	865	—	24
Jequetepeque	3, 264	—	—	456
Chicama	9, 462	153, 053	588	15, 129
Moche	33, 621	19, 236	360	4, 660
Viru	240	45, 616	—	528
Chao	—	—	—	—
Santa	708	—	—	14, 184
Lacramarca	6, 708	—	—	976
Nepena	1, 260	24, 752	—	—
Casma	384	16, 678	—	—
Culebras	—	—	—	—
Huarmey	1, 692	6, 616	20	612
Fortaleza	3, 768	8, 476	96	8, 060
Pativilca	2, 220	—	—	176
Supe	96	3, 949	—	—
Huaura	5, 232	3, 961	732	2, 568
Chancay–Huaral	2, 482	7, 312	1, 332	168
Chillon	29, 874	12, 743	960	1, 392
Rimac	186, 288	16, 267	3, 444	55, 080
Lurin	1, 776	15, 806	1, 020	1, 020
Chilca	2, 208	9, 654	744	12
Mala	9, 768	156	—	11, 208
Omas	96	10, 697	—	—
Canete	3, 288	2, 665	108	1, 152
Topara	—	2, 569	20	—
San Juan	4, 041	103, 928	1, 231	1, 830
Pisco	—	—	—	—
Ica	15, 186	113, 574	109	354
Grande	2, 172	51, 452	60	—
Acari	288	109	36	—
Yauca	—	—	—	—
Chala	—	—	—	—
Chaparra	—	—	—	—
Atico	—	—	—	—
Caraveli	—	96	—	180
Ocona	—	—	—	—
Camana	—	—	—	—
Quilca	24	72	12	828
Tambo	—	—	—	—
Osmore	1, 440	1, 581	—	11, 358
Locumba	—	—	—	—
Sama	—	—	—	—
Caplina	36	14, 208	204	—
TOTAL	366, 535	995, 317	12, 021	137, 428

Source : PLANIR, 1987

1.5 STORAGE CAPACITY

1.5.1 Natural Storage

Nationwide there are other available surface sources of the water resource, such as lakes, temporary or permanent-regime water reservoirs of a variable size located between elevation 4,000 and 6,000 m above sea level of the Cordillera of the Andes. The source of water supply for the lakes is the seasonal rainfall coming from this range, the thaw of some snow-capped mountains and filtrations proceeding from upper basins, through surface runoff,remanent filtratiion, evaporation and mass that are stored.

The seasonal absence of surface water in the Coast and the Highland regions has led to the execution of studies and works that have permitted the hydraulic exploitation of lakes as natural dams, regulating currently 3,028 mcm. Besides this, there is the potential offered by the 11,673 lagoons not yet under study or explotation, and the possibility to exploit the physiography existing in the Cordillera of the Andes favorable for water storage and damming by means of dams. A summary of this is presented in Table 1.4

With regard to the Watersheds, in the Pacific Watershed the basins having the greatest number of lakes are the Santa (630), Cañete (447), Camaná (364) and Ocoña (344); in the Atlantic Watershed there are more lakes, the basins of the Mantaro (2,232), Marañon (1,247) and Pampas (924) stand out; in the Titicaca Watershed there are less lakes; the basins of the Ramis (410) and Ilave (120) stand out.

1.5.2 Artificial Storage

The almost absence of rainfall in the Coast and the slight rainfall in part of the Highland cause seasonal water shortages and droughts with certain periodicity; furthermore, the national territory presents an uneven geography with natural formations favorable for the construction of dams that regulate the river flows and store water in flood time, increasing the water availability for different purposes during the low water period.

The regulation capacity is 1,941.88 mcm with a big potential for a greater exploitation, having under study dams of the order of 44,028.04 mcm. Table 1.5 shows the national inventory of dams prepared by ONERN in 1980.

In the Pacific Watershed, the basins and dams with the largest regulation capacity are: Chira (1,258.4 mcm) with the reservoirs of Poechos (1,000 mcm) and San Lorenzo (258 mcm). In the Atlantic Watershed, there is the Mantaro basin (66 mcm); and in the Titicaca Watershed there are not important reservoirs in use. One characteristic of the dams in the country is that they have larger regulation capacity in the Coast region due to the shortage of the water resource.

The dams under study show a total damming of 44,028.04 mcm distributed in 17,200.60 mcm for the Pacific Watershed, 26,274.83 mcm for the Atlantic Watershed, and 552.61 mcm for the Titicaca Watershed. There are studies for 31 dams nationwide to divert waters from the Atlantic Watershed towards the Pacific Watershed which represents, as a whole, a regulation capacity of 6,041.9 mcm.

TABLE 1.4

INVENTORY OF LAKES

PACIFIC WATERSHED			ATLANTIC WATERSHED			TITCACA WATERSHED		
BASIN	No OF LAKE	No OF LAKE > 4km2	BASIN	No OF LAKE	No OF LAKE > 4km2	CUENCA	No OF LAKE	No OF LAKE > 4km2
Chira	13	—	Maranon	1247	79	Ramis	410	29
Piura	2	—	Chinchipe	5	—	Huancane	59	—
La Leche	11	2	Chamaya	36	2	Suches	12	1
Chancay-Lamb	6	1	Llaucano	52	2	Coata	146	17
Jequetepeque	106	1	Crisnejas	84	7	Illapa	8	1
Chicama	31	—	Huallaga	504	37	Llave	120	4
Moche	28	1	Pachitea	79	12	Ccallaccama	16	1
Viru	4	—	Perene	533	34	Pucho	6	—
Santa	630	82	Mantaro	2332	146	Maure	43	11
Nepena	32	1	Apurimac	747	40	Otros	21	11
Casma	68	—	Pampas	924	52			
Culebras	7	—	Puchachaca	394	17			
Huarmey	15	—	Urubamba	280	11			
Fortaleza	45	—	Yaveco	53	11			
Pativilca	222	14	Inambari	171	11			
Supe	28	1	TOTAL	7441	461	TOTAL	841	75
Huara	253	28						
Chancay-Huaral	121	19						
Chillon	75	8						
Rimac	191	25						
Lurin	32	1						
Mala	110	11						
Canete	447	54						
San Juan	90	4						
Pisco	118	9						
Ica	19	1						
Grande	6	—						
Acari	46	6						
Yauca	17	3						
Ocona	344	19						
Camana	364	26						
Quilca	106	3						
Tambo	198	12						
Osmore	11	—						
Locumba	21	3						
Sama	13	1						
Caplina	6	—						
TOTAL	3836	336						

SUMMARY

WATERSHED	No OF LAKE	No OF LAKE > 4km2
Pacific	3836	336
Atlantic	7441	461
Titicaca	841	75
TOTAL	12118	872

SOURCE: National Inventary of Lagoons and dams. ONERN. 1980

TABLE 1.5

DAMS UNDER EXPLOITATION AND STUDY

BASIN	DAMS UNDER EXPLITATION				DAMS UNDER STUDY					
	No	INFORMATION AVAILA	INFORMATION NOT AVAILABLE	CAPACITY mcm	No	INFORMATION AVAILABLE	INFORMATION NOT AVAILABLE	CAPACITY mcm	ADDITIONAL No	mcm
PACIFIC										
Zarumilla	—	—	—	—	1	1	—	1, 000 00	—	—
Tumbes	—	—	—	—	2	2	—	630 00	—	—
Chira	2	2	—	1, 258.40	8	8	—	3 973 00	1	91 60
Piura	—	—	—	—	3	3	—	2 680 00	—	—
Cascajal	—	—	—	—	1	1	—	220 00	—	—
Olmos	—	—	—	—	1	1	—	200 00	—	—
La Leche	1	1	—	3 00	2	1	1	80 00	—	—
Chancay-Lamb	4	3	1	331 00	4	4	—	103 00	1	7 00
Zana	3	3	—	2 40	1	—	1	S.D	—	—
Jequetepeque	—	—	—	—	10	8	2	1 137 60	—	—
Chicama	—	—	—	—	2	2	—	210 00	—	—
Moche	—	—	—	—	4	4	—	13 70	—	—
Viru	1	1	—	1.10	—	—	—	—	—	—
Santa	—	—	—	—	1	1	—	250 00	—	—
Nepena	2	2	—	0 70	2	2	—	6 65	1	4 50
Casma	—	—	—	—	2	2	—	69 00	—	—
Huarmey	—	—	—	—	1	1	—	150 00	—	—
Pativilca	—	—	—	—	1	1	—	137.10	—	—
Huaura	—	—	—	—	2	1	1	20 00	—	—
Chancay-Huaral	—	—	—	—	8	8	—	414 87	—	—
Chillon	—	—	—	—	4	4	—	438 75	—	—
Rimac	3	3	—	0 94	2	2	—	400 00	—	—
Lurin	—	—	—	—	3	2	1	540 00	—	—
Mala	—	—	—	—	3	2	1	50 50	—	—
Omas	—	—	—	—	2	1	1	0 60	—	—
Canete	—	—	—	—	2	2	—	261 00	—	—
San Juan	—	—	—	—	10	10	—	306.43	—	—
Pisco	1	1	—	32 00	8	8	—	1, 801 00	—	—
Ica	—	—	—	—	5	3	2	58 75	—	—
Grande	—	—	—	—	2	2	—	65 47	—	—
Acari	1	—	1	S.D.	5	3	2	92 00	—	—
Yauca	—	—	—	—	2	2	—	10 26	—	—
Ocona	—	—	—	—	2	1	1	8 00	—	—
Camana	—	—	—	—	3	3	—	1, 040 00	—	—
Quilca	2	2	—	245 00	3	3	—	236 92	—	—
Tambo	—	—	—	—	8	6	2	843 00	—	—
Osmore	—	—	—	—	3	3	—	27 10	—	—
Locumba	1	1	—	1 34	1	—	1	SD	—	—
Sama	—	—	—	—	2	1	1	25 50	—	—
SUB TOTAL	21	19	2	1, 875 88	126	109	17	17 200 20	3	103 10

TABLE 1.5

DAMS UNDER EXPLOITATION AND STUDY

BASIN	DAMS UNDER EXPLITATION				DAMS UNDER STUDY					
	No	INFORMATION AVAILA	INFORMATION NOT AVAILABLE	CAPACITY mcm	No	INFORMATION AVAILABLE	INFORMATION NOT AVAILABLE	CAPACITY mcm	ADDITIONAL No	mcm
ATLANTIC										
Utoubamba	—	—	—	—	1	1	—	20 00	—	—
Chamaya	—	—	—	—	7	7	—	924 19	—	—
Llaucano	—	—	—	—	1	1	—	180.00	—	—
Crisnejas	—	—	—	—	13	12	1	1, 079 83	—	—
Maranon	—	—	—	—	20	1	19	11, 000 00	—	—
Huallaga	—	—	—	—	13	1	12	7 700 00	—	—
Ucayali	—	—	—	—	5	—	5	SD	—	—
Perene	—	—	—	—	3	2	1	3.50	—	—
Ene	—	—	—	—	2	—	2	SD	—	—
Mantaro	2	2	—	66 00	22	19	3	1, 670 57	1	600 00
Pampas	—	—	—	—	17	13	4	2 686 74	—	—
Apurimac	—	—	—	—	1	1	—	1, 000 00	—	—
SUB TOTAL	2	2	0	66 00	105	58	47	26 274 83	1	600 00
TITICACA										
Maure	—	—	—		3	2	1	182 18	—	—
Ilave	—	—	—		2	2	—	239 24	—	—
Ramis	—	—	—		2	2	—	131 19	—	—
SUB TOTAL	0	0	0	0 00	7	6	1	552 61	0	0 00
TOTAL	23	21	2	1 941 88	238	173	65	44, 027 64	4	703 10

Source : National Inventary of Lagoons and Dams. ONERN, 1980

1.6 CLIMATIC ANOMALIES

In Peru there are diverse climatic conditions due to a series of factors such as: the Peruvian Oceanic Current of Humboldt, the Anticyclone of the South Pacific, the Cordillera of the Andes, and the Oceanic Equatorial Current; all of them acting together with the meteorological factors produce irregular situations in each of the regions of the Peruvian territory.

Thus, for example, the Peruvian Coast has parts where there is hardly any rain, being considered as deserts. In this region the total mean annual rainfall does not exceed 150 mm affecting the normal development of the agricultural and livestock activities. These activities are restricted to areas where irrigations have been made, or where the action of the permanent-regime rivers, coming from the western glaciers, play an important role.

In the Jungle region, the situation is opposite to that in the Coast having rainfall regimes that exceed 3,000 mm annually, that is the reason why this region is considered a humid tropic.

Finally, the Peruvian Highlands experiences seasonal rains of a great intensity and of a short duration which in few cases exceed the 1,000 mm annually. Due to the fact that this region has densely populated agricultural zones and crops are grown under a dry farming regime, the consequences of rainfall shortages are considerable, affecting not only the production but also the livestock subsistence (cattle, sheep and auquenid, especially). This is particularly true in the southern part of the country where the largest livestock population is concentrated. The zones mostly affected by droughts at a departmental level are shown in Figure 1.5.

In Peru, the Civil Defense System clasifies the natural phenomena under large groups:

- Ecological phenomena: epidemics, epiphytotic, epizooty and plagues.
- External geodynamic phenomena: cracking, alluvion, freshet, landslide, erosion, huayco, cave-in, and flood.
- Internal geodynamic phenomena: volcanic activity and earthquake.
- Hydrometeorological phenomena: hailstorm, freeze, torrential rain, snowfall, drought, electric storm and hurricane wind.
- Oceanologic phenomena: tidal wave and tsunami.

Of these, the hydrometeorological phenomena and some of the geodynamic phenomena, which cause human and material losses, are related to the water resource.

A chronological series of natural disasters occurred in the country from 1975 to 1987 is shown in Table 1.6. The greatest number of disasters corresponds to 1983, mainly caused by the Pacific Ocean Current "El Niño".

TABLE 1.6

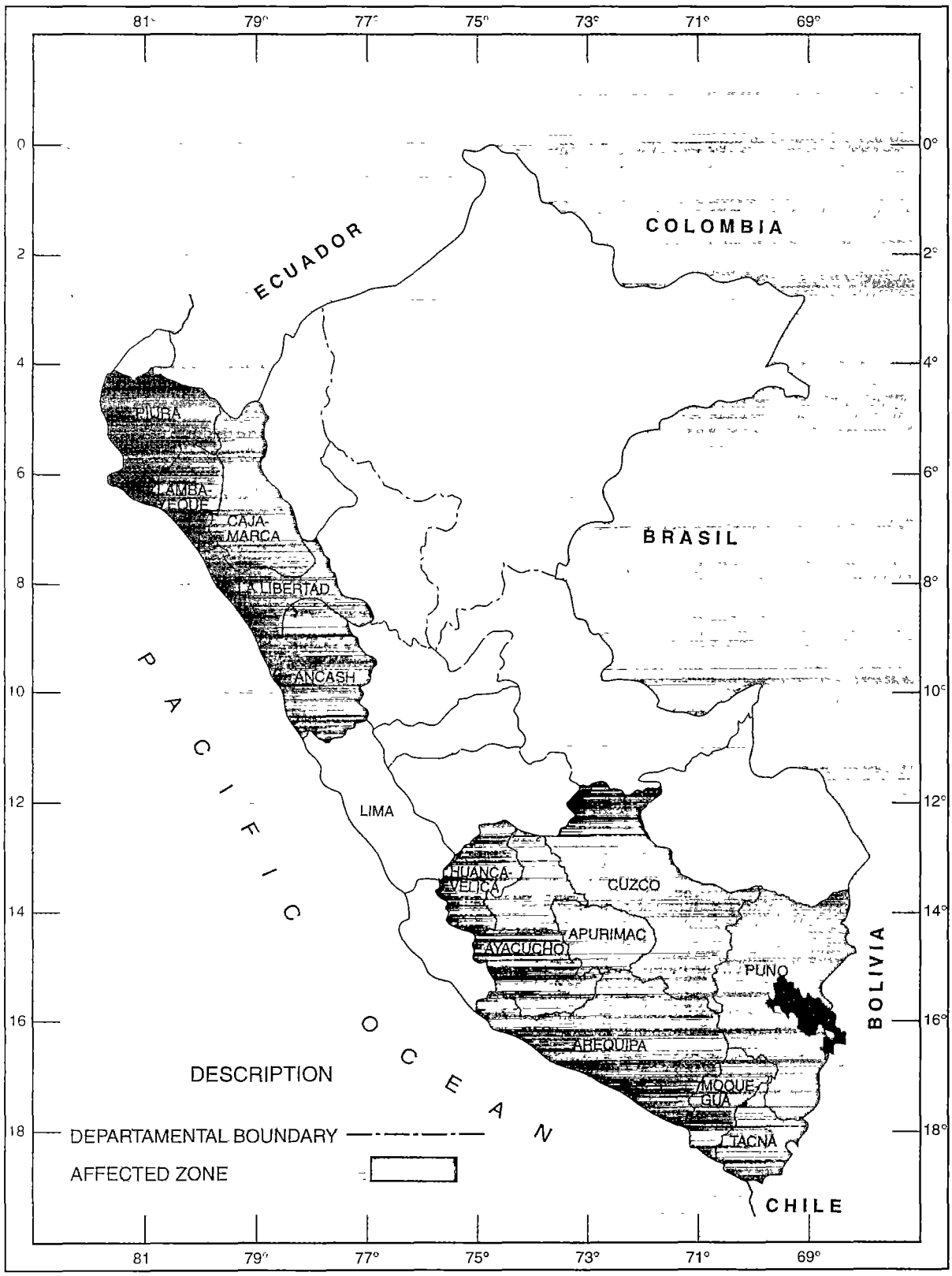
NATURAL DISASTERS OCCURRED IN PERU

NATURAL DISASTERS	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Cracking		2					1			
Alluvium			3	1	3	2	10	13	31	1
Swamping									1	
Freshet		1		1			6	5		2
Landslide		3	9	2	4	6	9	13	18	11
Slipping	2	4	1				1	21	40	19
Epidemics	12	11	14	4	15	21	2	4	10	5
Epiphytotic								1		
Epizooty									1	
Erosion									5	4
Hailstorm					1				3	1
Freeze		1			1	2		1	3	
Huayco		1	10	6	1	9	33	7	203	38
Cave-in				1						
Flood	10	6	24	8	9	2	32	60	157	35
Torrential Rain	7	5	1	9	4	22	1	4	109	20
Tidal Wave	1	1		1					2	
Snowfall					1	1				
Wreck									1	
Plague		1				1	1	1		
Drought		2		1					10	5
Earthquake		1			7	12	3	5	2	
Electric Storm	1	2	10	7	2	3	2	2	3	
Hurricane Wind	4	3		1	3	1	1	3	3	6
TOTAL	37	44	72	42	51	82	102	140	602	147

Source . National Defense Civil System

FIGURE 1.5

AREAS AFFECTED BY DROUGHT BY DEPARTMENTS



According to what the Civil Defense System has made known, updated statistical tables are being prepared. In Table 1.7 a summary of the damages occurred in 1994, nationwide, is shown.

Generally, the natural disasters happenning with more frequency annually are the land-slides (huaycos) and floods caused by torrential rains, corresponding to the freshet period; i.e. January, February and March. The huaycos generally occur in the basins of the Pacific Watershed and in the basin of the Highland zone of the Atlantic Watershed. The floods usually happen in the valley zones of the Pacific basins, having this disaster greater consequences due to the lack of defenses in the banks, especially in the urban areas.

An example of this is the flood that occurred in the Callao zone at the beginning of 1994, which produced floods in the urban and industrial areas as well as in the facilities of the port. In this year, also, huge financial losses for the country were reported. It is noteworthy that in some valleys of the Peruvian Coast, works for defense in the banks are being executed with the support of the private sector; this is the case, for example, of the valley of the Pisco river.

The most significant climatic anomaly in Peru is the socalled phenomenon of "El Niño"; this is produced by the rise in quantity and intensity of the warm current of "El Niño", and as a result the tropical oceanic waters invade the space normally occupied by the Peruvian Current of Humbolt which produces a wide alteration in the physical characteristics of the tropical Pacific Ocean, in particular, and in the atmosphere, in general. This phenomenon, shows itself, at a mature stage, as an invasion of warm waters coming from the West towards the American coasts; its effects can be very serious for the climate and the ecosystem, particularly, in Ecuador and Peru.

Today it is known that the phenomenon of "El Niño" is a recurrent and non-cyclic phenomenon; it occurs in different periods and with diverse intensities, as it happened in the 1925-1926 period; or the extraordinary event of the 1982-1983 period whose consequences were catastrophic for the Peruvian agriculture.

From a biological and meteorological point of view, the phenomenon of "El Niño" is localized by means of different indexes. Meteorologically, the best known index, used by the National Oceanic and Atmospheric Administration NOAA-Washington, is the Index of the South oscillation (SOI) which, if negative, is a favorable sign for the presence of the phenomenon of "El Niño".

The Office of Agriclimatic Impact Assessment of the Ministry of Agriculture verified that it is possible to register the tendency of the presence of the phenomenon of "El Niño" in view of the anomaly index of minimum temperatures registered in the coastal stations. Thus, for example, this anomaly, of extreme characteristics, produced in 1983 was localized in Piura, Chiclayo and in Lima in the first days of October of 1982; and the anomaly of moderate characteristics occurred in 1987 was detected since the last week of November of 1986.

The space distribution of the rainfall and the maximum and minimum temperatures nationwide permit to observe objectively excess or shortage zones, as well as areas under normal conditions. With regard to the variable under study, in Figures 1.6 and 1.7, the space distribution of rainfall anomalies for October of 1982 and January of 1983 is shown, where the typical performance of months affected by the process of the phenomenon of "El Niño" can be visualized.

TABLE 1.7

SUMARY OF EMERGENCIES AND DAMAGES PRODUCED NATION WIDE IN 1994

MONTH	PHENOMENON	DECEASE	VICTIMS	DWELLINGS			TOTAL
				DESTROYED	AFFECTED	ESTIMATED COST $ DWELLINGS DESTROYED	
JANUARY	19	47	3,159	201	200	296,000	4,132
FEBRUARY	56	23	68,731	581	12,893	1,325,500	23,255
MARCH	71	30	33,194	1,434	3,114	2,623,000	8,582
APRIL	36	3	11,226	272	1,303	305,500	4,766
MAY	5	12	1,559	50	320	50,000	0
JUNE	7	2	12	4	18	14,000	300
JULY	3	0	110	1	14	3,500	200
AUGUST	3	1	59	6	--	21,000	--
TOTAL	200	118	118,050	2,549	17,862	4,638,500	41,235

Source : National Defense Civil System

FIGURE 1.6

RAINFALL ANOMALIES OCTOBER 1982

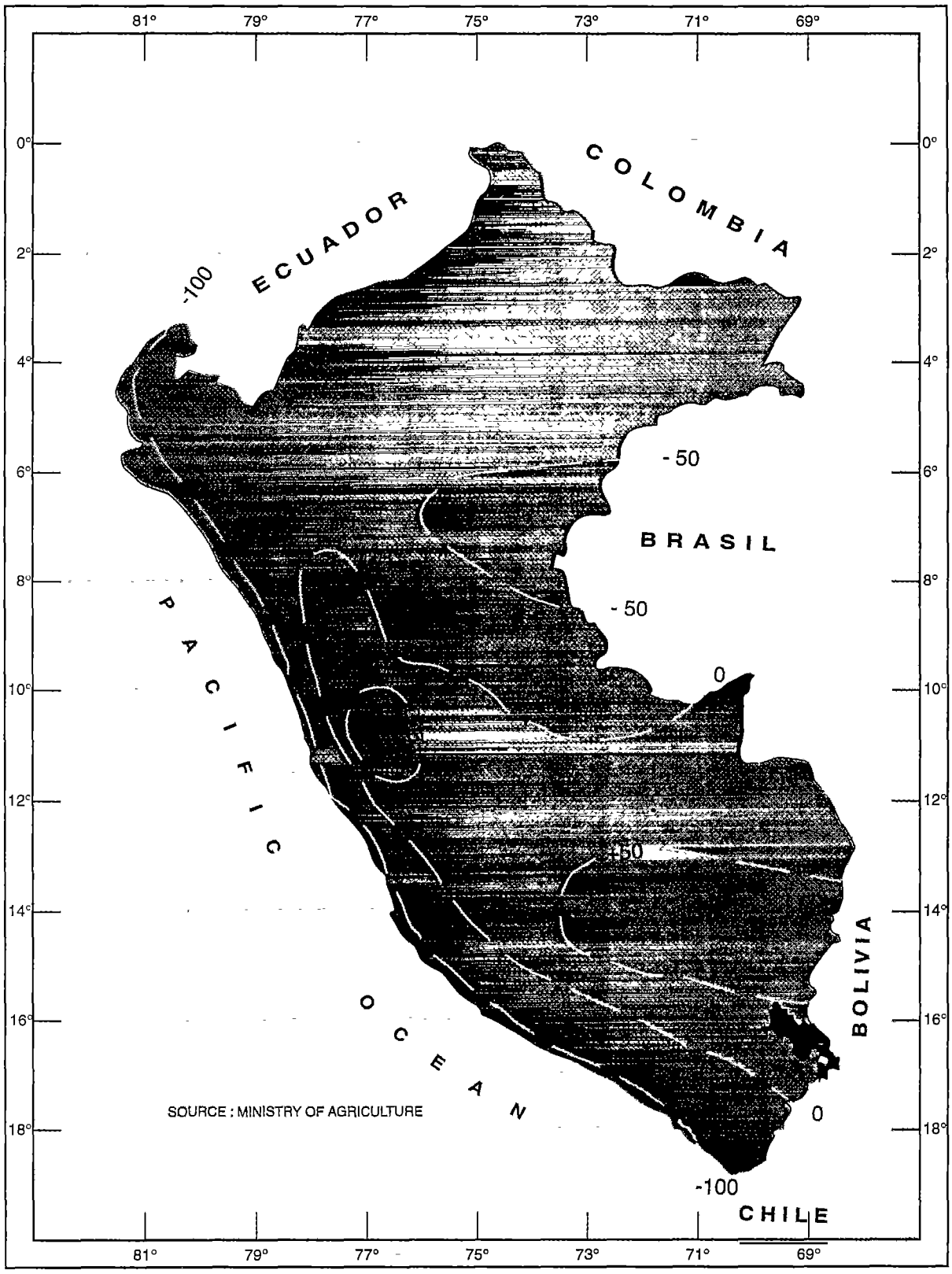
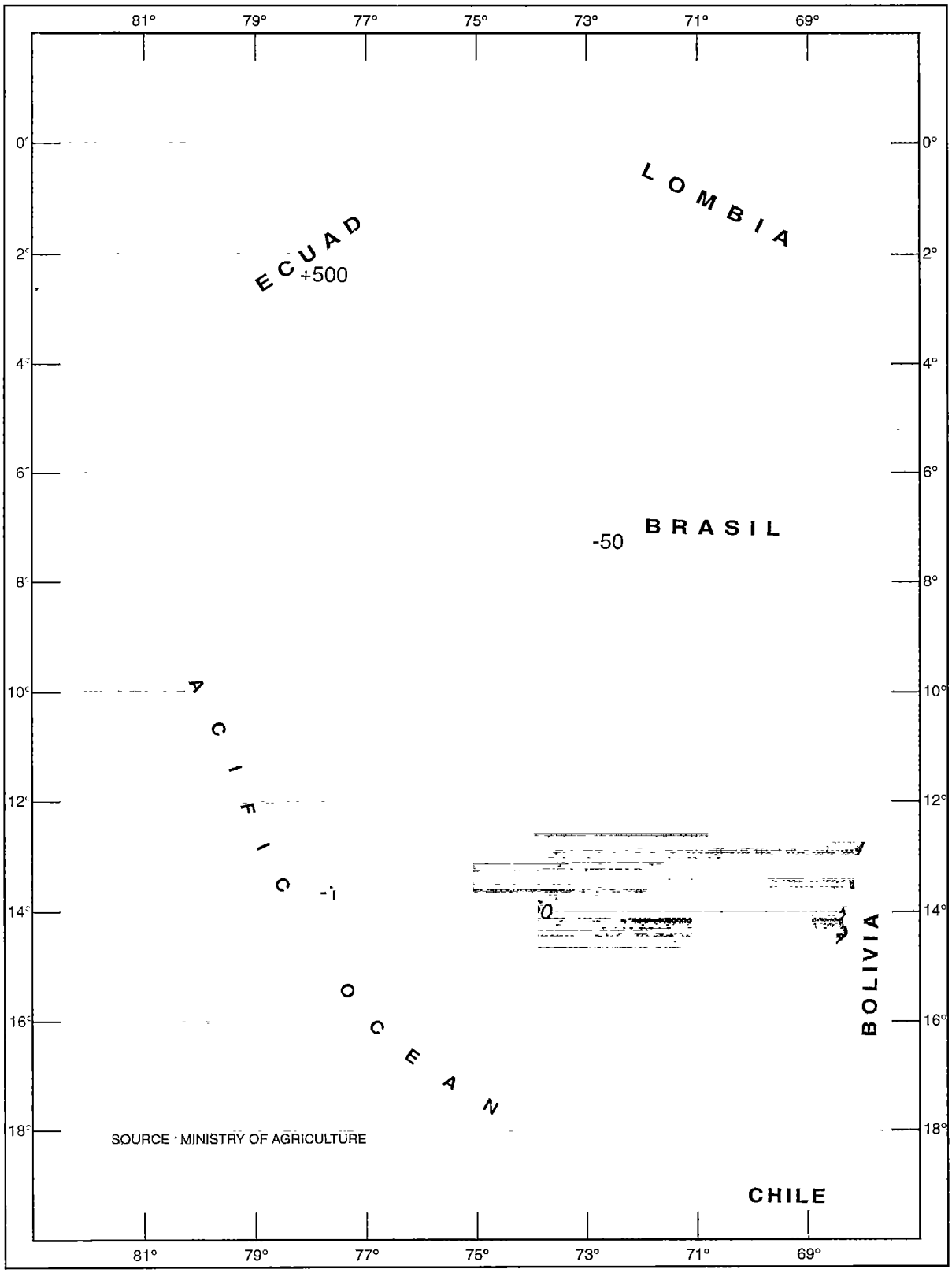


FIGURE 1.7

RAINFALL ANOMALIES JANUARY 1983



Finally, the Sea Institute of Peru (IMARPE) considers as biological indicators, among others, the presence of fitoplanctum as a signal of warm surface equatorial waters; and, according to its presence and distribution areas near the Peruvian Coast, it would indicate the degree of the presence of the phenomenon of "El Niño".

The phenomenon "El Niño" generally occurs in the summer and, if it happens, has the following consequences:

a) **Excesive pluvial rainfall in the northern area**
An excessive rainfall, especially prolonged, besides its mechanical effects on the plants and erosion effects, alters completely the ventilation and the thermic regime of the soil. The zones of the country experiencing excessive pluvial rainfall and flood, because of the phenomenon of "El Niño" are: Tumbes, Piura, Lambayeque, La Libertad and Ancash (except the upper provinces of the Highland), Lima (provinces of Barranca, Chancay, Huaral and Lima).

b) **Drought in the Southern Highland**
The drought is a very complex phenomenon that takes place in the soil-vegetal cover- free atmosphere system. It happens when the water balance is negative. The most affected zones by drought because of the phenomenon of "El Niño" are: Ayacucho, Huancavelica, Apurimac, Cusco, Puno and Arequipa (upper provinces). The impact of the phenomenon of "El Niño",taking as a reference, the one occurred in the 1982-1983 period, affected mostly the agricultural activity producing an 85% of losses; losses in the livestock activity and the irrigation infrastructure reached 8% and 7%, respectively.

Among the most significant economic effects, as a result of the phenomenon "El Niño", the following can be mentioned:

- A big impact on the agricultural activity of the Coast as a result of the low productivity of the crops; this was a consequence of the high temperatures of the air, especially the minimums temperatures, and of the decrease of the solar radiation availability. These factors altered the normal growth and development of the crops, principally, sugar cane, cotton, and potato. In second place, the losses were also caused by the mechanical effects of the excessive rains in the Northern Coast which produced losses of crops and livestock.

In the case of the Southern Highland, the drought hada double effect: a low productivity of the crops, and the complete loss of crops and livestock for lack of water.

Faced with a similar situation, it would be convenient to take preventive measures, since an increase in the volume of water stored in the reservoirs of the Northern Coast would be produced. This increase in water would be used to carry out a complementary agricultural campaign. Moreover, the excess of rainfall will permit the growth of grass with a supportability of 2 or 3 head of cattle/ha, approximately, as it was estimated in a previous experience.

1.7 WATER, DEFORESTATION AND ITS INFLUENCE ON SOIL EROSION

Although water is esential for life in the most diverse uses, it can also become a negative agent because of the destruction it may cause either by the excessive rainfall or the destruction of the vegetation protecting the soil, usually as the result of the human being's actions.

The particular characteristics of each of the natural regions of Peru favor the erosion which is the most prejudicial process of soil degradation. The soil erosion occurs in slope zones experiencing rain; in the Peruvian Highlands it is a process happening with alarming characteristics such as: bare slopes, rocky risings, and rivers loaded with soil particles during the rainy seasons. This situation gets worse because of a bad management of the stock and vegetation.

Along the Andean slopes, the soil deterioration is very notorious. According to an FAO estimate, about 1,500 tons of soils per/km^2 are lost annually; this is a number that worries when compared to the tolerant erosion limit that is 30 tons per km^2 annually.

The demographic pressure over the few productive areas force the rural populations to use intensively and inadequately the protecting soils, with the resulting economic and social consequences. This, plus the lack of control of erosion and inadequate techniques for soil use have caused a dramatic decrease of productivity due to the soil deterioration to severe erosion levels.

According to what is pointed out in the document "Classification of Soils by Capacity of Larger Use", Peru has 4,902,000 ha of soils for open land cultivation, and 2,707,000 ha of lands for permanent cultivation; these two figures together amount to approximately 7,600,000 ha representing 5.9% of the area of the country.

Soil erosion by water is the first consequence of deforestation, especially in soils that need protection. In the Upper Jungle, the huaycos and alluvions, which destroy roads, devastate populated centers and lands of cultivation or pasture, and kill hundreds of people, are becoming more frequent each year. The most spectacular recent events were: the destruction of part of Villa Rica in 1986, as a result of an alluvion formed in the Entaz river whose rough basin was totally razed; and the event occurred on December of 1987 in the province of Perene, as a consequence of the anarchical deforestation process of the basin of Ubiriki river, which caused tens of deaths.

The peasants's future depends on their capacity to conserve the soil capital. It has been proved that the erosion in cultivated lands in the Upper Jungle is galloping, registering annual losses of 300 tm/ha under average pluviosity conditions. (Rios,1978). In this author's opinion, 100% of the lands dedicated to agriculture in the Upper Jungle suffer from some degree, mostly severe, of erosive process.

Felipe Morales et al (1978) (1981) in works carried out in San Ramon, Chanchamayo valley, recorded losses of 148 tm/ha/year in bare soils, and of 119 tm/ha/year in soils exposed to falow, burning and maize, potato, and bean cultivations. The nutrient losses with these treatments were high reaching up to 116 kg/ha of nitrogen, 4 kg/ha of phosphorus, 19 kg/ha of potassium, 361 kg/ha of calcium, and 7 kg/ha of magnesium.

Dourojeanni and Paulet (1967) estimated the "E" Factor to apply the Universal Equation of soil loss (according to the formula of Fournier), to Tarapoto; these authors found out a value of 328.9 (in metric units) which is four times the value they estimated for the case of Jaen, where it rains five times less.

Low (1966-1967) estimated the potential erosion of the Andean Eastern watershed between 5,000 and 7,000 tm/km²/year.

A diagnosis study of the erosion problems in Peru, carried out by ONERN in 1982 (unpublished), shows in general terms the actual erosion conditions in the country, under their different forms, whether aeolian, hydric, or gravitational. This study gives a simplified view of the principal erosive processes, pointing out the critical areas at each region level as well as the areas with the highest erosive potential or subject to greater degrees of erosion in the future.

The Highlands is the most affected region as it presents about 6,000,000 ha with serious erosion problems; next is the Upper Jungle with 300,000 ha presenting serious erosion problems, and 4,800,000 ha with average erosion problems.

As it can be seen, there would be 21,102,000 ha with severe and moderate erosion problems at the Highlands level, and 5,100,000 ha in the Upper Jungle which would add 26,202,000 ha.

The distribution of high fragility zones in the Highlands includes the departments of Cusco, Puno, Ayacucho, Apurimac and Huancavelica followed by Cajamarca and Piura in the North. In the Upper Jungle, this distribution includes the departments of San Martin, Huánuco (Tingo Maria), Pasco (Oxapampa), Junín (Chanchamayo), and Cusco (Quillabamba).

With regard to the high Andean pastures, there are 21,795,000 ha, approximately half of which have at present serious overpasture problems and is affected by years of drought. This is the case principally of some departments in the South of the country such as: Puno, Cusco, Arequipa, Huancavelica and Apurimac which, as a whole, have 14,555,000 ha of pastures representing 67% of the total pastures of the country. Approximately 7,000,000 ha of that total would face overpasture and laminated erosion problems, apparently imperceptible but of unpredictable consequences.

In Peru, like in other parts of the world, shifting agriculture is the principal cause of forest destruction and of the depredation of the natural resources, in general, having the erosion and deforestation disastrous consequences such as:

- Increase of erosion or loss of soils by effect of the water and wind on lands that are not used according to their capacity of larger use: this happens in the Coast, the Highland, and the Jungle. 60% of the soils of the Coast and the Highland are in an accelerated process of deterioration because of erosion. 42% of the Peruvian Amazonian Jungle is affected by erosion ranging from slight to very serious levels.

- Deforestation of the dry forests of mesquite trees, in the Northern Coast, and in the coastal hills. At the beginning of the 80's, the destruction of the dry forest was estimated as reaching 50%, and the prawn exploitation was affecting very seriously the woods of Mangle, located in the mouths of the Tumbes and Zarumilla rivers.

  The magnitude of the deforestation in the Jungle is a complex matter which has not been sufficiently studied. Table 1.8 shows preliminary data in this regard. Apart from speculations regarding the deforestation of some 14,000,000 ha in prehispanic times, studies from 1975 on to reveal that an other 7,500,000 ha have been deforested so far in the 20th century.

- Increase of erosion on the slopes of the Andean and inter-Andean valleys by effect of forest destruction and the development of inappropriate cultivation practices. In this sense, the erosion by effect of water is the most intense due to the cultivation of steep slopes, overpasture, watershed deforestation, and to inefficient management of the soils.

- Degradation of high Andean pastures because of an irrational handling of pastures. There are around 20,000,000 ha occupied by near 90% of the national livestock population. The development of the rearing of South American camelidae has not been given the level and importance this significant resource of the Andean fauna deserves; on the contrary, the depradation of wild camelidae through the poaching has been intensified.

- Increase of deforestation due to shifting agriculture and to the impact of an undiscriminate felling, including firewood extraction. This situation has serious effects on the quality and quantity of the water resources. The expansion of the agricultural frontier, at the expense of the destruction of tropical forest lands, is a constant practice exercising a strong pressure on the evolution of the forest.

- A progressive increase of the desertification process throughtout the national territory due to the lack of appropriate measures for soil protection and for the control of activities of agricultural, forestry, industrial development and on productive and fertile soils. In the Highlands, the desertification affects the natural grazing lands because of the pastoralism practice on them, the grazing land burning as a management practice, and the non application of appropriate techniques for the management of pastures and livestock.

TABLE 1.8

AREA OF DEFORESTED AMAZONIAN WOOD IN PERU
(Preliminary data by departments up to 1990)

DEPARTMENTS	ORIGINAL AREA OF AMAZONIAN WOOD		DEFORESTED AREA		
	Area (Hectares)	% Amazonian Wood	Area (Hectares)	% Depart. Wood	% Amazonia Wood
Piura	47,770	0.06	8,400.0	17.6	0.01
Lambayeque	6,600	0.01	*	*	*
La Libertad	117,100	0.15	20,800.0	17.8	0.03
Cajamarca	505,000	0.67	412,000.0	81.6	0.54
Amazonas	3'464.300	4.59	2'080,000.0	60.0	2.75
Huánuco	2'296,500	3.04	557,000.0	24.2	0.74
Pasco	1'811,300	2.40	226,000.0	12.5	0.30
Junín	2'338,600	3.10	774,000.0	33.1	1.02
Huancavelica	42,800	0.06	*	*	*
Ayacucho	324,600	0.43	123,000.0	37.9	0.16
Apurimac	72,800	0.10	*	*	*
Cuzco	3'406,200	4.51	227,000.0	6.7	0.30
Puno	1'345,200	1.78	40,000.0	3.0	0.05
Loreto	36'279,500	48.01	1'038,000.0	2.9	1.37
San Martín	4'904,800	6.49	2'105,000.0	42.9	2.79
Ucayali	10'137,500	13.42	890,000.0	8.8	1.18
Madre de Dios	8'460,000	11.20	84,000.0	1.0	0.11
TOTAL	75'560,500	100.00	8'585,200.0		11.35

* The information missing corresponds to zones to be evaluated.

SOURCE: General Directorate of the Environment (INRENA)
(Information obtained through image analysis of Satellite LANDSAT TM, at the 57 % of the total area of woods).

CHAPTER II

INTERRELATION IN THE USE OF WATER

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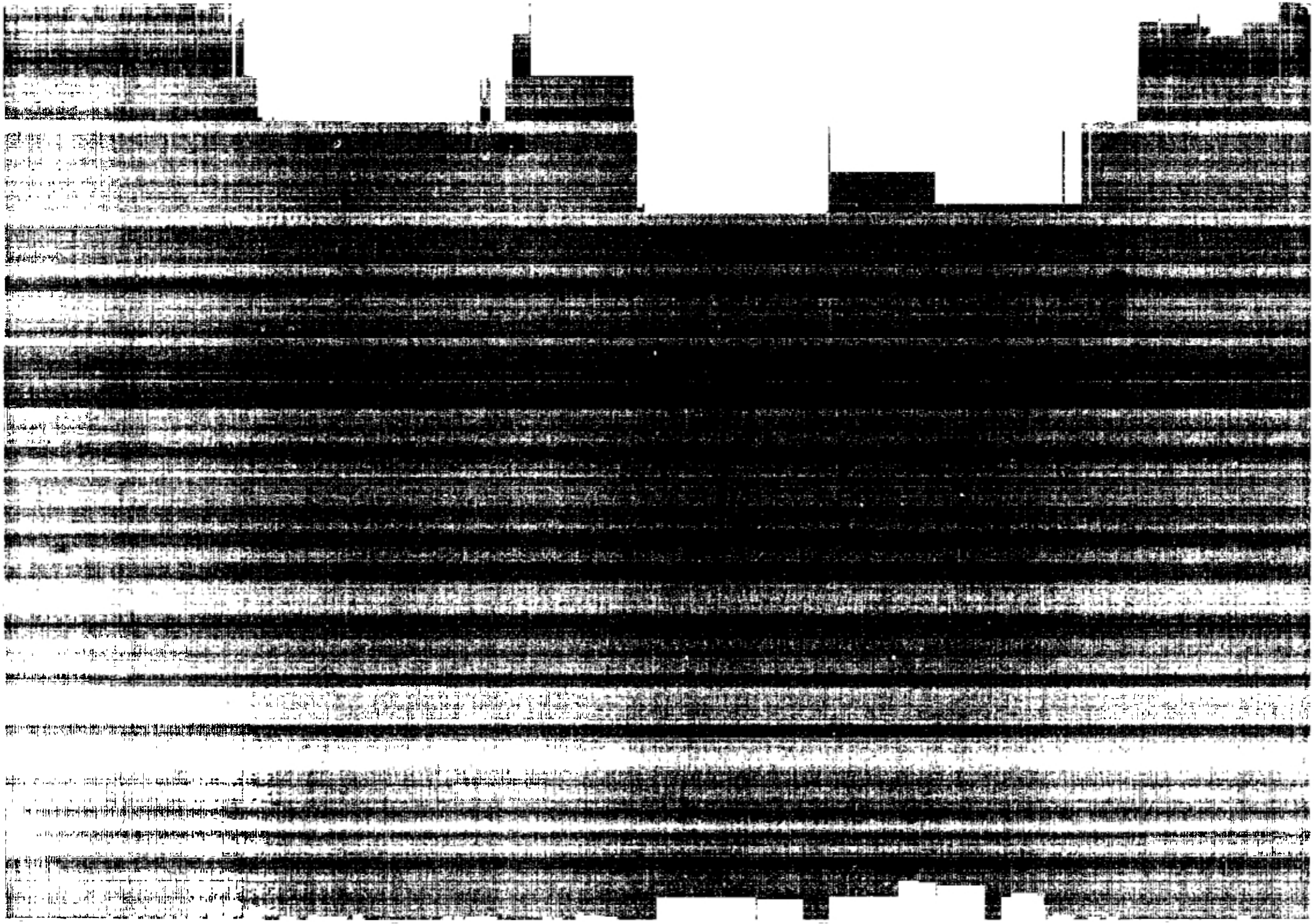

CHAPTER II

INTERRELATION IN THE USE OF WATER

2.1 USE OF THE WATER RESOURCES

The knowledge of the actual use of water in its magnitude and space distribution permits to order, to plan, and to improve the water resources of the country. To this end, the former ONERN elaborated in 1984 a national inventory of the use of water, and the General Directorate of Waters and Soils with the support of the Deutsche Gesellschaft Fur Tecchische Zusammerbect (GTZ), through the World Bank, prepared in 1992 a basic situational study about Peru's water resources nationwide. This study reveals that during the visits made to the different production sectors related to the water use, in general a deficiency in updated information was detected, mainly due to the budget reduction for operations in the Institutions. Today, this situation has become worse especially because of the structural changes and the policies of the different Government's sectors.

The various uses of water are mentioned below:

2.1.1 Population Use

The population use of water varies according to the country's population. In 1984 the ONERN determined a demand of 896 mcm nationwide for a population defined by the 1981 census of 17,025,024 inhabitants. According to the National Institute of Statistics (INEI), the population for 1992 would be 23,996,200 inhabitants whose water demand for sewage and non-sewage would be of 1,264 mcm.

The demand of water for population use, the per capita consumption, and the estimated population are presented by basins and watersheds in Table 2.1, following the ONERN's criteria.

The population use of water has limitations in the Pacific Watershed because of the resource quality and availability; its demand corresponds, however, to more than 80% of the national consumption. In the Atlantic watershed the consumption represents 18%, and in the Titicaca Watershed this represents approximately 2% of the national consumption.

The supply of population water is accomplished by means of two sources: surface waters regulated and retained during the dry season for cities of the Coast and some cities of the Highland and the Jungle; and by means of underground waters from the aquifers generally used for the cities of the Coast. Water supply is made through house services using pipes from treatment plants, tank truck, house wells, and direct intake from the natural water sources.

At a national and regional level, Lima with a population of 7,200,000 millions inhabitants in 1992 represented 30% of the national population (at present, higher figures are estimated). The population water supply was as follows: 20.74 m^3/s coming from surface waters of the Rimac river and the lakes of the upper part of the basin of Santa Eulalia river; and 7.24 m^3/s coming from underground water of the aquifers belonging to the basins of Rimac and Chillon rivers where there are about 1,000 wells.

The demand in 1992 was of 30.8 m^3/s which meant a deficit; under these circumstances, works that would relieve this situation were started, such as: the damming of Yuracmayo which would supply a regulated flow of 2 m^3/s during the dry period (May-November), enlargement of the daily regulation system from 0.5 mcm to 1.5 mcm and of the water capacity of the treatment plant of the city of Lima (Atarjea) from 15 m^3/s to 20 m^3/s, enlargement of the capacity of extraction of underground water to 13.3 m^3/s, adjustment of the urban flow network which would allow a production of 29.3 m^3/s, out of which 17.3 m^3/s would come from the treatment plant and 12 m^3/s from underground water.

2.1.2 Agricultural Use

The use of water for agricultural purposes is the most extended nationwide. In the Coast region, 100% of the agricultural area is under irrigation, 84% of which corresponds to annual crops. In the Highland region, around 70% of the agricultural area is under dry farming and the rest under irrigation; 79% of crops are transitory. In the Jungle region, 95% of the agricultural area is under dry farming and 45% of the crops are transitory.

The agricultural area under dry farming uses the seasonal rainfall occurring in the regions of the Highland and the Jungle. In the Coast region, the agricultural area under irrigation depends on the water availability.

The demand of irrigation water for agricultural purposes is concentrated in the Pacific Watershed with 87% approximately, in the Atlantic Watershed with 12%, and in the Titicaca Watershed less than 1%. The basins having the largest demand of agricultural water in the Pacific Watershed are: Chira, Piura, Chancay, Lambayeque, Jequetepeque, and Chicama; the basins having the largest use of water for irrigation in the Atlantic Watershed are: Marañon, Huallaga, Urubamba, and Apurimac; and the basin having the largest demand in the Titicaca Watershed is the basin of the Maure river, see Table 2.1

2.1.3 Livestock Use

The livestock population of the country is varied and the demand is estimated according to modules proposed by well-known organizations related to the sector. The principal species studied and their respective demands of water use are: cattle 7.3 m^3/year, sheep and goats 1.1 m^3/year, pigs 2.92 m^3/year, horses 7.3 m^3/year, South American camelidae 1.46 m^3/year, fowl 0.09 m^3/year, and other species 0.66 m^3/year.

In quantitative terms, the populations that mostly consume the water resource are the fowl, next are the sheep and cattle.

2.1.4 Industrial Use

The use of water for industrial purposes is very important since it contributed with an average of 22% to the GNP of the country for the 1980-1990 period, reaching 21% for the 1990 year. The water resource in this sector is basically used for refrigeration and vapor production, and directly as industrial input.

The Directorate of Statistics of the Ministry of Industries, Tourism, Integration and International Commercial Negotiations (MITINCI) has the latest information corresponding to 1988 which referred to 15,136 industries. Presently there could be more than 42,000 industries.

More than 91% of the industries are located in the Pacific Watershed, therefore, it has a high water consumption for industrial purpose; in the Atlantic Watershed this percentage is around 8%, and in the Titicaca Watershed less than 1%.

2.1.5 Mining Use

The mining activity in the 1980-1992 period increased in number of plants using the water resource for mineral treatment and recovery in the extraction, concentration, refining, smelting, and other processes. The water resource is the input of an activity that produced an average of 12% of the GNP of the country for the 1980-1990 period.

The methodology employed by ONERN defined a module for water use in terms of the kind of plant, installed capacity and daily treated average. Based on this and according to statistics, the water use was estimated in 206.7 mcm for 1992; 73% of this total corresponds to plants located in the Pacific Watershed; 26% to the Atlantic Watershed; and 1% to the Titicaca Watershed.

At the watersheds level, there is an estimate of the number of plants and of the water use which shows an increase in the number of plants; this means, in turn, a growth in consumption. However, in 1992 around 22% of the plants were not in operation because of security and financing problems. Today, an increase in figures is estimated thanks to the pacification process.

2.1.6 Energy Use

The use of water for energy purposes is not consuming, rather the water can be reused later for other purposes without reducing its availability. The use estimate nationwide was made by the Planning Management of ELECTROPERU in 1989 where the installed power stations and their potential at the watershed level were indicated in quantitative terms.

In Peru, the power stations basically used are: hydroelectric power stations which employ the water to generate electrical energy, and the thermal power stations which employ the water to refrigerate the generating plant. The hydroelectric power stations employ 95% of the total water used nationwide.

The demand of water for energy use in the 1980-1992 period showed a slight variation regarding the figures presented in the study by ONERN in 1984. This was due to the few investments made during such period to increase the electrical energy availability. The relative large power stations that were built during the above-mentioned period were: Carhuaquero with 75 MW and 19.5 m^3/s and Charcani with 80 MW and 24 m^3/s in the Pacific Watershed; Restitución in the basin of the Mantaro river generating 270 MW and 91 m^3/s in the Atlantic Watershed.

At present, the use of water for energy purposes represents a greater volume in the Pacific Watershed with 82% of the use nationwide; 16% corresponds to the Atlantic Watershed and 2% to the Titicaca Watershed. The basins of the Pacific Watershed that involve the greater volume of water are: the basin of the Santa, Pativilca, Rímac and Chili rivers; in the Atlantic Watershed they are: the Huallaga, Perene, Urubamba and Mantaro; and in the Titicaca Watershed it is the basin of the Coata river.

TABLE 2.1
USE OF WATER FOR DIFFERENT PURPOSES

BASIN	CONSUMING USE (Thousands m3)						NON CONSUMING USE (Thousand	
	AGRICULTURAL	POPULATION	MINING	INDUSTRIAL	LIVESTOCK	TOTAL	ENERGY	TOTAL
PACIFIC								
Tumbes	273. 724	20 534	—	9 787	276	304 321	5. 062	5. 062
Chira Piura	2. 163. 117	47. 080	188	10. 561	3 456	2 224. 402	86. 371	86. 371
Olmos	66. 013	782	—	573	148	67 516	615. 000	615 000
Chancay-Lambay.	2. 196. 591	46. 904	—	36. 926	2 206	2 282 629	37 325	37. 325
Zana	364. 086	3. 067	—	6 624	286	374 061	7 736	7. 736
Jequetepeque	689 436	6 838	—	3. 556	1. 502	703. 334	24. 100	24. 100
Chicama	1. 384 386	10. 177	224	125. 586	980	1. 521 353	31 822	31. 822
Moche	387. 207	41. 611	1. 470	34. 434	1. 084	466. 006	27 999	27 999
Viru Chao	282. 132	486	—	643	133	283. 393	12	12
Santa	151. 010	36. 317	4. 096	12 836	2. 285	206 546	723. 171	723 171
Nepena	179. 330	713	151	1. 311	333	181. 838	8. 227	8. 227
Casma	197. 559	1 939	805	351	374	201. 028	1. 298	1. 298
Huarmey	145. 383	1. 883	1. 750	466	321	149. 803	3. 081	3 081
Pativilca	585. 303	9. 924	117	37 516	1. 012	613. 872	594 913	594 913
Huaura	424. 193	15. 682	2. 126	8. 321	914	451 236	77. 242	77. 242
Chancay-Huaral	316 567	6 484	2. 337	2. 134	675	328 197	124. 479	124 479
Chillon	125. 149	9 445	—	27. 496	844	162. 734	1. 254	1. 254
Rimac	178. 149	820. 596	10 449	671 310	1. 310	1. 479. 814	550. 875	550. 875
Lurin	86. 901	1. 997	—	2. 778	373	92. 049	233	233
Mala	180. 234	2. 338	1. 787	8. 013	525	192. 777	2. 964	2. 964
Canete	411. 751	7. 480	1. 523	456	917	422. 107	3. 336	3 336
San Juan	416. 673	11. 860	492	1. 619	637	431. 271	4. 475	4 475
Pisco	356. 501	8. 165	3. 632	5. 520	479	374. 297	7. 231	7. 231
Ica	377. 748	22. 177	47	3. 426	525	403 921	2. 037	2 037
Grande	277. 389	2. 861	188	311	911	281 660	1. 925	1. 925
Acari	254. 453	2 853	3. 630	295	548	261 577	55. 288	55 288
Yauca	214. 892	538	186	509	509	216. 614	1. 920	1. 920
Chala	35. 735	488	127	509	149	36. 988	2. 702	2. 702
Ocona	101. 345	810	1. 109	791	899	104. 954	1. 534	1. 534
Camana	437. 019	4 403	3. 828	1. 367	1. 476	448. 093	10. 208	10 208
Vitor Chili	345. 545	45 456	1 759	83. 097	791	476. 648	1. 043. 807	1. 043 807
Tambo	328. 225	5. 779	—	3 500	641	338. 145	5. 681	5. 681
Osmore	56. 335	5. 032	60 087	277	138	121 869	112. 607	112. 607
Locumba	136. 884	2. 995	49. 973	186	223	190. 260	69. 165	69. 165
Sama	80. 380	865	—	103	171	81 519	—	—
Caplina	114 925	9. 855		361	128	125. 059	821	821
SUB TOTAL	14. 200. 269	1. 018. 063	152 041	1. 103. 440	27 868	16 501. 681	4. 245 899	4 245. 899

Source: Basic Situational Study of the Water Resources in Peru. 1992

TABLE 2.1
USE OF WATER FOR DIFFERENT PURPOSES

BASIN	CONSUMING USE (Thousands m3)						NON CONSUMING USE (Thousand	
	AGRICULTURAL	POPULATION	MINING	INDUSTRIAL	LIVESTOCK	TOTAL	ENERGY	TOTAL
ATLANTIC								
Amazonas	4. 023	20. 878	—	1. 637	234	26. 772	11 969	11. 969
Maranon 1	348	486	—	126	38	997	1. 209	1 209
Maranon 2	100	241	—	154	35	530	161	161
Maranon 3	117 821	3. 026	—	63	672	121 581	—	—
Maranon 4	178 875	5 686	—	57	1. 043	185 661	11 091	11. 091
Maranon 5	288. 644	21. 856	1. 511	164	5. 250	317 425	77 029	77 029
Maranon 6	228. 181	8. 809	5. 172	115	5. 158	247. 435	27. 122	27. 122
Huallaga 1	1. 300	1. 696	—	109	202	3. 307	495	495
Huallaga 2	8. 541	11. 717	—	95	866	21. 219	2 791	2. 791
Huallaga 3	5. 487	1 683	—	55	293	7. 418	104	104
Huallaga 4	150. 909	17 320	6. 413	1. 100	1. 976	177. 718	148. 385	148 385
Ucayali 1	197	433	—	154	22	806	—	—
Ucayali 2	1. 344	828	—	199	115	2. 484	—	—
Ucayali 3	278	4. 636	—	4 230	228	9. 372	10. 113	10 113
Ucayali 4	23	226	—	76	35	360	—	—
Pachitea	1 702	1. 197	—	137	397	3 433	941	941
Urubamba 1	—	—	—	102	—	102	—	—
Urubamba 2	321. 683	34. 513	—	3. 587	3. 756	363. 519	236. 857	236 857
Tambo	—	—	—	229	—	229	—	—
Perene	19. 241	16. 338	2. 848	4. 252	1. 151	43. 830	837. 462	837. 462
Ene	—	—	—	110	—	110	—	—
Apurimac 1	2. 065	383	—	56	168	2. 672	—	—
Apurimac 2	233. 240	5. 208	843	29	3. 043	242. 163	89. 669	89 669
Apurimac 3	231. 525	3. 587	—	60	3. 571	238 733	35. 233	35 233
Pampas	45. 696	7. 580	1. 267	6	5. 181	59. 730	45 641	45. 641
Manaro 1	99. 784	17. 886	5 717	4 491	3. 872	131 749	3. 982. 421	3. 982. 421
Manaro 2	51. 631	39. 174	29. 462	27. 036	3. 294	150. 596	1. 398 518	1. 398 518
Alto Purus	35	21	—	87	2	145	2	2
Madre de Dios 1	185	1. 628	—	196	98	2. 107	375	375
Madre de Dios 2	951	158	—	210	32	1. 351	—	—
Inambari	2 469	1. 331	—	56	729	4 585	3. 551	3 551
SUB TOTAL	1. 996 378	228. 420	53 033	48 947	41. 461	2. 368. 139	6 881. 139	6 881. 139
TITICACA								
Maure	27. 074	238	—	233	374	27. 919	8	8
Ilave	18. 048	3 388	370	252	2 191	24 149	694	694
Coata	4. 547	8. 964	398	2. 178	2. 107	18. 194	7. 836	7. 836
Ramis	10. 492	3. 517	571	149	3. 469	18 198	2 351	2 351
Huancane	10. 916	1 689	401	130	1. 506	14. 642	1 753	1. 753
SUB TOTAL	71. 077	17. 796	1. 840	2. 942	9 647	103. 102	12 642	12. 642
TOTAL	16 267. 624	1. 284. 279	206. 714	1. 155. 329	78 976	18 972. 922	11. 139 480	11. 139 480

Source: Basic Situational Study of the Water Resources in Peru. 1992

2.2 WATER BALANCE

The Rainfall vs Referential Potential Evapotranspiration (ETO) ratio at the level of the natural regions comprised in the Pacific Watershed is variable. There is a notorious monthly shortage of the water resource in the Coast due to the lack of significant rains; whereas the Highland region presents a less critical ratio. In the Atlantic Watershed, the balance is highly positive; and in the Titicaca Watershed there is a positive balance too.

PLANIR jointly with the Spanish Cooperation CEDEX elaborated in 1990 the latest study on water resources in Peru nationwide. In this study, employing a hydrological methodology at the planning level, they prepared the water balances in the basins, as shown in Table 2.2.

Notwithstanding the results of the Water Balances, the rainfall distribution (Figure 1.4) plays an important role in the seasonal availability of the water resources, with shortage periods in the Pacific Watershed (throughout the year in the Coast and partially in the Highland) and in the Titicaca Watershed, mainly in the May-December period. The water balances at the basin level in each watershed are shown in Table 2.2.

In the balances presented in Table 2.2, the concept humid or effective basin (Contributing Area) is understood as the area of the basin starting from the isohyet 200 mm as contributor (this is the case of the Pacific Watershed); and by natural resource is understood the sum of the internal resource and the external resource which, in turn, is equivalent to the specific contribution.

The no coincidence with the total area of the country is due to the fact that the interbasins of the Pacific Watershed have not been considered; these interbasins generally present a small potentiality of runoff. On the other hand, the points of control (hydrometrical stations) are not situated in the mouth of the basin, but at a certain distance upstream; these areas do not produce, anyway, runoff.

As regards the Atlantic Watershed, the balance in the basins of Putumayo and Yavari rivers was not established because these rivers flow into the countries of Colombia and Brazil, respectively.

2.3 LEGISLATION AND APLICATION OF POLICIES

The State's role in relation to the water resources is defined by the General Law of Waters which assigns the State the responsibility to formulate policies of development and use of the water resource; in the practice, however, there are gaps regarding the State 's role as a promoter of technological improvements in the irrigation systems.

It is noteworthy that the different institutions related to the use of water such as the agriculture, energy, mining, drinking water supply and sewerage, health sectors, and other sectors in a smaller proportion, traditionally have not kept in touch, or related among themselves, and normally have acted in a totally independent way which has led to the little effectiveness in the measures adopted and a duplicity of functions.

The Legislative Decree No 653, promulgated on July of 1991, "Law for the Promotion of Investments in the Agricultural Sector", introduced substantial changes in the management and administration of the water and land resources; the following points can be mentioned as the most important:

TABLE 2.2
WATER BALANCE

Pacific Watershed

BASIN	TOTAL AREA km2	CONTRIB AREA km2	RAINFAL mm	SPECIFIC CONTRIBUTION mm	ET mm	INTERNAL RESOURCE Hm3/year	EXTERNAL RESOURCE Hm3/year	NATURAL RESOURCE Hm3/year
ZARUMILLA	650	580	625	149	476	86	63	149
TUMBES	1850	1700	540	103	437	174	2366	2540
CHIRA	7800	7050	800	406	394	2862	1577	4439
PIURA	8020	4750	576	247	329	1173	0	1173
CASCAJAL	1250	1050	285	36	250	37	0	37
OLMOS	750	300	350	69	291	21	0	21
MOTUPE	1620	970	435	111	324	108	0	108
LA LECHE	1620	870	570	260	310	226	0	226
CHAN-LAMBAYEQUE	3600	3100	860	499	431	1331	0	1331
ZANA	720	595	927	394	533	234	0	234
CHAMAN	500	200	325	56	269	11	0	11
JEQUETEPEQUE	3700	3000	603	304	299	913	0	913
CHICAMA	3800	3050	546	248	298	756	0	756
MOCHE	1950	1570	490	164	326	258	0	258
VIRU	1620	1120	560	112	448	125	0	125
CHAO	1080	850	425	105	320	89	0	89
SANTA	12400	10640	740	557	183	5924	0	5924
LACRAMARCA	730	30	250	24	226	1	0	1
NEPENA	1630	700	454	127	327	89	0	89
CASMA	2850	1090	563	212	351	231	0	231
CULEBRAS	630	550	253	27	226	15	0	15
HUARMEY	2150	750	396	88	308	66	0	66
FORTALEZA	1730	1010	457	128	329	129	0	129
PATIVILCA	4550	3520	919	424	495	1492	0	1492
SUPE	1300	230	350	243	107	56	0	56
HUAURA	3800	2940	653	384	269	1128	0	1128
CHAN-HUARAL	2100	1750	614	281	333	491	0	491
CHILLON	2150	1250	512	213	299	266	0	266
RIMAC	3130	2250	600	338	264	755	0	755
LURIN	1400	580	452	209	243	142	0	142
CHILCA	530	90	350	64	286	6	0	6
MALA	2220	1520	594	351	244	533	0	533
OMAS	930	350	375	76	299	27	0	27
CANETE	5950	5050	743	343	400	1732	0	1732
TOPARA	820	150	390	84	306	13	0	13
SAN JUAN	3350	2250	585	198	387	446	0	446
PISCO	3590	3430	618	226	392	774	0	774
ICA	4330	2030	465	129	337	261	0	261
GRANDE	10370	3800	435	110	325	418	0	418
ACARI	4450	2750	588	158	433	428	0	428
YAUCA	4050	2350	661	268	393	631	0	631
CHALA	1150	220	260	27	234	6	0	6
CHAPARRA	1230	340	310	45	265	15	0	15
ATICO	720	50	250	23	227	1	0	1
CARAVELI	1550	250	250	23	227	6	0	6
OCONA	15220	12120	615	256	359	3101	0	3101
MAJES-CAMANA	17000	12000	600	257	343	3083	0	3083
CHILI	12740	7200	368	68	300	491	0	491
TAMBO	12472	7873	498	151	337	1235	0	1235
OSMORE	3350	650	395	87	308	57	0	57
LOCUMBA	5800	2320	387	58	329	134	0	134
SAMA	4585	985	313	60	253	58	0	58
CAPLINA	3050	400	285	102	183	41	0	41
TOTAL	200317	126103	499	183	318	32688	4006	36692

Source . CEDEX, 1990

1Hm3/year = a 1mcm/year

TABLE 2.2
WATER BALANCE

Atlantic Watershed

BASIN	TOTAL AREA km2	CONTRIB AREA km2	RAINFAL mm	SPECIFIC CONTRIBUTION mm	ET mm	INTERNAL RESOURCE hm3/year	EXTERNAL RESOURCE hm3/year	NATURAL RESOURCE hm3/year
CHIRIACO	3510	3510	1453	869	585	3049	0	3049
HUALLAGA	94340	94340	2290	1652	638	155878	0	155878
MARANON MEDIO	28380	28380	2925	2201	724	62430	9147	71577
BAJO MARANON	42380	42380	2097	1468	629	62225	0	62225
AMAZONAS	55810	55810	3080	2418	664	134378	0	134378
ACRE	9350	9350	4500	3811	689	35638	0	35638
URUBAMBA	32110	32110	2678	1998	680	64174	0	64174
VILCANOTA	26540	26540	1219	693	526	18398	0	18398
CHOTANO	1950	1950	1119	365	754	712	0	712
HUANCABAMBA	3340	3340	765	332	436	1110	0	1110
TABACONAS	2185	2185	1255	692	563	1512	0	1512
PUTUMAYO								50464
NAPO	45470	45470	3238	2570	668	116888	32171	149059
YAVARI								107238
TIGRE	34430	34430	2726	2072	654	71350	9462	80812
PASTAZA	20920	20920	2518	1871	647	39148	30688	69836
SANTIAGO	8065	8065	2735	2081	654	16784	43557	60341
NIEVA	4210	4210	2472	1827	645	7692	0	7692
CENEPA	6370	6370	2257	1621	637	10324	0	10324
CHICHINPE	4610	4610	1580	984	596	4538	442	4980
UTCUBAMBA	7000	7000	935	525	410	3678	0	3678
CHAMAYA	2500	2500	1076	616	460	1541	0	1541
LLAUCANO	2260	2260	1061	535	526	1209	0	1209
CRISNEJAS	4680	4680	945	300	645	1404	0	1404
ALTO MARANON	31920	31920	928	467	459	14915	0	14915
AGUAYTIA	11250	11250	3572	2897	675	32599	0	32599
PACHITEA	27820	27820	2809	2153	657	59891	0	59891
PERENE	18170	18170	1609	1011	598	18372	0	18372
MANTARO	34780	34780	937	380	557	13207	0	13207
APURIMAC	42530	42530	1151	641	510	27255	0	27255
PAMPAS	22800	22800	872	296	576	6748	0	6748
UCAYALI	131565	131565	2383	1752	631	230581	0	230581
YURUA	9830	9830	3270	2602	668	25577	0	25577
PURUS	19930	19930	4162	3478	684	69317	0	69317
DE LAS PIEDRAS	20030	20030	4185	3500	685	70119	0	70119
TAMBOPATA	16650	16650	4121	3437	684	57237	0	57237
INAMBARI	18920	18920	2231	1596	635	30194	0	30194
MADRE DE DIOS	38500	38500	3406	2735	671	105298	0	105298
TOTAL	884885	884885	2238	1523	614	1575370	125467	1858537

Titicaca Watershed

BASIN	TOTAL AREA km2	CONTRIB AREA km2	RAINFAL mm	SPECIFIC CONTRIBUTION mm	ET mm	INTERNAL RESOURCE hm3/year	EXTERNAL RESOURCE hm3/year	NATURAL RESOURCE hm3/year
SUCHES	1150	1150	691	189	502	217	0	217
HUANCANE	3618	3618	636	177	459	639	0	639
RAMIS	15714	15714	740	156	585	2443	0	2443
COATA	4548	4548	857	319	538	1450	0	1450
ILLPA	1305	1305	658	168	490	220	0	220
ILAVE	7668	7668	653	181	472	1387	0	1387
MAURE	2153	2153	482	57	405	124	0	124
ZAPATILLA	495	495	709	200	509	99	0	99
CCALLACCANE	1085	1085	713	203	510	220	0	220
TOTAL	37736	37736	680	183	497	6799	0	6799

Source : CEDEX. 1990

- The access to land ownership is allowed to any natural or juridical person; also, the transfer of the agricultural property is freely permitted.

- An active participation of the national and foreign agricultural producers is propitiated in the matter of water use, in order to improve the irrigation systems and the use of underground water and sewage to enrich uncultivated lands for agricultural, livestock, forestal, and agrindustrial production.

- The agricultural activity is subject to the conditions of a social market economy.

- The participation of the water users in the administration, operation, improvement and maintenance of the irrigation infrastructure is ratified; their participation in the collection of the water tariff and the administration of these funds in the scope of their jurisdiction is ratified as well.

- It is established that the water tariff be paid per unit of its volume and at its real cost.

- The Authority of Waters is ratified in the administration of the water resource and the Autonomous Authorities of Hydrographical Basins are created as bodies in charge of planning and coordinating the rational use of the water resources. This body is chaired by the Technical Administrator of the Irrigation District and is composed of three delegates of the Board of Users, two representatives of the producers, one representative of the energy and mining sector, one representative of the Ministry of Transport, Housing and Building, the Executive Director of the most important project in the basin, and the Mayor of the largest densely populated province.

- The preferencial order for water uses with agricultural purposes is established as follows: direct consumption by livestock, irrigation of agricultural lands with the existing infrastructure, irrigation of lands with excess water using the existing irrigation infrastructure, soil improvement, enlargement of the agricultural area by means of irrigation.

The Ministry of Agriculture has pointed out various future guidelines to be followed by the sector of water resource management; these can be summarized as follows:

- Appointment and reinforcement of the authorities in charge of water and basin management who are responsible for the administration of the water with agricultural purposes; this in coordination with the Board of Users and the Commission of Water Users for Irrigation.

- Execution of actions in the following priority areas: improved use of irrigation water, recovery and maintenance of the irrigation and drainage infrastructure, recovery of degraded lands, use of underground water and treated sewage, investments in small and medium-sized irrigation works, elaboration of a policy for the environment protection in accordance with a sustained exploitation of our natural resources.

2.4 CONFLICTS IN THE ADMINISTRATION OF THE USE OF WATER

In the last years, legal provisions have been promulgated by the Governments to transfer, create, and eliminate the Institutions in charge of water resource administration, or to change the sector

structures through various Organic Laws; these have shown that, in spite of the efforts made to change and improve the present situation in order to attain an optimum efficiency in the use and management of water resources, it has not been achieved yet in a satisfactory way. This has generally resulted in conflicts related to water administration and use which are mentioned below:

- The low budget allotted to the Water Authority prevents it from having appropriate human resources with reasonably accepted wages for the functions to be accomplished, equipment, transportation costs, control and measurement of the water resource, infrastructure and materials for a better fulfillment of its functions.

- The permanent political-judicial interference in matters related to water resource administration, as well as the deactivation of the Technical Administrations in the Irrigation Districts, have weakened the Water Authority.

- Lack of basic updated information using computers in the inventory of resources, users' register, water use, distribution and waste of water, exploitation of underground water and their characteristics, areas under irrigation, and crops.

- Water users' ignorance of their rights and duties, as well as of the destination of the contributions they make through the water tariff which cause conflicts regarding the administration of water in the Irrigation Districts.

- Lack of a permanent training for the users of water for agricultural purposes that allows them to learn new irrigation and drainage techniques, and to make an optimum use and management of water, especially, at the plot level where the irrigation is less efficient.

- The irrigation systems are worn away and hydraulical structures are out of operation. The total average efficiency in the country is estimated approximately in 38% which means losses of above 4 thousands mcm/year, in a country where the Coast region has scarce water resources.

- Lack of control in the cultivation and irrigation plans that affects the water resource distribution and, in additio, the water larceny that is difficult to supervise because of the non implementation of the Commissions of Water Users for Irrigation and Technical Administrations in the Irrigation Districts.

- A low water tariff collection due to the long process of approval by the Government, and to the fact that its destination is not under the control of the water users which results in deficient collection administrations. Moreover, this tariff has a minimum referential value inadequate for the agricultural sector.

2.5 CONFLICT SOLUTION

The Decree-Law No 17752 "General Law of Waters" and the Legislative Decree No 653 "Law for the Promotion of Investments in the Agricultural Sector", that are presently in force, regulate the use of the water resource. These legal norms provide that the Technical Administrator of the Irrigation District has as one of his functions to solve, at a first administrative instance, claim matters resulting from the application of the water legislation; and the Autonomous Authority of the Hydrographical Basin has as a function to solve, at a second and last instance, the appeals made against the resolutions adopted by the Technical Administrator of the Irrigation District.

The zone that presents the greatest conflicts related to the water resource is the basin of the Rímac river which is the main source of water supply for the capital of Peru; furthermore, its waters are used to generate electric energy, and for industrial and mining purposes. Today, this basin administration is quite complex; that is the reason why some policies for the integral management of this basin are being developed and executed. This is the also case of the Mantaro river, especially, in the Lake Junín, which at present faces the problem of a high pollution because of mining tailings. The zones of Hospicio and La Yarada, situated in the South of the country, face the problem of shortage of the water resource which leads to an over exploitation of underground water and, as a result, its designation as a reserve area by the Government.

CHAPTER III

WATER IN THE PERUVIAN ECONOMY

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CHAPTER III

WATER IN THE PERUVIAN ECONOMY

3.0 INTRODUCTION

Water is essential for life. This fluid is taken from its sources, it is transported, it is treated and it is consumed. Such simple and clear concept establishes the link between the socioeconomical circumstances and the human being. Precisely, there are two fundamental requirements in the constant interelation between the human being and the water: the kind of water that can be used and the necessary quantities to satisfy both their biological and socio-economic needs.

In order to analyze the problems and conflicts that emerge due to the use of water resources, it is fundamental to know the **Demographical Aspects**, including the education, poverty levels and the basic services infrastructure for the population; then, to know the **Economic Aspects** where the economic sectors are identified and their importance in the economic evolution of the country is recognized. It is also necessary to analyze the importance of the **Water in the Economy** as an input for the different productive sectors or as a complementary element of the production. Likewise, in this study we determine both the importance of potable water, its use as an evacuation means for waste and pollutants and its economic importance for the transportation of people and load in the principal navigable rivers of the country. Finally, we also consider its importance as a recreational means.

3.1 SOCIAL ASPECTS

3.1.1 Total populations

According to the IX Population and IV Housing Census of July 11, 1993, Peru reached a total population of 22,639,443 inhabitants. It includes the censed, ommitted, and estimated populations of the native communities in the Peruvian Amazon.

With regards to the number of inhabitants in the Americas, Peru holds the seventh place, being the United States of America in the first place.

At the Latin American level, Peru holds the fifth place after Brazil, Mexico, Colombia, and Argentina.

In relation to South American countries, Peru holds the fourth place while it holds the second place in relation to the Andean Pact. See Table No. 3.1

In the 1981-1993 period, Peru's total population increased in 4,877,212 inhabitants reaching an annual average growth rate of 2.0%. Such rate confirms the decreasing trend of the population growth velocity and is basically justified by the decrease of the fecundity levels and the growth in the difusion of the contraceptive methods. See Table No. 3.2

TABLE 3.1

LATIN AMERICA: CENSED POPULATION BY COUNTRIES

COUNTRIES	TOTAL	DATE OF CENSUS
BRASIL	146154502	09/01/1991
MEXICO	81249645	06/12/1990
COLOMBIA 1/	33987000	data not available
ARGENTINA	32615528	05/15/1991
PERU	22048356*	07/11/1993
VENEZUELA	18105265	10/21/1990
CHILE	13231803	04/22/1992
ECUADOR	9648189	11/25/1990
BOLIVIA	6420792	06/03/1992
PARAGUAY	4123550	08/26/1992
PANAMA	2339329	05/13/1990

1/ Estimate
* Nominally censed population

SOURCE: CELADE - INEI

TABLE 3.2

PERU: DISTRIBUTION AND GROWTH RATE OF THE TOTAL POPULATION BY DEPARTMENTS (1981-1983)

DEPARTMENT	POPULATION				GROWTH RATE	
	1981	%	1993	%	1972-1981	1981-1993
TOTAL	17762231	100.0	22639443	100,0	2,6	2,0
AMAZONAS 1/	268121	1.5	354171	1.6	2.6	2.3
ANCASH 1/	862380	4.9	983546	4.3	1.4	1.1
APURIMAC	342964	1.9	396098	1.7	0.7	1.2
AREQUIPA	738482	4.2	939062	4.1	3.1	2.0
AYACUCHO	523821	3.0	512438	2.3	1.0	-0.2
CAJAMARCA 1/	1063474	6.0	1297835	5.7	1.4	1.7
CALLAO	454313	2.6	647565	2.9	3.5	3.0
CUSCO	874463	4.9	1066495	4.7	1.7	1.7
HUANCAVELICA	361548	2.0	400376	1.8	0.5	0.9
HUANUCO 1/	498532	2.8	678041	3.0	1.7	2.6
ICA	446902	2.5	578766	2.6	2.0	2.2
JUNIN	896962	5.0	1092993	4.8	2.4	1.7
LA LIBERTAD	1011631	5.7	1287383	5.7	2.3	2.0
LAMBAYEQUE	708820	4.0	950842	4.2	3.2	2.5
LIMA	4993032	8.1	6478957	28.6	3.7	2.2
LORETO 1/	516371	2.9	736161	3.2	2.6	3.0
MADRE DE DIOS	35788	0.2	69854	0.3	3.9	5.7
MOQUEGUA	103283	0.6	130192	0.6	3.1	1.9
PASCO 1/	229701	1.3	239191	1.1	2.5	0.3
PIURA	1155682	6.5	1409262	6.2	2.9	1.7
PUNO	910377	5.1	1103689	4.9	1.2	1.6
SAN MARTIN	331692	1.9	572352	2.5	3.9	4.7
TACNA	147693	0.8	223768	1.0	4.4	3.5
TUMBES	108064	0.6	158582	0.7	3.5	3.2
UCAYALI 1/	178135	1.0	331824	1.5	3.5	5.3
METROPOLITAN LIMA	4835793	27.2	6434323	28.4	3.9	2.4

1/ Reorganized according to the Political Administrative Division of 1993

SOURCE: National censuses of 1940, 1961, 1972, 1981 and 1993-inei

NOTE: The total population includes The censed, omitted and estimated population of native communities.

3.1.1.1 Urban and rural population

In the 1940-1993 period, the annual growth of inhabitants and the annual growth rate were as follows:

Period	Intercensus Increase (People) (*)		Annual growth Rate (%)	
	URBAN	RURAL	URBAN	RURAL
1940-61	2'501,045	1'197,734	3,7	1,2
1961-72	3'360,317	271,145	5,1	0,5
1972-81	3'033,428	433,574	3,6	0,8
1981-93	4'366,676	676,470	2,8	0,9

(*) Nominally censed population

According to the Census of 1993, the nominally censed urban population of Peru was 15,458,599 inhabitants, representing 70.1% of the total population. The nominally censed rural population was 6,589,757 people, reaching 29.9% of the total population.

In the intercensus period of 1981-1993, the urban population increased by 39.4% while the rural population increased by 11.4%

The annual average growth rate was 2.8% and 0.9% for the urban and rural population, respectively.

3.1.1.2 Population by departments

The 1979 Constitution created the politic division of Peru by regions. According to the 1993 Constitution, Peru is politically divided into regions, but these will be created by population agreement. In the meantime, departments remain.

Table No. 3.2 shows that the eight most important departments as for their population volumes are: Lima, Piura, Cajamarca, La Libertad, Puno, Junin, Cusco, and Ancash.

3.1.1.3 Population growth by departments

Taking into account as a reference the annual mean rate of growth at a national level which is 2.0%, there are eleven departments and the Constitutional Province of Callao which are above the national mean rate, being Madre de Dios the department that reached the maximum annual growth rate with 5.7%

Table No. 3.2 shows the growth rate by departments. Ayacucho is the department which shows a negative growth rate of -0.2%

3.1.1.4 Urban and rural population by departments

At a national level, the population is composed by an urban population that comprises 70.1% of the total population and by a rural population that comprises 29.9% of the country's population. See Table No. 3.3

The population at a department level is distributed as follows:

a. In sixteen departments and the Constitutional Province of Callao, the population is mainly urban. This group is headed by the Constitutional Province of Callao with 99.9%; the department of Lima is next with 96.8%, and the two last places are held by the departments of Ancash and Madre de Dios with 57.4% each.

b. In eight departments, most of their population live in rural areas. The first place of this group is held by Cajamarca with 75.3% of rural population; Huancavelica is next with 73.9% and, last of all, Ayacucho with 51.9%.

3.1.1.5 Population density

The population density is an indicator that permits to observe the relation between the number of inhabitants and the territorial area of a region, country, or continent.

According to the Census of 1993, there are 17.9 inhabitants per km^2 in Peru. This figure puts Peru below not only the Latin American average which is 22 inhabitants per km_2, but also the world average which is 39 inhabitants per km^2. However, it is higher than the average in North America which is 13 inhabitants per km^2 and Oceania which is 3 inhabitants per km^2.

At a department level, Peru has a well differentiated population density. The Constitutional Province of Callao shows the highest population density with 4,405.8 inhab/km^2. Metropolitan Lima is the second most densely inhabited city with 2,288.5 inhab/km^2. The departments in the Jungle (Ucayali, Loreto, and Madre de Dios) have the lowest population density in the country. See Table No. 3.4

3.1.1.6 Composition of the population by sex and age

According to the Census of 1993, the female population is 11,091,981, i.e. 50.3% of the total population. The male population is 10,956,375, i.e. 49.7% of the total population. This indicates that in Peru there are more women than men. See Table 3.5

In the intercensus period of 1981-1993, the male population increased in 29.1%, and the female population in 30.3%.

TABLE 3.3

PERU: URBAN AND RURAL CENSED POPULATION BY DEPARTAMENTS: 1981 - 1993

DEPARTAMENT	U R B A N				R U R A L			
	1981		1993		1981		1993	
	ABSOLUTE	%	ABSOLUTE	%	ABSOLUTE	%	ABSOLUTE	%
TOTAL	11091923	65,2	15458599	70,1	5913287	34,8	6589757	29,9
AMAZONAS	81973	32,2	119517	35,5	172587	67,8	217148	64,5
ANCASH 1/	439597	53,2	548028	57,4	386802	46,8	406995	42,6
APURIMAC	83422	25,8	133949	35,1	239924	74,2	248048	64,9
AREQUIPA	583927	82,6	785858	85,7	122653	17,4	130948	14,3
AYACUCHO	183688	36,5	236774	48,1	319704	63,5	255733	51,9
CAJAMARCA 1/	211170	20,6	311135	24,7	815274	79,4	948673	75,3
CALLAO	440446	99,3	639232	99,9	2967	0,8	497	0,1
CUSCO	348396	41,8	471725	45,9	484108	8,2	557038	54,1
HUANCAVELICA	85775	24,7	100439	26,1	261022	75,3	284723	73,9
HUANUCO 1/	148427	31,1	252778	38,6	329450	68,9	401711	61,4
ICA	341619	78,7	472232	83,5	92278	21,3	93454	16,5
JUNIN	510662	59,9	678251	65,5	341576	40,1	357590	34,5
LA LIBERTAD	631529	64,3	870390	68,5	350545	35,7	399871	31,5
LAMBAYEQUE	518631	76,9	709608	77,1	155811	23,1	211187	22,9
LIMA	4542911	95,7	6178820	96,8	202966	4,3	207488	3,2
LORETO 1/	255290	52,9	398422	58,0	227539	47,1	288860	42,0
MADRE DE DIOS	15960	48,4	38433	57,4	17047	51,6	28575	42,6
MOQUEGUA	78391	77,1	106601	82,8	23219	22,9	22146	17,2
PASCO 1/	121802	57,5	133383	58,9	90116	42,5	92912	41,1
PIURA	697191	61,9	976798	70,4	428674	38,1	411466	29,6
PUNO	283222	31,8	423253	39,2	607036	68,2	656596	60,8
SAN MARTIN	181210	56,7	335942	60,8	138541	43,3	216445	39,2
TACNA	122187	85,4	195949	89,7	20898	14,6	22404	10,3
TUMBES	81837	78,8	136287	87,6	22002	21,2	19234	12,4
UCAYALI 1/	102660	62,9	204795	65,1	60548	37,1	110015	34,9

1/ Reorganized according to the Administrative Political Division of 1993

SOURCE: INEI - National census of 1981 and 1993

TABLE 3.4

PERU: AREA AND DENSITY, BY DEPARTMENTS: 1981 and 1993

DEPARTAMENT	AREA		NATIONAL DENSITY Inhabitants per/km2	
	Km2	%	1981	1993
TOTAL	1285215,60	100,0	13,8	17,9
AMAZONAS	39249,13	3,0	6,8	9,0
ANCASH	35825,57	2,8	24,1	27,5
APURIMAC	20895,79	1,6	16,4	19,0
AREQUIPA	63345,39	4,9	11,7	14,8
AYACUCHO	43814,80	3,4	12,0	11,7
CAJAMARCA	33247,77	2,6	32,0	39,0
CALLAO	146,98	0,0	3091,0	4405,8
CUSCO	71891,97	5,6	12,2	14,8
HUANCAVELICA	21131,47	1,7	16,3	18,1
HUANUCO	36938,09	2,9	13,5	18,4
ICA	21337,83	1,7	21,0	27,1
JUNIN	44409,67	3,5	20,2	24,6
LA LIBERTAD	25569,67	2,0	39,6	50,3
LAMBAYEQUE	14231,30	1,1	49,8	66,8
LIMA	34801,59	2,7	143,5	186,2
LORETO	368851,95	28,7	1,4	2,0
MADRE DE DIOS	85182,63	6,6	0,4	0,8
MOQUEGUA	15733,97	1,2	6,6	8,3
PASCO	25319,59	2,0	9,1	9,4
PIURA	35892,49	2,8	32,2	39,3
PUNO	71999,00	5,6	12,6	15,3
SAN MARTIN	51253,31	4,0	6,5	11,2
TACNA	16075,89	1,2	9,2	13,9
TUMBES	4669,20	0,4	23,1	34,0
UCAYALI	102410,55	8,0	1,7	3,2
METROPOLITAN LIMA	2811,65	0,2	1719,9	2288,5

SOURCE: INEI - National census of 1981 and 1993

TABLE 3.5

PERU: CENSED POPULATION BY SEX AND MASCULINE INDEX, ACCORDING TO QUINQUENNIAL AGES: 1981 AND 1993

AGE GROUPS	POPULATION							
	TOTAL		MEN		WOMEN		MASCULINE INDEX	
	1981	1993	1981	1993	1981	1993	1981	1993
TOTAL	17005210	22048356	8489867	10956375	8515343	11091981	99,7	98,9
0 - 4	2434329	2739753	1229643	1389810	1204686	1349943	102,1	103,0
5 - 9	2402258	2762653	1211659	1399805	1190599	1362848	101,8	102,7
10 - 14	2176029	2652970	1107837	1349591	1068192	1303379	103,7	103,5
15 - 19	1864691	2374171	932930	1186260	931761	1187911	100,1	99,9
20 - 24	1601575	2124128	789840	1035917	811735	1088211	97,3	95,2
25 - 29	1277594	1797972	623765	871903	653829	926069	95,4	94,2
30 - 34	1020448	1548955	509305	760900	511143	788055	99,6	96,6
35 - 39	883976	1293769	430495	622891	453481	670878	94,9	92,8
40 - 44	739950	1057031	373411	525469	366539	531562	101,9	98,9
45 - 49	643422	862423	319344	424731	324078	437692	98,5	97,0
50 - 54	532482	717182	267970	358182	264512	359000	101,3	99,8
55 - 59	399526	573662	202193	285499	197333	288163	102,5	99,1
60 - 64	336250	517568	166096	258258	170154	259310	97,6	99,6
65& MORE	692680	1026119	325379	487159	367301	538960	88,6	90,4

SOURCE: INEI - National census of 1981 and 1993

The Pyramid by age for Census 1993 shows a relative reduction in the minor ages and a slight increase in the intermediate ages, i.e. the mean age of the population increased from 19 to 22 years during such intercensus period. This shows the index of an aging process of the population.

3.1.2 Education level

The Census of 1993 reports 7,648,632 people of 15 years of age and older that finished the primary education and have continued studying. In 1981, the percentage was 41.6% while in 1993 is 55.9%.

With regards to the college education level, 20.4% of the population has reached such level. This percentage has doubled, compared to 1981 which was 10.2%. The percentage of men with superior education is higher (21.6%) than that of women (19.3%).

In the urban area, the population with high school and college education is higher than in the rural area, as shown in the following Table for a population of 15 years of age and older.

LEVEL OF INSTRUCTION	URBAN	RURAL	TOTAL	%
WITHOUT ANY LEVEL	640,734	1,036,972	1,677,706	12,3
NURSERY OR KINDER	34,672	13,742	48,414	0,3
PRIMARY	2,508,831	1,795,099	4,303,930	31,5
SECONDARY	4,196,671	658,626	4,855,297	35,5
SUPERIOR	2,686,292	107,043	2,793,335	20,4
TOTAL	10,067,200	3,611,482	13,678,682	100

Illiteracy

Every person older than 15 years of age who does not read or write is considered an illiterate.

According to the Census of 1993, there are 1,784,281 illiterates in the country. This results is below by 15,177 illiterate people in relation to 1981, i.e. 0.8%. This reduction of illiteracy is more notorious in the rural area. On the other hand, the illiteracy grew in the urban area by 135,859 people during the 1981-1993 period. Table No. 3.6 shows the illiterate population by departments.

TABLE 3.6

PERU: ILLITERATE POPULATION FROM 15 TO MORE YEARS OF AGE AND ILLITERACY RATE, BY SEX, BY DEPARTMENTS : 1993

DEPARTAMENT	ILLITERATE			ILLITERACY RATE		
	TOTAL	MEN	WOMEN	TOTAL	MEN	WOMEN
TOTAL 1/	1784281	487113	1297168	12,8	7,1	18,3
AMAZONAS	36977	10508	26469	19,9	11,0	29,4
ANCASH	123837	33557	90280	21,1	11,8	29,8
APURIMAC	77776	22037	55739	36,9	21,5	51,5
AREQUIPA	46879	10662	36217	7,6	3,5	11,6
AYACUCHO	92887	24138	68749	32,7	18,0	45,8
CAJAMARCA	193735	52009	141726	27,2	14,9	39,0
CALLAO	13561	3505	10056	3,0	1,6	4,4
CUSCO	154424	43209	111215	25,4	14,3	36,4
HUANCAVELICA	71162	18345	52817	34,1	18,7	47,7
HUANUCO	89927	26035	63892	24,7	14,5	34,6
ICA	21156	6160	14996	5,8	3,4	8,0
JUNIN	82708	18987	63721	13,4	6,3	20,2
LA LIBERTAD	104539	27812	76727	13,0	7,2	18,4
LAMBAYEQUE	63865	19654	44211	11,0	7,1	14,6
LIMA	184354	41775	142579	4,1	1,9	6,2
LORETO	40349	13627	26722	10,8	7,0	14,9
MADRE DE DIOS	3245	1157	2088	8,0	4,8	12,9
MOQUEGUA	7693	1921	5772	8,8	4,2	13,9
PASCO	20053	5174	14879	15,2	7,8	22,8
PIURA	135170	46310	88860	16,3	11,3	21,2
PUNO	145101	34707	110394	22,2	10,9	32,9
SAN MARTIN	40603	13510	27093	12,5	7,6	18,5
TACNA	10836	2916	7920	7,4	3,9	11,2
TUMBES	6452	2870	3582	6,6	5,5	8,0
UCAYALI	16992	6528	10464	9,6	6,9	12,6
METROPOLITAN LIMA	161988	36670	125318	3,6	1,7	5,4

1/ It does not include people who did not declare if they knew how to write and read.

SOURCE: INEI - National census of 1981 and 1993

3.1.3 Gainfully Employed Population (GEP)

According to Table No. 3.7, the GEP in Peru is of 7,109,527 people and represents 51.2% of the total population of working age, which is 15 or older.

The Non-Gainfully Employed Population (Non-GEP) reaches 6,783,453 people, i.e. 48.8%

TABLE 3.7

PERU: POPULATION OF 15 OR MORE YEARS OF AGE PER URBAN AND RURAL AREAS ACCORDING TO THEIR OCCUPATION: 1981 AND 1993

OCCUPATION	1981 a/				1993			
	URBAN		RURAL		URBAN		RURAL	
	ABSOLUTE	%	ABSOLUTE	%	ABSOLUTE	%	ABSOLUTE	%
TOTAL	6,756,303	100.0	3,167,114	100.0	10,202,367	100 0	3'690,613	100.0
GEP	3,452,073	51 1	1,737,587	54 9	5,237,240	51 3	1'872,287	50 7
NON-GEP	3,304,230	48.9	1,429,527	45.1	4,965,127	48.7	1'818,326	49 3
GEP	3,452,073	100 0	1,737,587	100 0	5,237,240	100.0	1'872,287	100 0
EMPLOYED	3,225,858	93.4	1,690,020	97.3	4,793,080	91.5	1'810,680	96 7
UNEMPLOYED	226,215	6 6	47,567	2 7	444,160	8 5	61,607	3.3
NON-GEP POPULATION	3,304,230	100.0	1,429,527	100.0	4,965,127	100.0	1'818,326	100.0
HOUSEHOLDERS	1,879,304	56 9	1,149,283	80 4	2,896,050	58 3	1'394,842	76.7
STUDENTS	1,233,124	37.3	212,878	14.9	1,372,101	27.6	262,460	14.4
RETIRED	90,241	2 7	6,290	0 4	296,110	6.0	16,306	0.9
BONDHOLDERS	6,199	0 2	769	0 1	61,261	1 2	21,812	1.2
OTHERS	95,362	2.9	60,307	4.2	339,605	6.9	122,906	6.8

a/ It does not include people who did not specify their occupation.

SOURCE: INEI - National census of 1981 and 1993

During the 1981-1993 intercensus period, the unemployment rate has increased both in the urban and in the rural areas. In the urban area, it grew from 6.6% in 1981 to 8.5% in 1993. In the rural area, it grew from 2.7% to 3.3%. Table No. 3.8 shows the GEP by activity sector.

TABLE 3.8

PERU: DISTRIBUTION OF THE GAINFULLY OCCUPIED POPULATION OF 15 OR MORE YEARS OF AGE BY SEX, ACCORDING TO THEIR OCCUPATION: 1993

ACTIVITY SECTOR	GEP		SEX			
			MEN		WOMEN	
	ABSOLUTE	%	ABSOLUTE	%	ABSOLUTE	%
TOTAL a/	5913509	100.0	4276915	100.0	1636594	100.0
PRIMARIO 1/	1951385	33.0	1696882	39.7	254503	15.5
SECUNDARY 2/	969579	16.4	755793	17.7	213786	13.1
TERCIARIO 3/	2992545	50.6	1824240	42.6	1168305	71.4

a/ It does not include those who did not specify their occupation.
1/ PRIMARY SECTOR: Agriculture, Farm and Livestock, Hunting, Fishing, Forestry, and Mining.
2/ SECONDARY SECTOR: Building and Manufacturing Industry.
3/ TERTIARY SECTOR: Commerce and Services.
SOURCE: INEI - National census of 1981 and 1983

At the department level, the GEP at the Primary Sector is mainly located in Huancavelica with 77.9%, Amazonas with 74.6%, Cajamarca with 71.5%, and Apurimac with 70.0%.

In the Secondary Sector, the largest rate of GEP is located in the Constitutional Province of Callao (25.2%), Lima (22.8%), Lambayeque and Moquegua (18.3%) each, La Libertad (17.8%), Arequipa (17.6%), Ica (16.8%), and Ancash (15.1%).

In the Tertiary Sector, the largest proportion of GEP is located in the Constitutional Province of Callao (71.2%), Lima (71.1%), Tacna (64.7%), Arequipa (58.4%), Ica (54.1%), Lambayeque (52.9%), and Tumbes (50.9%).

3.1.4 Housing

According to the Census of 1993, in Peru there are 5,099,592 dwelling units. This figure related to that of 1981 shows that the number of households has been growing in Peru each year in 121 thousand dwelling units, i.e. an average rate of 2.8%, a higher figure than the population growth rate (2.0%). In the intercensus period, the number of households increased in 1,455,000 units. Table No. 3.9 shows the type of dwelling, quantity, and occupational status.

TABLE 3.9
TYPE OF DWELLING, QUANTITY AND LOCATION

TYPE OF DWELLING	FAMILY DWELLING		OCCUPIED (%)		NON-OCCUPIED(%)	
	1981	1993	1981	1993	1981	1993
INDEPENDENT HOUSE	3,216,230	4,255,277	99.3	96.2	0.7	3.8
BUILDING APT.	149,706	212,731	98.4	92,4	1.6	7.6
HOUSE IN MANOR	93,057	70,720	99.2	92,8	0.8	7.2
HOUSE IN ALLEY	142,598	153,945	99.1	96.0	0.9	4.0
MAKESHIFT HOUSE	28,667	179,264	99.6	98.0	0.4	2.0
SHANTY OR HUT (*)	------	195,777	---	97.5	----	2.5
OTHER TYPE	14,343	31,878	100.0	100	----	---
T O T A L	3,644,601	5,099,592	99.2	96.2	0.8	3.8

(*) In 1981 it was considered as an independent house.

3.1.5 Standard of living

The survey about standard of living (ENNIV-91) carried out in November 1991 by Cuánto Inc. had the following results:

In the rural highland, the percentage of population in severe poverty is of 68% while in the urban highland it reaches 47% of the population, and in the urban coast it reaches 55%.

In Metropolitan Lima, the population in severe poverty represented 49% of the population.

3.2 ECONOMIC ASPECTS

3.2.1 Historical evolution

3.2.1.1 Overview

The economic evolution in Peru shows that until 1968, the private enterprise was generating entity of all the productive activity; the national productivity presented normal growth rhythms without problems of high inflation or external indebtedness and, on the contrary, with a favorable trade balance.

The most dynamic economic sectors were fishery, mining, manufacturing, and agriculture.

In the 1969-1980 period, during the Military Government, the State assumed the role of entrepeneur in the country's economy, establishing companies in some sectors of the economy, such as: mining, fishery, telecommunications, and trade, especially mining, fishing, and agriculture products and inputs for the farming and livestock production.

The manufacturing sector was protected against the free importation of consumer goods, according to the pattern of imports substitution.

The global production presents a growth stage (1969-74) and a crisis stage (1975-1980) and it is in this second period when the national production drops in almost all its sectors and, at the same time, the problem of high inflation starts.

In the 1980-1990 period, the State companies keep up their presence in the national economy without suffering substantial changes up to the end of the decade.

In the 1980-1989 period, the global production of the country shows growth and productive recession periods.

In the 1980-1981 period, the GDP keeps its percentage variations, which were 5.4% and 5.3%, respectively.

In 1982-1983, the GDP decreases; in 1983, this decrease is -13.2% and the per capita GDP decreases -15.1%. This reduction is explained by the climatic effects of the El Niño phenomenon that reduced the agricultural and fishing production. The manufacturing production diminished as well by effect of the economic policy of imports liberation that affected mainly the textile industry.

In the 1984-1987 period, the GDP recovers reaching the highest production levels, being 1986-1987 the most productive years when the GDP grew in 10.8% and 10.4%, respectively.

Since 1988, the economy enters a recession in which all the sectors reduce their production.

As Table 3.10 shows, the GDP diminished -8.1% in 1988, -12.4% in 1989, -4.9% in 1990, and -2.3% in 1992. Only in 1991, the GNP grew in 2.6% and the GDP per capita grew in 0.7%.

TABLE 3.10

GROSS DOMESTIC PRODUCT 1980 - 1992
(Prices prevailing year 1986)

YEAR	Gross Domestic Product		Per capita Gross Domestic Product		Variation % GDP	
	(N.Soles)	(Mill. $)	(Intis) 1/	(Dollars)	Total	Percapita
1980	346,871	22,906	20,056	1,324	5.4	2.8
1985	337,420	22,282	17,377	1,148	1.7	- 0.5
1986	373,976	24,696	18,847	1,245	10.8	8.5
1988	379,542	25,064	18,412	1,216	- 8.1	- 9.9
1989	332,635	21,966	15,747	1,040	-12.4	-14.1
1990	316,388	20,893	14,681	970	- 4.9	- 6.8
1991 *	325,192	21,475	14,777	976	2.8	0.7
1992**	316,087	20,873	14,070	929	- 2.8	4.8

(*) Preliminary
(**) Estimated
1/ One Nuevo Sol = One Million Intis

Note: The exchange rate used to value the GDP in dollars prevailing is that of 1986 (1 dollar = 15.143 intis)
Source: National Institute of Statistics and Systems (INEI) - National Direction of National Accounts.

The recession that affected the national production during the 1982-1992 period had as a main reason the accumulative effect of bad management of the economy in the 1969-1987 period. As a consequence, there is a high cost of banking credit, i.e. a very high real interest rate and very low salaries.

The drop of the manufacturing production and the low salaries have conditioned the growth of the informal trade, especially that of imported products in the main cities of the country.

With regard to inflation, it started to rise in 1988 becoming soon an hyperinflation. In 1990, inflation rose up to 7,694.78%. In 1991, it started to decline as a result of the application of a stabilization and structural adjustment program and by the end of 1993, it was of 39.5%

Regarding the Minimum Salaries, the decade of the 1980s showed a constant loss of its real value mainly due to the inflationary process that Peru suffered. During that decade, the State played an important role in the determination of the salary levels in the country.

The Agrarian Reform applied by the Government in the 1970s finished the operation of farms by the big private companies that existed in agriculture, transforming them into cooperatives and communities.

The administrative control of the large cooperatives, located mainly on the Coast, was given to people without executive capacity, transforming them into inefficient centers where the main benefits favored often a minority of members. In the highland, with the application of such a reform, the small holdings were emphasized.

By the end of 1980, the country's external debt was 12,000 million dollars. In 1968, it was only 500 million dollars.

The government that began in 1980 did not correct the economic deficiencies of the former regime, especially in the agrarian aspect and the problem of inefficiency of the public companies.

In 1985, a new government is elected which aggravated the economic problems inherited from the former decade; the policy of subsidies is extended, the credit for the agriculture was a disaster, the country was isolated from the international credit because of delinquency in the payment of the debt (at the end of 1990, the external debt exceeded $20,000 million dollars) bringing about a disaster in the fiscal policy; the inflation turned uncontrollable as a result of the inorganic emission. The State's duty in the maintenance of the infrastructure of the basic services (transportation, health, education, power supply, etc.) was disregarded causing its deterioration.

The government which took office in 1990 found the country in an economic ruin and with two serious problems in the social aspect: the terrorist violence and the narcotrafficking.

The economic crisis of the country had, as a base the inefficiency of the basic economic sectors, an agriculture with low yields, a manufacturing sector in constant depression and a financial sector with high costs of capital.

The current government has implemented an economic stabilization and restructuring program for the country, releasing the international trade and the internal trade from all distortion, correcting the tax system, turning public companies into private ones and eliminating the monopoly that the State held in some sectors of the economy. The exchange rate has been stabilized, all kinds of subsidies have been eliminated, the inorganic emission has been totally reduced, and the net reserves show positive balances.

Similarly, the agrarian sector has been opened to the private investment in the new lands habilitated by the irrigation projects, without affecting the property of the lands obtained as a result of the Agrarian Reform applied in the 1970 decade.

Peru is progessively inserting into the international financial community after the former government isolated the country financially.

The terrorist violence has diminished after 1992. During its 12 years of activity, it has left a balance of 20,000 victims and losses for $20,000 million dollars. The narcotrafficking and smuggling problems are diminishing.

In April 1992, the government closed the Congress and called for elections in December of the same year, causing delays in the international community's economic assistance program. Finally, a new Constitution was enacted in December 1993.

3.2.1.2 Productive Sectors of the Economy

a. FISHING SECTOR

The Peruvian sea has a lot of hydrobiological resources because some factors converge in it as: the coldness of its water and the abundance of phytoplankton and zooplankton.

Fishery in Peru is an economic activity that has different development levels and that ranges from handicraft fishing to industrial fishing, including deep sea fishing or trawling fishing which is totally plundering.

Before 1960, the fishing activity had a handicraft structure. Fishing was done to supply human consumption and to produce canned fish.

In 1960, fishing in the Peruvian sea had an astonishing development, due to the increasing demand of fish meal in the international market. This fish meal is a basic ingredient in the elaboration of concentrated food for cattle, pigs, and fowl.

The big demand of fish meal by developed countries promoted the organization of fishing business activities and the capture of the anchovy and the sardine for the manufacture of fish meal and oil.

Between 1962 and 1972, Peru reached the first place among fishing countries in the world and also the first producer of fish meal and oil.

In 1970, Peru was the first fishing country in the world because the total fishing exceeded 12 million tons.

After 1970, extractive fishing started to diminish with a lightning speed. For example, in 1975, only 3,407,000 tons and, in 1980, only 2,697,120 tons were extracted from the sea.

From 1981 on, the extractive fishing began to recover, reaching 4,110,386 tons in 1985 and 6,841,796 tons in 1990. For 1991, preliminary figures indicate a fishing volume of 6,635,594 tons.

In 1980, the fishing sector contributed with 0.4% of the total GNP and, in 1985, rose to 0.7%. In 1989, it reached the maximum contribution of the decade with 1.14%. The preliminary figures of the years 1990, 1991, and 1992 give a 1.2%, 1.03%, and 1.0%, respectively.

Some factors that contributed to the fishing declination were:

- The monopolist nationalization of the extractive fishing, of the industrialization, and of its commercialization, creating many bureaucratic enterprises that failed due to management deficiency.

- The plundering of the ichthyologic resources, as a consequence of an irrational exploitation.

- The occasional weather alterations, such as the rise of the temperature of the marine waters under the influence of El Niño current, which produced the migration of cold water fish to the South.

- The reduction of the international market for fish meal and canned tuna.

b. MANUFACTURING SECTOR

In the 1970-1975 period, the manufacturing industries grew 5.1% in relation to the former period. This development was produced using a State policy based on an economic pattern of imports substitution which prohibited the importation of some foreign manufacture products.

In the 1975-1980 period, the situation of the manufacturing industry started to deteriorate; the growth rate reached only 1.5% in relation to the former period.

In the 1980-1985 period, the industrial production evidently dropped reaching -2.1% of growth. Such drop was due to an economic policy based on free importation of consumer goods.

In the 1985-1990 period, two phases are observed: a first phase with a slight growth of the manufacturing industry (1986-1987). In 1986, the production grew in 18.1% with respect to 1985. The second phase (1988-1990), when the situation of the manufacturing industry was chaotic, shows that the production in 1989 dropped 18.8% in relation to 1988. This situation continued worsening until 1990.

In 1991, the production rose 6.4% with respect to the previous year, but in 1992 the production decreased 6.1%.

In 1993, according to the National Society of Industries, the manufacturing sector was in a critical situation because 50% of the enterprises were working below their installed capacity, being the electric appliances area the most affected with 0.6% of its installed capacity.

The critical situation of the manufacturing sector is explained by the policy of free importation of consumer goods and the disloyal competition of border smuggling. These two elements have reduced the participation of the national industry in the domestic market and its costs are also high in comparison with the costs of foreign products.

c. FARMING AND LIVESTOCK SECTOR

The ancient Peruvians dominated the untilled lands of the Coast and the wild interandean hillsides in which they cultivated cotton, corn, potatoes, sweet peas, peanuts, quinoa, sweet potatoes, yucca, pumpkins, squash, Indian fig, medlar, rose apples, sapodilla, eggfruit, etc. The the Pre-Incas and Incas' mastering of hydraulic engineering of rivers as an instrument of irrigation agriculture is evident.

According to chronicles of that time, the Peruvian Coast was irrigated and cultivated between 700,000 and 1,200,000 ha in the Incan Empire. During the Colony, the agriculture activity in the Coast diminished when it lost its management unit and its collective form. This fact, together with the mercantile policy impossed in such centuries, only looked for the production of precious metals. The consequence of such policy was the diminishing of the cultivated area in the coast to 300,000 ha. In the Republican period, there was indifference for the agriculture, the stimulus of the price in the external market of products such as cotton and sugar cane improved the agriculture in the Coast.

In 1920, the first irrigation, "The Imperial", was built in the valley of Cañete and Lima. This was the beginning of great irrigation projects and the modernization of the agriculture in the Coast.

In the 1900-1988 period, the execution of irrigation projects allowed the incorporation of 210,510 ha and the improvement of 370,159 ha. The Coast concentrated 60% of the benefited areas.

With regards to the operation and maintenance of the irrigation systems, the State has not assigned enough economic resources for its operation in these two last decades. This has originated a deterioration in the infrastructure of the irrigation systems, mainly in the Coast.

In 1989, the State transferred the administration of the irrigation systems to the Board of Users of each valley. In this way, the irrigation user would directly finance the operation and maintenance of the irrigation systems.

In 1991, by means of Decree Law No. 653 ("Law of Promotion of Investments in the Agrarian Sector"), the State established fundamental changes in the handling and management of water resources and, in turn, permitted that any individual or legal person could have access to land property. This will allow the agrarian sector to have a more dynamic economy in benefit of the national development.

The National Institute of Development (INADE), in accordance with its 1994-1996 program, is developing research and executing 20 irrigation projects of major importance at the national level. 10 of such projects are in the Coast, 7 in the Jungle, and 3 in the Highlands.

The National Institute of Natural Resources (INRENA), in accordance with its 1993-1994 program, is developing research of irrigation projects of small and medium magnitude, and, in turn, is generating new research upon request of future beneficiaries.

d. MINING SECTOR

Mining is one of the most important productive activities in the economic history of the country.

The metallic mining activity in the ancient Peru began 2,000 years B.C. with formative cultures as Chavin, Paracas, and Chimu, which were qualified as the best metallurgic cultures of the Pre-Incan period. When the Incas conquered the Chimu Kingdom, many of the expert metalworkers and goldsmiths were taken to Cuzco with the purpose of teaching their marvellous art to the Empire's artisans.

In the Inca period, the minerals (especially gold, silver, and copper) were obtained from the exploitation in the superficial veins existing in the mountain sides. Gold was also obtained from the placers alongside the rivers.

In the Inca Empire, gold and silver did not play any mercantilist role. Coins did not exist either, so they did not mean wealthy and economic power. Bronze was especially used in the confection of arms. Gold and silver only had a luxury purpose of ornament and decoration in temples and palaces, in the confection of idols and of dresses and attires.

During the Spanish Colonial period (1543-1821), the principal economic activity was mining.

For Spaniards, the precious metals meant money. Due to this reason, search and exploitation of the gold and silver mines constituted the principal mining activity. Quicksilver mines were also exploited; they were used to benefit silver. At the end of the XVIII Century, about 800 silver and 70 gold mines existed in the Peruvian Viceroyalty.

The huge quantities of gold and silver extracted from the mines were transformed into coins and sent to Spain, forming the solid base of its economy.

With the beginning of the Republic (1821), Peru achieved a great mining boom. In the present century, and particularly after the Second World War, the mining sector has attracted the greatest investments, both national and foreign.

In 1979, the mining production reached its highest annual growth rate with 10.3% in relation to the previous year. In the decade of the 80s, mining lost its growth rhythm with respect to the former decade, being 1988 the year with the lowest production.

In 1980, the mining extraction contributed to the GNP with 3.7% while in 1985 the contribution almost did not change. But from 1986 on, its contribution began to decline reaching only 2.8% of the total GNP in 1990. (Source: INEI).

In 1991 and 1992, the mining extraction kept its diminishing tendency. In spite of such decrease, mining is still the main foreign currency source in Peru. Table No. 3.11 shows the production of mining products during 1985-1992.

TABLE 3.11

PRODUCTION OF PRINCIPAL MINING PRODUCTS 1985 - 1992
(THOUSANDS)

TYPE	1985	1986	1987	1988	1989	1991	1992*
COPPER (fmt)	401.3	399.3	406.3	316.3	368.3	323.5	369.4
LEAD (fmt)	216.2	201.9	204.0	161.2	203.3	209.7	194.2
ZINC (fmt)	612.9	604.0	619.3	498.5	620.9	598.2	602.6
SILVER (kl)	2010.7	2005.9	2001.0	1650.5	1932.2	1927.5	1572.7
IRON (flt)	3358.8	3289.9	3304.8	2793.9	2907.8	2147	1819.5

(*) PRELIMINARY
fmt FINE METRIC TONE
flt FINE LARGE TONE

SOURCE: **Ministry of Energy and Mines - Office of Mining Statistics**

3.2.2 Current situation

In the first quarter of 1994, the performance was as follows:

a. Production by Sectors

According to statistics from the National Statistics and Information Institute (INEI) and Central Reserve Bank (BCR), the Gross Domestic Product grew 8.7% in March 1994. All the productive sectors registered increases, especially the fishing sector with a growth of 44.6% influenced by the continental fishing for human consumption, canned and fishing for the meal and oil fish manufacturing. Other sectors that showed increases above average were: construction (30%), farm and livestock (10.7%), due to increase yield of crops and the recovery of the poultry production. The other sectors grew at lower rates: electricity (8.4%), manufacturing (8.0%), commerce (7.6%), and mining (4.2%).

As shown, economy reactivation was observed in different sectors, especially the construction sector which stood out for its great dynamism, basically linked to the program of rehabilitation, maintenance, and construction of highways and to the continuance of hydroelectric infrastructure projects. The agriculture and livestock sector was linked to the presence of favorable weather conditions.

The investment programs foreseen in both sectors indicate that they will continue being the main booster elements in the economy.

On the other hand, the fishing sector grew 168% in March 1994, basically due to the great anchovy extraction for the elaboration of fish meal. The latter increased significantly from 32 thousand gmt to 1 million 90 thousand gmt, due to the end of the season of prohibition of fishing established between February 4th to March 6th. The good weather conditions and the investment taking place in the sector contributed also to achieve such result.

The consumer goods industry increased 6.7%, where the growth in the branches of tobacco (82%), dairy products (29%), and butchery and meat conservation (15%) were prominent. The former, although it increased significantly, has not shown an important dynamism in the last months, and its physical production has reached 86% of the referential period (August 1990). In part, this is due to the competence by the imported products. On the contrary, the dairy industry would indeed be having an important development, with a production reaching 30.3% from the one obtained in the base period. It is worth to mention that the main branches of the sector registered a contraction in the month mentioned above.

In March 1994, the agriculture and livestock sector expanded in 2.2% as a consequence of a bigger agriculture production (4.4%), which in part was balanced by the lower cattle production (-2.1%).

Among the products used for industry, the larger cotton production, basically in Ica, Ancash, and Lima, stood out. It is worth mentioning that this crop also registered a growth of the cultivated area in relation to the former campaign with an area planted of 95% of the sowing surface programmed.

So far in the current campaign (August 93-March 94), with regard to the sown land of the principal crops, the surface would have increased in 25% as an average in comparison with the same period of the former campaign, having achieved 83% of the programmed sowings.

b. Prices

In April 1994, the prices index in Metropolitan Lima rose in 1.5%, the lowest rate of the year. The accumulated inflation in the first four months of 1994 reached 7.7% while the prices variation of the last 12 months was 27.9%.

With respect to the informal exchange rate, it did not register any variation. With this, the devaluation corresponding to January-March 1994 is 1.2%.

c. Wages

In relation to wages, in April 1994 the legal minimum wage increased from S/.72 to S/.132 (Nuevos Soles) per month, after it remained invariable since February 1992. This increase meant a recovery of 80.6% in relation to the prior month and 43.1% in relation to the same month of the prior year. Nevertheless, the minimum wage remained below the estimated value for the popular consumption basket.

3.2.3 Economic prospective

In the Letter of Commitment presented by Peru to the International Monetary Fund, the features for the economic guidance of the country during 1994 are outlined, stating among the main objectives to continue with the control of inflation, diminishing it to a range between 15% and 20%. The fulfillment of this goal means the maintenance of not only the restrictive monetary policy, but also of the fiscal policy with a severe control of the current expense and a determined intention of improving the revenues. As a result, the growth of production depends on the foreign and national private investment and the public investment oriented to social support.

The fishing sector is the most dynamic. For 1994, an investment of US$ 205 million mainly alloted to the renovation of processing plants and to the purchase of a fishing fleet was estimated. According to the kind of fishing, such investment would be distributed as follows: US$ 120 million for industrial fishing, US$ 80 million for human consumption fishing, and US$ 5 million for handicraft fishing.

The growth of the Manufacturing Sector for 1994 would be slightly lower than the one foreseen by some private sources (8% against 9%). This would be based on the reactivation of the branches related to the primary extractive sector and to the electrification and construction activities. The branches that reached some maturity in the industrial reconversion would be added to those.

The Construction Sector would continue being dynamic in 1994 and 1995, mainly due to the programs of huge works of irrigation infrastructure, education, health, rehabilitation and construction of highways, housing programs, and so on.

Although the Mining Sector decreased, it shows good prospectives, mainly because of the importance that the gold production is generating. There are also several international auriferous companies interested in investing in Peru.

The Monetary Policy is oriented to achieve the inflation goals that will range from 15% to 20% at the end of 1994.

The emission goal, according to the Commitment Letter, will be limited to a nominal growth of the monetary base of 20% in the year.

According to the Letter of Commitment presented to the IMF, Peru will try to improve the Central Government wages in 1994. Such payroll is estimated to increase somewhat faster than the GNP growth, through a readjustment of the bureaucrats' salaries scale, trying to partially shorten the gap with the private sector wages.

3.3 WATER IN THE NATIONAL ECONOMY

Water is a very important resource in the economy of a country and its economic value is in the multiple uses that it is given in each sector of the economy.

3.3.1 Farming and livestock use

The economic development of a country has the agriculture as a spinal column and it is very little what can be achieved in development matters if the farm and livestock sector is not dynamic.

The economic development implies a series of transformations in the different sectors of the economy, and the farm and livestock sector contributes in different ways, due to its several interactions and sector interdependence.

In our country, it is important to achieve an increase in the food offer because:

- the country's population grows more than 400,000 inhabitants in the average, annually.
- the food demand has an income-elasticity bigger than 1, i.e. that any variation in the income generates a strong increase in the food demand.

a. LAND RESOURCE

According to the studies carried out by ONERN in 1982, the actual use of land at the national level was of 2,528,294 ha of which:

717,089 ha (28.35%)	are located in the Coast
1,231,142 ha (48.69%)	are located in the Highlands
580,063 ha (22.94%)	are located in the Jungle.

So far, the use of land has not changed significantly. The increase in the agricultural areas because of new irrigations have compensated the agriculture areas lost mainly due to urban expansion in the principal cities of the country.

The relation of agricultural area used with respect to the population registered in the Census of 1993 gives a ratio land/man of 0.11 ha/inhab. This index is the lowest not only in Latin America, but in the world.

According to studies carried out in 1992 by the General Directorate of Water and Soil (DGAS), there are 876,000 ha in the Coast that could be developed for agricultural use, being the water resource the principal limitation. In the highlands, the actual use has surpassed the potential use in 156,000 ha. In the Jungle, there is the greatest potential of agricultural lands with 4,611,000 ha

b. WATER RESOURCE

The close relationship between the water resource and the farming and livestock production is well known. The availability of such resource is very irregular along the Peruvian territory, the precipitations are very unevenly distributed, and, as a result, the rivers flow in very variable regimes.

In the Coast, cultivation is performed on the whole under irrigation and the lands have a higher fertility. This is the most important region because of the economic density of its crops and the high technological development in the irrigation systems, but its main restriction is the water resource.

In the highlands, only 30% of the whole agriculture surface is irrigated and the rest is cultivated with rainfall. Therefore, the development of the agriculture activity is subject mainly to the precipitations that seasonally appear.

In the Jungle, 5% of the exploited agricultural area is cultivated under irrigation and 95% is cultivated with rainfall.

c. DEMAND OF SUPERFICIAL WATER

The demand of water for consuming and non-consuming use is obtained from the rivers that form the Pacific, Atlantic, and Titicaca watersheds, which permits the irrigation.

The Pacific watershed permits the irrigation of the Coast valleys which have a water demand for agricultural purposes of 14,200 mcm that represents 87.29% of the national water demand.

The Atlantic watershed permits the irrigation of the Highlands and the Jungle. The water demand for agricultural purposes in this watershed is 1,996 mcm, which represents 12.27% of the national water demand.

The Titicaca watershed also permits the irrigation of the cultivation areas in the Highlands. The water demand in this part of the Highlands is 71 mcm and represents 0.44% of the water demand at a national level.

d. UNDERGROUND WATER

Because the Coast is an arid zone, the exploitation of the underground water for the population, industrial, and farming and livestock use is indispensable. Its significance in agriculture is notorious and it is used for irrigation all year long or as complementary irrigation during the drought months (June-November).

In 1987, PLANIR estimated that the underground water exploitation in the Pacific watershed reached 1,508 mcm, volume that is taken out from 8,009 opencut, tubular, and mixed wells. The underground water exploitation in the Atlantic and Titicaca watersheds is not significant and there is no updated data for its evaluation. The exploited volume of underground water in the Pacific watershed for agricultural use is 995.3 mcm and for livestock use is 12 mcm. The private activity is the one which has developed the highest investments to obtain underground water.

e. DAMMING WATER

The current volume of damming water is 1,941.88 mcm, which breaks down as follows: The Pacific watershed has in exploitation 1,875.88 mcm, using 21 reservoirs that regulate the Coast rivers; the Atlantic watershed exploits 66 mcm with two reservoirs. The State, which has financed the reservoir works, has made large investments for the construction of dams.

f. FARMING AND LIVESTOCK PRODUCTION AND WATER COST

The development of the Peruvian economy has shown some sectorial shifts, because some sectors, such as mining, manufacturing, and services have raised their contribution to the formation of the GNP. The farming and livestock sector has shown a relative loss in its share, due to the fact that its growth rate has been lower than that of the other sectors. Thus, it diminishes from 23.5% in 1950 to 17.22% in 1960, while in 1970 it was 14.66%; 11.2% in 1980; and, 12% in 1990.

From the collection of water tariffs with agrarian purposes achieved between 1972-1990, US$ 18.8 millions were used for the operation and maintenance of the irrigation systems. Such amount represented annually about US$ 0.99 millions, from which US$ 1,556 could correspond to each district monthly. Such figure is not enough for the operation of the irrigation systems and to guarantee their respective operation and maintenance.

According to studies made in 1992, the collection of water tariffs with agrarian purposes represented only 20% of the actual tariff and the water cost is a minimal part in the total production cost of the cultivations. The percentage of water cost in relation to the total production cost for the following cultivation was:

- Cotton, in Piura, 0.48%
- Rice, in Piura, 0.42%
- Rice, in Camana, 0.58%
- Quinoa, in Puno, 0.43%

3.3.2 Industrial use

Water availability is a factor increasingly prevailing for the industrial companies, sometimes becoming decisive for those activities which consume large volumes of such element.

The most important national industries according to water consumption are:

- Beverages: Soft drinks, beer, and wine. Water is an indispensable input for these products both in quantity and quality. In addition to being incorporated into the product, water is used principally in the washing of containers, machinery, and refrigeration.

  In spite of the economic crisis, this industry is one of the most profitable in the country, which holds its growth rate and operates in the three regions of the country.

- Fish meal and oil: These industries are located mainly in the Coast, especially in Callao and Chimbote.

- Textile: This industry has a domestic and international market. The raw material is cotton and wool. Water is used for bleaching the cotton and for washing the wool. The major industries are located in the Coast and in the Highlands.

- Oil:The use of water in oil production is lower than in the refineries, which are mainly located in Callao and Talara.

- Steel: This industry uses water largely in refrigeration. The major steel company is located in Chimbote (Coast).

  According to the information from the Ministry of Industry, Tourism, Integration, and International Trade Negotiations (MITINCI), in 1988, the Pacific watershed supplied water to about 92% of the domestic industry with 1,103 mcm, while the Atlantic watershed supplied water to approximately 7% with 49 mcm, and the Titicaca watershed supplied water to 1% of the national industry, which consumes 3 mcm.

  According to calculations made by DGAS for 1991, the estimated amount to be collected on account of the water tariff for non-agrarian purposes, for industrial use, would be S/.1,235,302 Nuevos Soles, while its production generated S/.8,782 million of Nuevos Soles, i.e. the collected amount would represent 0.013% of the industrial GDP.

3.3.3 Drinking water and sewerage

Although the drinking water supply requires only reduced volumes in relation to other consuming uses of water, its social significance surpasses all. Likewise, there are great investments carried out to obtain drinking water in the quantity and quality required for its distribution.

For the registered population in the Census of 1981, the national water demand for population use was calculated in 896 mcm and, for the current population, a national demand of 1,264 mcm ($40m^3/seg$) is estimated, considering the served and not served population. Its distribution by geographic regions is as follows:

- Coast, 1,018 mcm
- Highland, 228 mcm
- Jungle 17.8 mcm

Metropolitan Lima and the city of Callao concentrate 31.3% of the national population registered in the Census of1993, whose drinking water demand is 20.74% m^3/seg of which 13.5% m^3/seg come from the superficial waters of the Rimac River. The remaining 7.24 m^3/seg come from the underground water of the aquiferous of the Rimac and Chillon rivers, where approximately 1,000 wells are working.

Studies made in 1992 calculated a demand of 30,8 m^3/seg. Therefore, the populations of Lima and Callao have a water deficit of 10,06% m^3/seg.

The drinking water consumption in Lima and Callao billed in 1992 was 381,1 mcm, distributed as follows: domestic consumption 311.6 mcm; commercial consumption 35.4 mcm; industrial consumption 11.7 mcm; and, State consumption 22.4 mcm.

The estimated amount to be collected on account of water tariff with non-agrarian purposes for population use in 1991 is 1,3 millions of Nuevos Soles.

The investments made in sanitation works present the following historical series: in 1986, US$ 51.7 millions were invested; in 1990, the investment was reduced to only US$ 17.6 millions; and, in 1993, the investment increased noticeably reaching US$ 186.6 millions. This was due to the projects execution by the State for the expansion of the drinking water and sewerage services at impoverished zones.

The lack of updated statistic data of the monetary revenues for drinking water and sewerage services has not permitted an economic analysis of the sector.

3.3.4 Power use

The Hydro-electric Power Stations use waterfalls to generate electricity and, once the water is used, it could be destined to other consuming uses. Until 1980, 267 Hydro-electric Power Stations were in operation.

The steam thermic Stations require a relatively large water volume. Water coming from the vapor condensation operates the turbines and keeps the salt concentration within the desired limits. The estimated quantity ranges from 0.25 and 1.0 l/kWh generated. Until 1990, there were 924 thermic stations.

A thermic station requires water largely to use it as a refrigerant and such requirement ranges from 100 and 600 l/kWh generated, in accordance with the characteristics of the thermic stations.

In 1990, the Thermic and Hydro-electric Power Stations used 11,140 mcm of water and the electricity production was 13,162.4 GWh.

That same year, the city of Lima consumed 4,424 GWh and the industrial sector demanded most of the electric power with 1,718.7 GWh.

The estimated amount to be collected on account of water tariff for power use in 1991 reaches 51.4 millions of Nuevos Soles, figure which represents 93% of the total amount collected for the year. Therefore, the power sector is the one which most contributes to the State for the water use and which pollutes it less.

3.3.5 Mining use

The participation of the mining activity in water consumption is small. It represents only 1.09% of the total water for consuming use, i.e. it consumes 207 mcm. This is the sector that most contributes to the generation of foreign currency from exports.

The estimated amount to be collected on account of water tariffs for mining use is 2.17% of the total amount to be collected from the 1991 tariff. Likewise, such amount represents 0.09% of the foreign currency generated for the State by the sector.

3.3.6 Waterway and lacustrine navigation

The navigable rivers have an abundant volume and are located in the Jungle, being the main one the Amazon River, which is the largest and most plentiful of the world, and in which ships of high tonnage navigate, carrying regional products abroad or bringing foreign products to the country. Iquitos, the major waterway port in Peru, is located at the left margin of the Amazon River.

Other main rivers are: Ucayali River, where Pucallpa, considered as the second most important waterway port in Peru, is located; Madre de Dios River, where Puerto Maldonado, considered another important waterway port near the Bolivian border, is located.

In the 1984-1992 period, Iquitos exported 50 thousand tm and imported 363 thousand tm in commodities. In the same period and with respect to the cargo transportation within the country, Iquitos mobilized 7.4 millions tm, Pucallpa 1.9 millions tm, and Yurimaguas 0.61 millions tm.

For the passenger transportation by waterway, small crafts (boats) and also ships of more than 50 tons of Gross Register are used. In some zones of the Jungle, the small crafts are the only means of transportation.

The lack of statistics which express in monetary terms the cargo and passenger transportation by waterway, land, and air, is the main restriction that does not permit an economic analysis.

3.3.7 Water and its recreational use

Peru has the richest hydrographic system in the world. However, the use of water for recreational purposes is an activity little developed as a touristic offer.

The basins of the Atlantic watershed form the Peruvian Jungle rivers which could be used with recreational purposes with a great touristic potential, especially those rivers located in the high and low Jungle, where beautiful landscapes and the most important and exotic flora and fauna in the world complement the waterway excursion.

As an economic activity, tourism has had a sharp drop in these last years. The national tourist also had a minimum participation because of his diminished expense capacity in the large sectors of the country. With respect to receptive tourism, it has been recovering since 1992 and it is a reason for this analysis because it is a source of foreign currency for the country.

The receptive tourism to the Peruvian Jungle is carried out by air, being the most visited cities: Iquitos, Pucallpa, Yurimaguas, Puerto Maldonado, Juanjui, Tarapoto, and so on.

The entrance of foreign tourists to Peru is also made by waterway through the ports of Iquitos and Puerto Maldonado.

Iquitos is the most attractive center in the Jungle for foreign tourists. Excursions along the Amazon, Itaya and Nanay rivers are the main objective of the touristic flow to Iquitos.

Pucallpa is another touristic pole attraction from where travel starts by waterway to Iquitos along the Ucayali river up to the Amazon River. Similar attractive places can be found in Yurimaguas, Puerto Maldonado, Juanjui, and Tarapoto.

The Titicaca watershed has a great importance for the receptive tourism that enters by lacustrine way through Lake Titicaca (Puno), which is located in the andean zone of Peru and Bolivia, and which is a touristic attraction, due to the presence of native communities like the Uros, who live in the floating islands on the Lake.

Table No. 3.12 shows that the entrance of foreign tourists increased in 1992, after the critical diminishing of 1991. The foreign currency reception increased due to the revenues left by each tourist since 1990, reaching an increase of 220% in 1991 in relation to 1981 and of 56% in relation to 1990, as shown in Table No. 3.13.

TABLE 3.12

RECEPTIVE TOURISM

	No.OF TOURISTS PER YEARS				
MEANS OF ENTRANCE	1981	1985	1990	1991	1992*
FLUVIAL					
. IQUITOS	1,600	800	1,400	900	1,100
. PUERTO MALDONADO				298	340
LACUSTRINE					
. LAKE TITICACA (PUNO)	300	1,000	500	100	400
TOTAL	1,900	1,800	1,900	1298	1,840

(*) Preliminary

SOURCE: MITINCI - National Direction of Tourism

TABLE 3.13

FOREIGN CURRENCY INCOME DUE TO RECEPTIVE TOURISM
(fluvial and lacustrine means)

YEAR	NUMBER OF TOURISTS	REVENUE PER EACH TOURIST US $	APPROXIMATE REVENUES US $
1981	1900	783	1,487,700
1985	1800	1000	1,800,000
1990	1900	1107	2,103,300
1991	1298	1728	2,242,944

3.3.8 Comparative yields in different alternative uses

The public sector has not generated information about water use yields for different purposes; therefore, it has not been possible to make a comparative analysis of the water resource efficiency, according to its use.

In the investigations done by private institutions, there are isolated works that do not permit to standardize the information with comparative purposes.

3.3.9 Multi-purpose programs

The national development policy should consider the water resources availability coming from lakes and dams, considering that there is a valuable potential of supplying for several uses.

The Pacific watershed presents a geographic characteristic proper for the hydroelectric mini-station and station installations and pisci-farms, which would permit a larger use of the water resource, increasing, in turn, the profitability of the economic programs for the development of the hydrographic basins.

The State, through INADE, basically includes the following components in the programs: power, agricultural irrigation, drinking water, agricultural industry, health and education infrastructure.

The principal Special Projects that INADE is developing with multi-purpose programs are: Jaen-San Ignacio-Bagua, Huallaga Central Bajo Mayo, Alto Huallaga, Pichis-Palcazu, Madre de Dios project, Majes, Siguas, Highland-Center-South and Binational Lake Titicaca.

3.4 WATER RESOURCE MARKET

The water resource in our country has a great potential market in:

- **The power sector.** It has in its portfolio 11 hydroenergetic projects to perform until the year 2007. It will generate an installed power of 803 MW and an effective power of 978.2 MW. Likewise, this sector is developing hydroelectric mini-stations projects for locations distant from urban centers and zones of critical poverty.

- **The urbanistic process.** The fast urban expansion that is carried out in the main cities of the country has created a great demand in the sanitation and drinking water supply.

- **The Agrarian Sector.** It is the largest potential market for the water resource.

The agrarian activity in the Coast is the most developed technologically for export crops. At present, the exploitation of crops for foreign markets is being encouraged and, at the same time, the domestic market productivity is being improved.

INADE, in accordance with its 1994-96 program, is making studies and works for 20 irrigation projects at a national level, from which it has programmed to use 364,299 ha in the Coast and to improve 382,298 ha which represent a great market for water.

3.5 INSTITUTIONAL ASPECTS

The current government has started a shift process to a more normative and promoting State rather than an operating one. This has led to a reduction of personnel and budget to perform activities by operations, originating also the discontinuance in the statistic information at a national level.

At present, we can see that the information is scattered in the different public institutions and, in turn, is incomplete and outdated. This is the principal weakness to perform future macro-economic programs at a sectorial and/or global level.

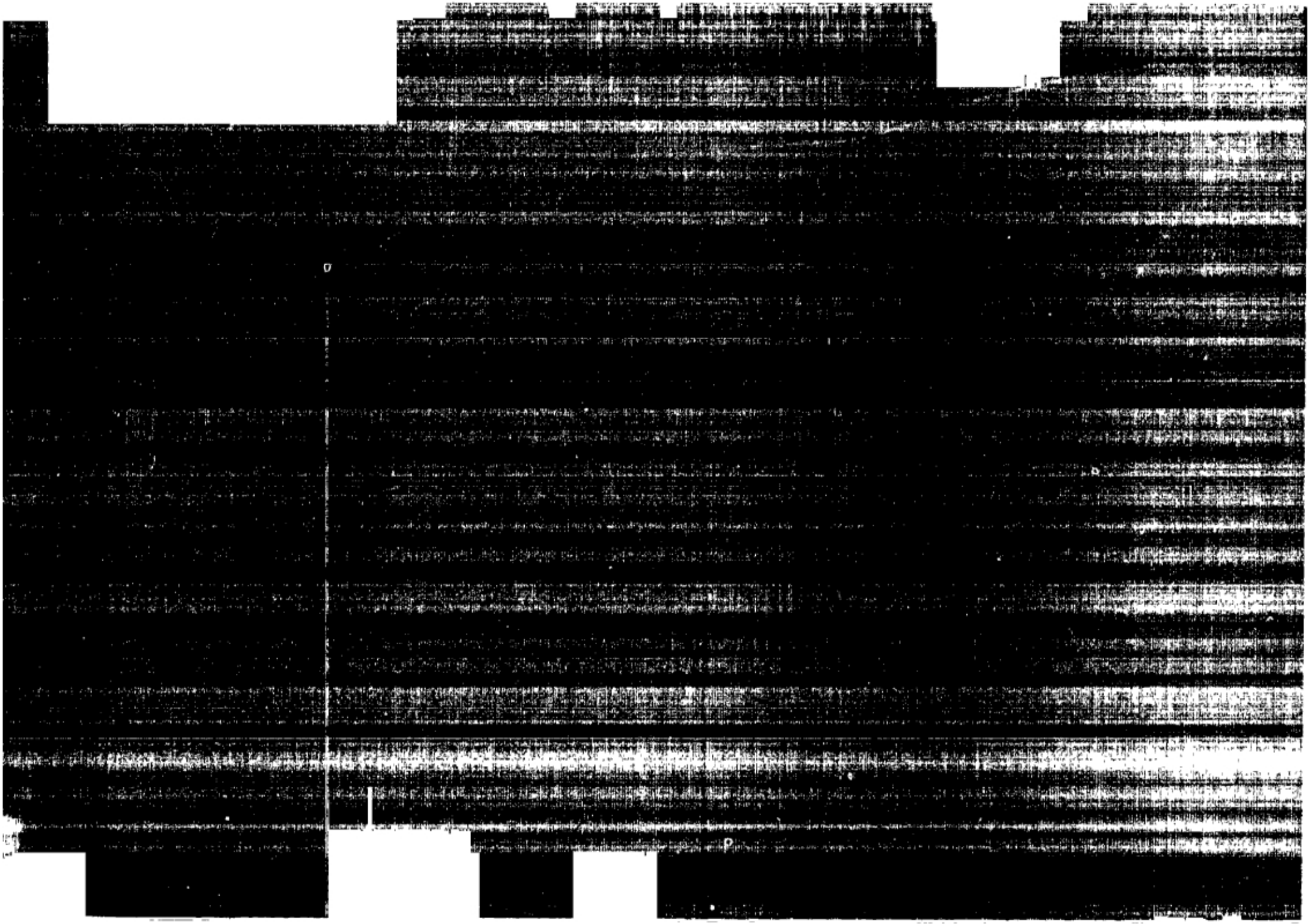
CHAPTER IV

WATER POLICIES: INSTITUTIONAL AND LEGAL ASPECTS

INDEX

ANNEX

LIST OF THE LEGAL AND ADMINISTRATIVE PROVISIONS THAT RULE THE GENERAL POLICY OF THE RATIONAL USE OF WATER, AND OTHER SIMILAR NORMS



CHAPTER IV

WATER POLICIES: INSTITUTIONAL AND LEGAL ASPECTS

4.1 LEGAL BACKGROUND REGARDING WATER POLICIES

The pre-Inca cultures, before the XIV century, practised agriculture under irrigation where the local authority distributed the lands and, with them, the water assigned to be used for agricultural purposes. It is estimated that, at that time, the area under irrigation was 1,000,000 ha in the Peruvian Coast. During the development of the Inca Empire, the use of the surface waters was for domestic, animal, and agricultural purposes. For this latter use, admirable channels were built to convey the resource in the Coast, because of the lack of rainfall, as well as in the Highland of the country, in order to have sustained agriculture in the Andes during the normal annual period. The "Varayoc" or social political leader distributed the water to his community according to his judgement and in terms of his hierarchy.

When the Inca Empire fell under the Spanish control, the agricultural area under irrigation was reduced as the Inca population was forced to work in the mining activity; thus, the water use for agricultural purposes was reduced. At that time, the Spaniards used the water by day and the native communities used it at night and in non working days. It is estimated that the area under irrigation dropped to 300,000 ha in the Coast region during the Colony period.

In the Republican period, substantial changes regarding the use of water for agricultural purposes were not initially defined, since the decision depended on the master or landowner who, because of having the ownership of the land, assumed he was also the owner of the water found in the scope of his property.

In practice, the owner of the property negotiated the water resource excess with the users; this was the predominant practice to obtain the right to use the water. However, some efforts to regulate the use of water were made during the Colony such as the so-called "Regulations of Cerdan" (1784) and the "Regulations of Dean Saavedra" (1699) which regulated the use of water in the valleys of Viru, Moche and Chicama.

In 1902 the Water Code, promulgated on February 25, 1902, went into force; at that time the Magna Carta of 1860 was effective. That Code became the first organic norm on water resources ratifying the private property of the water and, with this, the right to determine its use. That Code also established that the waters rising, continuosly and discontinously, in individual, municipal or Government lands belonged to the respective owner for his use or exploitation, as long as they run over the same lands (Article 5). According to Article 4, are of public domain: first, the rivers; second, the torrents, springs and streams that have not been object of a prior appropriation; and third, the excess waters of rivers flowing into the ocean. Therefore, that Code acknowledged the right to private property of the waters as part of the ownership of the land.

By Decree-Law No 7335 and No 7336, both promulgated on September 28, 1931, the Technical Administrations of Waters were established to distribute irrigation water in the Coast valleys; also, the Superior Council of Waters was constituted with diverse administrative functions.

Article 37 of the Constitution of 1933 provided that **"the mines, lands, woods, water, and in general, all sources of wealth belong to the State, except the legally acquired rights. The law will**

determine the conditions for their utilization by the State or for their concession, in property or in usufruct, to individuals".
By Decre- Law No 17752, promulgated on July 24, 1969, it was established that **"the waters, without exception, are the State's property, and their ownership is inalienable and imprescriptible. There is neither private property on the waters nor acquired rights on them. The justified and rational use of water can only be granted in accordance with the social interest and the country's development".** (Article 1)

"The volumetrical measurement is the general norm to be applied to the different uses of waters; it is compulsory for the users to install the control and measurement devices for adequate water distribution and exploitation". (Article 11)

"The users of each Irrigation District will pay tariffs... (that)**...will serve as a basis to cover the expenses of water resource exploitation and distribution".** (Article 12)

Title II deals with the conservation and preservation of the waters establishing the users' obligations and the prohibitions to avoid its pollution. This law has many regulations.

The Political Constitution of 1979 stipulated that **"the renewable and non renewable natural resources were the Nation's patrimony. The minerals, lands, woods, waters and,in general, all the natural resources and energy resources belong to the State. The law determine the conditions for their utilization and their concession to individuals".** (Article 118)

The Legislative Decre No 653, Law for the Promotion of Investments in the Agricultural Sector, promulgated on July 30, 1991, derogated, among other decrees, the norms gathered in the Decree-Law No 17776. The article 51 of this Decree provides that **"the uses of water for agricultural purposes, whatever its source and origin may be, are subject to the resource availability and the real needs of the object it is assigned to".**

Article 54 of the above-mentioned norm stipulates that **"the irrigation district is constituted by the geographical demarcation on which the Technical Administrator of the corresponding Irrigation District has competence"...** and... **"has among his functions to administrate the waters for non agricultural and agricultural uses, according to the cultivation and irrigation plans approved. He will take into account the hydrological, agrological, and climatological realities in the geographical scope of the corresponding hydrological basin, acting as the maximum decisory body in the matter of use and conservation of the water and soil resources within his respective jurisdictional scope".** (Article 55)

Articles 59 and 60 refer to the water user organizations: **Commissions of Users for Irrigations** for each irrigation sector or subsector; and the **Board of Users** for each Irrigation District. The users will pay water tariffs per volume unit; these tariffs will serve as a basis to finance the expenses for the administration, operation, maintenance and improvement of the hydraulic infrastructure, costs of work amortization, as well as the costs of studies and works on conservation of soils and waters and basin management. This law was regulated by Supreme Decree No 048-91-AG.

The Political Constitution of 1993 states that **"the renewable and non renewable natural resources are the Nation's patrimony. The State is sovereign regarding their exploitation. The conditions for their utilization and their granting to indiviiduals are determined by organic law. The concession gives the holder a right subject to such legal norm".**

According to our latest Magna Carta, the task to enact development laws related to the water resource, in the perspective of the twenty-one century, is not focused anymore on analyzing the juridical nature of the water ownership but on furnishing the legal provisions that help and facilitate an adequate water management and the measures to reduce the environmental risks related to its use. These provisions are subtituting for the current regulations full of imprecise, subjective or phased out contents whose application is subject to a discretionary and volitive element of the administrative body. This is the case of a pronouncement about the rights of the administrated body which, when established under an interventionist, authoritarian and statist mentality, may become the main opponent to the State's efforts to introduce and to reinforce realistic policies so that the free market should be responsible for appraising the almost always scarce water resource and promoting private investments.

Likewise, special emphasis should be put on the norms regarding prevention and control of water pollution and on the close relationship this resouce has with the other nature components, because of the multiple uses it has. This fact is materialized in our legislation when waters for agricultural and non agricultural purposes are distinguished.

4.2 PROPOSED ORGANIC LAW OF WATERS

This proposal was elaborated by the Ministry of Agriculture and is still waiting for discussion and approval. It refers to the exploitation, preservation, and conservation of land waters, whether running or standing, found in the surface or subsoil of the national territory.

As the waters are the Nation's patrimony, any natural or juridical person can use or exploit them, but the respective right is necessary.

The Water Law is a real right meaning the faculty to use or exploit the water endowment, in an exclusive way, and use them for any purpose.

If the supply source contains a quantity enough to satisfy all the water rights, the right is permanent; otherwise, the right is contingent.

In order that a natural or juridical person can exploit the water resource, he needs a water right which will be given by the Hydrographical Basin Directorate of the respective jurisdiction.

Five of these hydrographical basins will be cconstituted: the Amazon river (headquarters in Iquitos), Lake Titicacca (headquarters in Puno), from Zarumilla to Huarmey rivers in the Highlands and Northern Coast (headquarters in Chiclayo), from Culebra to Ica rivers in the Highlands and Central Coast (headquarters in Lima), and from Grande to Caplina rivers in the Highlands and Southern Coast (headquarters in Arequipa).

Once the existence of available volumes is confirmed, each basin directorate will offer the required water in public auction and will establish the water right in behalf of the person that obtains it.

The underground waters are excluded from this auction since to have rights on them, it is enough to be the owner of the land where the water will be extracted from. Nevertheless, the State can restrict the water granting, if this harms others having water rights.

The resolution establishing this right will be inscribed in the Public Register of Waters where the following details will be included: name of the natural source which the water runs from, the flow

or volume it has, the modality or characteristic for its use, if the right is consumptive or not, and if it is of permanent or individual practice. The consumptive right is the one that does not oblige to restore the waters after use; and the non consumptive right is the ones that obliges to restore them.

The water right can be transferred, negotiate, pledge or mortgage, separately from the property or activity to which the water resource is assigned, and according to the norms of the Civil Code of Peru about real rights related to real estate.

Rights on permanent and consumptive waters will also be granted by law provision, when the water is extracted from wells and is used for drinking and for domestic use.

The water can also spring within the owner's land to die out or flow to the ocean; or the spring can be the result of the construction of tunnels or other works, as long as this fact does not affect others.

Likewise, the water can be used, but without having right on it, in the following cases: when the water is collected or drops in a property, proceeds from artificial drainages, or a lower property takes the water coming from the runoff of a higher property.

The distribution of waters in natural sources and hydraulic works will be under the responsibility of the water users' organizations (hereinafter called Boards of Basin Users), and of the Commissions of Channels (before called Commissions of Users for Irrigation). Besides distribution, they will be in charge of carrying out the hydrological studies and measurement, the care of the banks and, in general, the care of the hydrographical basin.

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

The admnistrative jurisdiction in the matter of waters will be exerted, in hierarchical preference order, by the National Council of Water, the Basin Directorate, the Basin Subdirectorates, and the Public Registry of Water Rights. This Council has, among its functions, to solve, as a last resort, the matters related to the granting, use, or modification of the water rights, as well as to standardize the administrative norms related to this subject.

The National Council of Waters is conceived as an institution dependent on the Ministry of Agriculture; it is ccomposed of 6 (six) directors appointed by supreme resolution having as its most important function to appoint the basin directors in the country.

With relation to fines and sanctions, worthy of note is the fact that any person infringing this law will be administratively penalize. Who will deserve sanction? The person who, without having the right, takes out water from lagoons, lakes, dams, ponds, or other natural deposits, whether surface or underground sources; also the person who takes or uses the water in larger quantities than permitted or in a way different to the one mentioned in his title. Likewise, the person who, without authorization, should dam, divert, or retain the waters from rivers, brooks, channels, drains, aquaducts, springs, and other artificial or natural sources or watercourses.

The articles of these norms also consider that the person who would damage or obstruct the natural or artificial defenses of the banks would be subject to sanction. Finally, those who would occupy

the parts of the reservoirs subject to inundation, the adjacent areas, the channels and surveillance paths would also commit a fault.

The Basin Subdirector, on his part, can impose the fines on those who infringe the provisions of such law; these fines can be repeated while the infringement situation persists.

The money proceeding from the fines will be used by the respective Basin Subdirector to carry out actions for the protection of the basin itself; for that purpose, the administrative body can involve the board of water users of the place. In the case of fine collection, the Basin Subdirector can turn to the coercive executor of the place.

As it can be seen, this project intends to achieve a rational water management, especially, in agriculture, in order to avoid wasting it, as it has been happening in the country. The improvement of the project lies in the hands of the Commissions of Energy and Infrastructure, Environment and Amazonia, and of Agriculture which will express their respective opinions.

4.2.1 Criteria to Regulate the Organic Law of Waters

First of all, the legal provisions regulating directly or indirectly the water resource will have to be compiled and exhaustively analized, in order to promulgate a Consolidated Text thats agrees with the provisions related to water regulation.

Regarding the tax aspects inherent in the water rights, the modality, the collection conditions, and other aspects required for their normal effectiveness will have to be provided in the laws. These regulations will have to consider mechanisms that would permit to calculate the payment of taxes in terms of the real use of the right; and , in case this does not exist, the collection of a presumptive rent will have to be established which will lead to a control of speculation in a possible water market. It is also necessary to analyze the legal provisions that presently rule the collection of land taxes for the purpose of establishing the valuation criteria without taking into account the water, because otherwise it could result in a double taxation . The possibility to consider certain percentages of the fixed investments on common use hidraulic infrastucture as deductible should be contemplated, as well.

With regard to the Organizations of Users, the regulationss should provide the following aspects: the creation of registries for organizations of water users, both of basin boards and of channel commissions, and for associates and directors, and annex them to the public registries; also, transitory provisions that would regulate the form and conditions under which the new juridical person will assume the obligations contracted by the merged organizations, making mention of the new geographical scope where they will have jurisdiction;criteria that rule the geographical delimitation in terms of the different concepts stated in the Proposed Organic Law of Waters so as to make them coincident with the jurisdiction assigned to each juridical person of the basin, in the principal channel, secondary channel, underground aquifer, drainage works, and district.

Such regulations should also provide that the cadastral plans of the different areas are fully identified with the diverse concepts stated in the article 12 of the Proposed Organic Law which should appear in the resolution that constitutes the water right. Finally, it should provide norms that specify the functions, administration and surveillance of the organizations of users.

On the other hand, the norms for the prevention and control of water pollution should be exhaustively studied; in addition, the provisions contained in the Environment and Natural Resources Code in this regard, and the regulations of the other sectors should be compiled, complemented, and agreed. The article 8 of this Code stipulates that any work project or activity, whether of a public or private nature, liable to cause damages intolerable for the environment needs an Assessment of the Environmental Impact subject to approval by the competent authority. The article 15 of this code prohibits to pollute or alter the waters to the point of turning their use dangerous. From articles 107 to 112, norms about water and sewerage are given; and from articles 113 to 118 the regime of administrative sanctions for infractors is established. The Chapter on Offenses and Penalties of the Environment and Natural Resources Code has been abolished by the Penal Code that typifies the offenses of environment pollution: ilegal granting of licenses; deposit, commercialization or pouring of industrial or domestic wastes implying an environmental risk; ilegal exploitation of natural resources; ilegal exploitation of aquatic species.; destruction of forest resources; ilegal utilization of agricultural lands; ilegal authorization of projects and environment alteration. The Code provides penalties not greater than four years of imprisonment for all these cases.

The norms for the exploration and exploitation of underground waters should incorporate surveys, criteria, and other minimum requirements so that the basin authority can impose or suspend closed seasons, or restrict the exploitation. They should also consider periodicity and the other formalities when providing the organizations with registries of the extracted flows and of the static and dynamic levels on the wells under exploitation. Besides, they should regulate the inspection visits.

To write the regulations that will rule the public registry of water rights and annex it to the public registry of the real estate is also required.

Another necessary step is to design norms so that the administrative jurisdictional bodies can regulate the processes before the water superior instances, the administrative resources, resolutions and other administrative aspects related to their participation in the matters of waters. It is of special importance to delimit the express functions that correspond to the authority and the boards regarding studies and care of basins, so the fulfillment of these functions and the link between these water authorities and organizations and the environmental authorities are guaranteed, avoiding, this way, function disputes.

Likewise, the granting of public hydraulic infrastructure holding to organizations of users and other juridical persons of private law should be regulated; the rights, obligations, grounds for lapse, destiny of works executed by the users, tariffs for the exploitation of public goods, etc. should also be determined.

Finally, norms that regulate the public and private investment on hydraulic infrastructure, and norms that deal with the regime of infractions and fines are needed.

4.3 THE USE OF WATER IN EACH HYDROGRAPHICAL BASIN

Title V "On Waters" of the Legislative Decree No 653 "Law for the Promotion of Investments in the Agricultural Sector" refers to the agricultural use of waters, jurisdiction and administrative competence, and to the organizations of water users.

Article 55 stipulates that in the hydrographical basins having regulated irrigation and/or where water use is intensive and multisectorial the Autonomous Authorities of Hydrographical Basin (AAHB) will be created as the maximum decisory body in the matter of use and conservation of the water and soil resources in their respective jurisdictional scope. The AAHB have a Board composed of five delegates of the agricultural organizations representative of the producers and/or users of the zone, besides the Technical Administrator of the Irrigation District and a representative of the Ministry of Energy, the Ministry of Transport, Housing and Building, INADE or the most important irrigation project of the zone, and of the respective local government. This board, as a whole, will formulate the plans for the exploitation of the water resources in the scope of its jurisdiction, and will coordinate with other adjacent basins, when necessary, in accordance with the regulations and supervision of the national water authority.

The AAHB have among their functions: a) to promote the formulation of master plans for the rational explotation of the water resources; b) to supervise the water actions and basin management; c) to watch the fulfillment of the regulations; d) to coordinate with the adjacent AAHB; e) to formulate and approve the plans of reforestation, soil conservation in the upper parts of the basin, defense in the banks, and other actions inherent in its adequate management; f) to resolve in second instance and as a last resort in the matter of water; g) to carry out other actions leading to an adequate management of the respective basin. The Technical Administration of the Irrigation District resolves in first administrative instance.

So far, the following AAHB have been created: Jequetepeque, Chancay-Lambayeque, Chira-Piura, Chillon-Rimac-Lurin, and Santa-Lacramarca.

What follows is the list of legal and administrative provisions that rule the general policy of the rational use of water, as well as other similar legal norms.

ANNEX

LIST OF THE LEGAL AND ADMINISTRATIVE PROVISIONS THAT RULE THE GENERAL POLICY OF THE RATIONAL USE OF WATER, AND OTHER SIMILAR NORMS

LAWS

Law No 24177
Several irrigation programs are declared of public necessity and national concern.
Promulgated:May 31, 1985
Published:June 19, 1985
Legal Norm:1631, p. 35816

DECREE LAWS

Decree Law No 17752
General Law of Waters
Promulgated:July 24, 1969
Published:
Legal Norm:Legislation Summary (green)
Volume of 1969 (p. 331)

Decree Law No 22133
The Government authorizes the execution of small-sized and medium-sized irrigation and drainage works in order to expand the agricultural frontier of the country.
Promulgated:April 4, 1978
Published:
Legal Norm:Volume No 89, p. 238

Decree Law No 25509
The agricultural activity is declared in state of emergency, and support programs are started, especially, in favor of small farmers.
Promulgated:May 22, 1992
Published:May 26, 1992
Legal Norm:Volume No 192, p. 245

Decree Law No 25533
This decree provides that the license granting the use of mineral-medicinal water sources, as well as the control of their exploitation for tourist purposes fall under the competence of the Ministry of Industry, Domestic Trade, Tourism and Integration (MICTI)
Promulgated:June 5, 1992
Published:June 7, 1992
Legal Norm:Volume No 193, p. 165

Decree Law No 25902
Organic Law of the Ministry of Agriculture
Promulgated:November 27, 1992
Published:November 29, 1992
Legal Norm:Volume No 198, p. 343

Decree Law No 26111
Law of General Norms of Administrative Procedures
Promulgated ; December 28, 1992
Published : December 30, 1992
Legal Norm : Volume No 199, p. 416

LEGISLATIVE DECREES

Legislative Decree No 48
Those funds proceeding from tariffs for the use of water for agricultural purposes constitute an income for the Boards of Users.
Promulgated : March 13, 1981
Published : March 14, 1981
Legal Norm : Volume 107, p. 89

Legislative Decree No 106
This decree modifies the provisions of the General Law of Waters
Promulgated : June 5, 1981
Published : Special separate (July)
Legal Norm : Volume No 108, p. 108

Legislative Decree No 313
The General Law of Expropriation is promulgated.
Promulgated : November 2, 1984
Published : November 14, 1984
Legal Norm : Volume No 131, p. 118

Legislative Decree No 611
The Code of the Environment and Natural Resources is promulgated.
Promulgated : September 7, 1991
Published : September 8, 1991
Legal Norm : Year/Volume IX - 8687

Legislative Decree No 653
Law for the Promotion of Investments in the Agricultural Sector.
Promulgated : July 30, 1991
Published : August 1, 1991
Legal Norm : Volume No 182, p. 25

SUPREME DECREES

Supreme Decree No 261-69-AP
Regulations of Titles I, II of the Decree Law No 17752 "General Law of Waters"
Promulgated : December 12, 1969
Published:
Legal Norm : Legislation Summary of 1969, p. 710

Supreme Decree No 274-69-AP/DGA
Regulations of Title IV "On Underground Waters" of the Decree Law No 17752.
Promulgated : December 30, 1969
Published:
Legal Norm : Issue edition of DGASI, p. 77

Supreme Decree No 275-69-AP/DGA
Regulations of Title V on "Mineral-Medicinal Waters" of the Decree Law No 17752.
Promulgated : December 30, 1969
Published : December 30, 1969
Legal Norm : Issue edition of DGASI, p. 92

Supreme Decree No 41-70-A
Complement of the Regulations of Title III of the Decree Law No 17752 "General Law of Waters" (given on July 24, 1969)
Promulgated : February 20, 1970
Published:
Legal Norm : Volume of 1970, p. 187

Supreme Decree No 473-71-AG
The Regulations of Title VIII "Water Rights" of the Decree Law No 17752 "General Law of Waters" are approved.
Promulgated : November 23, 1971
Published:
Legal Norm : Volume No 61, p. 362

Supreme Decree No 495-71-AG
Regulations of Title X of the Decree Law No 17752, "General Law of Waters".
Promulgated : December 1, 1971
Published:
Legal Norm : Volume No 61, p. 362

Supreme Decree No 929-73-AG
The Regulations of the Title VI of the Decree Law No. 17752 "General Law of Waters" are approved.
Promulgated : September 12, 1973
Published:
Legal Norm : Volume No 68, p. 329

Supreme Decree No 930-73-AG
The Regulations of the Title IX of the Decree Law No 17752 "General Law of Waters" are approved.
Promulgated : September 12, 1973
Published:
Legal Norm : Issue edition - DGASI, p. 126

Supreme Decree No 1098-75-AG
The Regulations of Title VII "On the Studies and Works" of the Decree Law No 17752 "General Law of Waters" are approved.
Promulgated : September 10, 1975
Published:
Legal Norm : Issue edition of DGASI, p. 107

Supreme Decree No 158-81-AG
The articles 87, 112, 134, 140, 144, 154 and 166 of the Regulations of Titles I, II and III of the Decree Law No 17752, approved by the Supreme Decree No 261-69-AP, are modified.
Promulgated : November 12, 1981
Published:
Legal Norm : Volume No 112, p. 106

Supreme Decree No 026-82-AG
In the Public Agricultural Sector, a Special Project called Private Project of Integral Development "PRIDI" is created.
Promulgated : February 25, 1982
Published : February 26, 1982
Legal Norm : 436 - p. 6840 (El Peruano, offical newspaper)

Supreme Decree 027-82-AG
The Directors of Agrarian Regions are authorized to extend, by resolution, the payment of tariffs for the use of water for agricultural purposes.
Promulgated : February 25, 1982
Published : March 3, 1982
Legal Norm : 442 - p. 6966 (El Peruano)

Supreme Decree No 005-82-SA
The tariffs for waste pouring in terrestrial or maritime waters of the country and for the use of sewage for irrigation purposes, referred to in the articles 207 and 208 of the Supreme Decree No 261-69-AP, promulgated on December 12 of 1969 and modified by Supreme Decree No 008-78-SA, of October 26 of 1978, are modified.
Promulgated : March 18, 1982
Published : March 20, 1982
Legal Norm : 466 - p. 9319

Supreme Decree No 122-82-AG
The Municipalities are responsible for fixing the value of the Right of Extraction of Non Metallic Materials deposited in the river-beds or watercouses.

The Ministry of Agriculture is responsible for granting the permissions for the extraction of non metallic materials.
Promulgated : October 28, 1982
Published : November 3, 1982
Legal Norm : 678, p. 11228

Supreme Decree 029-83-SA
The articles 197 and 199 of the supplement of the Regulations of Title III corresponding to the General Law of Waters, Decree Law No 17752 that was approved by Supreme Decree No 41-70-A, are modified.
Promulgated : August 19, 1983
Published : August 25, 1983
Legal Norm : 965 - p. 18262

Supreme Decree No 014-84-AG

The Beds and immediately bordering Areas of the rivers in the Coast of the country are declared in state of emergency.

Promulgated : February 24, 1983
Published : March 6, 1983
Legal Norm : 1159 - p. 23672

Supreme Decree No 018-84-AG

The beds and the immediately bordering areas of the rivers are considered within the scope of the measures contained in the Supreme Decree No 014-84-AG promulgated on February 24 of 1984.

Promulgated : April 5, 1984
Published : April 10, 1984
Legal Norm : 1194 - p. 2464

Supreme Decree No 067-84-AG

This decree modifies the article 5 and the Second Transitory Provision of the Regulations for the Granting of Uncultivated Lands and Waters for Irrigations, Private Projects of Integral Development and Other Agrarian Uses, approved by Supreme Decree No 019-84-AG promulgated on April 5 of 1984.

Promulgated : July 19, 1984
Published : July 21, 1984
Legal Norm : 1294

Supreme Decree No 103-84-AG

Clause (i) is appended to article 9 of the Regulations of Title IX corresponding to the Decree Law No 17752, "General Law of Waters"

Promulgated : November 15, 1984
Published : November 17, 1984
Legal Norm : 1414 - p. 30279

Supreme Decree No 007-85-AG

The tariffs for the use of surface water for non agricultural purposes are approved.

Promulgated : January 17, 1985
Published : February 2, 1985
Legal Norm : 1493 - p. 32336

Supreme Decree No 033-85-AG

The Regulations for the execution of soil surveys are approved.

Promulgated : April 12, 1985
Published : April 23, 1985
Legal Norm : 1493 - p. 34288

Supreme Decree No 047-85-PCM

The Regulations of the Legislative Decree No 313, "General Law of Expropriation" are approved.

Promulgated : June 21, 1985
Published : June 22, 1985
Legal Norm : 1634 - p. 35922

Supreme Decree No 009-86-AG
Lands suitable for cultivation, so qualified by the Ministry of Agriculture, are declared intangible for Urban Adaptation and Expansion purposes.
Promulgated : February 7, 1986
Published : February 8, 1986
Legal Norm : 1875 - p. 42280

Supreme Decree No 071-88-PCM
The Consolidated Text of the Basic Law of the Regionalization is approved.
Promulgated : June 12, 1988
Published : June 14, 1988
Legal Norm : 2830 - p. 65773

Supreme Decree No 035-89-AG

The Minimum Value of the component "Board of Users-Income" of the tariff for the use of water for agricultural purposes is fixed.
Promulgated : May 22, 1989
Published : June 4, 1989
Legal Norm : 3213 - p. 7493

Supreme Decree No 037-89-AG
The Regulations of the Water Users are approved.
Promulgated : May 26, 1989
Published : June 4, 1989
Legal Norm : 3213 - p. 74945

Supreme Decree No 036-89-AG
The scope of the Supreme Decree No 025-87-AG (Choque river) is extended for two more years.
Promulgated : May 26, 1989
Published : June 4, 1989
Legal Norm : 3213 - p. 74944

Supreme Decree No 102-89-AG
The Underground Waters are reserved for an Irrigation Project (Rio Grande - Puno).
Promulgated : December 13, 1989
Published : December 17, 1989
Legal Norm : 3415 - 80225

Supreme Decree No 103-89-AG
The scope of the Supreme Decree No 038-87-AG (Arma river - Arequipa) is extended for two more years.
Promulgated : December 3, 1989
Published : December 18, 1989
Legal Norm : 3415 - 80225

Supreme Decree No 003-90-AG
The Regulations of Tariffs and Fees for the use of water are approved.
Promulgated : January 29, 1990
Published : February 11, 1990
Legal Norm : 3471 - p. 81853 list of Errata published on April 2 of 1990, page 83328

Supreme Decree No 024-90-AG
Article 1 of the Supreme Decree No 108-89-AG is modified (the Excess Waters of the sub-basin of Rio Grande are given in favor of the communities of Aranea, Chuquino, Limata and Oriental, instead of the Development and Socioeconomic Promotion Corporation of Puno).
Promulgated : April 25, 1990
Published : May 13, 1990
Legal Norm : 3566 - p. 84781

Supreme Decree No 0015-91-AG
The minimum and maximum amounts of the fines established in the Title IX of the Decree Law No 17752, General Law of Waters, are updated.
Promulgated : April 25, 1991
Published : June 26, 1991
Legal Norm : 3984 - p. 97901

Supreme Decree No 134-91-PCM
Farmers of the frontier zone that use electric energy are given incentives.
Promulgated : August 24, 1991
Published : September 2, 1991
Legal Norm : 4057 - p. 99690

Supreme Decree No 0048-91-AG/OGA-OAD-UT
The Regulations of the Law for the Promotion of Investments in the Agricultural Sector are approved.
Promulgated : October 30, 1991
Published : November 11, 1991
Legal Norm : 4129 - p. 101634; Volume No 185, p. 208

Supreme Decree No 014-92-AG
The Autonomous Authority of the Hydrographical Basin of Jequetepeque is created, whose jurisdictional scope embraces the basins of Chaman and Jequetepeque rivers.
Promulgated : May 8, 1992
Published : May 30, 1992
Legal Norm : 4335 - p. 107207

Supreme Decree No 020-92-AG
The Autonomous Authority of the Hydrographical Basin of Chira-Piura is created, whose jurisdictional scope embraces the basins of Chira and Piura rivers and part od the sub-basin of Huancabamba river.
Promulgated : May 8, 1992
Published : May 30, 1992
Legal Norm : 4335 - p. 107207

Supreme Decree No 021-92-AG

The Autonomous Authority of the Hydrographical Basin of Chancay-Lambayeque is created, whose jurisdictional scope embraces the basins of Chancay, Lambayeque, Zaña rivers and part of the sub-basin of Chotano river.

Promulgated : May 8, 1992
Published : May 30, 1992
Legal Norm : 4335 - p. 107208

Supreme Decree No 037-92-AG

The Boards of Users and the Commissions of Users of Water for Irrigation nationwide are declared in reorganization, so that the Technical Administrators of the Irrigation Districts , in a period not later than 30 days counted from the publication of this Supreme Decree, proceed to call for elections in the respective Boards of Users and Commissions of Users of Water for Irrigation.

Promulgated : September 8, 1992
Published : September 9, 1992
Legal Norm : 4442 - p. 109076 Volume No 196, p. 146

Supreme Decree No 038-92-AG

This Decree specifies that the period of thirty (30) days, stated in the article 1 of the Supreme Decree No 037-92-AG, is also the period in which the call, suffrage, and proclamation of the candidates elected will have to take place to renew the Boards of Directors in the Commissions of Users of Waters for Irrigation and Boards of Users nationwide.

Promulgated : September 18, 1992
Published : September 20, 1992
Legal Norm : 4453 - p. 109284

Supreme Decree No 041-92-AG

The term for the reorganization of the Boards of Water Users and the Commissions of Users of Water for Irrigation nationwide (stated in the Supreme Decrees No 037-92-AG and 038-92-AG) is extended.

Promulgated : October 6, 1992
Published : October 8, 1992
Legal Norm : Volume No 197, p. 172

Supreme Decree No 211-EF

The tariff to be paid by the Users of Water for Non Agricultural Purposes is fixed.

Promulgated : December 21, 1992
Published : December 23, 1992
Legal Norm : Volume No 199, p. 312

Supreme Decree No 053-92-AG

The Regulations of the Organization and Functions of the Ministry of Agriculture and of its Decentralized Public Institutions are aproved.

Promulgated : December 22, 1992
Published : January 3, 1993
Legal Norm : p. 111743

Supreme Decree No 055-92-AG
The Regulations of Organization and Functions of INRENA are approved.
Promulgated : December 22, 1992
Published : January 16, 1993
Legal Norm : p. 112246
List of Errata of the Supreme Decree No 055-92-AG, published on January 18 of 1993.

Supreme Decree No 01-94-AG
The Regulations of the Organization and Functions of the National Project of Hydrographical Basin Management and Soil Conservation are approved.
Promulgated : January 7, 1994
Published : January 9, 1994
Legal Norm : 4939 - p. 120867

Supreme Decree No 005-94-AG
The Regulations of Organization and Functions of the Ministry of Agriculture are modified.
Promulgated : February 9, 1994
Published : February 10, 1994
Legal Norm : p. 120867

Supreme Decree No 46-94-AG
Provisions aimed at improving the administration of the Irrigation Districts and to strengthen the Organizations of Water Users are dictated.
Promulgated : September 16, 1994
Published : September 18, 1994
Legal Norm : El Peruano, 5191 - p. 126032

Supreme Decree No 49-94-AG
The Autonomous Authority of the Hydrographical Basin Chillon-Rímac-Lurín is created.
Promulgated : October 19, 1994
Published : October 21, 1994
Legal Norm : "El Peruano", 5224 - p. 126884

SUPREME RESOLUTIONS

Supreme Resolution No 0155-88-AG
The allotment of an entry called "National Board of Users of Irrigation District of Peru Self-Lien" is provided.
Promulgated : April 12, 1988
Published : April 18, 1988
Legal Norm : 2767 - p. 63993

Supreme Resolution No 033-94-AG
The nominations are annulled and Technical Administrators are appointed in diverse Irrigation Districts.
Promulgated : March 15, 1994
Published : March 16, 1994
Legal Norm : 5005 - p. 121651

MINISTERIAL RESOLUTIONS

Ministerial Resolution No 00617-81-AG-DGASI
Regulations of the Water Tariffs
Promulgated : July 10, 1981
Published : July 14, 1981
Legal Norm:

Ministerial Resolution No 0030-84-SA/DVM
The functions of control, surveillance, and sanction regarding the use of Sewage for Irrigation purposes are delegated.
Promulgated : February 27, 1984
Published : April 11, 1984
Legal Norm : 1195, p. 24676

Ministerial Resolution No 0239-93-AG
A Multisectorial Commission in charge of determining the 1992 Tariff of Waters for non agricultural purposes is constituted.
Promulgated : July 8, 1993
Published : July 11, 1993
Legal Norm : 4756 - p. 116207

Ministerial Resolution No 057-93-AG
The First Meeting of the National Network of Managements of Hydrographical Basins to be held in the city of Lima is made official.
Promulgated : November 30, 1993
Published : December 2, 1993
Legal Norm : 4901 - p. 119293

Ministerial Resolution No 00025-94-SA/DVM
The Tariffs referred to in the articles 207 and 208 of the Regulations of Titles I, II, and III corresponding to the General Law of Waters are fixed.
Promulgated : February 10, 1984
Published : February 17, 1984
Legal Norm : 1141 - p. 32202

Ministerial Resolution No 0369-94-AG
To start a registry of enterprises and institutions qualified to execute studies of environmental impact on the Agricultural Sector is resolved.
Promulgated : July 13, 1994
Published : July 15, 1994
Legal Norm : 5126 - p. 32202

VICEMINISTERIAL RESOLUTIONS

Viceministerial Resolution No 029-88-AG
The Regulations of Organization and Functions of the National Program of Basin Management and Soil Conservation are approved.
Promulgated : July 8, 1988
Published : July 12, 1988
Legal Norm : 2864 - p. 66679

Viceministerial Resolution No 001-90-AG/RNDR
The Regulations of the Coordination Committee of Waters and Irrigation are approved.
Promulgated : January 18, 1990
Published : January 30, 1990
Legal Norm : 3460 - p. 81489

DIVISION RESOLUTIONS

Division Resolution No 011-93-INRENA
The Tariffs of Services, Sale of Technical Information and other services offered by the General Direction of Waters and Soils are approved.
Promulgated : May 25, 1993
Published : June 1, 1993
Legal Norm : 4715 - p. 115305

Division Resolution No 054-93-INRENA
The requirements to be fulfilled by the personnel serving in the Boards of Water Users are regulated.
Promulgated : June 14, 1993
Published : September 23, 1993
Legal Norm : 4832 - p. 117753

Division Resolution No 109-93-INRENA
The term of the Resolution No 054-93-INRENA regulating the personnel number in the Boards of Water Users in the country is extended.
Promulgated : October 23, 1993
Published : December 2, 1993
Legal Norm : 4901 - p. 119301

DIRECTORAL RESOLUTION

Directoral Resolution No 001-94-AG-INRENA/DGAS
The Boards of Users and the Commissions of Users of Water for Irrigation of diverse Irrigation Districts are declared in reorganization.
Promulgated : September 26, 1994
Published : October 14, 1994
Legal Norm : "El Peruano", 5215 - p. 126734

CHAPTER V

THE AGRICULTURAL USE OF WATER

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CHAPTER V

THE AGRICULTURAL USE OF WATER

5.1 AGRICULTURE SECTOR

5.1.1 History of the Sector

The exploitation of the water resource through the execution of irrigation works has a long and rich history in Peru dating from the pre-Incas cultures. In the pre-Hispanic period, the agriculture under irrigation, that started in the Chavin culture more than 3,000 years ago, was based on small channels. From that time and until century XV, hydraulic works were executed which, even today, are worthy of admiration not only because of their complexity but also because of the adequate use of the water and soil resources that can be observed; and also because of the effective vertical integration of ecological floors in order to diversify their agricultural production. According to historians, in this period there were around 700,000 to 1,200,000 ha of lands under irrigation in the Peruvian Coast.

There are, in addition, numerous archeological evidences that prove that the ancient inhabitants knew techniques to extract water from the soil using networks of underground channels.

The little rainfall and the impossibility to develop a dry farming account for the construction of irrigation infrastructure in the Coast of Peru. The importance that maize cultivation had for the Andean cultures accounts for the development of the irrigation infrastructure in the Highland. Various irrigation systems that collected water from the snow-covered mountains and lakes and carried it through channels, many times carved in rock, were constructed in the Highland.

During the first quarter of century XX, the construction of irrigation works was started; thus, in the 1900-1980 period 210,510 ha of new irrigated lands were incorporated, and improvements actions were undertaken in 370,149 ha, totalizing 580,659 ha. In 1920 the first irrigation work, technically conceived since the pre-hispanic time, was started: the "Imperial" irrigation in the Cañete valley; plots smaller than 40 ha were sold to the private sector . In 1943 the first project formulated by the Directorate of Water and Irrigations was approved; this was the "Irrigation Improvement of 31,000 ha in the Low Piura and the Irrigation of 20,000 ha in the department of Piura. In 1948 the General Directorate of Waters and Irrigations of the Ministry of Promotion of Public Works prepared the first "National Plan of Irrigation and Irrigation Improvement Works".

Due to the lack of final studies, only very few of these works could be executed, among them, the most important work was the "Diversion of the Quiroz" from the basin of the Chira river to the basin of the Piura river. In 1950 the first stage of this work was started and, in 1955, the second stage whose most significant structure was the San Lorenzo dam, comprising the irrigation improvement of 31,000 ha in the valley of Piura.

At the present time, a promotion of investments from the private sector has been established in favor of this sector, encouraging the economic pluralism by allowing that any natural or juridical person has access to the land, and guaranteeing the private property;

also, propitiating a steady development and the financing of actions, mainly by the private sector. In turn, the public sector is responsible for the normative activities and activities of control and supervision of actions related to agriculture.

Historically, the agriculture and livestock sector has contributed significantly to the total production of the Peruvian economy. In spite of such contribution,measured in terms of its participation in the GNP, it has decreased in the course of time. In the 1950s, statistics showed an agricultural GNP of 24%; in the 1960s of 17%; and in the 1980s of 11%. From 1990 on, the agricultural GNP continues in a decreasing trend with a value of 9.9% until June of 1992. This value coincides with the lost of its importance as a work source; thus, whereas in 1970 45% of the labor force was used, in 1987 only 32% was used.

The agricultural export participation in total exports has also suffered a contraction in the course of time. In the 1960s, this participation was 30%; in the 1970s was 20%; and in the 1980s only a 10%. The agricultural and livestock balance of trade, for the 1970-1984 period, has moved from a positive balance of US $ 81 millions in 1970 to a negative balance of US $ 100 millions in the last years. This situation is partly due to the free import of farming and livestock inputs and products such as cereals, oleaginous products, dairy products, and others. A palliative to this low performance of the agricultural sector in the foreign front is that a great part of the so-called non-traditional exports in the industrial sector is based on farming and livestock products of traditional export such as textiles, cacao paste, asparagus, mangos and others.

As regards employment, the average rate of unemployment, that was 4.4% in the 1970-1975 period, became 6.4% in the 1976-1982 period, and 9.9% in the 1986-1988 period. It is estimated that for a Gainfully Employed Population (GEP) of 7.5 million of inhabitants, the current unemployment rate is of 16%. Until 1992, the traditional credit for the agricultural sector was granted by the State Development Banking through the Agrarian Bank of Peru (BAP), recently liquidated. This credit covered 40% of the active agrarian area. The economic policies of the present government, however, have deactivated such Development Banking, propitiating, this way, that the private Banking assumes that role.

5.1.2 Present Policies and Future Guidelines

As a recent policy, substantial changes in the management and administration of the water and soil resources have been introduced by virtue of the Legislative Decree No 653 promulgated on July 30 of 1991' "Law for the Promotion of Investments in the Agricultural Sector"; it is worth meentioning, among these changes, the following:

- The access to the land ownership is allowed to any natural or juridical person.
- A free tranfer of the agrarian property is permitted.
- A participative activity of the national and foreign agrarian producers, in the matter of water use, is propitiated by improving the irrigation system and exploiting the underground water and sewage to prepare lands for the agricultural, livestock, forestal or agrindustrial production. The agrarian activity is subject to the conditions of a social market economy.
- The participation of the water users in the administration, operation, improvement and maintenance of the irrigation infrastructure is ratified; their participation in the collection

of the water tariff and administration of these funds in the scope of their jurisdiction is ratified too. It is established that the water tariff be paid per unit of volume and at its real cost.

- The Authority of Waters is ratified in the administration of the water resources and the Autonomous Authorities of Hydrographical Basins are created (AAHB).

Article 101 of the above-mentioned Decree states that the use of surface water for agricultural purposes will be preferably destined to profitable crops and in good quality soils; such article establishes the following order of priorities in the use of water for agricultural purposes:

First: Direct consumption by livestock

Second: Irrigation of agricultural lands with existing irrigation systems.

Third: Irrigation of crops in agricultural lands with excess water using existing irrigation systems.

Fourth: Soil improvement

Fifth: Expansion of the agricultural area by means of irrigation.

On the other hand, the same Decree fosters the use of treated sewage for irrigation purposes; it also states that those users having invested, at their own risk, in the efficient use of water and underground water exploitation, will not suffer any reduction in their endowment of surface water.

The Ministry of Agriculture (MA) has pointed out a number of future guidelines to be followeed within the sector, including those related to the management of natural resources such as water. These guidelines can be summarized as follows:

1. Appointment and strengthening of the Water and Basin Authorities in charge of the water administration as well as of the collection of the respective water tariff in coordination with the Boards of Users and the Commissions of Users of Water for Irrigation.

2. Execution of actions in the following priority areas: technical management of irrigation water, recovery and maintenance of the irrigation and drainage infrastructure, recovery of degraded lands, use of underground water and treated sewage, investments in small and medium-sized irrigation schemes.

3. Elaboration of a policy for environment protection concordant with a sustained exploitation of our natural resources, biodiversity and preservation of the genetic material of the fauna, flora and forestry.

In the farming and livestock sector, some aspects in the use and management of the water resources must be improved further, such as, for example:

a) There should be a coherence between the crop schedule programmed in a specific valley and the resource availability.

b) It is necessary to take preventive measures in order to avoid harvest losses, whether because of the destruction of cultivated areas or the lack of the water resource, considering that events such as droughts, avalanches and floods occur in the practice, nationwide, with an annual regularity with different degrees of intensity.

c) Investment priority on rehabilitation projects when the water resource is available, rather than on projects for incorporation of new areas.

d) The producers that work in irrigated agriculture have a constant worry at the moment of the harvest: the selling price of their products which determines the profitability of their work.

5.2 WATER DEMAND OF THE SECTOR

5.2.1 Variations

The principal water uses are:population, agricultural, livestock, energy, mining, and industrial which, to different extents, have return waters of a variable quality.

5.2.1.1 Agricultural Use of Water

The use of water for agricultural purposes is the most exploited throughout the country. In the Coast region 100% of the agricultural area is under irrigation, 83.7% of this total has annual crops. In the Highland region, about 70% of the agricultural area is under dry farming (79% of the area has annual crops) and the ramainder is under irrigation. In the Jungle region 95% of the agricultural area is dry farming with 45% of annual crops. The agricultural area under dry farming uses the rainfall seasonally occurring in the Highland and Jungle regions. In the Coast region, the agricultural area under cultivation depends on the water availability for irrigation. The programming of the cultivated area is prepared by the Technical Administrations of the Irrigation Districts (ATDR) in coordination with the Board of Water Users.

During the last thirty years, the agricultural area under cultivation has remained balanced nationwide. The estimated monthly area under cultivation, in the Pacific Watershed, prepared in 1987, with slight modifications confirmed by the General Directorate of Waters and Soils (DGAS) in 1992, at the level of Hydrographical Units,is as follows:

Month Total ha	Aug. 361,321	Sep. 347,419	Oct. 434,494	Nov. 475,861	Dec. 520,534	Jan. 626,905	Feb. 645,615	Mar 664,950	Apr 691,807	May 677,727	Jun 672,416	Jul 568,894

The water demand amounts to a total of 14,200.27 mcm (87.29%) for the above-mentioned area. The water demand in the Atlantic watershed amounts to 1,996.278 mcm (12.27%) for a cultivated area of 246,317 ha, and in the Titicaca Watershed amounts to 71.077 mcm (0.44%) with a cultivated area of 6,096 ha.

5.2.1.2 Total water use and the relation between population, water availability and consumption

The total consumptive use of water in the country is 18,972 mcm; 85.74 % of this figure corresponds to agricultural use, 6.66% to population use, 1.09% to mining use, 6.09% to industrial use, and 0.42% to livestock use. The non consumptive use for energetic purposes is 11,139 mcm. At the watershed levels, the Pacific watershed consumes 86.97% of the national consumptive use; the Atlantic watershed consumes 36.26%, and the Titicaca one consumes 0.06%.

The total use of water for diverse purposes nationwide is summarized in Table 5.1.

TABLE 5.1
TOTAL USE OF WATER FOR DIFFERENT PURPOSES NATIONWIDE

	CONSUMPTIVE USE						NON CONSUMPTIVE	
	Agricult	Population	Mining	Industrial	Livestock	TOTAL	Energy	TOTAL
Pacific (mcm) (%)	14,200 (86.05)	1,018 (6.17)	152 (0.92)	1,103 (6 68)	28 (0.17)	16.501 (100.00)	4,245	4,245
Atlantic (mcm) (%)	1,996 (84.33)	228 (9 63)	53 (2.24)	49 (2.07)	41 (1.73)	2.367 (100.00)	6,881	6,881
Titicaca (mcm) (%)	71 (68.27)	18 (17.31)	2 (1.92)	3 (2.88)	10 (9 62)	104 (100.00)	13	13
TOTAL (mcm) (%)	16,267 (85.74)	1,264 (6.66)	207 (1.09)	1,155 (6.09)	79 (0.42)	18.972 (100.00)	11,139	11,139

Source: Basic Situational Study of the Water Resources in Peru, 1992-DGAS

With regard to the relation between availability, population and water consumption, it can be said that the Pacific Watershed with 60.35% of the national population only has 1.69% of the total of the water resource. However, its water consumption represents 87.02% of the national consumption. The Atlantic Watershed with 34.84% of the national population has 97.81% of the water resource, being its consumption 12.43%. The Titicaca Watershed with 4.81% of the national population only has 0.5% of the water resource, being its consumption 0.54%. The relations availability/population in m_3/inhabitants are obviously wider in the case of the Atlantic Watershed having more water resources; and more critical in the case of the Pacific Watershed where the water resources are scarce. The relation consumption / availability is 400 times higher in the Pacific Watershed than in the Atlantic Watershed and 40 times higher than in the Titicaca Watershed, as shown in Table 5.2

TABLE 5.2

WATER RESOURCE AVAILABILITY AND ITS RELATION WITH POPULATION AND CONSUMPTION

WATERSHED	Population (P)		Availability (A)		CONSUMPTION (C)		A/P RELATION	C/A RELATION
	(Inhab)	%	(mcm)	%	(mcm)	%	(m3/inh)	(%)
Pacific	14,482,025	60 35	34,624	1 69	16,501	86 98	2,390	47 65
Atlantic	8,360.061	34.84	1,998,751	97 81	2,367	12.47	239,083	0.12
Titicaca	1,154,099	4.81	10,172	0 50	104	0 55	8,813	1.02
TOTAL	23,996 185	100 00	2,043,547	100 00	19,278	100 00	250,286	0 94

More than half of the area under irrigation and of the users involved in the agricultural activity of the Coast are subject to the irregularities of the annual and interannual water regimes. So the water resource availability is subject to a marked variation for them. In the Highlands, the production volumes and possibility are strongly related to the climate conditions since they are affected by adverse phenomena (droughts, freezes, etc.)

5.2.2 Quality of the return waters

Faced with the lack of a national study about the quality of the water for diverse purposes, INRENA is carrying out an inventory nationwide of the water quality. This study is about to be published and based on it, very important results are being obtained such as a new classification of water for different purposes and the determination of the principal focuses of pollution nationwide with different intensity degrees.

An advance of the mentioned study concerning the river pollution in the country is presented in the following summary:

RIVERS WITH THE HIGHEST POLLUTION AND RISK PARAMETERS

RIVER	RISK PARAMETER
Huallaga	Nitrates, copper, dissolved oxygen
Llaucano	Copper, zinc, cadmium and lead
Santa	Total coliformes, copper, lead, cyanides nitrates
Rímac	Total coliformes, copper, lead, cyanides
Pisco	Salinity, cadmium, nickel, lead, cyanide, arsenic
Locumba	Salinity, mercury, cadmium, nickel, arsenic
Mantaro	Nitrates, cadmium, copper, lead, zinc
Moche	Mercury, cadmium, copper, lead, arsenic

5.3 USE EFFICIENCY IN DIFFERENT CROPS AND REGIONS

There should be a coherence between the crop schedule programmed in a specific valley and the resource availability; otherwise, it will be impossible to approve the crops and irrigation plans when it is impossible to have availability of the water resource.

At the present time, some contradictions are found in valleys with shortage of surface water where rice and sugar-cane crops are programmed, instead of sowing more profitable crops and with the least water demand. In modern agriculture under irrigation, due to the fact that the costs are high and the fertilizer and insecticides input have a strong repercussion, the crops need to be oriented towards export in order to have an acceptable profit.

5.3.1 Efficiency of gravity irrigation

The efficiency of gravity irrigation includes three (3) components: conduction, distribution and application efficiency; as a whole, they permit to calculate the irrigation efficiency. It is commonly expressed in terms of fraction or percentage and is the relation between the amount of water consumed by the plants and the total amount of water coming from the source.

Table 5.3 shows the efficiencies obtained in each valley; this information has beeen collected by technical staff of the General Directorate of Waters and Soils of the Ministry of Agriculture based on documents of the former ONERN and of former PRONADRET.

The application efficencies measured in each valley show a variation range between 30% and 72% with an average of 35%; they reach their highest values in the basins of Chancay-Huaral, Chillon, Rímac, San Juan, Pisco, Moquegua and Tacna.

The irrigation through furrows and ridges has an efficiency relatively above the average, especially in the valleys near Lima, what leads to think of a possible correlation between: proximity to a secure market and greater irrigation efficiency. The valleys of Ocoña, Camana, Santa and Lacramarca present low application efficiencies (around 30% and 35%) due to the use of wells as an irrigation method for rice cultivation. At present, the valleys show a low irrigation efficiency because of the following causes:

- Although the Government and farmers have worried about introducing some agronomical improvements such as better varieties , phytosanitary control and fertilization, among others, very little or nothing has been done to improve the practices of irrigation water use and management; likewise, there is very little research on irrigation at the plot level.

- The irrigation techniques employed are mostly empirical and subject to the farmer's judgement. The irrigation intervals are fixed according to: habits, availability, or changes observed in the development of the crops, so permanent activities of technological transfer are necessary.

- The existence of channels without lining causes big losses due to the accumulation of filtration originating salinity and swamping problems in the low zones of the valleys.

- An excessive length of channels without lining, employed for the service of certain plots, aggravates the filtration problem.

- Irregular section of channels, in some cases distorted by effect of badly executed cleaning works.

- Serious defects in the design of channels.

- The existing deterioration of the irrigation infrastructure that includes from a lack of measurement and control systems to, in some cases, collapsed channels.

The above mentioned points indicate the necessity to restore and improve the existing irrigation, drainage and road infrastructure, parallel to the training and assistancee to the users' organization.

TABLE 5.3

EFFICIENCIES-IRRIGATION METHODS AND PREDOMINANT CROPS PER VALLEYS

VALLEY	EFFICIENCIES (%)			IRRIGATION METHOD	PREDOMINANT CROPS
	STAGE(1) CONDUC	STAGE(2) APPLICAT	STAGE (3) IRRIGATION (1)X (2)		
TUMBES	80	50	40	Furrows and pits	Rice, Fruit bananas
CHICAMA	85	40	34	Furrows	Sugar-cane, Maize, Dried vegetables
MOCHE	88	38	33	Furrows, ridges	Sugar-cane,Maize, Alfalfa
VIRU	77	56	43	Furrows	Maize, Sorghum, Sweet potatoes, Asparagus
CHAO	77	56	43	Furrows	Maize, Sorghum,Fruit trees
SANTA	75	35	26	Furrows, ridges and pits	Sugar-cane, Sugar, Rice Maize, Alfalfa
LACRAMARCA	75	35	26	Furrows, ridges and pits	Sugar-cane, Rice Alfalfa, Maize
NEPEÑA	74	45	33	Furrows, ridges	Sugar cane, Maize Alfalfa
CASMA	75	53	40	Furrows	Maize,Cotton,Dried veget
HUARMEY	75	53	40	Furrows	Maize,Dried vegetables Yucca, Cotton
FORTALEZA	85	50	42	Furrows	Sugar-cane,Maize, Potato
PATIVILCA	85	50	42	Furrows	Sugar-cane, Maize, Potato
SUPE	85	50	42	Furrows	Maize, Sugar-cane
HUAURA	85	52	44	Furrows, ridges	Maize,Dried veget.,Cotton
CHANCAY-HUARAL	75	60	45	Furrows	Maize, cotton, Potato citrus fruits
CHILLON	75	60	45	Furrows, Ridges	Maize,Sweet potato,Alfalfa
RIMAC	75	60	45	Furrows, ridges	Food crops and gardens
LURIN	75	55	41	Furrows, ridges	Fruit trees, Maize, Sweet potato, tomato
MALA-OMAS	75	51	38	Furrows, ridges	Cotton, Banana, Maize, Potato
CAÑETE	75	60	45	Furrows	Cotton, Potato, Sweet Potato,Maize,Fruit trees

Source: Information given by DGAS, Ministry of Agriculture

TABLE 5.3

EFFICIENCIES-IRRIGATION METHODS AND PREDOMINANT CROPS BY VALLEYS

VALLEY	EFFICIENCIES (%)			IRRIGATION METHOD	PREDOMINANT CROPS
	STAGE(1) CONDUC	STAGE(2) APPLIC.	STAGE (3) IRRIGAT (1) X (2)		
SAN JUAN	70	60	42	Furrows	Cotton, Maize, Grapevine
PISCO	70	60	42	Furrows and Ridges	Cotton, Maize, Pallares, Pastures
ICA	60	55	33	Furrows and Ridges	Cotton,Grapevine,Pastu Dried Vege ,Pallares
GRANDE	60	55	33	Furrows and Ridges	Cotton, Citrus fruit,Maize Dried Veg ,Alfalfa
ACARI	75	42	31	Furrows, Ridges	Maize, Alfalfa
YAUCA	75	42	31	Furrows, Ridges	Olive tree,Maize,Alfalfa
CHALA	75	42	31	Furrows, Ridges	Olive tree,Alfalfa,Maize
CHAPARRA	75	42	31	Furrows, Ridges	Olive tree,Maize,Alfalfa
ATICO	75	42	31	Furrows, Ridges	Olive,Fig tree, Alfalfa
CARAVELI	75	42	31	Furrows, Ridges	Grapevine, Wheat, alfalfa
OCOÑA	78	30	23	Furrows, Ridges	Rice, bean, Maize
CAMANA	78	30	23	Furrows, Ridges	Rice, Bean, Maize
MAJES	69	45	31	Furrows, Pits	Rice, Bean, Maize
ILO MAQUEGUA	70	72	50	Flood, Furrows and pits	Alfalfa, Wheat,Barley , Maize,Dried veg.,Olive tree
LOCUMBA	67	49	33	Flood and Furrows	Alfalfa, Wheat, Barley, Maize, Fruit trees
SAMA	72	42	30	Furrows, Ridges	Maize,Pastures,Potato
CAPLINA	72	42	30	Furrows, Ridges	Maize,Olive tree, Potato

Source: Information given by DGAS, Ministry of Agriculture

5.3.2 Efficiency of pressurized irrigation systems

The pressurized irrigation is not very much spread in Peru yet, but it has been developing slowly in the last 20 years. At present, there are around 17,720 ha nationwide under this kind of irrigation system; 16,000 ha of this total are located in the Coast.

In Table 5.4 the geographical distribution of the different pressurized irrigation systems used in Peru is shown.

TABLE 5.4

PRESSURIZED IRRIGATION SYSTEMS USED IN PERU

IRRIGATION SYSTEM	COAST	HIGHLAND	JUNGLE	HIGH
ASPERSION Conventional aspersion	X	X	X	X
Drift	X	X	X	X
Irrigation Machines	X	-	-	-
LOCALIZED Dripping	X	+	-	-
Microaspersion	X	+	-	-
Exudation	X	-	-	-

X = used
+ = used only in some places
- = information not available
Source : DGAS-MA

The zone having the major area with pressurized irrigation is the Southern Coast of the country, where aridity and the resulting shortage of water resource makes theoretically the best of its use.

The Majes and Joya irrigations in Arequipa, the Yarada in Tacna, and many farms in the flat lands of Pisco and Villacuri are the places where the pressurized irrigation systems are mostly spread.

There are no studies that measure the real irrigation efficiency being obtained in the field with these systems. The irrigation efficiency as a quantified value is not commonly determined; only high efficiencies in qualitative terms of production and productivity are reported. Those dedicated to grow asparagus in Ica and olive trees in Tacna are included in this group.

Some values of irrigation efficiency, compiled by the technical staff of the General Directorate of Waters and Soils - DGAS of the Ministry of Agriculture, are shown in Table 5.5.

TABLE 5.5

IRRIGATION EFFICIENCY VALUES BY SYSTEMS AND TECHNOLOGICAL LEVEL REACHED

IRRIGATION SYSTEM	TECHNOLOGICAL LEVEL		
	LOW	MEDIUM	HIGH
IRRIGATION BY ASPERSION			
-Drift	0.65	0.70*	0.80
-Irrigation machine	0.65	0.70*	0.80
-Conventional aspersion	0.60*	0.70*	0.75
LOCALIZED IRRIGATION			
-Dripping	0.80	0.85*	0.90 -0.95
-Microaspersion	0.80	0.85*	0.90
-Exudacion	0.75	0.85	0.90

* Values generally found in Peru

Source: DGAS-M.A.

5.3.3 Agricultural production, efficient use of water and competitiveness of agriculture

Some problems in the use of water for agricultural purposes, as well as regarding the production, productivity and commercialization of the products have arisen in some of the big irrigations financed by the Peruvian Government; this problems has spread to other irrigated lands within the national agriculture.

The production of fruit trees and food crops for domestic consumption of the country is not profitable because this consumption has already been satisfied and any additional production at a large scale does not find a market.

Before the agrarian reform of the decade of the 1970s, put into force by the military government, the farmers had the posibility of growing industrial products such as sugar-cane and cotton. With the agrarian reform, these crops became inefficient, the yields decreased to anti-economic levels and large extents of these crops were eliminated.

Today, the markets Peru had have largely been lost. The Peruvian cotton known before by its great quality, now is practically unknown in the international market.

Many of the most efficient farmers are at present trying to enter the international market of fruits and vegetables. This endeavour demands a great sophistification by the farmers, both because of production problems and marketing problems.

With regard to production, the conquest of market, especially in the industrialized countries, requires two elements:competitive costs and adequate quality. Peruvian farmers in order to satisfy these two requirements have been forced to introduce new varieties and new production systems. In relation to quality, a product that not only adjusts to the demand but also fulfills the phitosanitary conditions demanded by the importing countries is required. Regarding this latter aspect, the Peruvian farmer has had to try to export product by product because of the need to overcome serious diseases and infestations that do not exist in the receiving countries.

This situation has led the farmers to try to win markets product by product. Up to now, mangos, asparagus and, among animals, llamas and alpacas, are being exported. In addition, efforts are being made to export grapes and citrus fruits.

As regards commercialization, there are a number of problems to be solved by the farmers, such as: the control made by the phitosanitary department of the USDA in the shipment place in Peru, the availability of effective and rapid transportation to the foreign markets, the entrance of the market through appropriate representatives in the importing countries, an efficient distribution system and, finally, the product selection and an adequate packing.

The Association of Exporters of Peru has a committee in charge of the fruit and vegetables sector which is already doing a systematic job in order to achieve the product by product export.

The Ministry of Agriculture is working on a national fruit program.

An important aspect under consideration is that of the Peruvian agriculture competitiveness. There are some excellent studies carried out by Peruvian economists in this matter. Competitiveness implies to determine the most favorable crops, from an ecological point of view, to be grown in the country so they can compete in the international market.

There is a large quantity of microclimates in Peru. Thus, with an adequate technology, the yield of many crops allow their entrance in the international markets in the most diverse seasons.

Without too much effort, some crops are already being exported from the country without facing a big competition due to their high yields and high quality obtained by ecological reasons. This is the case of the asparagus in the coastal zones of Trujillo and Ica.

On the other hand, some Chilean industrialists are considering the possibility of buying land in the Chavimochic irrigation for tomato production, due to the same ecological reasons.

As regards the institutional situation and the human resource availability to facilitate the export of these agricultural products and conquer international markets, Peru has a series of positive factors, but efforts in other sectors are also needed.

To begin with, the present government's policies have created a favorable climate for these export activities. The reduction of the bureaucracy in the government has reduced, to the least, the steps needed for these activities.

On the other hand, it is necessary to reinforce the governmental institutions that guarantee the control of quality of the exported products as well as the phitosanitary control.

Likewise, many associations of farmers know the general direction to be taken in order to develop new export lines. However, more experience in the operational aspect must be acquired to gain the export markets which have to be conquered product by product.

The dialogue with other Latin-American exporting countries is needed to discuss common policies necessary faced with the protectionist and, sometimes, excluding policies of the industrialized countries. This dialogue has already been initiated.

5.4 EFFECTS OF THE SECTOR ON THE QUALITY OF WATER

In many parts of the world, serious pollution problems have been presented because of the use of fertilizers, insecticides, fungicides, herbicides, and other chemical products employed as an input in the agricultural production. As a result of this pollution, a great number of these chemical substances have been prohibited in the most developed countries, because they are highly toxic for the fauna, flora and the human being. National systematic studies about the pollution problems these chemical inputs are causing, due to their generalized use in agricultural production, have not been carried out in Peru. It is also known that, under certain circumstances, the problem becomes worse. For example, in the case of surface waters dragging chemical wastes to certain lakes or lagoons, the concentration of these products can increase to the point that they start to affect seriously the natural flora and fauna of the lakes.

In the case of the fertilizers, the most notorious problem is caused by nitrogen. The maximum permissible level of nitrates in the water is a concentration of 50 mg per liter. In the case of the insecticides, fungicides and herbicides, the toxicity level varies from one component to another. The use of many of them has been forbidden in the most developed countries. The lack of information existing in the country about the situation of the pollution caused by these substances becomes a serious problem, especially because export products can be rejected in the world market for containing very small quantities of these substances that are normally detected in the importing countries. Apart from this fact, however, it is of vital importance for Peru to start the carrying out of systematic studies about the problem in order to avoid the water pollution and the pernicious effects not only on the flora and fauna but also on the population health.

5.5 AREAS IN CONFLICT

5.5.1 Between the sector and other uses of the water

The general planning for a good water resource management is based on the comparison of two basic parameters: water availability and demand, both coherent with the physical aspects of the territorial environment. Nevertheless, the variation of the water element and the reaction of man give rise to a complex of interactions capable of originating conflicts with relation to the water resource availability and quality. These conflicts can be divided into three groups:

a) Conflicts created by the excess of the water resource or rain intensity and that have aleatory character and produce the following effects: flood and natural erosion.

b) Conflicts created by the shortage of the water resource and that have aleatory character too and directly affect water availability: aridity and droughts.

c) Conflicts created by a bad management of the water resources or the incoherence in water and soil management in the basin. This kind of conflicts arises because of man's negative actions on the environment and can embrace: shortage, erosion, and water pollution.

The historical analysis and demand projections of the water resource in Peru and the relation with the water resource potential reveals the following:

a. An inverse distribution between population and their economic activities, and the water resource availability. In this regard, it must be pointed out that the Coast, where these resources are scarce in relation to the Highlands and Jungle, presents the largest economic and social concentration. This difference tends to strongly increase if the following fact is considered: in 1972 the Coast region concentrated a total of 6.5 million of inhabitants (46% of the total population of the country); while in the year 2,150 (prospective horizon at a very long term), it will house 37.0 million of inhabitants; this is almost six (6) times the population of 1972. These figures give an idea of the situation and the tendency the water demands will have not only for population use but also for farming and livestock, industrial, and energy use.

b. Peru like most of the countries in the world is facing the consequences of the world energy crisis. Hence, with the purpose of dealing with this crisis adequately, it has been decided to use at its maximum in the next decades the hydroelectrical potential available in the country, estimated in 65,000 MW. This decision will imply a greater pressure on the water resource but, in turn,the utilization of a non polluting energy source.

c. The farming and livestock problems and, basically, those of agriculture under irrigation that affect directly and negatively the production and productivity are, among others, the following: the imperative need to regulate the irrigation by means of dams; the existing inefficient systems of impounding, conduction, distribution and control; and the inefficient exploitation of underground waters. This leads us to the need to expand the agricultural frontier and to use the natural resources intensively. To achieve this, a big effort to improve and enlarge the cultivated lands in the Coast and Jungle, as well as to exploit integrally those existing in the Highlands (irrigation, fertilization and forestation) will have to be made. This aim will imply the incorporation of 2 or 3 million hectares of new lands in the next twenty years, with the resulting use of important water resources.

d. The need to foster the economic and social development of the country means an intense exploitation of our mining potential and the implementation of an aggressive industrialization program. For this reason, the Government is carrying out actions to get a direct involvement of private investments. In most cases, this does not imply a great demand of water, but means the continuous pollution of the water resources that flow into the watersheds with the resulting decrease of the natural availability.

5.5.2 Situation of the water resource

Regarding the situation of the water resource, some regions require greater and immediate attention; these are:

a. The Rimac river so that it can satisfy the different demands, principally the population and energy demand of the capital of the country.

b. The present critical situation for the supply of Moche river where the city of Trujillo is situated.

c. One situation that tends to be similar to that of the city of Lima is that visualized in the city of Arequipa since its water supply source, the Chili river, is being exploited more and more intensely; as a consequence there are virtually no immediate possibilities to regulate it. The demand is increasing and will continue increasing by effect of the population growth, the expansion of the agricultural frontier, the industrial development and the growth of the mining demand.

d. Regarding water demands for population, industrial, energy and agricultural use, the departments of Moquegua and Tacna require, both in the medium-term and long-term, the search and immediate localization of new water resources, as well as the conservation of the existing ones, considering the present and future water use in important areas of this region.

5.5.3 Solution alternatives

In view of the situation of potential conflict that may arise in some basins, as it has been pointed out in the above paragraphs, it is important to pay special attention, in the coming years, to this conflict possibilities in the use of water for different purposes or by different subsectors. On the one hand, it would be convenient to study the solution alternatives in matters referred to an increase of the supply and to the elimination of pollution. On the other hand, it is important to establish policies leading to the priorization of the water use for certain purposes and to the creation of a superior authority responsible for solving or settling conflicts when they arise. Based on what has been mentioned and other aspects that require attention, it is necessary to undertake the following:

- To carry out the systematization of the water resources in order to make their use properly compatible at the sectorial and regional level in order to accomplish the national aims and objectives.

- To propose an adequate policy with regards to inventories, evaluation, research, use, conservation and preservation of the natural resources, as well as an adequate institutional framework as part of a planning system.

- To set up a national program for the treatment of sewage and polluted waters of mining, industrial and other uses; as well as an educational program about the importance of an adequate use of water.

- The situation of extreme unbalance in the relation population/water resource must be paid preferential attention, and political and economic support must be given by the Government and private investment. This should be done by implementing regional development plans and territory improvement policies, in other words, the development of the interior of the country must be intensified.

5.6 INSTITUTIONAL STRUCTURE

With the object of undertanding clearly the institutional structure of the organizations that have any responsibility in the policy definition or in the management of water with agricultural purposes, it is convenient to analyze first the institutional structure of the Ministry of Agriculture, principal responsible of the actions carried out in the sector of use of water for agricultural purposes.

The Decree Law No 25902 "Organic Law of the Ministry of Agriculture" states the purpose, scope, competence, and function structure both of the Ministry and its decentralized offices.

The scope of the Agricultural Sector comprises the lands of agricultural, sheepherding, forestal use, and animal husbandry of agricultural nature; also the watercourses and beds of the rivers and their banks; the waters of rivers, lakes and other aquiferous sources for agricultural use; the hydraulic infrastructure for agricultural production; forestal resources, flora and fauna, the crops, animal raising, silviculture, exploitation of wood and wild products; the pertinent services in the matter of agrarian technology, protection and agrarian health; matters related to natural resource conservation and management; the agrindustry, agri-export and the commercialization of products and inputs.

The Agricultural Sector is composed of the natural and juridical persons related to the agricultural production in a national scope: the Ministry of Agriculture as the central and governing body, its Agrarian Regions in a regional and local scope, its Decentralized Public Bodies at a central, regional and local level. The Ministry of Agriculture has the following functions:

a) To formulate, coordinate, and evaluate national policies concerning the Agricultural Sector in the matter of preservation and conservation of the natural resources;

b) To supervise and control thee fulfillmeent of the present laws and regulations in the agrarian matters;

c) To establish the conditions that allow free participation of the agrarian productive agents;

d) To promote the private investment participation in the development of the Agricultural Sector;

e) To promote the operation of a National System of Research and Transference of Agrarian Technology;

f) Others assigned by law.

5.6.1 Organic Structure of the Ministry of Agriculture

a) Top Management

- Minister of Agriculture
- Vice-Minister of Agriculture

b) Advisory Body

- Agrarian Advisory Council

c) Body of Control

- General Inspectorate

d) Counsel Body

- Department/Office of Agrarian Planning
- Department of Juridical Counseling

e) Support Bodies

- Department of Agrarian Information
- Department of Administration

f) Deconcentrated Bodies

- Agrarian Regional Directions

g) Decentralized Public Bodies

- National Institute of Agrarian Research - INIA
- National Institute of Natural Resources - INRENA
- National Service of Disease Control - SENASA

5.6.1.1 Deconcentrated Bodies

The Agrarian Regional Directorates carry out the activities of the Ministry of Agriculture at the regional level and promote the activities related to the productive sector within the extent of their jurisdiction.

The Agrarian Regional Directorates that embrace more than one department can have Agrarian Regional Subdirectorates and, in all cases, will have Agrarian Agencies and Agrarian Districts.

The Agrarian Agencies and the Agrarian Regional Directorates constitute the first and second instances, respectively, in the matter of administrative procedure.

5.6.1.2 Decentralized Public Bodies

The Decentralized Public Bodies of the Ministry of Agriculture have legal capacity of public domestic law and technical, administrative, economic and financial authonomy.

- **NATIONAL INSTITUTE OF NATURAL RESOURCES**

It is an organization in charge of promoting the rational and integral use and exploitation of the renewable natural resources in order to achieve a steady development.

INRENA has the following functions:

a. To propose, coordinate, conduct, and agree upon the policies for a rational use and conservation of the renewable natural rsources.

b. To identify, survey, evaluate, and supervise permanently the renewable natural resources so that their conservation, preservation and rational exploitation be possible.

c. To coordinate with public and private sectors the use and conservation of the renewable natural resources.

d. To propose policy and norm guidelines in matters of basin management.

e. To assess the environmental impact of the agrarian projects in order to introduce corrective measures, if necessary, and to perform the follow-up of these measures; and

f. Other functions applicable accordingg to the legal provisions in force.

A. Organic Structure of INRENA

The organic structure of INRENA is the following:

GOVERNING BOARD

- Board of Directors

TOP MANAGEMENT

- Chief

CONTROL BODY

- Office of Internal Control

COUNSEL BODY

- Planning Office
- Juridical Counseling Office

SUPPORT BODIES

- Administrative Office

SPECIALIZED BODIES

- General Directorate of Waters and Soils
- General Directorate of Forestry
- General Directorate of Protected Areas and Wild Fauna
- General Directorate of Studies and Projects on Natural Resources
- General Directorate of Rural Environment

a. General Directorate of Waters and Soils

The General Directorate of Waters and Soils is the body in charge of proposing policies, plans and norms concerning the sustainable use of irrigation water and soil resources, and of supervising and controlling their exeecution. In turn, it is responsible for controlling and promoting the rational use, the conservation and preservation of these resources.

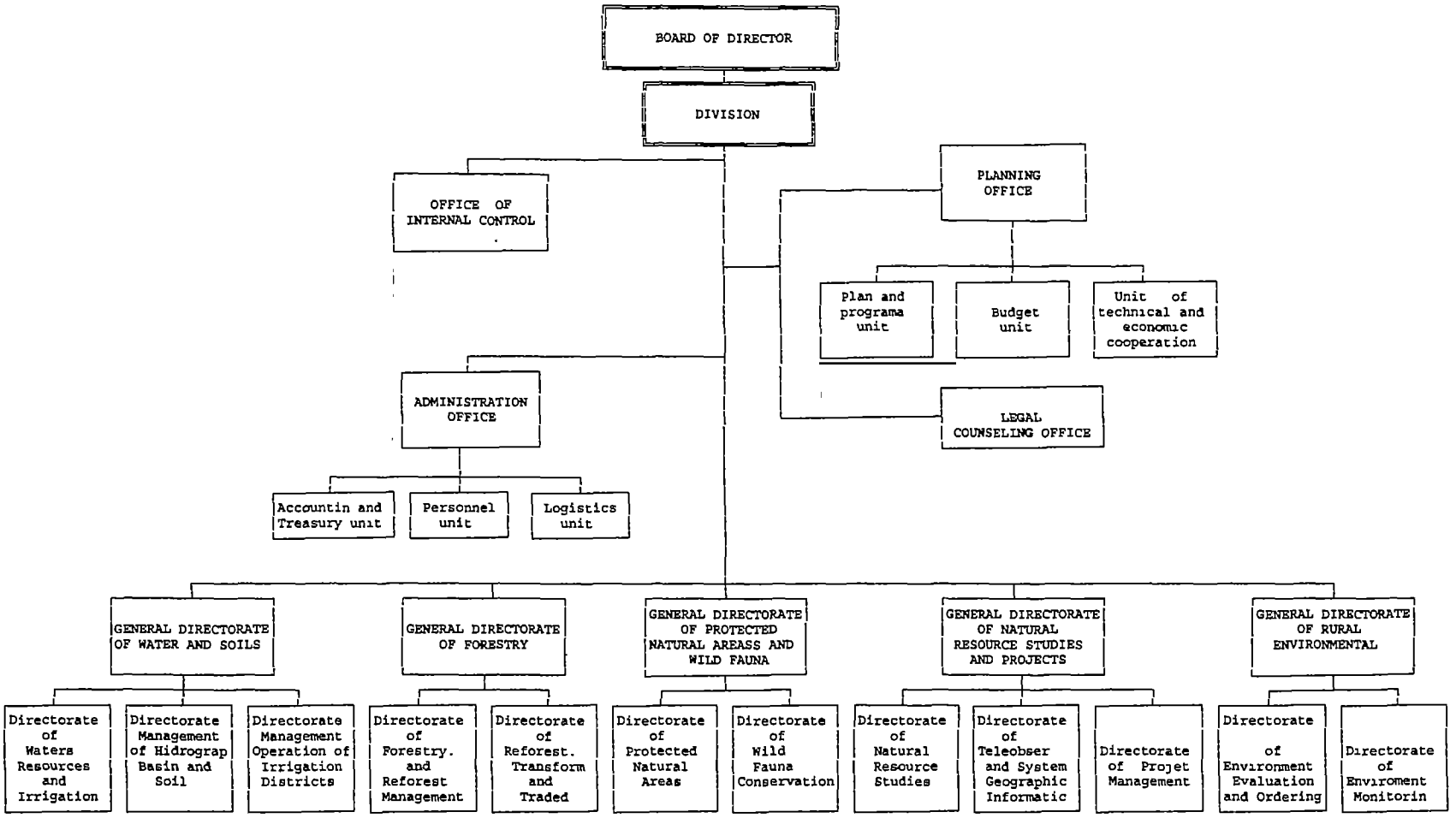
The structural chart of the National Institute of Natural Resources is attached to this document for a better understanding, Figure 5.1.

The human resources that INRENA had available for 1994 were in total 191, distributed as follows: 48, between executives and directors; and 143 as part of the administrative personnel.

For 1994, INRENA had an approved assignment of the Central Government of 250,000 nuevos soles for studies (Pre-Investment) within the Water Balance Sub-Program .

FIGURE Nº 5.1

STRUCTURAL CHART OF THE NATIONAL INSTITUTE OF NATURAL RESOURCE - INRENA
(D. LAW, 25902 - S.D. 055-92-AG)



5.7 POLICIES OF THE SECTOR

Guidelines of agrarian policy have been defined in Peru, that have a great potential as an orientating and promoting element of the reactivation of the agrarian sector, in general, and of the agriculture under irrigation, in particular. The principal guidelines are the following:

5.7.1. Social

- Guarantee to: private property, title documents and property registry, granting of uncultivated lands, and plot concentration.

- Management of natural resources that favors an efficient and sustainable agriculture.

5.7.2 Financial

- Land prices will be subject to market conditions.
- Free commercialization, both external and internal, of agrarian inputs and products.
- Restructuration of the financial system; the National Development Banking acts as a "second floor" to support the Rural Savings and Credit Banks. Promotion of Revolving Funds for Inputs.
- Public investment is oriented to complement the private investment. The tendency towards big irrigation projects is going to be corrected by increasing the resources assigned to research and transfer of farming and livestock technology and by propitiating a greater competition and natural selection between public and private organizations which form the national system of generation and transfer of farming and livestock technology.

5.7.3 Institutional

- Reorganization and restructuration of the state system in the agrarian sector triying to improve operativeness and efficiency.

- Research and technology transfer based on public and private institutions, giving more emphasis to the latter with the participation of producers' organizations.

- Appointment and reinforcement of the authorities of water and basin management in charge of the water administration with agricultural purposes, as well as of the collection of the respective water tariff; this in coordination with the Boards of Users and the Commissions of Users of Water for Irrigation.

- Execution of actions in the following priority areas: technified management of irrigation water, recovery and maintenance of the irrigation and drainage infrastructure, recovery of degraded lands, utilization of underground waters and treated sewage, investmest in small-size and medium-size irrigation works.

- Elaboration of a policy for the environment protection concordant with a sustained exploitation of our natural resources, biodiversity, and preservation of the genetic material of flora, fauna and forestry. In this context, the programs and proyects of internationl cooperation oriented towards a rational and sustainable management of pastures and camelidae will be strenghtened; likewise, those programs contained in the National Program of Forestal Action will be fortified.

- The National Program of Basin Management and the works for soil and water conservation will be declared of national interest in orden to increase their potential. This task would start in the middle, high Andean and top forest zones.

- In the matters of irrigations, priority will be given to the maintenance of irrigation and drainage infrastructure, as well as the development of small-size irrigation projects.The different irrigation projects will be strictly evaluated in order to give priority to their execution in accordance with the resource availabilty and, especiallly, the profitability of the project.

5.8 OTHER INSTITUTIONS RELATED TO THE USE OF IRRIGATION WATER

There are institutions, both from the public sector and the private sector that participate, to different extents, in the management and rational use of the water resources of the country. Some of them are briefly defined below indicating their participation in the sector.

a. National Project of Management of Hydrographical Basin and Soil Conservation - PRONAMACHCS

It is a decentralized technical body dependent on the Vice Ministry of Agriculture and whose objetive is to design, promote and execute administrative, technical and management strategies and actions for an integral use of hydrographical basins through soil conservation, reforestation and rural infrastructure, for the purpose of protecting and exploiting rationally the renewable natural resources, and the human and capital resources of the high Andean zones.

The work scope of this project is mainly the Highlands with an effective presence in 16 departements and 29 provincial agencies having as a basis 200 microbasins located in 18 hydrological basins.

In order to face the improvement of the irrigation infrastructure, this project has national coverage in the 24 departments of Peru, having greater incidence on high-Andean and socially depressed zones.

b. National Institute of Development - INADE

It is one of the bodies dependent on the Ministry of the Presidency; it is in charge of the direction of hydraulic projects nationwide; the works can be executed by administration on by contract.

c. Water users' organizations

By water user is understood any natural or juridical person that uses the water under a licence regime and is registered in the respective water use list; these users must be organized in Commissions of Users of Water for Irrigation and Boards of Users. These organizations are non-profit, of an indefinite term and must have their address in the territorial jurisdiction where they operate.

The water users' aim is to achieve the active and permanent participation of their members in the development, conservation, preservation and rational use of the water and soil resources, in accordance with the provisions arisen from the water authority, and according to the General Law of Waters and its Regulations.

d. Non Governmental Organization of Development

A large number of Non Governmental Organizations of Development have been constituted in Peru. These Organizatios have a nationwide participation in the execution of studies and small-size and medium-size hydraulic works, as well as in the training, expansion and agricultural development, among others. They also represent an important option to assist the water users' organizations in the transition to an efficient and autonomous management in the scope of their responsibilities.

5.9 MARKETING OF IRRIGATED FARMING PROJECTS

The Executive Power has promulgated Legislative Decrees where the norms aimed to promote the private investment on infrastructure works and public services are contemplated; one of these is the Legislative Decree No. 758 "Law for the Promotion of Private Investments". By virtue of these norms, the Goverment is empowered to grant, in concession, the construction, repair, maintenance and/or exploitation of infrastructure works and public services to national or foreign juridical persons, through the procedures of Public Auction or Competitive Bidding. This law provides the general norms applicable to the infrastructure works and public services that can be granted in concession to private investors; this way the possibilities of private investments on infrastructure are adequately promoted and spread, both in the country and abroad.

5.9.1 National Markets

The Privatization Plan of infrastructure works and public services of the Projects under the responsibility of INADE is based on the legal provisions conferring them the responsibility to foster the private sector's participation in the execution and development of the projects, in compliance with the SD No. 189-PCM, legally based on the following decrees:

- Legislative Decree No.261 (June 24, 1983) Law of the creation of INADE and the Regulations of INADES'S Organization and Fuctions.
- Supreme Decree No. 153-90-PCM, it considers the Investment Projects as National Projects.
- Decree Law No. 25553 (June, 1992) - INADE reassumes the conduction and direction of the diverse projects.
- Legislative Decree No. 757, law acting as a frame for the growth of the private investment.
- Legislative Decree No. 758; norms for the Promotion of Private Investments in the Public-Service Infrastructure.
- Supreme Decree No. 189-92-PCM, regulations of the Private Investments in Infrastructure Works and in Public Services.

The general objetive of this activity is to transfer, to the private sector, the construction, repair, maintenance and exploitation of hydraulic infrastruture works for irrigations and energy, and public services related to the projects under the responsibility of INADE. The Supreme Decree No. 027-93-PRES, published on January 28 of 1994, authorizes the

Hydraulic Special Projects of INADE: Chira - Piura, Olmos -Tinajones, Jequetepeque - Zaña, Chavimochic and Majes to grant, in concession, the major hydraulic infrastructure of the above mentioned special Projects, as well as of the Irrigation Districts of San Lorenzo and Regulated Chili to the private sector. These services will be financed by means of the payment made by the users of new areas and existing valleys benefitted by the Project for the "rent and amortization" concept of the tariff of water for agricultural use.

The actions performed within the Plan of Promotion to the Private Investments in INADE'S projects are the following:

- Auction of lands with major or minor irrigation infrastructure.
- Concession of the operation and maintenance of the major irrigation and drainage infrastructure.
- Concession of hydroelectric plants.
- Identification of project packages: irrigation and energy infrastructure, technological package, and farming-livestock and agrindustrial development.

5.9.2 International Markets

The experience in other countries has shown that the private sector, through the concession system, contributes to the financing of infrastructure works and public services, becoming, this way, a fundamental element for economic development. In this sense, Peru has regulations of the Private Investments in infrastructure works and public services approved by Supreme Decree No 189-92-PCM.

Likewise, the activities necessary for the promotion of these works and the benefitted lands, both for the national and international market, are being implemented.

5.10 INFORMATION LIMITATIONS THAT AFFECT THE SECTOR PERFORMANCE

5.10.1 Identification

The process for the insertion of Peru in the International Financial System demands necessarily a full knowledge of the global problems intended to be solved and which have led to request the respective financial assistance. In Peru, the problems of the agricultural sector, especially those related to the water resources, have not been typified nor defined appropriately with the detail the mentioned process requires. As a consequence, the existing deficient information makes it difficult to elaborate proposals that allow to direct the investments needed to encourage the raise of this sector.

The irrigation works executed in the country have evidently had a positive overall impact on the areas involved. However, so far the results are considered heterogenous, but still positive, because, in most cases, they do not agree with the proposal of the project documents. At the regional and local level, the following effects are obvious: increase in the production, productivity and intensity in soil use; however, costs and tendency deserve analysis and discussion too, therefore a bank of updated information is needed.

As regards the area under irrigation in the country and the state of the infrastructure used, the information available is incomplete and inconsistent. This fact is due to the following reasons:

- Breaking of the information channels by effect of the regionalization process; and these have not been replaced.

- Withdrawal of key human resources and discontinuity in the statistical system due to the reduction of the State system and the fiscal austerity measures.

- Dispersed and, many times, contradictory information. In the case of the Highlands, this situation is due to the large number of projects involved and the different executors participating in the work, mainly at the regional level.

5.10.2 Recommendation of strategies to overcome the limitations

a. To reinforce the National Information System under the responsibility of INRENA to make possible the continuation and updating of the national inventories regarding information about water resources and soils, as a basic aspect when deciding on the plans of water exploitation nationwide.

b. To provide the Irrigation Districts with systems of computer-assisted information, through a bank of data; this should be information that permits to propose the most adequate planning at the short, medium and large-term.

c. It is necessary to have information related to private investments, among them, those executed by the NGOs so as to not duplicate actions and investments.

5.11 INTERNATIONAL COOPERATION

5.11.1 Assistance Programs

In accordance with the Legislative Decree No 719, Law of International Technical Cooperation (C.T.I.) dated November 19 of 1991, the National Institute of Natural Resources-INRENA has prepared the Program of International Technical Cooperation for the 1993-1995 period. This Program is composed of projects and/or studies which can appear into three forms:

- Projects under execution
- Projects under negotiation
- Priority for new applications

There also records of projects considered under the form of TCDC (Technical Cooperation among Developing Countries). The formulation and execution of the national policy of international technical cooperation has been assigned by the Government to the Executive Secretariat of International Technical Cooperation (SECTI) dependent on the Ministry of the Presidency. This department has set up the administrative, technical, normative elements which determine the formulation process of the cooperation request.

5.11.2 Investment Programs

5.11.2.1 NATIONAL INSTITUTE OF NATURAL RESOURCES-INRENA

At present, INRENA is carrying out 14 projects of International Technical Cooperation whose relation is shown in Table 5.6. For the purpose of better organizing the ITC program, five (5) working lines are given which, in turn, have three (3) programs:

I Forestal Development, Flora and Wild Fauna

a. Assistance program for the forestation as part of integral rural development.
b. Program for forestal management and exploitation.
c. Program for wild fauna management and conservation.

II Institutional Strenghtening

III Irrigation and Drainage Improvement

a. Small-size and medium-size irrigation systems.

IV Development of Protected Areas

a .Implementation and development of protected areas.

V Systematization of Hydrographical Basins for Environment Management

a. Programs of agriecological zoning.
b. Programs of environmental monitoring.

TABLE 5.6

INRENA'S INTERNATIONAL TECHNICAL COOPERATION PROJECTS UNDER EXECUTION

PROJECTS	LOCALIZATION		OBJECTIVE	COOPERATING SOURCE
	DEPARTMENT	PROVINCE		
I FORESTAL DEVELOPMENT, FLORA AND WILD FAUNA				
Reforestation in Rioja.	San Martín	Rioja	To contribute to the reduction of the negative effects of wood felling through reforestation and enlargement of the Agricultural Frontier developing extension, training and forestal research activities	International Tropical Wood Organization (OIMT)
Management and Exploitation of the National Wood Alexander Von Humboldt	Ucayali	Coronel Portillo	To elaborate a management plan on 105, 000h of the National Wood Alexander Von Humboldt in order to use the Natural Resources of the wood, under the sustainable yield concept.	International Tropical Wood Organization (OIMT)
Agricological System of Communal Management in the Northern Coast of Peru – Mesquite tree Project	Lambayeque	Chiclayo Lambayeque Ferreñafe	To improve the standard of living of the rural inhabitants through a maintenable use of the natural resources, especially of the dry woods of the Northern Coast of Peru.	Netherlands Government (Holland)
Peruvian Project of Primatology OPS	Loreto	Iquitos	Conservation and sustainable exploitation of the non human primates and environment in order to obtain scientific, economic, social and cultural benefits, considering the present and future generations' needs. It is executed by IVITA of the UNMSM.	Pan American Health Organization of (OPS) World Health Organization (OMS)
Implementation and Development of Protected Areas	Nationwide		Preservation and conservation of representative samples of the ecosystems of the country and of the processes generating them. Preservation of the biological diversity of these ecosystems.	GTZ Germany
Deforestation Monitoring in the Peruvian Amazonia	Loreto		To design a monitorin methodology of the deforestation through satellite images.	IMPE – Brasil
Creation of a National Fund nationwide for natural areas protected by the Government FONAMPE	Nationwide		To establish a trusteeship fund to strenghten the National System of Natural Areas Protected by the Government (SINAMPE)	Global Environment Facility (BEF)

to be continued

TABLE 5.6

INRENA' S INTERNATIONAL TECHNICAL COOPERATION PROJECTS UNDER EXECUTION

continuation

PROJECTS	LOCALIZATION		OBJECTIVE	COOPERATING SOURCE
	DEPARTMENT	PROVINCE		
II IRRIGATION AND DRAINAGE IMPROVEMENT				
Sub Sectorial Program of Irrigation (FAO)	Multidepartmental (Coast)	Several	To allow the users' participation in the design of the proposals of pre-investment studies and raise the organization and management level for an effionet performance of their organizations in the operation and maintenance of the adjusted systems	World Bank (BM)
Surface Water Balance of 53 Hydrographical Basins of the Pacific Ocean Watershed	Nationwide	Several	To elaborate the surface water balance of the 53 basins of the Pacific Watershed	UNESCO Regional Office of Science and Technology for Latin America (ROSTLAD)
III HYDROGRAPHICAL BASIN ORDERING FOR THE ENVIRONMENTAL MANAGEMENT				
Pilot Study of Environmental Ordering of the Pisco-Paracas-Ica Area	Ica	Pisco	To develop an Environmental Ordering Plan for the coastal zones and Marine Areas of the South East Pacific.	Permanent Commission of the South Pacific (CPSS)
Collection of Referential Soils and Data Base of Peru.	Lima	Lima	To establish the soil collection and the data base for Peru.	International Center of Information and Referential Soils (ISRIC) Holland
IV INSTITUTIONAL STRENGTHENING SUPPORT				
Regional Project of Participative Forestal Development in the Andes of Peru.	Nationwide (Highlands		Regional Project that embraces Ecuador, Colombia, Bolivia, Peru and is strengthening the national institutes so that they can better assist the rural communities in the natural resources use and management, and in the forestal resource use and management.	Netherlands Government (Holland)
Action Plan against deserted lands	Nationwide (Coast)		To determine the degradation surface of lands suitable for agrioulture and forestry	United Nations Development Program

5.11.2.2 NATIONAL INSTITUTE OF DEVELOPMENT - INADE

The investments used come from funds of the Peruvian Public Treasury, as well as capital proceeding from International Agreements.

The projects under INADE's responsibility are found at different stages of development. The studies and/or work execution programmed for the 1994-1996 period are the following:

Projects in the Coast

1 Puyango-Tumbes (Binational)
2 Chira - Piura
3 Olmos
4 Tinajones
5 Jequetepeque - Zaña
6 Chavimochic
7 Chinecas
8 Majes - Siguas
9 Tacna
10 Pasto Grande

Projects in the Jungle

11 Jaen-San Ignacio - Bagua
12 Huallaga Central - Bajo Mayo
13 Madre de Dios
14 Pichis Palcazu
15 Alto Mayo
16 Alto Huallaga
17 Rio Putumayo (Binational)

Projects in the Highland

18 Central-South Highland
19 Cachi River
20 Lake Titicaca (Binational)

The geographical ubication of each of the above-mentioned projects is shown in the map of Peru, Figure 5.2.

5.12 OPERATIONAL MATRIX

Figure 5.3 shows the operational matrix of the steps to be taken to apply for International Technical Cooperation.

FIGURE 5.2

AREAS ENCOMPASSED BY INVESTMENT PROJECTS OF INADE

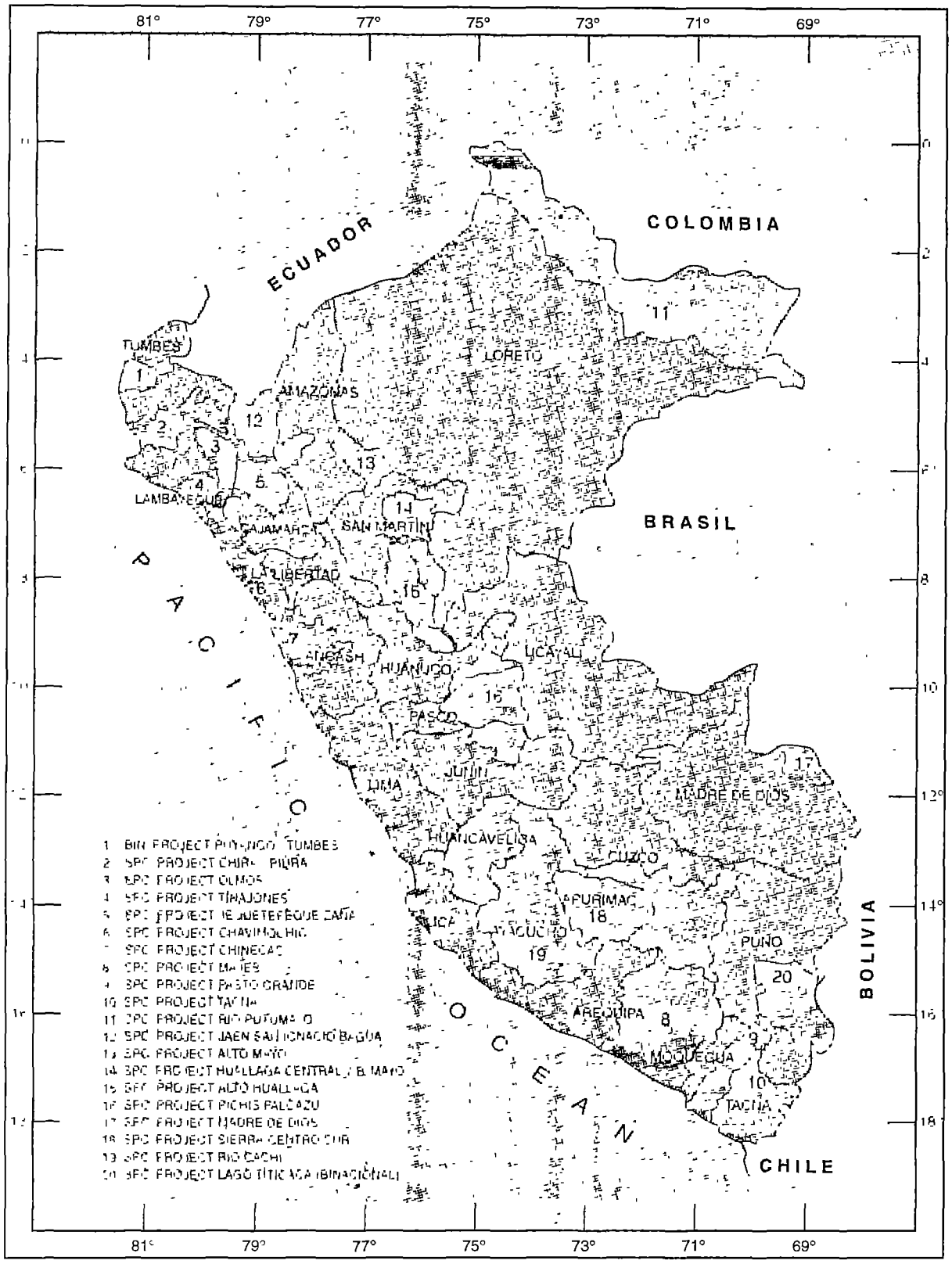
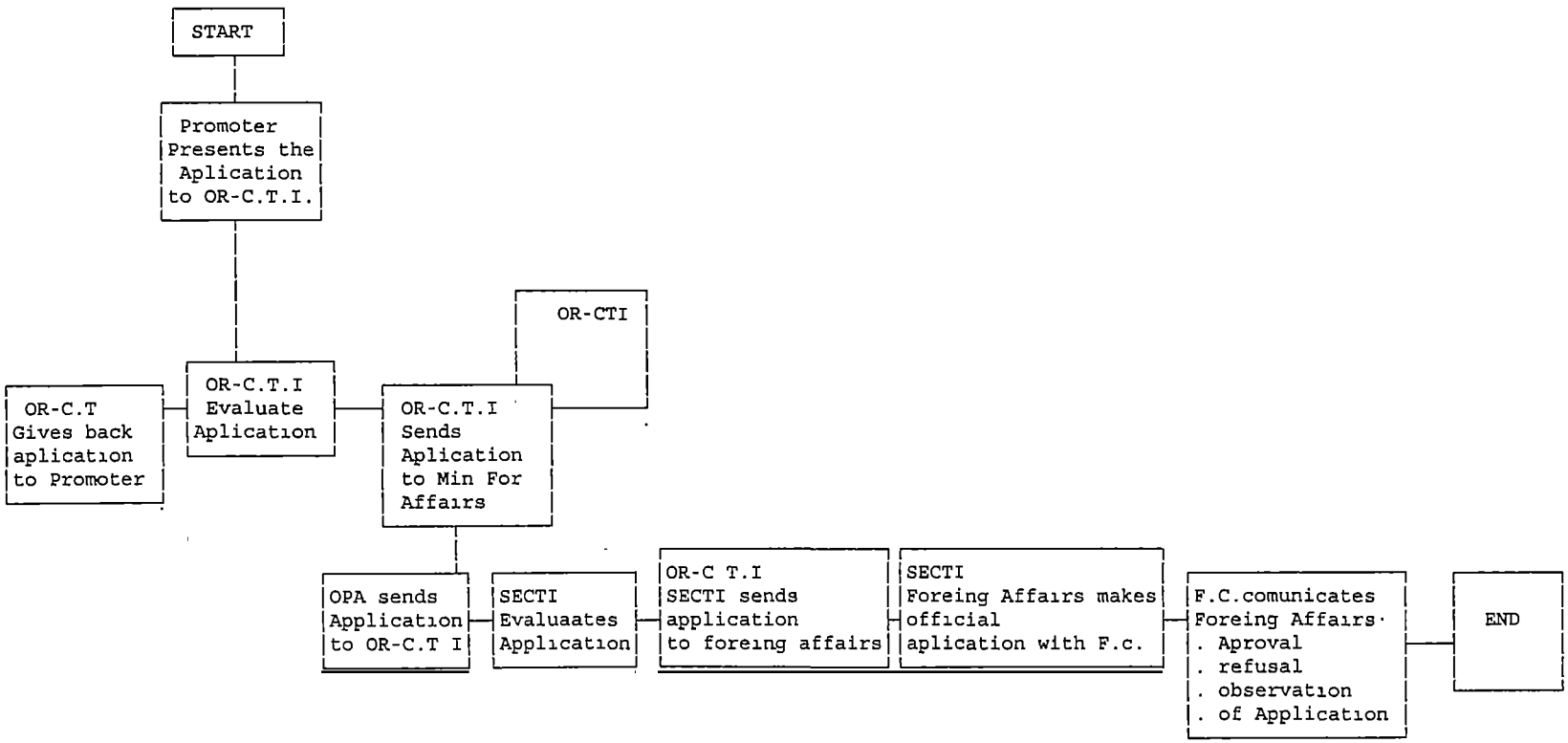


FIGURE 5.3

PROCEDURES FOR THE HANDLING OF APPLICATIONS FOR INTERNATIONAL TECHNICAL COOPERATION



CHAPTER VI

DRINKING WATER AND SANITATION

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CHAPTER VI

DRINKING WATER AND SANITATION

Historically, in our country, Basic Sanitation has been understood as the rendering of drinking water and sewerage sevices only, without taking into account other services, such as the public cleaning and pluvial sewerage. Additionally, such rendering of services was divided into two areas:

a) the urban environment comprising all those urban centers over 2,000 inhabitants; and,
b) the rural environment where locations under 2,000 inhabitants are grouped.

The responsibility of assistance to both groups corresponded to different Ministries. Thus, the population of the urban area was assisted by the Construction and Housing Ministry while that of the rural area was assisted by the Health Ministry.

6.1 HISTORICAL EVOLUTION

6.1.1 In the urban area

The native irrigation channels and the first drainage structures, still existing in Metropolitan Lima, were built by different ethnic groups settled in the Rimac River valley approximately 2,000 years B.C.

After the foundation of Lima in 1535, the water supply and drainage system was forming a network of little superficial ditches along the middle of the streets, supplying public fountains and receiving the sewage that finally discharged into the native irrigation channels.

In the 1860s, as a result of the population growth and the persisting epidemics, the Government and the Municipality installed underground sewers as an effective sanitation method, well known in Europe. However, they continued depending on the native irrigation channels for the final discharge of such water. It was just in the 1920s when the bases for the current system of Lima's sewerage were established.

The institutions of the Sanitation Sector have evolved in the last years, according to the institutional transformation that the country has had as a whole and where we can identify three periods:

a. First period

Until the middle of the 1980s, except in some isolated cases like in Metropolitan Lima and in the most dispersed and smallest populations, the drinking water and sewerage services of the urban centers were managed in a very centralized manner by the State, following a tendency to a planning and global management of the services, according to the general pattern in many Latin American countries.

The pattern, valid for its time and circumstances, is based on a public service concept that should be financed and even subsidized by the State. Its main goal is the total coverage of

the service needs for sanitary reasons. For this pattern, the entrepreneurial efficiency, although permanently searched, remains in fact relegated to a second place.

In this way, the ex "Subdirectorate of Sanitary Works" from the Ministry of Economic Development and Public Works was created. In turn, it was transformed into the former "General Directorate of Sanitary Works" when the Housing Ministry was created in 1969.

Subsequently, by Legislative Decree No. 150, the State company National Service of Drinking Water and Sewerage Supply (SENAPA) was created in 1981, substituting such General Directorate and absorbing the so-called Autonomous Companies of Lima, Arequipa, and Trujillo. In this way, SENAPA was formed with a Main Enterprise integrated by about 15 Affiliate Enterprises (which in time had a management increasingly independent) and about 10 operative units throughout the country.

If with SENAPA the centralized pattern does not change in the denomination of the central entity, the "Sanitary Works" concept, that gives priority to the construction of installations, changes by that of "Drinking Water and Sewerage Services" which emphasizes the attention to the user.

It is important to stress that parallel to this centralized organization, the drinking water and sewerage services in approximately 200 urban localities that gathered 20% of the total urban population have continued being managed directly by the Provincial and/or District Municipalities in that period, a situation that still endures.

b. Second period

In the middle of the 1980 and also following a similar tendency in other Latin American countries, a decentralization process starts with the promulgation of Laws No. 23878 and 24650 and its annexes and amplifying Laws and Decrees by which the country is divided into 12 regions, according to the precepts of the 1979 Constitution.

The regionalization process was not totally implemented, especially due to legal interpretative problems and to the lack of an adequate legislation that would consider the competence and relations of the Central Government, the regions and the Municipalities.

However, in the case of the drinking water and sewerage services at the urban level, a drastic transformation is produced, perhaps not clearly planned. As a matter of fact, in April 1990, Legislative Decree No. 574, complemented by Legislative Decree No. 601, provides the transfer of all the Affiliate Enterprises and Operation units of SENAPA to the Provincial and District Municipalities, and establishes that SENAPA be transformed into an enterprise in charge of only giving technical assistance to such Municipalities. Likewise, this provision established that the attention to the rural and urban areas is responsibility of the Construction and Housing Ministry and, for such purpose, the Basic Sanitation Directorate is created. However, this was never implemented.

At present, the new 1993 Constitution establishes the responsibility of the Municipalities in the rendering of public services, while the regions are responsible for the coordination and execution of regional socio-economic plans. Likewise, its Article No. 197 establishes: "Regions support local Governments. Neither they substitute them nor duplicate their action or competence." What is provided would be in accordance with the Regionalization

laws still in force, the same that do not authorize the regions to render drinking water and sewerage services. Such function is assigned to the Municipality Governments at a provincial level, according to the Municipalities Organic Law (23853) and the new Constitution.

c. **Third period**

In the middle of the decentralization process which has not been completed yet, new transforming forces appear.

The State, esentially questioned for its inefficiency, tends to be reorganized and rationalized, creating at the same time the conditions to make the participation of private investment in public service operations possible.

In this framework, a series of actions and legal provisions are given. Such actions and provisions have been changing the surroundings, and, therefore, have obliged to carry out the adjustments that would permit to achieve an adequate organization. Here are enumerated the main ones:

- Legislative Decree No. 674 of September 1991 promotes the private investment in the State enterprises.

- Legislative Decree No. 627 of November 1991 promotes the private investment in the Sanitation field at an exploitation of the services level, leaving to the Municipalities the decision of granting the respective license.

- In May 1992, by means of Decree Law No. 25491, the merge of the Construction and Housing Ministry with the Transportation Ministry is approved. The transfer of SEDAPAL to the Ministry of the Presidency is also disposed, separating it totally from the rest of the sector that remained in the Transportation Ministry.

- In June 1992, the Organic Law of the Ministry of the Presidency disposes the transfer of SENAPA to the Ministry of the Presidency.

- In September 1992, Decree Law No. 25738 orders that all the functions of the Sanitation Sector be developed by the Ministry of the Presidency - ViceMinistry of Infrastructure, establishing the transfer of the General Directorate of Basic Sanitation (not implemented), of the Executing Unit of the National Program for Drinking Water and Sewerage, and of the Tariffs Commission (CORTAPA).

- In December 1992, Decree Law No. 25965 creates the National Superintendency of Sanitation Services as the organism in charge of proposing the norms for the rendering of sanitation services, supervising the rendering of such services, promoting the development, and evaluating the performance of the entities which render services. Parallel to this, Decree Law No. 25973 declares in dissolution and liquidation the enterprise National Service of Drinking Water and Sewerage (SENAPA).

6.1.2 In the rural area

The evolution suffered by the institutional structure of the sanitation services in the urban area was also reflected in the rural area.

In fact, services started to be promoted from 1962 on when Law No. 13997 is promulgated, stating that the Public Health Ministry through the Directorate of Rural Basic Sanitation (DISABAR) be in charge of them. Thus, services created were given to Administration Boards formed by settlers for their management, operation, and maintenance.

DISABAR organized its activities through 17 offices of Rural Basic Sanitation. When Regionalization occurred, these offices began to depend on the Social Affairs Secretariats of the Regional Governments. DISABAR was, therefore, in charge only of the not-yet-established Lima/Callao Region and of the technical advisory actions in the rest of the country.

Parallel to Decree Law No. 574 ("Law of Organization and Functions of the Construction and Housing Ministry"), the Legislative Decree No. 584 ("Law of Organization and Functions of the Health Ministry") was promulgated. The latter, among other aspects, assigns this organism the formulation, normativeness, coordination, supervision, and evaluation, at a national level, of the Basic Sanitation policies, protection of the environment, etc. The equipping functions, rehabilitation and conservation of equipment, construction of physical infrastructure and rural basic sanitation were transferred to the Regional Governments.

Such functions apparently overlapped the ones determined for the General Directorate of Basic Sanitation and Environment of the Construction and Housing Ministry. It is understood that this function should be interpreted in the scope of the competence of the Health Ministry.

6.2 COVERAGE AND SERVICE CHARACTERISTICS

6.2.1 Service Coverage

Tables 6.1 and 6.2 show the way in which the coverage percentage both in drinking water and in sewerage have varied. We can also see that the situation at the national level deteriorated steadily. In spite of a certain growth, this occurred at a very slow rate in Metropolitan Lima.

When making a comparison of the drinking water services with other South American countries, we can see that Peru holds the second to the last place before Bolivia and Paraguay (Table 6.3), and with respect to sewerage, it is in the penultimate place before Bolivia.

TABLE 6.1
COVERAGE OF DRINKING WATER AT THE URBAN LEVEL

YEAR	NATION	NATIONAL (Without Metropolitan Lima)	METROPOLITAN LIMA (Sedapal)
1982	63.0	60.7	67.4
1983	63.6	61.2	68.0
1984	62.9	62.0	64.6
1985	66.2	64.1	70.0
1986	67.2	64.0	73.1
1987	73.0	67.8	76.4
1988	73.5	63.3	79.0
1989	74.0	62.7	80.1
1990	75.3	66.5	83.2
1991	74.4	67.8	79.5

SOURCE: - Annual Reports of SENAPA and SEDAPAL
- Technical Inventory of Localities SENAPA

TABLE 6.2
COVERAGE OF SEWERAGE AT THE URBAN LEVEL

YEAR	NATION	NATIONAL (Without Metropolitan Lima)	METROPOLITAN LIMA (Sedapal)
1982	55.8	52.5	61.8
1983	56.6	53.7	62.0
1984	56.4	53.4	61.8
1985	64.1	63.9	64.4
1986	61.2	57.0	68.9
1987	61.6	56.0	71.9
1988	59.8	52.0	74.4
1989	57.7	48.0	75.7
1990	59.0	41.0	78.1
1991	62.0	45.0	75.1

SOURCE: - Annual Reports of SENAPA and SEDAPAL SEDAPAL
- Technical Inventory of Localities SENAPA SENAPA

TABLE 6.3
COVERAGE OF DRINKING WATER AT SOUTH AMERICAN LEVEL AS OF DECEMBER 1988

COUNTRY	COVERAGE OF DRINKING WATER
Brazil	96
Venezuela	89
Colombia	88
Chile	86
Uruguay	85
Argentina	64
Perú	58
Ecuador	58
Bolivia	46
Paraguay	33

SOURCE: "Ingeniería Sanitaria" Journal by AIDIS
Vol XLIV Nos. 1 y 2 Jan/June 1990

In the rural area, the available information shows a much lower coverage. Only 23.7% of the population has access to water supply services and only 17.4% has access to sewerage services.

The National Superintendency of Sanitation Services has obtained the last preliminary figures related to sewerage and drinking water coverage at a national level. See Table 6.4 However, the service coverage should be interpreted with other general indicators, like the fact that data does not separate the drinking water access cases by house services or by public fountains, the quality of the services due to hours of coverage and the quality of drinking water.

TABLE 6.4
COVERAGE OF DRINKING WATER AND SEWERAGE AT A NATIONAL LEVEL

COVERAGE	POPULATION	DRINKING WATER			SEWERAGE		
		Attended population		%	Attended population		%
		Inhabitants	Families (*)		Inhabitants	Families(*)	
NATIONAL	22,128,466	13,458,445	2,691,689	61	10,761,922	2,152,384	49
Urban	15,567,602	11,795,604	2,359,121	76	9,725.550	1,945,110	62
Rural	6,560,864	1,662,841	332,568	25	1,036,372	207,274	16

(*) According to 1981 Census 5 inhabitants/dwelling
SOURCE: Special Project National Program of Drinking Water and Sewerage PRONAP-PRES May 1994 (preliminary figures)

6.2.2 Service characteristics

A Drinking water

a. Quality

With respect to the quality of water, there are not too exigent controls at the national level. Only in the main cities, which sum approximately 62% of the total urban population, there is regular monitoring regarding the control and surveillance of the quality of water. In the rest of the urban cities in the country, there is a total abandonment.

Among the most important reasons for such problem, we can mention the following:

An inadequate implementation of the majority of the existing labs.

Inexistence of a permanent Monitoring Program.

Lack of an adequate operation and maintenance of most of the treatment plants in the country.

Disinfection in the main cities is controlled adequately, while in the rest of the administrations there is no technical management.

Outdating of the Technical Norms of Control and Surveillance of the quality of water, in relation to the requirements and the national reality.

There is no qualified personnel on the operation and maintenance of treatment plants and labs.

Together with this problem, there is an absence of surveillance of the quality of water by the Health ruling entities of the country (Health Ministry).

b. Quantity

The water production levels in most of the sites exceed the required quantities for covering the maximum daily demand. The national average supply per capita is 287.4 lts/inhabit/day, an acceptable value. However, the high percentage of leakages in the system, added to the waste of house service, clandestine and without water meters, unbalance the drinking water system, showing us apparent deficits in the structure.

c. Continuity

Important indicators to evaluate the continuity of the drinking water service are the number of hours per day that such service is offered and the adequate conditions of pressure in the system.

In our country, 72.6% of the urban attended population has 16 to 20 hours of drinking water service daily, the majority of this population is concentrated in Metropolitan Lima. Only 7.82% of the population has a service longer than twenty hours.

Ranks of Service Hours	Percentage of Attended Population
0 - 5	1.15%
6 - 10	10.74%
11 - 15	7.69%
16 - 20	72.60%
21 - 24	7.82%

B Sewerage

a. Sewerage System

Just as the water distribution network, the collecting one presents the same problem of pipelines with many years of service. They have constant obstruction which cause floodings in the streets.

If we observe in Table 6.5, the national average of the network/connection index is 8.1 mts/connection, but if we analyze the characteristics of our cities, we should reach an average of 11 mts/connection.

TABLE 6.5
INDEX NET/CONNECT SEWERAGE

REGION	(m/conn)
Loreto	N/A
Andrés A. Cáceres	8.1
Arequipa	5.9
Gran Chavín	9.8
Grau	5.1
Inca	9.0
José Carlos Mariátegui	10.0
Libertadores-Huari	6.4
Lima - Provincias	8.8

Lima - Callao	8.8
Nor Oriental del Marañón	6.1
San Martín - La Libertad	7.9
Ucayali	4.5
Average	8.1

b. Emission, treatment, and final disposal

The emission at the national level presents a sufficiently installed capacity with a surplus average of 54.1%.

One of the main sanitation problems of the country is the contamination through sewerage and its final disposal in cultivated fields or rivers. In the urban sector, there are 38 sewerage water treatment plants, which in their majority are not permanently evaluated. According to calculations, it is estimated that the deficit of sewerage water treatment in the urban sector is of 249 hectares of oxidation lakes at a national level.

6.3 INSTITUTIONAL SITUATION: Evolution and current situation

When the reinsertion of Peru to the International Financial System happened, we asked for support from the Inter american Development Bank (IADB), which sent a mission to define an Improvement Program for the Sector. Such task started with a diagnosis whose results were presented in May 1992.

According to the diagnosis results, the weakness of the sector institutions were pinpointed and the necessity of establishing an institutional regulation was posed. This would define the central level entities in charge of developing the ruling, normative, supervision, and inspection functions to enforce the regulations. Likewise, it was necessary to emit legal provisions that established the rights and duties of the service entities and protected the users' rights, making the development of the sector possible.

After the delivery of the diagnosis, a series of changes in the State organization occurred. They affected the sector to the point of dividing it into two different Ministries, a situation that fortunately was mended concentrating the sector in the Ministry of the Presidency. At this point, it is easy to conclude that it was practically impossible to carry out any improvement of the sector if a good settlement of it was not previously achieved. Due to this situation, it was agreed with the IADB to establish the institutional and legal rearranging of the sector before the loan negotiation. Such task was entrusted to the Executing Unit of the Dinking Water and Sewerage National Program (PRONAP-PRES).

Another important aspect inferred from the diagnosis was the situation of the service entities. Most of them might not be in the possibility of taking on debt commitments for enlarging the current infrastructure.

Finally, the diagnosis revealed that the majority of the existing services have a clear deficit of infrastructure.

Considering the results above mentioned, the program to be defined had to be addressed to strengthen the central and local level institutions in order to establish the required minimum conditions for improving, first, the rendering of drinking water and sewerage services and, second, the management of service enterprises, helping them to become entities financially feasible and able to access to a **second stage of the credit program bound to the improvement and expansion of services.**

6.3.1 Definition of the Sanitation Service System

According to what is established in Legislative Decree No. 574, the institutions that formed the sector were: the Directorate of Basic Sanitation and SENAPA, at a central level, and the service entities, at a local level. But, in fact, the Directorate above mentioned was never implemented.

When making its proposal for the sector's reorganization, the consulting firm, hired thanks to IADB resources, put forward the creation of the General Directorate and of a Technical Institute, and recommended the deactivation of SENAPA.

The subsequent changes in the State organization compelled to modify the former proposal, having finally decided that the system be formed by:

- The National Superintendency of Sanitation Services, decentralized organism of the Ministry of the Presidency, as an entity in charge of taking care and supervising that the sanitation services be given in the best possible conditions.

- The service entities, as local organisms comprised in the municipal area in charge of giving such services.

- The Executive Directorate of the Special Project Drinking Water and Sewerage National Program, as an organism depending on the Ministry of the Presidency, of transitory character, in charge of carrying out the Improvement Program of the Basic Sanitation Sector.

It is worth to mention that, in the structure being implemented, there are still some gaps which will make the efficient development of the sector difficult because it is not defined who will take on the functions mentioned below:

- As far as the sanitation structure is concerned, the current deficits are so large that the service entities could hardly face them by themselves. Consequently, the support from the central level will always be required in order to direct possible technical cooperation or investment sources and to give them priority at a national level. Such situation becomes complex if we consider that there is not a planning office in the Ministry it belongs to.

- The support for the elaboration of projects and execution of works of interest to the Government with special financing sources, such as FONAVI, FONCODES, etc., which could not be served by them, according to the functions clearly stated for each of these institutions.

6.3.2 Operative evaluation of the institutional change process

The improvements achieved, fulfilling the objectives of the Executive Directorate of the Drinking Water and Sewerage National Program (PRONAP-PRES) are the following.

6.3.2.1 Sector's regulations

For the fulfillment of this goal, the following actions have been carried out:

- By means of Decree Law No. 25738 of September 26, 1992, the Executing Unit of the Drinking Water and Sewerage Program is transferred to the Ministry of the Presidency, and the functions of the Basic Sanitation General Directorate are entrusted to it in order to act as a State ruling organism in matters of drinking water and sewerage services, sanitary disposal of excrements and reuse of sewage water, while the definite organization is established.

  On August 11, 1993, by Supreme Decree No. 018-93-PRES, the Executing Unit is granted the category of Special Project.

- By means of Decree Law No. 25965 of December 07, 1992, the **NATIONAL SUPERINTENDENCY OF SANITATION SERVICES** is created. This entity assumes the responsibility of proposing norms for the rendering of sanitation services, supervising their fulfillment and applying the sanctions required. Likewise, it must assess the performance of the service entities and promote their development.

- Law No. 26284 **"GENERAL LAW OF THE NATIONAL SUPERINTENDENCY OF SANITATION SERVICES"** of January 10, 1994, regulates the functioning of the Superintendency. It also determines the framework of its autonomy and defines its competence, scope, functions and attributions.

- **Closing of SENAPA** Having transferred the affiliate enterprises and the operation units of SENAPA to the Municipalities, the operation of SENAPA was practically cancelled, situation that compelled the provision of its winding-up by means of Decree Law No. 25973 of December 21, 1992.

- Law No. 26338 **"GENERAL LAW OF SANITATION SERVICES"** of July 22, 1994, which regulates the operation of all the entities involved in the rendering of sanitation services. It is necessary to point out that the preparation of this document was initiated by CEPRI-SEDAPAL without visible results. In view of this, the Executing Unit takes on the responsibility of the elaboration of such document, getting the support of CEPIS and the advice of a consultant provided by IADB.

6.3.2.2 **Improvement Program for the Basic Sanitation Sector - Project 0032-BID**
The actions performed in this respect are directed to the preparation of the Loan request to IADB in order to finance the Support Program to the Basic Sanitation Sector, which requires an investment of 200 million of dollars approximately. So far, the following has been done:

- **INTERNATIONAL BIDDING FOR THE PRE-ASSESSMENT OF CONSULTING FIRMS.** The preparation of a representative sample of the program was required for the elaboration of the loan request, defined by ten projects of Institutional and Operation Improvement in equal number of service rendering enterprises. For the elaboration of such projects, a bidding was put up for the selection of specialized firms. The projects were executed between January and June of the current year.

- **TERMS OF REFERENCE FOR THE ELABORATION OF INSTITUTIONAL AND OPERATION IMPROVEMENT PROJECTS.** With this document, a bid by invitation to the pre-classified firms should be convoked for the elaboration of the mentioned projects. Such document has been submitted to the consideration of IADB and all the required modifications have been introduced, having the final approval pending.

- Execution of the **SEMINAR-WORKSHOP ABOUT INSTITUTIONAL AND OPERATION IMPROVEMENT FOR DRINKING WATER AND SEWERAGE ENTERPRISES.** The purpose of this seminar was to present the terms of reference above mentioned to the service rendering entities, as well as to receive their opinions about their viability. Such event took place on 18-20 January, 1993.

- **PRIORITY LIST OF PLACES TO MAKE INVESTMENT AND PRE-INVESTMENT STUDIES.** The aim of this action is to define the Subprogram C scope, by which it is foreseen to perform feasibility and definite studies as a basis for the formulation of a Second Program bound to perform expansion works and improvement of the services, to be financed by a new loan.

- **PROCESS OF INTRODUCTION OF SOLUTIONS:** Once the diagnosis is over, the process of introduction of the proposed solutions for each service rendering entity is being planned. The introduction process will be developed through consulting firms.

- Organization of the **COURSE PROGRAM OF MANAGEMENT OF DRINKING WATER AND SEWERAGE.** This course will be given by ESAN and will have as its main objective to train officers from enterprises in modern techniques of management, which will permit them to act as counterparts in the elaboration of Operation and Institutional Improvement projects.

- **PROMOTION OF THE PROGRAM.** To develop the program, at a local level, it is required that the benefitted enterprises understand the benefits provided and, also, meet the conditions required for accessing to it. To achieve this objective, a very intense and constant promotional task, in addition to a training labor, is required in many cases.

- **GLOBAL PLAN FOR PROGRAM DEVELOPMENT** to envisage the program's development and its link with a second loan allotted to the expansion and improvement of the existing infrastructure with an investment of 400 million of dollars, approximately.

6.3.2.3 Implementation of the Superintendency

- Study for the **IMPLEMENTATION OF THE SUPERINTENDENCY.** At present, they are carrying out the corresponding studies to define the Superintendency Organic structure, its Function and Organization Manual, personnel selection and design of the corresponding wage structure.

- Elaboration of the **SUPERINTENDENCY MANAGEMENT PLAN.** The purpose of this document is to clearly set the Superintendency's objectives, goals, and strategies in the short, medium, and long term, and, after all these, to elaborate the corresponding budget.

- Formulation of **COMPLEMENTARY PROJECTS.** These projects have been proposed at a profile level and many of them have been considered for the management plan. The purpose of having these profiles is to maintain a project portfollo which eventually could be financed by Technical Cooperation or to facilitate their immediate execution. Some of these projects are in their initial implementation phase for which technical cooperation and own resources will be used. Such is the case of the Updating and Norms Formulation Project and the Strategic Plan for Small Sites.

- Additionally, the Superintendency is solving a series of sector documentation, opinion requests about priority of projects, and, at the same time, providing all the information requested.

6.3.3 Institutional human resources

From the reorganization and reduction of the State entities on, the sanitation sector assumed some personnel from the deactivated institutions. The remaining technical and professional personnel has been referred to private enterprises of the field. The National Superintendency of Sanitation Services is operating with only 30 people. Once the Management Plan is approved, its personnel requirement will be completed with the Register of Specialized Technicians and Professionals, as well as with auditing and consulting firms.

With respect to the situation of the service rendering enterprises at a local level, the is no centralized information about the human resources they have in each case. There is certain

information taken from a sample of 10 enterprises at a national level made in 1993. Such sample shows an average of 6.16 workers per each 1,000 connections.

According to the modern and current conception, it is evident that the sanitation sector requires the participation of specialists in planning, management, operation and maintenance of domestic sewerage and drinking water systems, industrial and pluvial, as well as in commercialization, finance, control and supervision, etc. All these aspects will be examined in the institutional and operation improvement studies, considered in the IADB loan which will be made at a central level and for each local enterprise that requires it.

6.3.4 Factors affecting the private investment

The General Law of Sanitation Services recently promulgated in July 1994 dedicates its Title VI to the participation of the private sector. It is expected that adverse factors do not arise in the near future, taking into account that, at present, the State has a regulating role in the activity, promoting the competition and avoiding monopolies. As the State achieves a more harmonic economic development in those sites distant from the most important urban centers, the private sector will become interested in participating in the sector.

6.3.5 External Cooperation Institutions

In the country, the institutions that performed studies and works in the sanitation field during the 1980s were SENAPA at the urban national level and SEDAPAL at the Metropolitan Lima level. The State always relied on external cooperation sources through government-to-government cooperation agencies, such as GTZ (German Government), JICA (Japanese Government), and the Dutch Government, all of which offer non-reimbursable financing cooperation.

On the other hand, the State received loans with partial contributions from the Peruvian Government, such as the loans made by the World Bank, the Inter American Development Bank, the Italian and Argentinian Governments.

6.4 EXTERNAL AND INTERNAL FINANCIAL RESOURCES

6.4.1 Historical investment

The large investments in the Sanitation Sector of the urban area were carried out by SENAPA and by SEDAPAL.

As mentioned before, SENAPA started to operate in 1982, developing investment programs principally aimed to extend the existing drinking water and sewerage services and, in a lower proportion, to improve the operation management and the institutional development.

During the 1982-1990 period, SENAPA invested a total of 76,100 thousand dollars of which 30% was invested in 1987.

As shown in Table 6.6, the annual investment was not constant, showing a sharp drop during 1990, when only 1,765 thousand dollars were invested.

TABLE 6.6

HISTORICAL INVESTMENTS IN THE SANITATION SECTOR
URBAN BASIC 1982 - 1990
(In Thousands of US$)

YEARS	SENAPA	SEDAPAL	TOTAL
1982	8,073	24,680	32,753
1983	4,400	7,500	11,900
1984	10,742	10,260	21,002
1985	3,643	8,969	12,612
1986	7,763	16,263	24,026
1987	22,660	19,549	42,209
1988	8,782	25,569	34,351
1989	8,272	21,714	29,986
1990	1,765	14,271	16,036
TOTAL	76,100	148,775	224.875

Such investments were oriented basically to finance the execution of Stages III and IV of the National Urban Plan of Drinking Water and Sewerage, and, in a lower proportion, to expansion works, lots with services, improvement of the operation control, etc.

With respect to SEDAPAL during the same period, it made an investment of 148,775 thousand dollars oriented mainly to works of system improvement and expansion, such as the execution of distribution works in shanty towns, drilling of tubular wells, distribution pipes, among others.

The main projects considered in its Master Plan were differed. Among these, we could mention the Mantaro's water transfer, Yuracmayo's dam (work in execution), derivation of sewage waters from Surco's collecting sewage, etc.
As it happened with SENAPA, the annual investments were not constant and a sharp decrease was observed during the years 1982, 1983, 1984, and 1990.

The other SENAPA affiliate enterprises only performed rehabilitation and replacement actions, without significant results.

It is important to mention that SENAPA managed, within its investments plans, the expansion and improvement works executed in all the country, with the exception of those executed by the Local Governments of the small sites.

As shown in Table 6.7, the Sector invested, in the 1985-1993 period, a total of 533,313.41 thousand dollars from which 65% correspond to investment made by service enterprises in Lima and the rest of the cities in Peru. In the rural area, the total investment was 186,192.9 thousand dollars, supposing that the Central Government, FONCODES and others attended this area.

TABLE 6.7
TOTAL INVESTMENT IN THE SANITATION SECTOR CURRENT DOLLARS

YEARS INSTITUTIONS	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
CENTRAL GOVERNMENT	1'942,719.0	27'509,486 0	6'717,366.0	13'126,396.0	2'751,351 0	572,987.0	293,600.0	9'154,033 0	23'747,219.0	85'815,157.0
MINISTRY OF HEALTH	1'942,719.0	5'576,486.0	6'717,366.0	3'182,899.0	2'751,351 0	572,987.0	293,600.0	439,675 0	160,546.0	
GOVERNMENT REGIONAL/CORDES	0	21'933,000.0	0	9'943,497 0	0	0	0	1'022,358.0	5'862,755.0	
LOCAL GOVERNMENT	0	0	0	0	0	0	0	7'692,000.0	17'723,918.0	
PUBLIC INSTITUTIONS	0 0	0.0	0.0	0 0	0 0	0 0	546,561 0	17'235,293 0	76'396,556.0	94'178,410 0
FONAVI */	0	0	0	0	0	0	0	5'821,600.0	51'688,632 0	
FONCODES	0	0	0	0	0	0	546,561.0	11'413,693.0	24'707,924.0	
PUBLIC ENTERPRISES	12'612,000.0	24'026,000 0	42'209,000.0	34'351,000 0	29'986,000.0	16'036,000 0	41'977,922.0	61'451,640.0	84'473,949 0	347'123,511 0
SERVICE ENTERPRISES	12'612,000 0	24'026,000.0	42'209,000 0	34'351,000.0	29'986,000 0	16'036,000.0	41'977,922.0	61'451,640.0	84'473,949.0	
OTHERS/**	200,000.0	139,000.0	38,000 0	1,000.0	1'034,000 0	988,882.0	1'001,976.0	820,415.0	1'973,056.0	6'196,329.0
Others	200,000.0	139,000 0	3.800e+04	1,000.0	1'034,000 0	988,882 0	1'001,976 0	820,415 0	1'973,056.0	
TOTAL	14'754,719.0	51'674,486 0	48'964,366.0	47'478,396.0	33'771,351.0	17'597,869.0	43'820,059 0	88'661,381 0	186'590,760.0	533'313,407 0

*/ Such indiudons are in charge of the management of the financial resources for the execution of projects, here we are only considering the investment by housing organizations, the investment amounts lent by the Enterprises and local governments are considered at the corresponding institutional levels

**/ They constitute investment made by private organisms

***/ For years 1992 and 1993, we have considered as an expense 62% of the programmed assignment in sanitation as executed.

SOURCE: PRONAP - PRES

6.4.2 Financial sources

The executed works were financed with resources coming from internal and external sources, of which 29% correspond to external resources.

With respect to SENAPA, it had financial resources coming from the Inter American Development Bank (IADB), the Dutch Government, the German Cooperation Agency (GTZ), among others.

IADB was the major resource supplier with 24% of the total investment made and, in a lower proportion, the Dutch Government with 3%.

With regard to the internal resources, the major sources were the National Housing Fund (FONAVI), which contributed with 37% of the investment; resources provided thanks to the Legislative Decree No. 163 with 19%; Public Treasury resources with 12% and, in a lower proportion, own revenues with 2% of the investment.

By means of the Legislative Decree No. 25702, the Decree Law No. 163 was made null and void. The latter, up to its derogation date (November 1992) had made it possible to afford some investment expenses, using funds arisen from the billing tax, as stated by such provision.

Another financing source for new investments should come from the tariff revenues. However, historically, an entrepreneurial criterion based on a technical, economic, and financial analysis has not been used. This has not allowed the rendering entities to count on these resources to assume their investment costs and, in some cases, they have not even covered their operation and maintenance costs.

It is important to point out that, since 1988, SENAPA has not counted on resources coming from IADB, situation which limited their investment in the Sector.

With respect to SEDAPAL, 30% correspond to resources coming from abroad, mainly from the World Bank, the Italian Government, the Argentinian Government, and the non-reimburable Japanese Financial Cooperation.
The internal resources come from their own revenues, the Public Treasury, and internal indebtedness via FONAVI. Their own revenues financed 30% of the investment, FONAVI 10% and the Public Treasury the remaining 30%.

The resource flows coming from the World Bank in order to finance works in Lima were interrupted due to national political circumstances, which did not allow the execution of important works.

Even if we take into account the investments carried out directly by the former affiliate enterprises and the contributions and subsidies made by other entities, such as foreign governments and NGO's, the annual average investment in the Sanitation Sector in the period mentioned in Table 6.8 did not exceed 50 million dollars, except in 1992 and 1993. This represented a value of 1% of the GNP and 0.2% of the GDP for the 1985-1990 period.

TABLE 6.8
HISTORICAL INVESTMENTS IN THE URBAN BASIC SANITATION SECTOR
BY FINANCING SOURCES 1982 - 1990
(In Thousands of US$)

YEARS	SENAPA							SEDAPAL							
	%	EXTERNAL	%	LOCAL	%	TOTAL	%	EXTERNAL	%	LOCAL	%	TOTAL	%	GRAND TOTAL
1982	9	696.0	91	7,377.0	11	8,073.0	68	16,782.0	32	7,898.0	17	24,680.0	15	32,753.0
1983	22	951.0	78	3,449.0	6	4,400.0	66	4,951.0	34	2,549.0	5	7,500.0	5	11,900.0
1984	47	5,026.0	53	5,716.0	14	10,742.0	70	7,137.0	30	3,123.0	7	10,260.0	9	21,002.0
1985	30	1,102.0	70	2,541.0	5	3,643.0	58	5,204.0	42	3,765.0	6	8,969.0	6	12,612.0
1986	66	5,154.0	34	2,609.0	10	7,763.0	18	2,960 0	82	13,303.0	11	16,263.0	11	24,026.0
1987	36	8,135.0	64	14,525.0	30	22,660.0			100	19,549 0	13	19,549.0	19	42,209.0
1988	7	564.0	93	8,218.0	11	8,782.0	14	3,619.0	86	21,950.0	17	25,569.0	15	34,351.0
1989	2	136.0	98	8,136.0	11	8,272.0	3	695.0	97	21,019.0	15	21,714.0	13	29,986.0
1990	3	58.0	97	1,707.0	2	1,765.0	12	1,752.0	88	12,519.0	9	14,271.0	7	16,036.0
TOTAL:		21,822.0		54,278.0	100	76,100.0		43,100.0		105,675.0	100	148,775.0	100	224,875.0

Nevertheless, we should highlight the effort made by the program since 1991, linked to the **SANITATION EMERGENCY PLAN** stated by Supreme Decree No. 007 of May 1991. By means of this program, 63 million Nuevos Soles with resources coming from FONAVI have been invested up to August 1993. Additionally, using financial resources from this same source, an investment of 34 million Nuevos Soles have been foreseen to carry out 24 water and sewerage projects in several cities in the country.

6.4.3 Tariff system

The criterion used for the determination of tariffs responded more to the economic policy managed by the Ministry of Economy rather than to a business criterion, based on an analysis of its technical, economical, and financial requirements.

This situation prevailed mainly in the 1985-1990 period. In the middle of 1990, a shift was experienced, establishing as a criterion that the tariff should cover all costs and generate resources for investments. However, we can still notice a lag in the tariff, in relation with the inflation indexes.

In the case of SENAPA and the Municipal Service Enterprises, they applied the following criteria:

- Tariffs for drinking water and sewerage services
- Tariffs of Free Contracting
- Tariffs of Collateral Services
- Sundry Dues

The revenues coming from the tariffs for drinking water and sewerage services are the principal variables which define the TARIFF REGIME in all the enterprises responsible for the services.

Tariffs of Free Contracting are agreed between the enterprises providing drinking water and sewerage services and the users identified as top consumers of the services, i.e. those users whose demand is higher than the whole of the users in a territorial jurisdiction.

a. Regulation of the drinking water and sewerage tariffs

Up to July 1990, the Regulating Commission of Drinking Water and Sewerage Tariffs (CORTAPA) set the tariff levels of the 11 Affiliate Enterprises and of the 14 Operation Units comprised in the SENAPA system.

For the rest of the Affiliate Enterprises and Operation Units, the Board of Entrepreneurs must set its tariffs because they were transferred to the Municipalities.

From August 1990 on, CORTAPA took the structure of costs as a basic criterion for setting the new tariffs, taking as an objective that the tariff should cover all costs and generate additional resources for investments.

On July 1994, the General Law of Sanitation Services deactivates CORTAPA.

b. Criteria used for setting the tariffs .-

The tariff should provide the necessary resources for the coverage of the operation costs and expenses as well as the annual depreciation expense, generating additional resources that contribute to the financing of investments in accordance with the tariff policy.

Social.-

The readjustment or modification of the tariff structure seeks to reduce its effects upon the low-income users.

Political.-

The readjustments that finally are to be applied should be in accordance with the price policy in force.

c. Tariff structure

The tariff structure generally comprises five types of users:

1) Social
2) Domestic
3) Commercial
4) Industrial
5) State

This classification is made mainly taking into account the users' dwelling units, house, commercial or industrial building, and the connections diameter.

Each type of user is divided into 2 subtypes, considering the users' income level and the connection diameter. Each type and subtype is assigned a minimum consumption range.

Each water enterprise could determine the conformation of different tariff groups, based on joining locations whose socio-economic and technological reality may be similar.

Therefore, each tariff group will express different price values per m^3 for each type of user.

d. General Law of Sanitation Services

This Law promulgated on July 1994 states in its TITLE V: ABOUT THE TARIFFS, among other aspects, the following:

- The services of drinking water and sewerage (sanitary and pluvial) provided by the service entities to both final users and to those who act as mediators are subject to tariff regulation.

- The Superintendency is responsible for establishing the normativeness, procedures, and formulas for tariff calculation.

- The tariff formulas should reflect the economic costs of the services being rendered. These costs take into account the management efficiency of the service entities. In the calculation, the seasonal variations and the optimized master plans, which bring about the respective tariff charges should be considered.

- The tariff formulas take into account the price indexes representative of the cost structure of the different systems defined in Title III.

- The application of approved tariff formulas, as well as the readjustment mechanisms due to cost increase, is compulsory for all the service entities and have an effectiveness of five (5) years.

- Exceptionally, the tariff formulas could be modified before the end of its effectiveness. For such purposes, the service entity asks the Superintendency for a modification of the values from the parameters established in the tariff formula.

By its own initiative, the Superintendency could make the modification of the values from the parameters when the variations in the assumptions used in the calculation produce changes in tariffs which result harmful to users.

- The approved tariffs are of compulsory application for all users, without exceptions.

- The tariff for the service of sanitary disposal of excrements, rendered in conditions of competition, is subject to the free trade. In the event that such condition is not fulfilled, the Superintendency will emit the necessary regulation.

- The tariffs or dues to be collected for drinking water and sewerage services in the rural area should cover, as a minimum, their operation and maintenance costs.

- The provincial municipalities approve the tariffs that the private or mixed service entities propose. In the case of the municipal service entities, their tariffs are approved by the stockholders' meeting or its equivalent, as the municipalities' representative.

6.5 CONFLICTS WITH OTHER WATER USERS SECTORS

In the last 20 years, the development styles applied in the country have led to a serious process of loss of life quality and social disorder. The unbalanced occupation of the territory, the increase of poverty, hovels and growth of shanty towns in the major cities of the country have generated a series of tensions and socio-economic and environmental problems, constituting an overload to the infrastructure of the urban public services, arising problems of garbage accumulation, lack of drinking water and drainage, pollution of marine and continental waters because of the poring of sewage water, etc.

Generally, conflicts arise when the same water supply is shared by more than one user, just as the case of the shared use for irrigation and drinking water, when the water resource does not have the volume demanded because of seasonal reasons.

Other conflicts are derived from the pouring of sewage water to water courses, cultivation fields and/or to the sea, going against the activities of other users of this water, such as populations who

consume it, farmers who contaminate their crops, handicraft fishermen of hydrobiologic products in the contaminated littoral, as well as the recreational use of beaches and marine waters, among others.

6.5.1 Harmful impact against the environment

Every activity performed by men causes an impact on the environment which surrounds him. In the same manner, the Sanitation Sector, along the process of production, distribution and consumption of drinking water, and its later final disposal in the drainages, causes impact on the environment. These harmful impact generates costs which are not perceived by the producer, but which damage other productive agents or to the rest of the society.

The majority of the environmental problems are rather local than national, with a tendency to get worse, mentioning the most critical: In the sea, the contamination by mining tailings is concentrated especially in Moquegua and Tacna; by residual waters, especially in Lima, Chimbote and Trujillo; and, by pesticides, along all the Coast through the rivers.

With respect to the contamination of the continental and underground waters as well as of the agricultural fields by pouring of untreated drainages, it is concentrated in major cities which have suffered an uncontrolled expansion, such as Lima, Trujillo, Arequipa, Huancayo, Tacna, among others.

6.5.2 Alternatives of solutions and management

The alternative of solution and environmental management, from a sector perspective, would be to reinforce the institutional support program of the sanitation sector (Loan 0032-BID), with a recycling subprogram, arrangement and recovery of ecosystems, introducing a reliable financing source.

From a national perspective, the current government promotes the necessity to implement a style of sustainable development with equity, based esentially on the social and heterogenous reality of the country and on the potentialities and comparative advantages of the nature in Peru. This concept applied to water resource, subject of the present study, poses us the necessity of a proposal for the National Strategy for Water Sector Integral Management, upon correction of limitations or obstacles, such as a centralist and not a regionalized view of the environmental problem of water, desarticulation of the consumption and production structure with the territory offer, insufficient and/or not coordinated conceptual and institutional bases concerning the environmemntal management, among others.

6.6 POLICIES AND STRATEGIES

6.6.1 General policy (Political Constitution of Peru)

- One of the State duties is to promote the general well-being which is based on justice and on an integral and balanced development of the Nation (Article 44).

- The private initiative is free. It is exercised in an economy of social free market. Under this regime, the State orients the country's development and acts principally in the areas of employment promotion, health, education, public services and infrastructure (Article 58).

- The State offers self-improvement opportunities to sectors that suffer any inequality (Article 59).

- The State acknowledges the economic pluralism. The national economy is based on the coexistence of diverse forms of property and enterprise (Article 60).

- No law or agreement could authorize or establish a monopoly (Article 61).

- The decentralization is a permanent process that has as an objective the integral development of the country (Article 188). The territory of the Republic is divided into Regions, Departments, Provinces, and Districts, in whose circumscriptions the unitary government is exercised in a decentralized and not concentrated manner (Article 189).

- The provincial and district municipalities and the delegates, in accordance with the law, are the organs of the local government. They have a politica, economic, and administrative autonomy in matters of their competence (Article 191).

6.6.2 National policies of the sector

- The Ministry of the Presidency is responsible for acting as a governing organism of the State in matters related to the sanitation services and, as such, of formulating policies and dictating norms for rendering of services.

- To meet as much as possible the population's needs in sanitation aspects.

- Redefinition of the State system, through its reduction and the perfectioning of its functions.

- Abandonment of the indiscriminated protection policy by the State. To promote the participation of the private sector.

- Decentralization.

- Support to the less favored sectors which do not have the economic capacity to afford all the service costs they receive, action that will be met through the Social Support Program and the users' participation.

6.6.3 Objectives of the Sector

Having the Sector's policies as a reference framework, the following objectives which will orient the actions to be performed are set:

- To improve the user services both in coverage and service quality.

- To define the new roles of each institution involved in the decentralization process.

- To improve the management of the service enterprises.

- To use optimally the financial resources both national and international.

6.6.4 Strategies

- The State's role will be oriented to mainly fulfill a ruling, regulating and supervision function.

- To reaffirm the responsibility of the municipal governments in the provision of the sanitation services.

- To seek the self-financing of the service entities by collecting real tariffs that include all the operation or expansion costs of the service.

- To establish proper technological solutions to attend the low-income sector. The investment that they demand should receive direct support from the State, complemented by external financing.

- To promote the participation of the private sector, for which it is necessary to prescribe clear regulations.

1.- Legal Instrument

GENERAL LAW OF SANITATION SERVICES

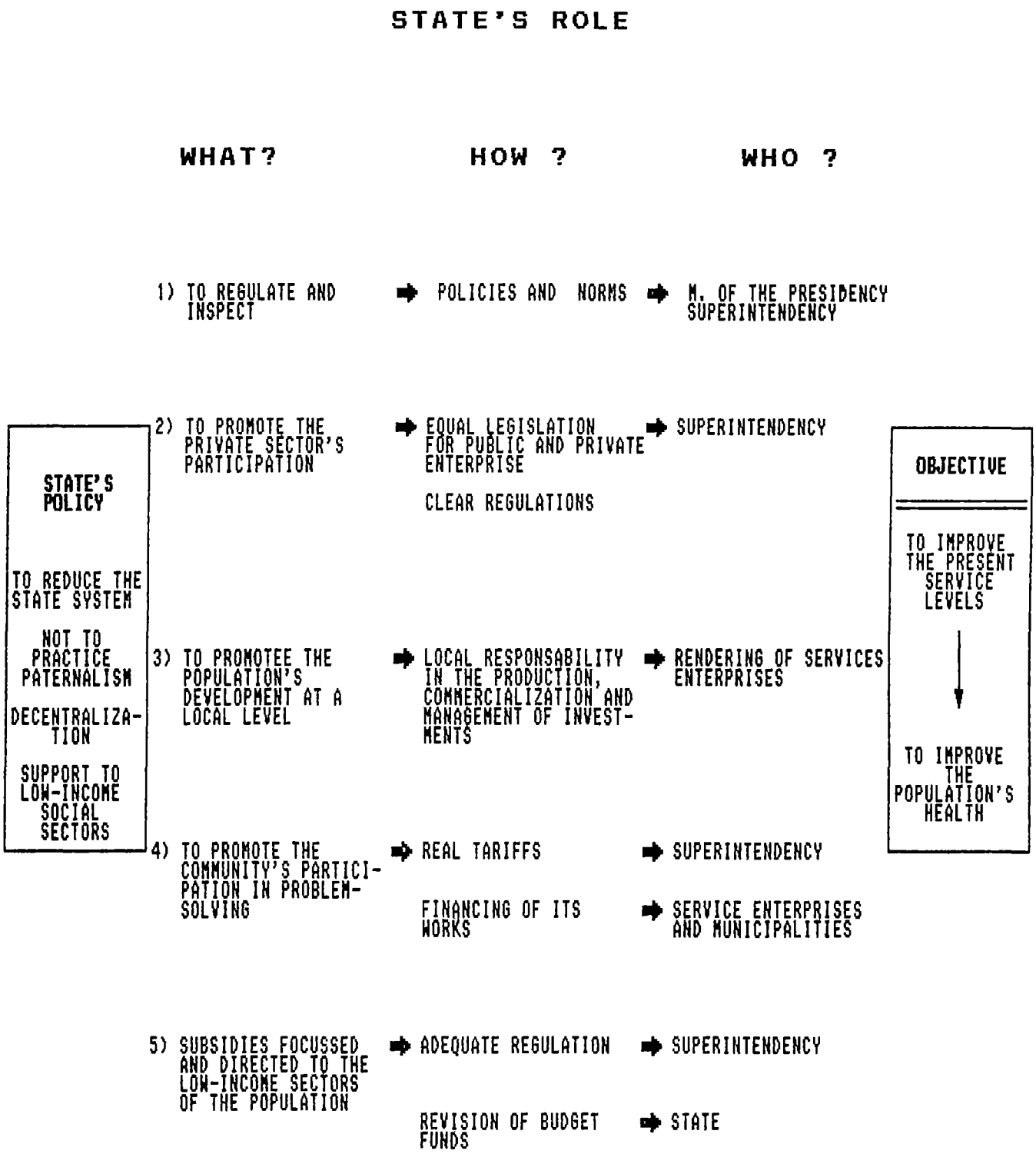
This Law states the norms which rule the rendering of sanitation services.

It declares the Sanitation Services as services of public necessity and utility and of main national concern, whose purpose is to protect the population's health and the environment.

It corresponds to the State, through its competent entities, to regulate and supervise the rendering of sanitation services as well as to establish the service entities' rights and duties, and to protect the users' rights.

2.- State's role

OUTLINE OF THE SANITATION SERVICE DEVELOPMENT



3.- Role of the private sector

The General Law of Sanitation Services takes into account the participation of the private sector in the rendering of sanitation services, as an aid to solve the large problems that the country faces as far as the sanitation services are concerned. It is obvious that the private sector will only enter to those sites that assure an adequate profitability, which will permit the State to concentrate its resources in those zones that will not be attractive to the private enterprises, due to their low economic level. As far as an improvement in the economic situation be achieved in other sites, the private sector could be increasingly interested in taking part in this type of services.

The Municipal government of a provincial level, as responsible for the rendering of sanitation services in its territory, will grant the exploitation right to a public, private or mixed entity (Article 44).

4.- Community participation, non-governmental organizations (NGO's)

Although it is a State policy to meet the sanitation service needs of the low income social sectors, it does not have a strategy to solve them, except through Social Support Programs that institutions not involved in the proper functions of the sanitation service sector carry out. Such institutions of social support work directly with the participation of organized communities and non-governmental organizations, basically in the rural area.

In most cases, the rural communities resort directly to the NGO's, due to the absence and/or little attention from the government authorities.

6.6.5 Management Plan of the National Superintendency of Sanitation Services (SSS)

It has been elaborated as an orientation document. It defines the policies, objectives, and strategies of the Superintendency's actions, in the medium and long term.

- Overall objective of the Superintendency

To regulate the rendering of sanitation services and to promote the development of the entities that render such services.

- Institutional Policies

The general outlines which orient its actions could be translated into the following policies:

1.- Policies concerning human resources, related to selection and recruitment.
- 1.a related to the motivation and incentives
- 1.b related to training

2.- Policies concerning management.
- 2.a related to Organizational Culture
- 2.b related to Efficiency levels
- 2.c related to the treatment with other national and international institutions
- 2.d related to the attention to less favored zones

3.- Policies of attention to users.

4.- Policies related to sanitation service enterprises (EPS).

4.a The **support** actions aim to **promote the EPS development** and eventually to solve specific problems.

4.b The **inspection and sanction** levels will be **differentiated at the beginning,** and equalitarian after achieving an adequate development of the EPS's.

4.c To elicit EPS's to adopt **organizational criteria of excellence** that include a high values system.

4.d To improve the public service enterprise management. The SSS will support the **private sector's participation** in strict accordance with what is stated in the legislation in force.

Specific Objectives:

To meet the overall objective of the institution, it has been defined a series of specific objectives which should be achieved in the medium and short term, in accordance with the schedule of activities that the institution will elaborate for such purpose.

1.- **Short-term objective** to be achieved between the second semester of 1994 and the first semester of 1995.

a) Implementation of SSS.
b) Definition of the inspection strategy and its implementation.
c) Setting up procedures for the attention of claims.
d) Definition with respect to the final destiny of the laboratory.
e) Participation in the privatization process of SEDAPAL.
f) Formulation and adaptation of norms, 1st Stage.

2.- **Medium-term objectives** to be achieved from the second semester of 1995 on.

a) Formulation of new norms, 2nd Stage.
b) Setting up the information system of SSS.
c) Contribution to the overall arrangement of the Sector.
d) Definition of the modality of attention to the Administration Boards, municipal entities, cooperatives, etc.
e) Definition of indicators and procedures for the performance assessment of EPS.
f) Definition of procedures for the adaptation and/or organization of EPS, in accordance with the new norm.
g) Promotion of development.
h) Training of the SSS personnel.
i) Sanitation education for users.
j) Definition of management indexes which will be used as a basis for establishing the tariffs formulas.
k) Elaboration of the macro and micro-measurement installation program.
l) Definition and approval of the methodology for the formulation of tariff norms.
m) Definition of the implemenmtation program of the new tariff system and its corresponding implementation.

Definition of strategies

Once the institution's specific and overall objectives are defined, having its policies as a guideline, the strategies to be followed for fulfilling the objectives and mission previously stated should be defined.

The analysis of the specific objectives to be achieved permits to define the following strategies that will be implemented at SSS.

1.- **To identify and formulate especific projects** to be developed by each area. Each one will have to fulfill a specific objective or work together with other projects to achieve it.

2.- **The management assessment** of each area will be done based on the achievement of the objectives proposed in each project.

3.- **The institutional image** is a worthy resource that should be cared and promoted by each and everyone of its members. So any decision that could place it in a compromising situation must be previously deliberated and count on the Superintendent's approval.

4.- **To clearly define the decision and responsibility levels** delegating as much as possible, but within a procedure of constant control and assessment. In decision making, special care not to affect other areas should be taken.

5.- **Team work** should be **promoted** constantly and this task is the Intendents' and Office Chiefs' responsibility.

6.- At the beginning, the **promotional activities for the EPS development** will be **emphasized** as an immediate means for reaching an improvement in the short-term rendering of services.

7.- The **inspection** actions **from the beginning** will mainly have a **corrective** purpose, not a punitive one, while reaching an adequate development of the rendering entities.

8.- An **open and constant dialog** with the **municipal governments** should be kept. Such dialog must be promoted by the Institution.

6.6.6 Effects, consequences, and requirements of the different strategies

The following effects are expected as a result of the application of the strategies drawn by the central government.

- Life quality and health levels depend, at the highest degree, on the access that people have to sanitation services.

- Rise of the economic activity in those places where the sanitation services offered are of good quality and where the user feel that the State takes care of his rights.

- The sanitation services will be given priority in the attention policies of the Central Government by declaring them of public utility and necessity and of national prevailing concern.

- To incite interest from international lending and cooperation organisms.

As a consequence of the strategies application, we may point out the following:

- The State must redefine its role to strengthen regulating institutions in order to focus management in an integral form, where the objective be the improvement of the service efficiency, the diminishing of the cost, and the rise of productivity. Likewise, it should compel the municipal governments to take on their responsibilities for the rendering of services.

- The high-income users will take on the total financing of the service supply they demand, liberating in this way the State's resources in order to reorient them to the low-income social sectors.

The strategies require, among other things, the following:

- Continuity of the governmental policies up to a medium term; stable institutions; respect to the plans and programs derived from the short and medium term strategies.

- The sector will direct all its efforts to optimization in order to face the high deficit in the short term.

- The financing of the operation costs and expansion of the coverage; all this linked to the payment capacity of the diverse groups of users.

- The formulation of strategies for the rural sector, looking for its incorporation in equalitarian conditions to the one the State renders to the urban sector. To look for the interrelation and incorporation mechanisms for the plans and programs of this sector's organized population and of the NGO's which have been working for a long time.

- Large investments will be required. This leads to the posing of alternative solutions that allow to reach goals without incurring in excessive debts.

6.7 NATIONAL AND SUPPORT PROGRAMS

By means of the Supreme Decree No. 018-93-PRES of August 11, 1993, the Special Project National Program of Drinking Water and Sewerage was granted the category of Special Project within the Ministry of the Presidency's list. Its principal function is to formulate, coordinate, promote, supervise, and evaluate the SUPPORT PROGRAM TO THE BASIC SANITATION SECTOR which will be financed by the loan Agreement BID PE-0032 of the Inter American Development Bank. At present, it is at its last stage of negotiations for the IADB's approval of the loan.

6.7.1 Objective of the program

The institutional strengthening of the Sector by actions of technical assistance and economic support to all the sector's organisms.

6.7.2 Components of the program

Subprogram A: "Strengthening of the sector at a central level" by improving the fundamental capacity of its institutions and its personnel.

Considered actions: hiring of consulting firms in the institutional, financial and commercial, economic assessment, technological and environmental aspects.

Specific studies, such as tariffs, subsidies, planning systems, financing of investments, attention to rural populations, normativeness, organization and development of service rendering entities, technological aspects in general, specialized training, divulgation and promotion of the program, equipping.

Subprogram B: "Institutional and operation improvement of the service rendering entities" aims to help service entities to transform themselves, in a medium term, into consolidated companies, operationally autonomous and financially viable. As specific objectives, to strengthen the business capacity, to achieve self-financing, to rationalize the operation, and to improve the quality of the service.

Considered actions;
- About Institutional improvement: to improve the organic structure, to implement management instruments, management of human resources, training.

- About Commercial improvement: tariff structure, to recover the credit portfolio.

- About Operation improvement: macro-measurement, leakage and waste control, cadastre, setting up, preventive maintenance, service rehabilitation and optimization, quality and control of water, elaboration of master plans.

Subprogram C: "Pre-investment study and definitive designs" whose objective is to elaborate the feasibility and definite studies that have higher priority in the country.

Considered actions:
- To give priority to investment projects at a national level.

- To give priority to investment projects at the service enterprise level.

- To seek for compatibility of both results.

- To elaborate investment projects that have priority.

6.7.3 Criterion of eligibility

For Subprogram B: To be a legally constituted enterprise or to be in the process of constitution; to have a minimum size of 4,000 drinking water connections to have a Board of Directors' agreement stating the will of resorting to the Subprogram; the commitment to contribute with the cross entry assigned.

For Subprogram C: To have resorted to Subprogram B and to be in the process of execution; to be considered in the roll of priority sites by the Executing Unit.

6.7.4 Investment and financing of the program

The amount of the investment is estimated in about US$200 million and will be financed 70% by the Inter American Development Bank through a credit granted to the Peruvian Government and 30% as a national cross entry given by the Peruvian State. The total cost of the Program, including the debt payment to IADB, will be assumed by the Government, transferring it to the service rendering entities as a capital contribution.

6.8 INVESTMENT PROGRAM

The State's objective is first, to strengthen the central level institutions and the service rendering entities, i.e. to raise their productivity before extending new services. According to what is scheduled, after reinforcing the institutions, the projects with a priority will be identified and the pre-investment and investment programs will be formulated. It is foreseen that in 1996 the Sector will be ready to apply for the financing of new investments.

6.9 LIMITATIONS AND RESTRICTIONS

There are limitations in the information available in the State institutions at a central level, because all the affiliate enterprises and operation units have been transferred from SENAPA to the Municipal Governments since 1990, and from that date on the information of all and everyone of the companies consolidated by SENAPA was lost. The National Superintendency of Sanitation Service has a Program called "System of Technical Inventory" (SIT), which includes Software, Database of all the urban sites in the country and Methodology. This program is in process of updating and complementation of the information.

With regard to the restrictions to the Sector's expansion, experience shows us that the natural resources are finite and scarce. They are subject to the nature's dynamic systems, with limitations of bearability and saturation which depend on the different ways of exploitation that the development styles impose. This means that the Sector could expand up to the bearability limit of the water resources linked to the geographical-physical space of the territory for purposes of settlement and population distribution.

CHAPTER VII

MINING USE

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CHAPTER VII

MINING USE

7.1 INSTITUTIONAL STRUCTURE OF THE MINING SUB-SECTOR

7.1.1 Introduction

The division of the Ministry in two large subsectors: Energy and Mines was authorized by the new organic structure of the Ministry of Energy and Mines M.E.M. established by Supreme Decree No. 0227-93-EM. The latter is subdivided into two principal directorates: of Environmental Affairs and of Mining.

The General Directorate of Environmental Affairs (D.G.A.A.) is a technical regulatory organism which depends hierarchically from the Vice-Minister of Mines, and is the one in charge of the coordinations with: other Directorates of the Ministry, Decentralized Public Institutions of the Sector, State Enterprises, Natural and Legal Persons dedicated to the Mining and Energy Activities.

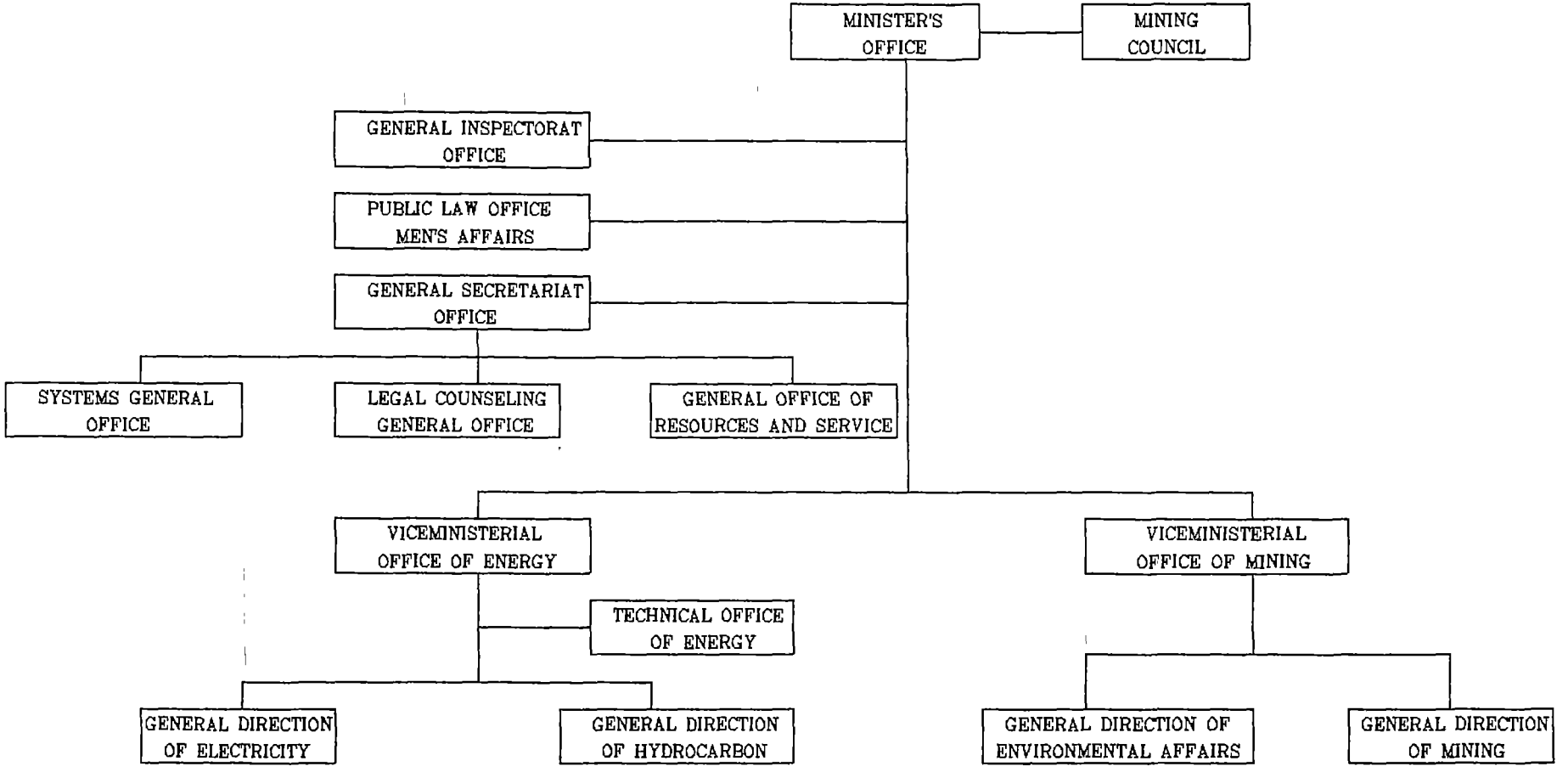
7.1.2 General Directorate of Environmemtal Affairs (D.G.A.A.)

a. Background:

The following chart describes in a sequence the antecedents to the creation of the D.G.A.A.:

- 3/4/81 Creation of Environmental Affairs Office by Decree Law 040
- 12/16/82 It starts functioning like an Advisory organ of the High Directorate of the Ministry
- 1986 It starts being part of the D.G.M. (Mining General Directorate) by Ministerial Resolution 013/86/EM/O.G.A.
- 8/1991 It recovers its initial level by Ministerial Resolution 168-91-EM/O.G.A.
- 2/3/92 The D.G.A.A. is established by Supreme Decree 008-92-EM/SG
- 19/6/93 The New Organic Structure and The Organization and Function Rules and Regulations are approved by Supreme Decree 027-93-EM.

STRUCTURAL CHART OF THE MINISTRY OF ENERGY AND MINES



b. Functions

The D.G.A.A. is in charge of many specific functions like:

- Propose policies and legal rules related to the Protection and Conservation of the Environment in the Energy and Mining Sector.

- Propose the technical rules for an adecuate application of the conservation and protection of the Environment in the Sector in coordination with the General Directorates of Electricity, Hydrocarbons and Mining.

- Regulate the evaluation of environmental impacts and establish the corrective measurements in case of being necessary for the control of the environment in zones of influence of the sector.

- Advise the high Directorate on environmental matters related to the sector.

- Promote the rational use of the natural resources integrating the ecosocial concept in the programs, projects and activities.

- Elaborate and divulge programs of environmental promotion so that the enterprises of the Sector could improve their environment for the benefit of their industries.

- Propose the projects and/or analyze the applications for Technical-Economical International Cooperation that could be required for the development of its activities.

- Propose training programs referred to the environment in the country or abroad, in the public and private sector.

- Maintain up to date the rolls and registries related to Environmental Affairs and;

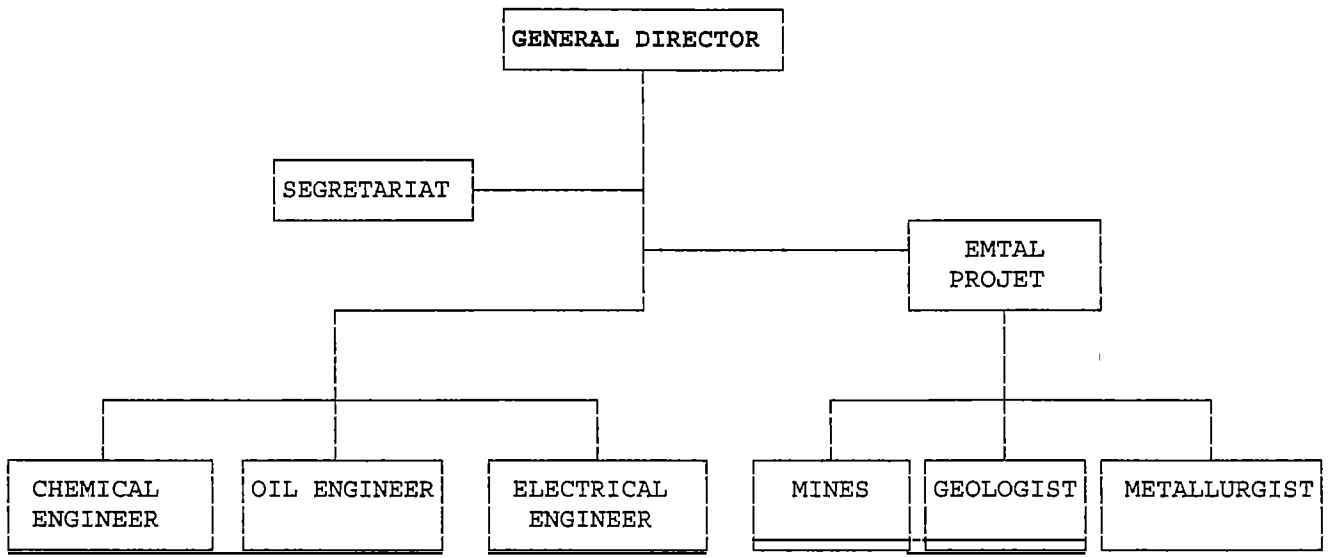
- Other specific functions that could be assigned.

c. Goals

The D.G.A.A. has an ambitious short, medium and long-term program. The principal goals on the short-term are: to formulate and implement the environmental policies, to develop the registries and environmental technical outlines, to fortify the institutionality of the D.G.A.A., to train the D.G.A.A. personnel, to develop the program of training and education workshops and the development of the environmental information system, etc.

The principal medium-term goals (1995-1996) are: to implement the environmental permissible limits (national standards) and to implement programs of environmental adequateness and management (PAMA) in the sector.

CHARTE OF THE GENERAL DIRECTORATE OF ENVIROMENTAL AFFAIRES (D.G.A.A.)



The long-term goals are basicallly the follow-up of the fulfillment of the PAMA, to fulfill the environmental norms that have been developed and to project the legislation and standards according to the international context.

7.1.3 General Directorate of Mining (D.G.M.)

a. Introduction

The General Directorate of Mining has at present a preponderant role in the development of the country by promoting, developing and controlling the mining activity. This way, it can keep up with the proposed policies and strategies of the present government.

b. Functions

The D.G.M. is in charge of the following basic functions:
- Mining Promotion and Development
- Technical control of the mining operations
- Economic and administrative control
- Elaboration of various statistics

It consists of two directorates: Promotion and Development, and Mining Control

c. Objectives

- To apply the policies and strategies undertaken by the present government which are contained in a Master Plan of the Sector.

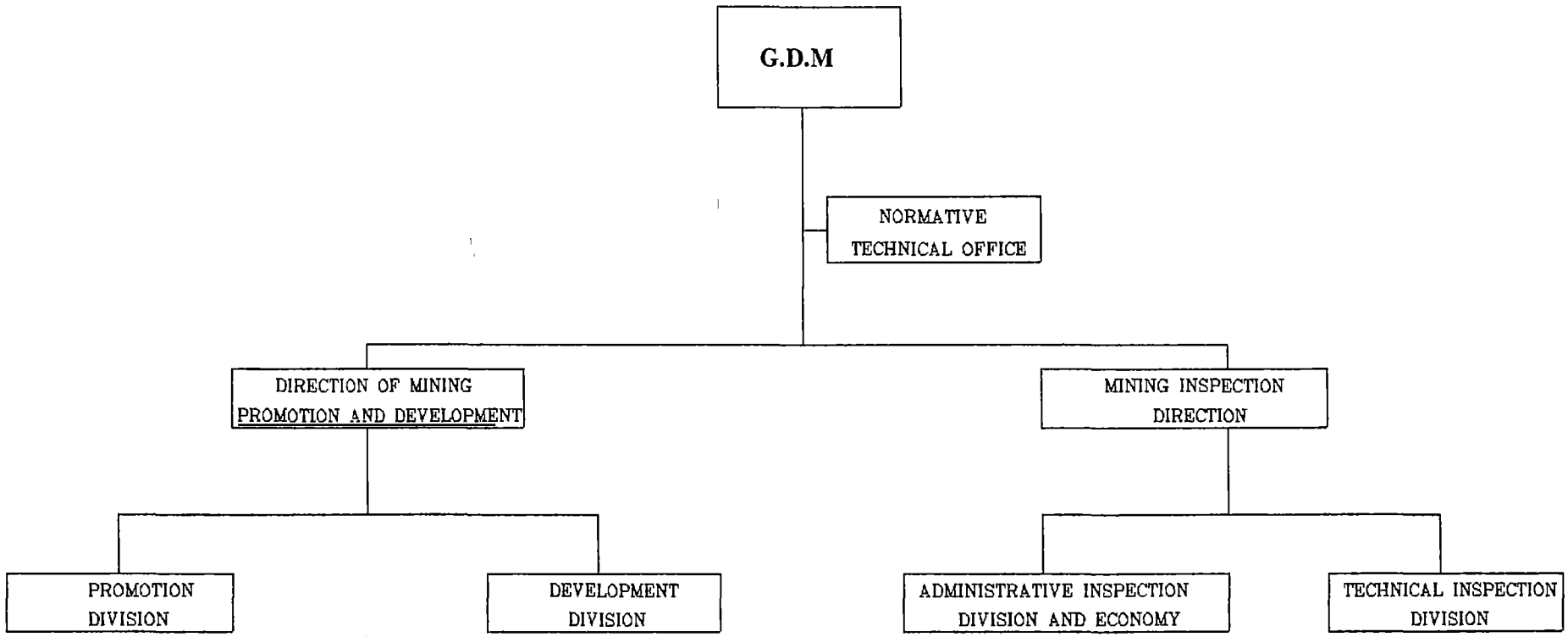
- To promote the mining investment so it can increase the mining capacity of the country in the shortest term.

- To reactivate the mining activity in all its forms (small, medium and great mining).

- To solve the problem of the mining informality.

- To take the way of a continuous development of the sector together with the environment.

GENERAL DIRECTORATE OF MINING -D.G.M .



7.1.4 Human Resources

The Ministry of Energy and Mines has an average of 200 professionals distributed in its different branch offices.

The present staff of the General Directorate of Mining consists of 27 professionals distributed in the following way:

-	Mining Engineers	14
-	Geologists	4
-	Economists	4
-	Chemical Engineers	2
-	Lawyers	2
-	Public Accountant	1
	TOTAL	**27**

The D.G.A.A. only counts with six professionals, three of them belong to the EMTAL Project (Program sponsored by the United Nations for the Mining Development).

7.1.5 Training Program

The training programs for the personnel are found within the policies and strategies of the sector. The training is being carried out principally in the country for the moment, with the contribution of national and foreign specialists in the different related matters who advise and prepare personnel, as it is being done in the D.G.A.A.

7.1.6 Brief historical description of the M.E.M.

The Ministry of Energy and Mines is created by decree law No.17271 of December 3rd, 1968, from two general directorates of the former Ministry of Development and Public Works and the Directorate of Energy, Mines and Petroleum. It took over the management of the mining and energetic resources on April 1st, 1969.

The M.E.M. is conformed by a central organ, institutions and public enterprises that work throughout the country, as well as by natural and legal persons which develop activities referred to the sector.

Sixteen ministers have taken over its management from its creation up to the present time.

The restructure carried out by the present government in its first two years has reduced substancially the employees and service workers from the Ministry of Energy and Mines (M.E.M.). The changes performed and the future ones are done in an accelerated way. This process of transformation bears a negative heritage left by the former governments (undone works). Because of this, the present personnel has to adjust to the same speed of change; nevertheless, this goal has not yet been attained because the programs mentioned above are not accompanied by integral plans like the one for training of personnel and especially the change of the traditional procedures in general.

The entering of transnational mining companies as well as substantial investments in the sector, demonstrated with the applications of petitionaries will require an effective support from the M.E.M. and in general, a continuous change which the nation awaits when entering the new century characterized by its extreme dinamism and competency besides the protection of the environment.

7.2 THE HISTORY OF MINING IN PERU

7.2.1 Background

The mining experience in Peru is well-known. The tradition forged has not been obtained overnight, but by an enriching process at each stage of our history. From the Pre-Inca cultures up to the present time, mining has had a preponderant rol in the development of the country, although it had not been the principal activity in the economy.

The metallurgic technology used in thePre-Inca period is astonishing for its excellent work that last up to our days and that are shown to the world through the Gold Museum, Anthropological Museum, etc; corresponding principally to the following cultures: Mochica, Chimu, Paracas and Nazca.

The main contribution of the colonizer was the introduction of industrialized methods impelled at the same time by a cruel explotation of the natives that decimated the population (Count of Lemos).

The beginning of the Republic marked the decline of the technology in the mining activity, mainly produced by the colonizer's disbandment, but from the mid XIX century onwards, there is an incessant opening of large-scale operations like in Casapalca, Morococha and smelting plants in various parts of Peru. The Pacific War produced the paralyzation of it (1879).

At the beginning of the twentieth century, the development of the mining activity was legally supported by the Mining Codes created in 1901 and in 1950 respectively, which start another stage of expansion with transnational companies, like the Cerro de Pasco Mining Corporation, Southern Peru Copper Corporation and the Northern Peru Mining and Smelting Corporation, among others.

The Peruvian Mining therefore has a prosperous present and future and the government is the one in charge of its development.

7.2.2 Ancient Peru (Pre-Inca and Inca)

Ancient Peruvians basically used these three metals: gold, silver and copper for religious ceremonies, war instruments and household use.

The civilizations that had great success in metallurgic technology, the Mochicas, Chimu, Nazca, Chavin and Paracas, more than miners were metallurgists.

Remarkable works that last up to now, like the masks, tumis (ceremonial knives), needles, pins, ceremonial vases, breast plates, ornaments in general, tools and weapons (mallets and metal points) are admired by everybody for its technic and finish.

The mining work only was restricted to superficial parts of all the deposits, exploiting the richest zones without deepening them. The mines located in Carabaya, Sandia, Cajamarca, Ancash, Cuzco and on the south-east of Bolivia were already exploited by them.

The Mochicas were expert silversmiths who dominated the technics that are used by the jewelers up to the present time.

The Incas knew the following as decoration technics: engraving, lamination, repoussé, inlaying, burnishing, and polishing. In order to join the metallic pieces they used the technics of: welding unions and setting unions using tiny nails, by means of bending, with pressure. Their main tools were different type of chisels, gravers, magnetite,iron and hard stone hammers. For smelting they used furnaces called Huayras. They knew well the properties of the metals like malleability and ductility, as well as the smelting technics in opened, bivalved and lost area molds.

7.2.3 Conquest and viceroyalty

The mining had a remarkable decline in the conquest period because the conquerors just dedicated themselves to loot the treasures and send them to Spain; afterwards, the civil wars between them reinforced this stage of postration.

The civil wars between the Pizarrists and the Almagrists, the insurrection of Gonzalo Pizarro and the rebellions of the indigenous are examples of what has been mentioned.

The discovery of the rich silver mines in Potosí and the quicksilver mines in Huancavelica in 1566 that were soon exploited are the most notorious of that century.

In the seventeenth and eighteenth century, when the Spaniards were well settled in these lands, mining had an apogee without precedents. The economy of the country was mainly based on the mining activity. Mines like the ones in Cerro de Pasco, Sandia, Carabaya, Hualgayoc and Castrovirreyna were discovered and exploited tirelessly.

To have an idea of the value of the riches obtained by the Spaniards, a remarkable chart summarizes the contribution of the mining activity in the economy of Spain:

Item	Origin	Value	Observations
1	Atahualpa's Ransom£	600,000-L.E *	
2	2The Occupation of Cusco£	2,000,000-L.E*	
3	Several loots£	3 5,000,000 L.E*	In the first 4 years of the Conquest
4	Exports to Spain	4400 million of ducats	XVI Century
5	Potosí	5,000 million of pesos	
6	Quicksilver-Huancavelica	676 million of pesos	Between 1570-1790
7	Gold Production	752,200 Gold Marks	Between 1746-1750 (Coin House)
8	Gold Production during the Colony	393 million of pesos	

* L.E = Pound sterling
Source: Metallic Mining in the Peruvian Economy Daniel Rodriguez Hoyle

7.2.4 Republic and present time

The turbulent years of the Republican period rebounded in the mining sector, due to the disbanding of the Spanish mine owners and the miners who abandoned their work to enroll into the new movements of independence.

The Nitrate deposits in Tarapaca and the guano deposits started to be exploited in 1830.

The same thing occurred with the copper, coal (Nazca, Ica) and oil (Brea and Pariñas) during the 1860's.

It is important to mention the contribution of foreigners in the development of the Peruvian mining such as: the French chemist Davelouis, the Polish Malinowski and Eduardo de Habich, and the Italian wise man Antonio Raymondi.

The Mining code given in 1901 contributed notoriously to the national development, creating a safe environment for foreign investments as in the case of the Cerro de Pasco Mining Corporation and the Northern Peru Mining Company. After the approval of the New Mining Code during the 1950's, the Southern Peru Copper Corporation starts its operations in the southern part of the country in 1954.

As for the legal aspect; laws have been modified in the last 30 years in three opportunities: L.D. 18880, L.D. 109 and L.D. 014 that is the one that rules at present with the new criteria of the use of squares.

7.2.5 The mining activity in Peru and its importance in the economy

The present development is the result of the very good reactivation policies sponsored by this government.

Recent statistics show the presence of Peruvian and foreign investors with 7,985 applications throughout the country with a total of 5,868,520 ha.; likewise, the mining production reached in 1993 is valued at US$ 1,600 million.

The importance of the mining sector has attracted the attention on an international level, according to a publication done by the Mining Journal-London Magazine about probable reserves that the country possesses which are the following: 570 million tons of phosphates, 850 million ounces of silver, 27 million tons of zinc among others; besides producing molybdenum, tungsten, cadmium, bismuth and secondary minerals, such as antimony, tellurium and selenium.

The annexed charts show the importance of this sector in the development of Peru from which we can determine the following:

COMPARATIVE ECONOMIC TABLES

TABLE 7.1

EXPORT VALUES (Million of Dollars)

Año	Mining	National	%
80	1795	3916	45
81	1493	3249	45
82	1312	3243	39
83	1578	3015	52
84	1368	3147	43
85	1205	2978	40
86	1042	2531	41
87	1219	2661	45
88	1192	2694	44
89	1548	2556	60
90	1446	3231	44→Average
91	1474	3329	44

TABLE 7.2

GROSS DOMESTIC PRODUCT PER ACTIVITY
(Percentage Variations)

		Average 1993/92	1994/93(Jan/Feb)
1.	Farm and livestock	6.0	7.9
2.	Agrarian	10.3	8.0
3.	Cattle	-1.6	7.8
4.	Fishing	23.8	16.3
5.	**Mining**	**7.8**	**2.7**
	5.1 Met. Mining	6.9	0.0
	5.2 Crude Oil	9.0	5.9
6.	Manufacture	6.7	11.9
	6.1 Priv. Rec. Prod	9.0	13.2
	6.2 Rest of Industries	5.7	11.2
7.	Construction	13.5	26.2
8.	Government	-0.1	-0.1
9.	Others	5.5	6.7
	9.1 Commerce	4.1	6.4
	9.2 Others	6.1	6.8
	GDP	6.5	8.9

TABLE 7.3

TAXES PAID BY THE MINING SECTOR

Year	National Total	Mining Sector	% Total
80	1022	278.4	27
81	1480	182.6	12
82	1423	214.1	15
83	3647	549.2	15
84	8617	1056.3	12
85	26878	2666.9	9
86	43748	1816.0	4
87	66788	3341.1	5
88	397306	3852.8	13
89	8079833	967355.0	11

- The value of the Mining Exports (V.E.M.) in the last 12 years have fluctuated between 39% and 60% of the total exports. In spite of the serious crisis in Peru from 1980 to 1991, the average of the V.E.M. was of 45% (Table 7.1).

- The Mining Sector has represented on average the 8% of the Gross Domestic Product in the 1980-1990 period (Table 7.2)

- During the 1980-1986 period, the remunerations in the Mining Sector were 2.5 times more than the average ones in Metropolitan Lima.

- The Mining Sector has a multiplying effect.

- During the 1980-1990 period, the level of the taxes paid to the government are in the level of 12% (Table 7.3).

7.2.6 Nature of the mining business

It has been found convenient to mention this point because its permanence in time and space is eminent, and the policies and strategies will have to be developed considering the following variables:

1. Fortuitousness
2. Short life due to its evanescent nature
3. Short active life of the miner
4. Great Profitability
5. Subjective investment

1. Fortuitousness

Factor that has nothing to do with the good administration subjected to internal and external variables like:

- Price of the metals
- Loss of the lode
- Substantial fall of the anticipated quality
- World supply and demand

2. Short life due to its evanescent nature

Caused by two main reasons: the high costs and the limited tonnage.

It is estimated that in the lapse of 10 or 15 years from now, the majority of them will have finished their reserves and deposits. On the other hand, other industries can last only with good administrative policies and strategies.

3. Short active life of the miner

Because of the hard life due to the lack of an adecuate infrastructure.

4. Great Profitability

It has a greater profitability than other economic activities like manufacture which is the principal source that generates foreign currency and work.

5. Subjective Investment

An investment performed will not necessarily have a future profitability. The mining investment is based on geological information that is not precise or unfailing.

Because of the evanescent characteristic of the mineral deposits due to their limited existence, exhaustive nature and short life (it is not renewable), mining is a peculiar activity that produces many unique problems, diferent from those generated in other industries: explore, discover, develop, exploit and to extract from the bottom of the mines, the material which contain a small percentage of value. Nevertheless, the whole process does not finish there. It is necessary to continue the process for the obtainment of a commercial product.

7.3 COMPETITION FOR THE USE OF WATER AND THE MANAGEMENT OF BASINS

7.3.1 Competition with other sectors

As it is known, the water resources are mainly required by settlements, agriculture, live stock, hydroelectric stations, industries, and mining, among others.

A clear idea of the magnitude of the level of competition between the Mining Sector and other sectors can be seen with the problem caused by the decree law 708-92-EM and by the applications presented in the last eighteen months of 7,985 requests which represent 5,868,820 ha. (735 ha./ petitionary average); while in all the Republican history, the applications for concession to exploit mines were only of 7 million ha. (See Table 7.4).

TABLE 7.4

PETITIONARIES AND APPLICATIONS FOR CONCESSIONS FOR THE EXPLOITATION OF MINES

TYPE	QUANTITY	HECTARES (ha)	%	% AT NATIONAL LEVEL *
Petitionary	7.985	5'868,820	45.83	4.57
Denounce ment	32.498	6'937,517	54.17	5.4
TOTAL	40.483	12'806332	100	9.21

* Peru has an area of 1,285,215 km2 or 128,521,500 ha.

The participation of the private mining enterprises in the development of the country is the key element which guarantees the free competition and with it the improvement of services. The increase in 84.6% of the existing hectares will logically influence the present water consumption, as well as the level of competition with the other sectors.

The growth of the mining sector will be seen in an effective way by the end of the next 5 years, minimum time required to consolidate a mining project, from the generation of a request up to the production of the first tonnage of concentrate. The regulation for the adecuate use of the water resource is of priority due to the competition that it will originate with other sectors.

If we observe thoroughly the maps enclosed, we can see that the density of the minig zones are located longitudinally in the country, spreading out from north to south.

As a consequence, all the hydrographic basins are affected by the mining activity.

The annexed cadastral map, which gathers applications, requests for concessions and grants, give us a clear idea of the level of competitiveness that will be generated in these basically mining areas with other productive activities (like agriculture and live stock) located in the same zones. Increasing the existing mining areas in 84.6% could lead us to the following problems if adequate measures are not taken:

1. High competition with other productive sectors and with themselves.
2. Pollution of the water resources.
3. Decrease of the agricultural areas due to pollution.
4. Confrontations.
5. Great consumption of water.

There is not a clear view at present of the future water sources that will be used by the principal settlements of the coast. Therefore, it is necessary to carry out an integral plan on a multisectorial level before the mining activity starts to generate a high degree of pollution if adequate measures for the protection of the environment are not taken in the probable areas where the projects of canalization towards the main towns of the coast are carried out.

In a recent publication done by "Situational Basic Study of the Water Resources of Peru" INRENA 1992, statistics referred to the use of water by different sectors and by each of the 36 basins located on the coast, agriculture is the one that consumes most water (86%), while mining only uses 1% of the total. (See Table 7.5).

TABLE 7.5

THE USE OF WATER BY DIVERSE SECTORS

ITEM	SECTOR	TOTAL (thousand m^3)	%
01	AGRARIAN	14,200,264	86.1
02	POPULATION	1,018,063	6.1
03	MINING	152,041	1.0
04	INDUSTRY	1,103,459	6.6
05	CATTLE	27,871	0.2
	TOTAL	16,501,698	100

7.3.2 Management of Basins

The cadastral map of mining activities shows that the applications for concessions, applications and grants are mainly found throughout the coast and the highlands, from the north to the south of Peru; though the places where gold is obtained by washing are in the following departments: Madre de Dios, Ucayali and Loreto (Marañón).

A clear advantage of having dense mining zones like in the central highlands is that the control of the basins can be done in an effective way. In the north and south area, the mines are scattered, therefore the control by the state entities of the waters and the levels of pollution could be more difficult. This is why it is logical to divide the mining zones into 4 parts for a better management, which are the following:

1. North Zone: Tumbes, Cajamarca, La Libertad, Amazonas,Ancash and San Martín

2. Central Zone: Lima, Cerro de Pasco, Huánuco, Junín

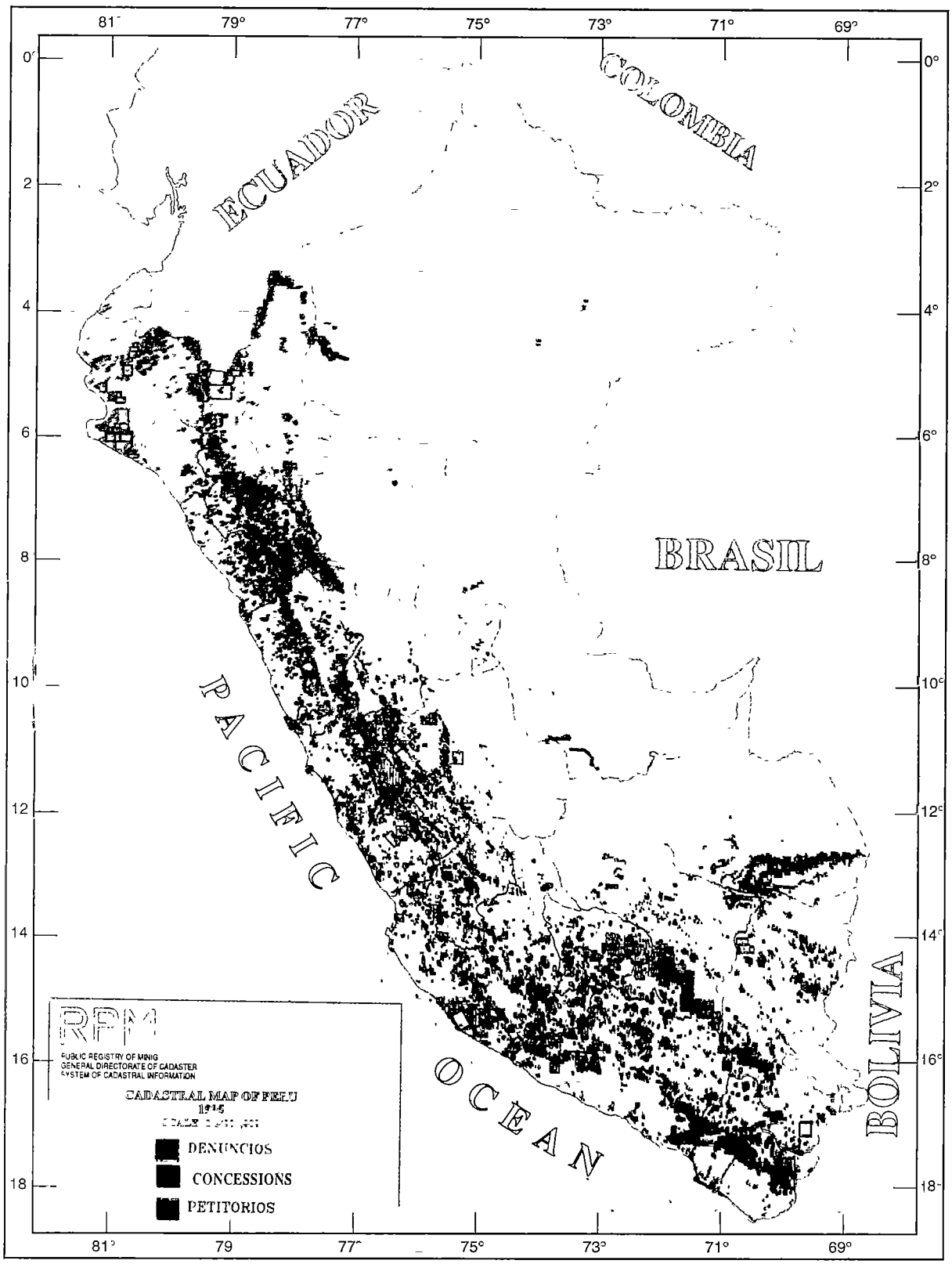
3. South Zone: Arequipa, Ica, Ayacucho, Apurimac, Cusco, Moquegua, Tacna and Puno.

4. Jungle Zone: Madre de Dios

Statistics show that the mining activity is the key for the development of the country, but at the same time the coherence with the environmental conservation must exist or the nation will doom due to the consequences brought by the water and land pollution, mainly caused by the informal mining as in the case of the gold exploitation and the behavior of unscrupulous miners that could pollute the natural resources with sodium cyanide and mercury.

FIGURE 7.1

NATIONAL MINING CADASTRUM



7.4 WATER DEMAND BY THE MINING SUBSECTOR

7.4.1 Water Consumption

Water is necessary for the mining camp, mining works and the benefit of the mineral, the latter one is the activity that most consumes and pollutes most due to the chemical reactives used in the process for obtaining the concentrate.

Precise statistics about the water consumption by the mining companies are not available though it is possible to infer it.

Basically, there are three kinds of water consumption in the mines:

- Human Consumption (Camps)
- Consumption for Mining Operations
- Consumption of the Plant of Concentration

7.4.1.1 Human Consumption (Camps)

The Unique Arranged Text (T.U.O.) of the General Mining Law approved by Supreme Decree No. 014-92-EM, clearly establishes in articles 328 to 335 of Chapter V that refers to "the Sanitary Facilities in the Workplace", the norms which the mining companies have to follow in reference to the quantity and quality of the drinking water for their workers.

It mainly establishes the following:

1. The drinking water temperature must fluctuate between 5°C and 25°C.
2. A source of water for each 100 workers.
3. Water supply for hygienic use no less than 50 liters per person.
4. Chemical-bacteriological water control for human consumption.

7.4.1.2 Consumption for mining operations

The sources of water used for the mining operations come from:

- Lakes whose waters are from rains or thaws
- Rivers

All are connected to a complete network of canals, pipelines, pumps and tanks that take the water to the required place.

The consumption depends principally on the quantity of perforating machines and compressors used (cooling system) and to a lesser extent for secondary operations inside the mine like cleaning and tidiness of the personnel. For example, in the Cerro Verde mine the following is used:

- For Grinding: 22 l/s
- For Concentration: 50 l/s

7.4.1.3 Consumption for operations of concentration

The plant of concentration uses the greatest percentage of water. The demand depends on the quantity of concentrate it produces; likewise, different kinds of methods, which exist for concentrating the mineral, use water. The best known in our country is the floating method.

The mineral floating method uses many sorts of chemical reactives mixed with water, giving it special properties that facilitate the separation of the mineral from the unwanted materials. This method is mainly used for the sulfurous minerals.

Other common methods also applied here, but in less proportion are:

a) By gravimetric separation which uses the specific gravity of the mineral to concentrate.

b) By lixiviation that employs the solubility of certain elements in solutions diluted in sodium cyanide.

c) By just size reduction (trituration and grinding)

7.4.2 Recovered waters

One of the most efficient ways to avail the water resources is recovering them from the post-processes of concentration.

One of the clearest examples that should be mentioned, is the recovery of the water from the floating plants in the last stage of the process which is the accumulation of washings.

The washing fields contain basically two constituent elements: water and washings. The former is used like a transportation element from plant of concentration to the field through pipelines and by impelling pumps.

The majority of the Peruvian mines apply this concept, reaching an average of 50% to 60% in the water recovery levels which are recycled and used again in the concentration processes.

7.5 POLLUTION IMPACT

7.5.1 Pollution waters in mining zones

7.5.1.1 Causes

- Ignorance of the appropriate technics for the preservation of the water purity; old-fashioned technics (concentrates, equipments and reactives), construction of dams for washings without technical criteria.

- Ignorance of the user in the legal and educational aspects of the environmental conservation.

- Unwillingness of the miner to carry out investments for the preservation of the water quality.

7.5.1.2 Consequences

- Water pollution with negative effects for the flora and fauna (rupture of the ecological balance) that make the rural/urban settlers complain constantly.

- The level of the contaminants for drinking water is not controlled by the present systems. Furthermore, there is an increase in treatment costs.

7.5.1.3 Solutions

- To approve effective and coherent laws which would protect the mining-ecological interests and to incentive the policies of refosteration and decontamination.

- To estimulate the ecological education at all levels.

- To improve the fiscaliization and control of the mining operations, especially of those which belong to the small mining and the informal sector.

- To improve the quality of the reactives and the metallurgic procedures that are not adecuate. (Re-engineering)

- To retire from the market the chemical products that cause high levels of pollution.

- To give an integral solution to the problem of the informal sector. (Previous census)

- To restrict the mining activity in protected areas and in those polluted critical areas.

- To establish with a technical criteria the maximum permissible levels of contaminants in the waters.

7.5.2 Pollution of Waters: Acid Waters

The biggest problem of the environment which affects the international and national mining industry is the acid waste caused by abandoned rocks left, entrances to mines, residues and walls of opened shafts. (Mining works).

Many mineral deposits contain mineral sulphides, both in the mineral ores and in the rock waste of their surroundings. When these mineral sulphides, especially pyrites and magnetic

pyrites are exposed to oxygen and water, they start to rust almost immediately. The acid waste could contain large concentrations of ferric and ferrous sulfates and present pH values of less than 1.0.

It is important to comment that there are natural lakes in Peru which have a bed composed by acid rocks and/or rocks mineralized with sulfide that without mining works become acid waters; there are no fish or vegetables in them.

7.5.3 Measurement of Water Pollution

- The level of the water pollution can be calculated measuring the biochemic demand of oxygen or D.B.O., the same which serves to measure the weight per water unitary volume of the dissolved oxygen used during the biological process of organic matter degradation and their values are from about 1 mg/l (natural water) to 300-500 mg/l in non-purified domestic waters.

- If the concentration of contaminant substances increase considerably, its degradation would finish with the oxygen dissolved in the water; this could produce asphyxia to the aquatic animals. From that moment, the aerobic bacteria, which are the ones that in normal conditions maintain their self-purifying power of water, are replaced by the anaerobic bacteria that help water decompose.

7.5.4 Mining and Pollution

The mining activity which generates work and foreign exchange to the country, due to its nature, can create a potential risk of environmental pollution due to different processes involved.

The methods of exploitation, concentration and refinement have a potential risk for the environment. The opening of a tunnel causes water flows of meteoric origin with different pH, the concentration of minerals involve the use of various kinds of chemical reactives and the generation of washings while the refinement causes gases of diverse nature, nevertheless the technology to anticipate or minimize all kinds of pollution exists here in the country.

If we analyze the problem of water pollution , consequence of the mining activity, we can see that it mainly owes it to the following four sources:

a) acid waters
b) water from washings
c) water from the metallurgic processes
d) sewage waters

The first is the natural product of the meteoric waters which acidifies when in contact with minerals that contain iron sulfates. Water from the washings is the product of the mineral concentration and it contain solids in suspension and chemical reactives. Water from the metallurgic processes contains metallic ions in solution; and finally the sewage waters are a consequence of the human consumption in the camps. It is possible to give back the level of original purity to all these kinds of water pollution with a previous treatment.

The Peruvian laws referred to pollution in general are in the vanguard in South America. The success of them depend mainly on the effective performance of the miner with an ecological conscience that must take care of a non-renewable resource of nature.

7.5.5 Informal Mining

Not only the streets elling is part of the informality, but this has passed the borderline to the mining sector where the people without being owners of the mining lots where they work and many of them without being miners, are working in gold mines, mainly in the departments of Madre de Dios, Puno, Ica and La Libertad.

It is calculated that about 50,000 people throughout the country annually produce around 8 tm of gold; nevertheless they work with no technical criteria nor security, likewise they use mercury to recover the gold without taking care of its manoeuvring, casting water residues and vapors to the environment.

There are scattered cases of informal miners that use cyanide of sodium for recovering gold (Study of the Informal Mining and the Environment in the areas of Puno and La Libertad-IDES pp. 123/143/200).

Not only the irrational use of chemical reactives characterize this activity but it goes beyond all kinds of environmental depredation like the following:

- Landscape alteration
- Ground destruction
- Elimination of the flora and the fauna
- Water pollution caused by residual lubricants

For this, it is logical to plan out a strategy for eliminating the informality in the mining sector for the benefit of the national mining and the environment by means of adecuate policies that could transform the informal into formal.

7.5.6 Chemical Pollution of the Water (Vestigial Metals)

The technical advances have increased the use of vestigial elements, frequently with inadequate security measurements until adverse effects are recognized. It is known that an excessive exposure can produce a serious illness, but the knowledge of subtle consequences of a cronic exposure to low concentrations of vestigial elements is still not well known.

The microbes can also contribute to the pollution process in various ways. The methylation of inorganic mercury in the great masses of water seem to take place through microbic actions. This process is very important because it converts a kind of mercury which is a little toxic into another one that is very dangerous for the human being, above all because the mercury methylate is absorbed and spread with celerity to all the tissues.

Two cases, both in Japan (Minimata and Ogono) constitute a few examples of serious intoxications caused by mercury methylate obtained through the following chain: microbe - water - fish - man. Cases of intoxication with mercury have not been registered in Peru, but it is known that informal miners pollute the water and the environment in alarming levels. It is important to notice the growing preoccupation of the existing pollution level

in the basin of Rimac river, so investigations about the quality of the drinking water in Lima City must be carried out.

7.5.7 Sources of Washing Generation

All the mines with plants of concentration produce residues (washings) which are the final product when concentrating the mineral for its later commercialization; likewise for obtaining them, the majority of many chemical reactives are highly contaminant organic and inorganic compounds.

For obtaining a ton of concentrate, several tons of mineral are required. This relation is called concentration radius, and the final residue is the washing. The concentration radius varies according to the mineral and its fineness; for example, this could be between 10 to 50 m.

Table 7.6 presents the information about the concentrator plants up to 1990 given by the Ministry of Energy and Mines where the total capacity of concentrate generation is shown. The quantity of washings per departments can be inferred from this Table.

TABLE 7.6

CONCENTRATOR PLANTS
tm/day

ITEM	DEPARTAMENT	INSTALLED CAPACITY	QUANTITY
1	AREQUIPA	27,032	41
2	AYACUCHO	100	1
3	CAJAMARCA	2,725	15
4	CERRO DE PASCO	24,535	26
5	CUZCO	9,885	12
6	HUANCAVELICA	13,990	17
7	HUANUCO	2,795	8
8	HUANCAYO	18,524	33
9	HUARAZ	12,920	41
10	ICA	10,135	77
11	LIMA	22,843	56
12	PIURA	555	5
13	PUNO	4,100	21
14	T..CNA	88,094	12
15	TRUJILLO	8,064	35
	TOTAL	246,297	400

7.5.8 Treatment Costs of the Water from the Mine

One of the principal barriers that the mining companies have to face for the treatment of the waters is its high cost, which at the same time rebounds in the total cost of the operation.

The industrial water treatment given by diverse national and foreign industries only represent from 0.1% to 1% of the total cost. This fluctuates between 2% and 7% in the national mining, depending on the installations and equipments they possess.

Basic inputs of lime, with a minimum percentage of 60% of CaO, and scrap metal have a high cost and little supply in the home market.

7.5.9 Known Cases of Water Pollution

1. Turmalina mine, Piura (Chanchaque/ San Miguel)
   Water Pollution (Washings)

2. Junin Lake
   Pollution of surrounding areas

3 Casapalca (1952)
   Collapse of washing fields into the river

4. Recuperada mine (1969)
   Collapse of washing fields

5. Atacocha (1971)
   Collapse of washing fields into the Huallaga river

6. La Alianza-Ticapampa Mining Co. (1971)
   Collapse of washing fields

7. Catac(Callejón de Huaylas)
   Washings from grades in mining shafts

* Data:Mining magazine - F. Perales

NB: Even though the majority of the quoted cases are fortuitous, futuristic prevention could have avoided them.

7.6 ANALYSIS OF THE LEGISLATION

7.6.1 Mining Legislation in Peru

Legal Frame:

The Peruvian mining is based on a principal legal frame which is composed of the following mechanisms:

a.- The Legislative Decree No. 109 corresponding to the "General Mining Law " given on June 12th, 1981.

b.- The Legislative Decree No. 708: "Law of Investment Promotion in the Mining Sector" given on November 6th, 1991 which partially modify the General Mining Law.

c.- Supreme Decree 014-92-EM: "Arranged Unique Text of the General Mining Law"given on June 2nd,1992. This principally consolidates the source of our Mining Legislation.

The new General Mining Law was put into practice on September, 1992, with which the National System of Squares is implemented with basic units of 100 sq.m. each (1 km x 1 km).

A National Map with the demarcation of the area of interest and this information put in a format given by the Public Register of Mining is what is required to formulate a petition where the following is specified:

- Data of the applicant
- Data of the location
- U.T.M. coordinates of the solicited quadrature

This System of Squares has reduced the time for the generation of a petition as well as the annoying proceedings.

Commentary:

Though the System of Squares has divided Peru into squares of 100 sq. m. each and the impact of the demand of mining petitions in the last 18 months have been a total success with 7,985 petitions which increases in 5.9 millions of sq.m. the Mining Sector and which sums up to 9.97% of all the Peruvian territory in mining boundaries, the disadvantage of this system is that in the solicited areas there could exist hydroelectric projects, agriculture and live stock zones, and settlements which in many occasions are not identified with a mere information given by the National Maps. An effect of competition among them is foreseen.

7..6.2 Arranged Unique Text (S.D. 014/92/EM)

Arranged Unique Text of the General Mining Law
(Supreme Decree No. 014-)

FIFTEENTH TITLE

ENVIRONMENT

Article No. 219 - In order to guarantee an adecuate atmosphere of stability for the mining investment clarifies what is stated in the article No. 53 of the Legislative Decree No. 613 in the sense that the establishment of protected natural areas will not affect the rights

previously given to them. In this case the adequation of these activities to the provisions of the Environment Code must be demanded. (Art. No. 47 Leg. Dec. No. 708)

Article No. 220 - Replace the articles No. 56 and No. 57 of the Legislative Decree No. 613 with the following text: "The protected natural areas are determined by Supreme Decree, with the approving vote from the Council of Ministers and countersigned by the Ministry of Agriculture. The way they must be managed is established by the National Government which is the one to administrate them, though this can be delegated to the Regional or Local Governments." (Art. No. 48, Leg. Dec. No. 708)

Article No. 221 - Substitute article No. 62 from the Legislative Decree No. 613 by the following text: "The natural or legal persons that carry out or wish to carry out activities of transformation and of exploitation need to have the projects about location, design and performance approved by the authority in charge."

This approval is conditioned to specifications of rules and obligations inherent to the defense of the environment and of the natural resources according to the norms established by the authority in charge. The new applications for concession of benefits will include an investigation on environmental impact. (Art. No. 49, Leg. Dec. No. 708)

Article No. 222 - Replace article No. 63 of the Legislative Decree No. 613 by the following text: "To request from the authority in charge a license, the project about construction of areas or mining-metallurgical residue deposits must include the following aspects in order to avoid water contamination in particular and environmental pollution in general:

a) that the technical conditions guarantee the stability of the system.

b) that the operation of systems be technically specified.

c) that the technical measures for the abandonment of deposits be indicated.

The residues thrown into the sea must be in technically acceptable conditions so that the human health and the qualities of the ecosystem are not altered. The authority in charge will establish the standards.

The study of the environmental impact in exploitation works, will be directed to the control of solid and liquid effluents. (Art. No. 50, Leg. Dec. No. 708)

Article No 223 - Substitute the article No. 66 of the Legislative Decree No. 613 with the following text: "The exploration and exploitation of mineral resources must take in consideration the following provisions:

a) The waters used in the process and discharge of minerals must be, if possible, reused totally or partiallly when it is technically and economically feasible.

b) Measures which guarantee the stability of the land must be adopted in open air exploitations.

c) All mining exploitations which use explosives near settlements must be under the

impact levels of noise, dust and vibrations established by the authority in charge. (Art. No.51, Leg. Dec. No. 708)

Article No. 224 - Replace article No. 67 of the Leg. Dec. No. 613 by the following text: "The radioactive residues emptied from the mining-metallurgic installations will not exceed the established permissible limits of the levels determined by the authority in charge. The people responsible of the installations will measure periodically the discharges and will inform the authority of any other alteration detected, adopting the necessary measures to prevent or avoid damage of the environment, health or property." (Art. No. 52, Leg. Dec. No. 708)

Article No. 225 - Substitute article No. 69 of the Legislative Decree No. 613 with the following text: "The authority in charge will carry out periodically samplings of the ground, water and air to evaluate the effects in the environment caused by the mining- metallurgic activity and its evolution in established periods; so it can adopt the corresponding preventive or corrective measures."(Art. No. 53, Leg. Dec. No. 708)

Article No. 226 - The authority in charge of the application of the provisions included in the Environmental Code of the Legislative Decree No. 613 and referred to the mining and energetic activity is the Energy and Mining Sector. (Fifth Final Provision, Leg. Dec. No. 708)

7.6.3 Program of Environmental Adequateness (P.A.M.A.)

Supreme Decree 014-92-EM

Arranged Unique Text (T.U.O.)

General Mining Law of June 2nd, 1992

Chapter IX - ENVIRONMENT

The mining-metallurgic head is responsible for the residue emissions, sheddings and dispositions in the environment that are produced as a result of the processes carried out in the installations.

Program of Environmental Adequateness	▸Objective▸	Reduce the levels of pollution

HOW?

Conducive measures for minimizing the impact on flora and fauna. It includes the effective treatment of land, air and water.

7.6.4 Rules and Regulations on Environmental Protection

- D.S. No. 016-93-EM of May 28th, 1993

- **Decrees the following:**

Article No. 1 - Approve the Rules and Regulations of the Fifteenth Title - T.U.O.

- **Consists of:**
- 4 Titles
- 4 Chapters
- 50 Articles
- 1 Complementary Provision
- 3 Transitory Provisions
- 2 Annexes

- **Scope:**

Application of the norms held in the Fifteenth Title of the Arranged Unique Text from the General Mining Law approved by S. D. No. 014-92-EM from the Environmental Code of the Leg. Dec. No. 613, from Leg. Dec. No.757 and Leg. Dec. No. 25763. This application reaches all the natural people, private or public, which carry out mining-metallurgical activities.

7.7 POLICIES AND STRATEGIES OF ACTION IN THE SUB SECTOR

7.7.1 Introduction

The General Directorate of Mining and the General Directorate of Environmental Affairs, following the policies and strategies given by the present government, have developed a Program of Annual Management inside the Frame of the Energy and Mines Sector Policy.

"The efforts are directed to the stimulation of "Sustainable Development".

7.7.2 Features of the Sectorial Policy

- The General Policy of the Energy and Mine Sector orientates the efforts of the Government towards the promotion of the private investment participation in the electric supply increase, the production of hydrocarbons and the mining production among others, acting in a direct way in the enlargement of the rural electric boundary and giving priority to the governmental intervention following a criteria of social-economic impact. Likewise, this policy establishes the promulgation of norms that will regulate the productor-consumer relation, guaranteeing: private investment, conditions of free competition and a productive, efficient energetic/mining development, in harmony with the Environment Besides:

- The Mining Sub-sector will support its development principally through: the intensification of explorations, the increase of production, the complete use of its existing installed capacity and the opening of new operations; for this purpose, reactivation measures, which are feasible according to the situation of the country, will continue to be promulgated together with actions to advance the implementation and consolidation of the Cadastral Mining Map and the Geological Map for a better growth of the mining potential.

- The preservation of the environment in the zones of intense energetic/mining activity must be propitiated so that it can maintain the adequate ecosystem for the development of life, promulgating the pertaining norms according to the national reality and coordinating with the sectors involved, besides spreading these norms efficiently and seeing to their fulfillment.

- The research functions must be transferred from the Public Institutions of the Energetic-Mining Sector to the Public and/or Private Education Sector which carry out activities related to science and technology, promoting the research, development and propagation of technologies regarding Unconventional Energy and Oceanic Mining.

7.7.3 Sectorial Diagnosis

Outstanding advances like the following have been registerd in 1993:

A. Mining

1. The Gross Domestic Product has increased in 9.5%, due to the increase of gold, Iron and Zinc production.

2. The efective presence of foreign investors like the cases of Hierro Peru and Yanacocha, and others as Cerro Verde and Quellaveco.

3. The generation of 4,700 petitions soliciting 3.4million sq.m. by 1,200 different petitioners.

4. The declaration of freedom to request for exploitation of 4,623,000 sq.m. which were assignated previously to state enterprises.

5. Contributions to local governments dues to the right of legal disposition; distributed monthly.

6. Promulgation of the Rules and Regulations of Environmental Protection, being Peru the first in South America to achieve the First National Contaminant Inventory of the Mining Activity.

B. Environment

1. Formulation and Implementation of the policies for developing, revising and redacting rules and regulations of environmental protection.

2. The Rules and Regulations of the Environment were put in force. (S.D. 016-93-EM).
3. The Rules and Regulations of the Environment for the Hydrocarbon activities were put in force.

4. Protocols and Technical Guidelines for the Mining-Metallurgic Sub-Sector were prepared with the assistance of foreign professionals.

5. Actions for fortifying the D.G.A.A.
   5.1 Recruiting of Consultants in Environmental Protection
   5.2 Reorganization of D.G.A.A.

6. Training of the D.G.A.A. Personnel together with national and foreign consultants and training and education workshops.

7. Environmental Mitigation and Management
   7.1 Development of Tools for the Evaluation of Environmental Impacts and Auditory.
   7.2 Programs of pilot monitoring
   7.3 Development of the Environmental Information System

7.7.4 Mining Sub-Sector: Objectives and Strategies

I. Objective:

Continue with the consolidation of the mining norms within the Arranged Unique Text of the General Mining Law.

Strategies:

1. Finish with priority, the norms referring to the alluvial mining.

2. Elaborate the Arranged Unique Text of the Rules and Regulations of the General Mining Law.

3. Carry out studies about the informal mining activity in order to outline a solution for the problems of a social, technical, economical, security and environmental nature; and its progressive pass to formality.

II. Objective:

Promote the investments in mining, as well as the full use of the installed capacity so the exportable supply of the mining-metallurgical products may be increased.

Strategies:

1. Elaborate an indicative plan with strategies that will point out to the possible investor where he can invest in order to support a continuous growth of the economy.
2. Elaborate a Data Bank of geological and mining-metallurgical activities.

3. Promote the investment in explorations and mining projects of polimetallic, auriferous and non-metallic deposits including the carboniferous ones.

4. Give priority to contract agreement of legal stability.

5. Promote mining projects like Michiquillay, Bayóvar, Tambo Grande, Ferrobamba-Chalcobamba Antamina and others, nationally and internationally.

6. Propose the creation of the enterprise Geomín-Peru for promoting, carrying out and, in its case, supervise the investments and the prospecting, exploration and exploitation mining activities under contracts.

7. Study the alternatives and/or propitiate the reopening or reflotation of the small and medium mining enterprises which have their production units paralized.

III. Objective:

Obtain more knowledge of the mining resources so they can be negotiated with private investors.

Strategies:

1. Continue searching and identifying mining deposits of economical interest and elaborating an inventory of mineral resources in the country.

2. Culminate with the evaluation and pass judgement for the freedom of request for exploitation of the areas assigned to institutions and enterprises belonging to the government that have not yet converted into the new system of concessions.

3. Implement and consolidate the Mining Cadaster and its corresponding publication.

4. Intensify the preparation of a Geological Map and of Metalgenetic and Tectonic Maps

IV. Objective:

Reactivate the research and development in the geological, mining and metallurgic activities adopting new technologies according to the national reality.

Strategies:

1. Promote the performance of investigation and development works in universities, technical institiutions and other ones devoted to research.

2. Carry out new programs of International Technical Cooperation in order to incorporate modern technological processes in the mining and metallurgic operations that are less efficient.

7.7.5 Environment: Objectives and Strategies

I. Objective:

Implement an environmental policy appropriate for each of the sub-sectors.

Strategies:

1. Coordinate the participation of Institutions and specialized national and/or international personnel through the International Technical Cooperation to elaborate the norms referred to the sector and its relation with the environment.

2. Culminate the Rules and Regulations for the environmental protection in the electrical sub-sector.

II. Objective:

Evaluate the environmental impact, product of the mining energetic activities at permissible levels, according to the sustainable development policy.

Strategies:

1. Carry out 10 monitoring pilot projects of environmental control of the mining-metallurgical activities covering approximately 10% of the national territory.

2. Make an evaluation of the present levels of pollution and ecological risks as a consequence of the mining energetic operations, conforming the Environmental Data Bank.

3. Carry out the environmental evaluation of the informal mining throughout the country.

III. Objective:

Contribute to the effort of creating a national conscience on environmental protection.

Strategies:

1. Sponsor, with the assistance of the International Technical Cooperation, Seminars, Forums or other events where the energetic-mining enterprises, institutions dedicated to the study of the environmental problem and governmental representatives will participate.

2. Promote the formation of professionals abroad, as well as implement a system of environmental information.

* **Source:** Energy and Mining Sector
Heading towards a sustainable Development
General Policy
Objectives and Strategies 1994

7.7.6 Policies to fight the Pollution of Waters

1. The increase of the areas in the Peruvian Mining Sector must absorb at the same time, technology which includes control and prevention of water and environmental pollution in general.

2. Prevent and counteract transference of foreign technology that could induce any kind of pollution.

3. Control by the Peruvian Government of all metallurgic equipment and reactives entering the Peruvian territory. In order to do so, that requirement must be stipulated in the import documentation (previous application to the D.G.A.). The same will apply to the mines in operation.

4. Carry out a balance in situ of how operative mines of the country are working, so that control and solution alternatives for the mining pollution of the waters are promoted.

5. The manifestos of the 1972 Stockholm Conference stated the close relation between the destruction of the environment and the economical mechanisms, therefore the measures commented before must be followed.

6. Revise and restructure the laws which will integrate mining production and pollution.

7. Enforce the ecological laws to which Man as element of the biosphere is subjected.

8. Creation of laws in order to regulate the control of waters in the basins.

9. Stimulate the constant effort for discovering and perfectioning the mining technology related to the prevention and elimnation of all kinds of pollution.

10. To provide orientation and technical assistance to the mining companies which generate contaminants of any kind, and make them responsible for taking care of the old residue deposits.

11. It must be admitted that some processes can not be changed immediately without disturbing the production.

12. Include in the solution for the environmental problem of the Mining Sector all the people affected. It must be understood that it is not only a Governmental and Mining problem.

7.7.7 Technical Policies (Suggested)

- Provide a comprehensive, scientific, technical and economical base for the mining industry in order to predict a long-term management of its requirements for rock residues.

- Establish technics which will help in the operation and closing of the generators of acid residues and rock remains generators in residue areas in a cheap, predictable, opportune and acceptable way for our environment.

* Use of technology to face the acid waters like:
  - Wet barriers
  - Solid soil compounds to cover the residues
  - Chemical treatment (CaO)
  - The simple neutralization of drainage acids in the mining operation leads to a production of significant quantities of mud which has a very low

percentage of solid that will require great areas for its storage. When recycling the mud, another much denser one that will possibly not throw heavy metals to the environment will be produced.

* Taken from the Canadian Mining Journal - Special Edition.

7.8 MINING PROJECTS IN PORTFOLIO AND OTHERS (ENERGETIC / ENVIRONMETAL)

The Arranged Unique Text of the General Mining Law constitutes a significant legal contribution to the development of the mining sector as it orders the existing legislation related to security and sanitation, environment and promotion measures for the investment in mining.

With the generation of 7,985 petitions in an area of 5,868,820 sq.m. (until March 1994) the level of interest from the private investors is notorius. The mining projects that had been put away will be activated again because the only restrictions they had, do not exist anymore (terrorism/lack of investment).

There are unending lists of mining metallurgic/energetic projects in Peru that will be carried out, besides the solicited potential mining areas (see Table 7.7).

The information that has been collected can give us a clear idea of the consumption of water resources, and the degree of pollution that they will generate if they are not controlled, when the considerable amount of the investments that would reach three thousand million dollars in the following 6 years and a total of six thousand million dollars in the following 10 years are known.

TABLE 7.7

No	Name of the Project	Type of Project	Mineral	Investment *
1	Alloys of Lead-Zinc-Bismuth Centromín Perú S.A.	Metalurgic Study		500
2	Alloys of Zinc-Aluminum Centromín Perú S.A.	Metalurgic Study		615
3	Expansion of Central Yaupa and Malpaso Hid.	Energy In Study		12,000
4	Expansion Mine-Plant Huancamina Treatment Plant Minerales Huánuco S.A.	Mining Exploitation & Expansion	Pb,Zn,Ag	4,000
5	Expansion U.O. Cerro de Pasco Centromín Perú S.A.	Mining Metalurgic Expansion		15,058
6	Antamina Minero Perú S.A.	Mining Exploitation	Cu,Zn,Ag	130,000
7	Auriferous Chavin (Chavinsa I) Aurífera Chavín S.A.	Mining Exploration & Exploitation	Au	1,800
8	Auriferous Madre de Dios Centromín Perú S.A.	Mining Exploration	Au	1,900
9	Bayóvar Minero Perú S.A.	Mining Exploitation		12,000
10	Berenguela Minero Perú S.A.	Mining Exploration & Exploitation	Cu, Ag	114,000
11	Cantera Angélica Baribent S.A.	Mining Expansion		1,082
12	Catarina Minera Patacocha S.A.	Mining Exploration	Au	5,000
13	Central Hid.Jicamarca Electro Perú S.A.	Energy In Study		153,000
14	Central Hid. Mayush Electro Perú S.A.	Energy In Study		300,000
15	Central Hid. Pías Consorcio Energético del Valle del Río Moche	Energy In Study		80,000

16	Central Hid. Platanal Electro Perú S.A.	Energy In Study		271,000
17	Central Hid. Yanango Cía Min. Buenaventura	Energy In Study		14,000
18	Central Hid. Yanango Cía Minera San Ignacio de Morococha S.A.	Energy In Study		120,000
19	Central Hid. Yuncán Centromín Perú S.A.	Energy In Study		500,000
20	Central Term. Callacu- yán /Minero Perú S.A.	Energy In Study		68,000
21	Cerro Lindo Cía. Minera Milpo S.A.	Mining Exploration		2,000
22	Cerro Verde Minero Perú S.A.	Mining Exploitation	Cu	74,000
23	Cía. Minera Aurífera Olimpo	Mining Exploration & Exploitation	Au	120
24	Citemín S.A. Cía Industrial de Tecnología Minera Centromín Perú S.A.	Mining- Metalurgic		200
25	Consorcio Minero de Comunicaciones	Others In Study		9,000
26	Corimarca	Mining Exploration	Cu,Pb,Zn, Ag,Au	1,000
27	Coroccohuayco Minero Perú S.A.	Mining Exploitation	Cu,Au	56,000
28	Denuncio "San Juan"	Mining Exploitation		100
29	Distrito Minero de Viso Aruri Soc. Min. Austria Duvaz	Metalurgic In Study		7,500
30	División Electrónica Centromín Perú S.A	Management Study		530
31	El Diablo Cía. Minera Tercera Dimensión S.A.	Metalurgic Exploitation- Expansio	Ag,Au	910
32	El Plomo Cía. Wolfram Fortuna	Mining Exploitation	Cu,Pb,Zn	180
33	Esperanza del Inca Aurífera Bonanza S.A.	Mining Exploitation	Au	1,053

34	Explotación Arenas Aurífera Chimú Minera Chimú S.A.	Mining Exploration & Exploitation	Au	1,000
35	Explotación de Placeres Auríferos	Mining Exploitation & Expansion	Au	3,500
36	Explotación de la mina Cleopatra de Hualgayoc Minas de Hualgayoc SA.	Mining Exploitation	Cu,Ag,Au	1,023
37	Explotación de la mina Cristal Cía. Minera Palos Verdes	Mining Exploration	Au	8,750
38	Explotación de un Yacimiento Aurífero Arbiet Studium S.A.	Mining Exploration	Au	521
39	Fabricación Hierro Esponja Hierro Perú S.A.	Metalurgic In Study		53,000
40	Ferrobamba-Chalcobamba Minero Perú S.A.	Mining Exploration	Cu	
41	Fundición de Cobre Tintaya Tintaya S.A.	Metalurgic In Study		115,000
42	Fundición para la Extracción de Estaño Funsur S.A.	Metalurgic In Study		13,000
43	Hilarión Cía. Min. Hilarión SA	Mining Exploration & Exploitation	Pb,Zn,Ag	10,000
44	Igor Fermín Málaga Santo-lalla e Hijos S.A.	Mining Expansion	Ag, Au	960
45	Inambari Consorcio Aurífero Río Inambari S.A.	Mining Exploitation	Au	8,000
46	Incremento de Reservas y Producción de "Edith Primera" Cía. Min. Sumasa S.A.	Mining Exploration & Exploitation	Pb,Zn,Ag,Au	180
47	La Granja Minero Perú S.A.	Mining Exploitation	Cu, Ag	520,000
48	Lixiviación a Presión en Cajamarquilla Minero Perú S.A.	Metalurgic Expansion		56,000

49	Manto Celeste	Mining Exploitation	Cu, Ag	2,000
50	Maraycasa Cía. Minera Cóndor SA Huaraz	Mining Metalurgic	Cu, Au	766
51	Mesa Redonda Comave S.A.	Mining Exploration	Zn, Au	1,100
52	Mi Recuerdo 1,2 y 3	Mining Exploitation	Pb,Zn,Ag	100
53	Michiquillay Minero Perú S.A.	Mining Exploitation	Cu	1'000,000
54	Mina La Piedra Cincelada SMRL Piedra Cincelada de Huaraz	Mining Exploration & Exploitation	Au	150
55	Mina Mónica F-88 Minera Patacocha S.A.	Mining Exploration	Pb,Zn,Ag	1,000
56	Mina Pallarnilloc N°1	Mining Exploration	Au	224
57	Mina Pibe Tres	Mining Exploration	Au	150
58	Mina Rescatada Minas Rescatadas S.A.	Mining Expansion	Pb, Ag, Au	400
59	Mina San Vicente Cía. Minera San Ignacio de Morococha SA	Mining Exploitation	Zn, Ag	6,000
60	Mishky Empresa Min. Mishky SA	Mining Exploitation	Au	930
61	Modernización de Unidades de Centromín Centromín Perú S.A.	Mining Exploitation		141,300
62	Nivel "5" Cortada Cía. Min. El Barón SA	Mining Exploitation	Cu, Zn, Ag Au	150,000
63	Nuevo Tramo de Carretera Central Propuesto por: Cía. Minera Buenavetura S.A.	Others In Study		60,000
64	Occidental 05 de Cajamarca SMRL Occidental 5 d Cajamarca S.A.	Mining Exploration	Pb, Zn, Ag	632
65	Pacocha II Etapa Cía. Minera Pacocha SA	Mining Exploitation	Cu, Pb, Zn, Ag	3,000

66	Parcoy Consorcio Min. Horizonte	Energetic Expansion	Au	1,620
67	Planta de Alambrón de Cobre Centromín Perú S.A.	Metalurgic Financing		17,273
68	Planta de Extracción Hidrometalúrgica de metales preciosos Cía. M. Buenaventura SA	Metalurgic In Study		20,000
69	Planta de Oxígeno Centromín Perú S.A.	Metalurgic Expansion		28,000
70	Polvo de Cobre Centromín Perú S.A.	Metalurgic Study		866
71	Potozí Cía. Min. Huacchara SA	Mining Exploration	Pb, Ag, Au	350
72	Producción de Cobre y Subproductos Neg. Min. Chavinita EIRL	Mining Exploitation	Cu, Zn, Ag, Au	1,500
73	Producción de Sales de Cu y derivados Soc.Min. Jicamarca N°2	Mining- Metalurgic Exploration	Cu, Ag, Au	600
74	Programa Habitacional de Curipata Centromín Perú S.A.	Others In Study		7,300
75	Proyecto Carbonífero de Jatunhuasi Centromín Perú S.A.	Mining Exploration		
76	Proyecto Embarcadero de Bayóvar Minero Perú S.A.	Others In Study		9,000
77	Proyecto Integral Veta Rosita Cía. Minera Lourdes de Cerro de Pasco	Mining Exploitation	Pb, Zn, Ag Au	500
78	Puchaquilca Fermín Málaga Santolalla e Hijos S.A.	Mining Exploration & Exploitation	Pb, Zn, Ag,	210
79	Puerto Min. de Huacho Referencias en la Sub-Comisión de Minería	Others In Study		80,000
80	Pushas Cía. Min. Huacchara SA	Mining Exploitation	Cu, Zn, Ag	250
81	Quellaveco Minero Perú S.A.	Mining Exploitation	Cu	350,000
82	Quispisiza Minera Soledad	Mining Exploration	Pb, Zn, Ag Au	250

83	Ractivación de la Mina Santa Cruz	Mining Exploitation	Pb, Zn, Ag	4,000
84	Reactivación Mina Cecilia Cía. M. El Altiplano S.	Mining Exploitation	Pb, Zn, Ag	1,000
85	Recuperación de Cobalto Hierro Perú S.A.	Mining In Study		
86	Recuperación de Cobre Hierro Perú S.A.	Metalurgic In Study		4,000
87	Refinería San Miguel Cía. Minera San Ignacio de Morococha S.A.	Metalurgic In Study		15,000
88	Relaves Coloniales de Cerro de Pasco SMRL Antón N°3 de Cerro de Pasco	Mining Exploration	Ag, Au	200
89	Reubicación Planta de Residuos Anódicos Centromín Perú S.A.	Metalurgic St udy		10,300
90	Río Cenepa	Mining Exploration	Au	500
91	San Antonio de Poto Minero Perú S.A.	Mining Exploitation	Au	22,300
92	San Juan de Chorunga Cía. Min. Explatoro SA	Mining Exploitation & Expansion	Au	1,007
93	Santa Bárbara	Mining Exploration & Exploitation	Au	1,000
94	Santa Rosa Dos Aurífera Sucahuaylla SA	Metalurgic Exploitation	Ag, Au	2,208
95	Señor de la Piedad y Pascua de Resurrección	Metalurgic Expansion		98
96	Sofía Inés N° 1 Minera Gorgor S.a.	Mining Exploration & Exploitation	Au	250
97	Sulfuros de Cobre de Coroccohuayco Minero-Perú-Tintaya	Mining Exploration	Cu	45,000
98	Tambo Grande Minero Perú S.A.	Mining Exploitation	Cu, Zn,	27,000
99	Transformación de Zinc Centromín Perú S A.	Metalurgic In Study		2,000
100	Transporte Masivo Rápido Centromín Perú - Enafer	Others In Study		40,000

101	Tratamiento de sulfuros de Baja Ley Southern Peru Copper Co.	Metalurgic Exploitation		90,000
102	Uranio de Macusani Presidencia del IPEN	Mining Exploitation		20,000
103	Veta Hércules-Bajo Nivel 6 Cía. Minera Alianza s.a.	Mining Exploration Exploitation	Pb, Zn, Ag	2,500
104	Virgen de Fátima	Mining Exploration Exploitation	Pb, Zn, Ag	1,670
105	Yaruchagua Cía. Minera Yaruchagua	Mining Exploitation	Pb, Ag, Au	300

(*) Million of dollars

7.9 INFORMATION PROGRAMS

7.9.1 Data Base

a. Introduction:

To have a true vision of the national reality about potential sources of water pollution in basins, it is necessary to consider a complete and up to date Data Base, as well as an institution that will concentrate all this information available to any natural or legal person interested in taking a skillful and opportune strategic, administrative or operative decision related to the quality and quantity of the water.

This institution must have the most advanced computer technology, besides the qualified professionals that will be in charge of processing and interpreting the information obtained.

This limitation was found when elaborating the present study. The information exists, but it is too scattered and incomplete in the country.

b. Data to recollect:

For a study of the Mining Sub-Sector, it is necessary to have the following basic information that will keep increasing as the requirements are created:

1. Basin in which it is located.
2. Name of the polluted river.
3. Contaminant mine:
   - 3.1 Name and address
   - 3.2 Location (Dpt., District, Province, Place)
   - 3.3 Contaminant Products
   - 3.4 Pollution Level
   - 3.5 Production of Mineral and Concentrate
   - 3.6 Quantity of Contaminant
   - 3.7 Historical Statistics
4. Affected Entities
5. Comparison with the permissible limits for each contaminant element
6. Samples obtained (monitoring)
7. Projects of Environmental Improvement and Control (Performance-Control)

c. Usefulness and Scope

To have a data base and an institution which gathers all this information will help the interrelation with other similar entities like foreign Institutions, the Public, Government and normative Branch Offices (D.G.A.A.) that have a similar office being set.

7.9.2 Mining Census

As it has been mentioned, it is necessary and imperative to count with a mining census in which the main objective is to have up to date information on operating mines and which will be operating in the short, medium and long term, subdividing them into 3 principle types: small, medium and great mining; and to have a real statistic of the informal mining that is the most difficult to be controlled because of the methods used to obtain the mineral without a technical criteria that can protect the environment.

7.10 DEFICIENCIES IN THE SYSTEM AND INFORMATION AVAILABILITY

7.10.1 Introduction

To elaborate the present study many information sources (Institutions) have been consulted, nevertheless, the result obtained from many of them was limited and in other cases of no value; likewise, information not up to date has been found.

We hope that the present study will help the country to have Information Centers that will offer a good service in the quality and quantity of the data required by the user.

The country requires precise and opportune information to take any decision for accomplishing a complete development.

7.10.2 Limitations Found

The present list of limitations found for the elaboration of this study can give us a clear idea of how scattered the information is and the inconveniences found.

1. Main institutions without Information Centers or Public Relations Department which will offer an efficient service.
2. Partialized Information
3. Non-up-to-date Statistics
4. Levels of Restricted Access
5. Lack of centralization and specialization of the information.
6. Non-up-to-date-level of specific subjects as the ecological ones.
7. There are no publications about the water subject in the country.
8. Statistics of water consumption in all the mines are not available because of its cost. They are not registered by many mining companies; only the medium-size and the big ones have them.
9. Due to the little cost of the water resource compared with the total costs, it is not considered at all; only the large mining companies do so.
10. The limited data gathered from libraries or information centers.

7.10.3 Recommendations

Create an institution that will centralize the information for carrying out its projection towards the development of the country.

INRENA should be the one to take the first step towards the creation of this institution.

CHAPTER VIII

INDUSTRIAL USE

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CHAPTER VIII

INDUSTRIAL USE

8.0 INTRODUCTION

The industrial development achieved in these two last centuries has been surprising and such growth eagerness has left, in many cases, other subsectors that deserve more attention forgotten.

Nowadays, we are living with two major problems: contamination (pollution) and scarcity of raw material.

The companies linked to the Ministry of Industry, Tourism, Integration and International Commercial Negotiations (MITINCI) are not divorced from this problem, in spite of the distinction of their granted tradition, and their economic and social importance. It is already a must of the current development of the national economy to avoid that, due to a problem of water availability, the industry sub-sector could be damaged not only in its future growth, but also in keeping up its current situation.

The subject we are devoting this chapter to is the interaction between the industry sub-sector and water, where the two problems above mentioned are increasingly evident. Just observing the condition of our rivers, lakes, Pacific Ocean littoral and the press references, one can realize about the magnitude it is reaching and the increasingly urgent need to adopt solutions in accordance with our possibilities. Not long ago, water was considered a non-value product whose use lacked significance in the cost structure of the products. Its influence is increasingly showing and, on the other hand, the enterprises are tightly linked to this resource, compromising seriously its chances of survival and development, originating thus that water become part in the component as an actual raw material.

The socio-economic interdependencies, increasingly linked, make it difficult to isolate and assign the competence of the solution to specific sectors. Costs will not always be supported by the stronger sectors, which gives a rather political character at the moment of taking measures that tend to diminish our contamination level.

In this sense, we present in this chapter the water's influence within the industrial sub-sector, its importance, pollution degree, costs and the most damaged sectors.

8.1 HISTORICAL ANALYSIS

8.1.1 The industrialization process

Until the end of the 1950s, there was not an explicit strategy for the industrial development. The manufacturing sector was developed in a framework of a liberal policy which privileged the development of traditional export activities, mainly agrindustrial. Thus, it is a fact t hat, until the middle of the 1950s, the export of cotton, sugar, wool, and coffee represented more than 50% of the Peruvian exports.

The single legal norm related to the Industrial Sector was Law No. 9140 of 1940, which granted the Executive Power the right to establish agreements to protect and encourage

the country's industrialization, through tax or duties exemptions. The industrial production was mainly oriented to the production of durable consumer goods bound for the low and medium class sectors, which grew swiftly because of the urbanization process, triggered by the important economic development, which characterized those times.

The relative boom of the export activity triggered at the same time a demand for intermediate and capital goods which encouraged the emergence of some industries, manufacturers of such goods with relative technological and economic success.

In 1959, Law No. 13270 (Law of Industrial Promotion) was approved. It opened a new stage in the industrialization process in the country.

8.1.2 Period 1959-1968: boost to the decentralized industrialization

Law No. 13270 established an integral juridic framework to promote the industrial development, based on the strategy of import substitution. It considered a set of incentives, which were established by contracts, to propitiate new industrial investments. Such incentives did not differentiate the type of production, but the industry nature: decentralized or basic, to which it was extended the tax and tariff benefits, boosting, in turn, the creation of decentralized industrial parks.

The main instruments of industrial policy used under this Law were:

a. Constitution of administrative organisms in matters of industries: National Institute of Industrial Technical Norms and Certifications, National Institute of Industrial Promotion and Superior Council of Industries.
b. The setting up of industrial statistics.
c. The industrial promotion regime based on:
   - reduction of the rates of profit taxes for periods of 10, 20, 40, and 50 years, according to the enterprise's nature and location.
   - Substantial increase of the effective protection through tariff increase to the importation of similar products and discount or exemptions of the total duties of import for new equipment and machinery that do not compete with those manufactured in the country, and for the import of semi-manufactured raw materials which are used by the benefitted industries.
   - Rights for direct purchases or leasing of fiscal lands. Right to obtain benefits from the expropriation of non-urban lands. Subsequently, this benefit was complemented and perfected with the Industrial Park Law.
d. Economic Development Regime by the Industrial Bank of Peru.
e. Regime of the Industrial Property.
f. Draw back of import duties in case of re-export; exemption of the export duties; compulsory acquisition of national products by the State, Municipalities and Official entities; equality in the tax treatment for raw material used in the manufacture of exempted products using the Special Codes or Laws, etc.

The application of this policy propitiated the appearance of new industrial plants, specifically plants of assembling, mixing, and packing. Thus, Supreme Decree No. 080 establishes a special regime for the automotive industry. The pharmaceutical industry grows due to the installation of new labs that mainly mix and pack health products. New basic

industries are set up for the production of cement, paper, chemistry and metallurgy, and the steel industry of Chimbote is consolidated (SOGESA, now SIDERPERU), based on the steel products demand which arose from the needs of construction, workshops and metalmechanics industries oriented to the manufacturing of spare parts and capital goods for the export industries (mining and agro-industry).

The action to create Industrial Parks had success in those zones where the promoting action of the government found dynamic regional development entities, with action and proposal capacity. Such is the case of the Santa Corporation, which consolidated the steel industry in Chimbote, the Board of Public Works and the Board of Rehabilitation of Arequipa, which successfully managed and implemented the Industrial Park in Arequipa.

8.1.3 Period 1970-1981: Selective industrialization with State and laboral participation

The General Law of Industry, Law No. 18350, promulgated in 1970 by the Military Government, starts a new stage in the industrialization process in the country. Although the basic scheme of the new legal framework is still oriented fundamentally by the import substitution, however, the development strategy incorporates new characteristic aspects to the industrial policy, such as:

a. The direct participation of the State in the productive activity, especially in the property of the so-called basic industry and promoting actively the so-called specific industries.

b. The creation of the Labor Community, formed by the total of the enterprise workers who acquire rights for the property and management of the enterprises, initially up to a 50% of the Net Income and sharing 10% of the income as a direct allotment. Subsequently, the access to property with diminished rights (the labor stocks do not give access to the Stockholders' Board) was reduced to 33.3%.

c. The total surrender of the national market to the local industry, through contracts that granted markets in exceptional terms of competition and the implementation of the National Register of Manufactures.

d. Priority was given to activities in four categories, seeking the modification of the productive pattern, reorienting the industrial accumulation process to the production of strategy inputs and capital goods along with the matrix of tax, tariff, financial, administrative and technological incentives, and an additional set of incentives to the decentralization.

e. The creation of an economic sector, called social property, which should be constituted as the most important sector of the economy in a progressive way, to which a large support is given at the beginning.

f. The applied industrial model gives great importance to the Andean integration process. It was adopted as an opening and competition mechanism facing the external market, the fulfilling of exemption programs and the setting up of the Common External Tariff of the Andean Group.

The regime of treatment to foreign capital was applied, and, in general, the country adopted a position of strict fulfillment of the Andean reserve agreement for scheduling, commitments not to promote tariff dismantling, industrial scheduling, etc.
The application of this industrialization model in its first year caused a substantial increase of the industrial development, especially in the industries oriented to the internal market, along with the expansion of the internal demand propitiated by the redistributed measures and the reinvestment process caused by the application of Labor Community norms.

The nationalization process of the basic industry, although at the beginning did not cause abnormal operative situations, later damaged the expansion program as well as the setting up of new or specific basic industries, due to an excessive bureaucratism which featured the State decisions, especially in the case of those investments projects whose implementation exceeded more than twice what was foreseen.

A change of direction in the government guidance in 1976, together with the presence of a strong economic crisis which caused the application of adjustment economic policies, generated the following: the deceleration of the industrial growth, changes in the legislation relative to the labor communities, paralysis of the public investment and the beginning of a dismantling process of the tariff protection. The economic recession cycle, which after nine years affected the country, undoubtedly contributed to the crisis period in the industrial sector. The increase of the import necessities of the country, and especially the high dependence of the industry, sharpened the recession process.

8.1.4 Period 1981-1985: Selective opening to the import of end consumers goods

The final restoration of the democratic regime in 1980 finds the country with a high level of available international reserves and the application of a more liberal economic management inspired by coinciding models introduced in other Latin American countries. During the first months of the new government, the tariffs barriers were completely dismantled and the national industry was submitted to a hard competition with the imported products, as a result of the application of tariff levels which in many cases were too low.

In 1982, Law No. 23407 goes into effect, emerging in a context of liberal economy that in the practice legitimates the industrialization pattern (historically applied since 1959), introducing some modifications that cause a change of the emphasis in the productive scheme towards the regional development. It permits the private investment in the basic industry and modifies the Labor Community scheme, allowing the workers' choice between two systems: either the participation in the net results of the management or the rights to laboral stocks and dividends.

The main policies and instruments of the Law are:

a. protection of the industry against the external competition in a framework of effective protection.
b. industrial promotion with tax benefits by their differentiation.
c. promotional industrial financing.
d. promotion of the industrial and handicraft small enterprise.
e. tax stability agreement.
f. regime of industrial property, training, industrial safety and hygiene, register, etc.

What is characteristic of this regime and its execution is the permanent contradiction when applying it in a framework of liberal policies that originated, as a consequence, a permanent period of uncertainty, incoherence and deindustrialization. When the Executive Power approved: tariffs exemptions and discounts not foreseen by Law, the institutional modifications in the management of the International Trade policy exposed industrial sectors to a hard external competition. The administrative industrial sector was weakened on account of a set of provisions that diminished access and directionality to the industrialization process; the programs of State purchases, originated in different service and productive sectors, damaged permanently the protection and preference regime for the local industry.

Undoubtedly, in this permanent fight between the local industry and the internal agents who defended imports, the external financial offers played an important role. They pressed for maintaining their whole offer of goods for import, even importing clothes, furniture, etc. together with capital goods which constituted the main part of the offers. The financing scarcity and the external debt problems gradually weakened this anomalous situation up to 1984. After the new economic crisis started in 1983, some protectionist mechanisms and policies were retaken for the industry.

8.1.5 Period 1985-1990: Back to the industrial protectionism

The government of that time found the country recovering from the economic crisis that started in 1983. The inflation pointed out the existence of an offer-demand maladjustment and of other gaps, especially the fiscal one, and the country's international reserves were recovering.

In such context, they opt for applying an economic model considered "heterodox" whose main instruments and general policies affected the industrial sector's performance, which continued ruled by Law No. 23407.

Thus, the following policies are established:

a. Total protectionism to the local industry. What is not manufactured here is not imported.

b. Expansion of the internal market, by a series of measures which encouraged the domestic demand: recovering of real wages, reduction of interest rates, special temporal employment programs, public expenses, etc.

c. Freezing of the exchange rate.

d. Prices control by supervised, regulated, controlled and special regimes.

As a result of the application of this regime, the industry expanded its production during 1986 and 1987 up to levels similar to those achieved in 1975-1976 and 1980-1981, which were the peak of the expansive cycles. However, the investment process, which implied an application of the excess generated by the application of this reinvestment policy to the diversification, expansion or generation of new enterprises, was very weak and the model tailed. Strangulations in the intermediate production of goods (steel, paper and cardboard, chemical products, glass, cement, etc.) appeared which along with the

exhaustion of international reserves led after five years to a new crisis (July 1988). Such crisis gave rise once again to the application of a set of adjustment policies which produced a stage of recession with inflation (stagflation).

8.1.6 Period 1991-1993: Opening of the economy and promotion of investments

With the beginning of the Stabilization Program and the Structural Reforms of the new Peruvian Government, the economic policy implemented from August 1990 on considered among its principal objectives the opening of the economy to the international markets and the promotion of national and foreign investments.

For the industrial sector, this policy implied a deep transformation and change in relation to the former situation in which an overprotected and subsidized industry prevailed and, consequently, became little competitive and inefficient in general terms.

The current process of the economy liberalization emphasizes the privatization of the entrepreneurial activity, the elimination of monopolies, the promotion of the national and foreign investment, the reduction of the State system, and especially a new commercial policy by means of a free-trade regime that eliminate all restrictions to exports and imports (licenses, visas, dues, registers, etc.) establishing a new tariff policy with only two levels: 15% and 25%.

8.2 WATER CONSUMPTION

The degree of industrial concentration in Lima in relation to the national total is estimated at 60%. This proves us that data shown in Tables 8.1, 8.2, 8.3, and 8.4 are representative.

On the other hand, it is important to mention that the water component is not dealt with independently as consumption in the subsector matrix, which concentrates the main macro-economic variables registered at an aggregate level by type of economic activity at the MITINCI Office of Statistics.

As shown in Table 8.1, the industry subsector in Lima and Callao registers a consumption equivalent to 11% of the total volume billed by SEDAPAL.

TABLE 8.1

BILLING PER ZONES OF THE INDUSTRY SUB SECTOR IN 1993 (Thousands of m3)

TITLE	ZONES						TOTAL
	NORTH	CENTER	SOUTH	EAST	WEST	CALLAO	
INDUSTRY	4,430	19,799	822	4,637	12,018	2,673	44 380
TOTAL	70,564	115,982	23,222	51,851	107,218	34,679	403 517
PARTICIPATION (%)	6 28	17 07	3 54	8 94	11 21	7 71	11 00

The following Table 8.2 shows us that from the total of users directly managed by SEDAPAL, 7% are subsector enterprises m intaining a use relation by connection of 1.39, being 1.41 the average.

TABLE 8.2

NUMBER OF CONNECTIONS AND USE UNITS BY ZONE OF THE INDUSTRY SUB SECTOR IN 1993

TITLE	ZONES						TOTAL
	NORTH	CENTER	SOUTH	EAST	WEST	CALLAO	
INDUSTRY							
CONNECTIONS	7.783	20.829	1.777	6 705	11 838	3.948	52 880
USE UNIT	9.191	32.255	2.257	7.798	17.555	4.607	73.663
TOTAL							
CONNECTIONS	174 276	135.210	104.659	128.936	122 356	66.823	732 260
USE UNITS	232.029	244.761	114 775	162.989	180 226	88.480	1 031.260
CONNECTION							
SHARES	4 47	15.40	1 70	5 20	9 68	5 91	7 22
USE UNITS	3 96	13 18	1 97	4 78	9 33	5 21	7 14

According to Tables 8.3 and 8.4, the subsector assigned to SEDAPAL contributes with 28% of its total billed revenues. While the subsector's users with their own supply source and industrial drainage register a consumption of 86% and contribute with 13% of the billed amount.

TABLE 8.3

BILLED AMOUNT PER ZONES OF THE INDUSTRY SUB SECTOR IN 1993
(Thousands of Nuevos Soles)

TITLE	ZONES						TOTAL
	NORTH	CENTER	SOUTH	EAST	WEST	CALLAO	
INDUSTRY	4 612	20.624	855	4.829	12.640	2.771	46.331
TOTAL	22.126	54.724	5.734	19.077	52.299	13.002	166 963
PARTICIPATION (%)	20 84	37 69	14 91	25 31	24.17	21 31	27 75

TABLE 8.4

VOLUME AND BILLED AMOUNT PER OWN SUPPLY AND INDUSTRIAL DRAINAGES IN 1993

UNIT	OWN SUPPLY			INDUSTRIAL DRAINAGE			BILLED AMOUNT (Thousands)
	INDUSTRIAL	TOTAL	%	INDUSTRIAL	TOTAL	%	
Thousands of m3	45.607	52 937	86.15	17.427	22.927	76 01	24.411

Summing up, it could be pointed out that the subsector with 8% of users in total (direct and own supply source users) registers a consumption of 20% and bills an amount of 37% of the total revenues of SEDAPAL.

This same situation usually exists in the drinking water and sewerage service enterprises in our country.

In the following Table 8.5, we can see the total number of users of the sanitation system, along with the volume billed to them. Therefore, the number of agents of the industry subsector and the water volume that would be charged to their consumption could be estimated. We could also establish an approximated demand of the drinking water by these users' universe at a national level. About this, it deserves a particular attention that water should be treated not just as an economic good whose value is the exchange and use rate fixed by the market or the State, but also has an ecological value, independent from its monetary value.

TABLE 8.5

INDEXES OF ENTREPRENEURIAL MANAGEMENT UNTIL DECEMBER 1989

ENTERPRISE	NUMBER OF CONNECTIONS	VOLUME PRODUCED (*)	VOLUME BILLED (*)
- Sedapal	**626,589**	**631,307**	**348,690**
- Sedapar	82,564	36,780	24,940
- Sedapat	85,978	35,342	25,865
- Sedacusco	25,750	15,290	11,124
- Sedalam	64,777	32,394	23,426
- Sedaloreto	32,658	20,414	11,239
- Sedatacna	20,866	9,464	7,283
- Sedatumbes	10,478	6,868	4,087
- Sedapiura	76,520	53,651	36,976
- Sedapuno	22,736	7,047	6,306
- Sedajunín	37,709	21,259	13,596
- Senapa	178,190	103,529	66,150
Sub Total	638,226	342,033	230,992
TOTAL	**1'264,815**	**973,340**	**579,682**

Source : Regulating Commission of Tariffs of Drinking Water and Sewerage CORTAPA
(*) Thousands of m^3

In general terms, it is inferred that, from the users belonging to the sanitation sector at a national level, 105 thousand belong to MITINCI and approximately demand 90 million of cubic meters annually. Consequently, in the capital of Peru, there is a concentration of almost 50% of the manufacturing and commercial activity of the country. See Table 8.6

TABLE 8.6

ESTIMATED WATER DEMAND PER ACTIVITY

TITLE	NUMBER OF AGENTS	ESTIMATED DEMAND (m^3)
SEDAPAL	53,000	44,400,000
REST OF THE SANITATION SECTOR	52,000	46,200,000
TOTAL	105.000	90,600,000

Like an additional comment, the National Society of Industries (SNI) has registered only 42 thousand agents in its database at a national level. The General Directorate of Environmental Health (DIGESA) registers 600 enterprises in its users' cadastre at a national level for the industrial watershed collection.

The disparity in figures somehow reflects the absence of an arrangement about the matter in the subsector and, on the other hand, the agents' non-attendance to the official institutions, is due to the lack of divulgation or of a centralized register in offices that do not have enough capacity to meet the people's demand.

8.3 WATER CONTAMINATION

The water contamination is characterized by its diverse forms and origins, embracing a panorama that ranges from the superficial sources to those causes located in the very deep sediments.

Many of such sources are related to the use that the soil receives, and can be characterized by the geographical scope of the resulting contamination, creating local and regional problems (at a basin level).

In the country, the industrial activity uses water directly as an input for the elaboration of finished goods or, indirectly, for the productive process. It is calculated that in 1984 the total quantity of water used by industry at a national level was 156.34 million of cubic meters. The industrial activity is largely located in the Coast and 95% of the water comes from the rivers of the Pacific watershed. Only 4.1% and 0.9% come from sources in the Highlands and Jungle, respectively.

The industrial activity is seriously affected by emissions of activities located at the rivers' streams, consisting of organic discharges, both domestic and industrial, which increase the turbidity and reduce the oxygen in the water. On the other hand, the inorganic emissions by the mining and industrial activities alter significantly the acidity degree (pH) of water.

Since each type of industry requires water with different characteristics, its treatment problem is solved individually by each enterprise. There are indicators that determine the maximum permissible limits for the diverse industrial processes and which are used by the industrial firms to

have a permanent control of the quality of water for the corresponding process. Table 8.7 illustrates the permissible contamination levels for each type of industry.

According to such Table, the turbidity of water produced by the organic discharges largely affects industries, except for the air-conditioning, pastry and laundry industries. The oxygen reduction damages those industries that use boilers during their productive processes. Finally, industries like brewery, rayon pulp and tannery besides boilers' feeding are the most affected by the inorganic residues of water.

The waste that the industries emit could be of a varied nature. It is considered that they usually are: organic salt, alkaline materials and acids, organic matters, suspended matters, floating materials, hot water, coloring matters, foamy matters, toxic products and radioactive materials.

The General Direction of Environmental Health (DIGESA), entity in charge of the supervision of water's quality, developed a cadastre which provides information related to the type and volume of the diverse pouring. In an illustrative way, Table 8.8 shows the pouring points in the main rivers of the country by type of industrial activity.

In general terms, we could affirm that the food, soft drinks and tobacco industries (CIIU 31) are those that have the highest number of pouring points (15 in total), followed by the chemical industries and chemical products derived from the oil, coal, rubber and plastic (CIIU 35) (with 7 points), and the paper, printing industries and publishing companies (CIIU34) (with 4 points).

Each type of industrial activity is characterized by emitting specific contaminant agents, namely:

- **Food:** The food and related preparation produce suspended solids and colloids as well as organic contaminants. The brewery and the dairy industries emit large loads of Biochemical Demand of Oxygen (DBO). The residues of the elaboration and packing of poultry and meat products show excrement and blood concentrations with high indexes of salmonella, as well as organic compounds and suspended solids, nitrogen and fats.

- **Oil refining:** Oil refining produces an average of 380 liters of affluents per crude oil barrel that is refined, and is mainly composed of toxic organic substances.

- **Oil extraction:** The contamination caused by oil extraction operations is the result of both the emission of hard water to the rivers and of the spilling of crude oil. It is known that in 1983, the major oil companies which were operating in the Peruvian Jungle discharged 6.6 million of hard water barrels to the Pastaza and Tigris rivers in Loreto. In 1990, the General Direction of Environment from the former ONERN estimated that the residual discharges coming from the oil exploitation to the superficial water reached 113.4 million of barrels.

- **Cellulose paper:** The effluents commonly emitted by a cellulose and paper factory contain organochloric compounds, colloidal salts, fats, anilines, refractory organic matters in solution, nutrients (phosphorous and nitrogen), oil, phenols, and others. These plants produce an average of 200 m^3 of effluents per ton of cellulose and 110 m^3 of effluents per ton of paper. During the refining process, phenols, other organic contaminants, suspended and dissolved solids, caustic and alkaline sludge, cyanide, hard metals and sulfides are eliminated.

- **Textiles:** The popular use of dyes with hard metals and oxidizer supposes very important contaminant loads.

- **Tannery:** It contributes to contamination with large emissions of sulfides, chromium and organic loads used in different working processes in leather, which are poured directly and without treatment into the rivers. So, main rivers, such as the Vilcanota in Cuzco or the Chili in Arequipa, suffer serious problems of organic contamination generated by tannery emissions.

- **Metal-mechanics:** Contamination is due mainly to emissions of hard metals, cyanide and corrosive acids, poured without treatment to the city's main sewage channels.

Table 8.9 shows the volume of industrial and mining pourings in superficial and marine waters by Departments in Peru. There are two departments with watersheds above 50 million of cubic meters and eight with pouring above 10 million of cubic meters.

The Coast is the region which registers the highest volume of emissions with 234 million cubic meters, followed the Highlands with 83 million cubic meters, and the Jungle with 2 million cubic meters. The total volume of residues poured in the country is of 328 million cubic meters. We must add the watersheds of the urban sectors to this volume.

The manufacturing processes of our industry (lay out) tend to the production of residues because it is impossible to reach the total transformation of a material into another that constitutes the desired finished product. The problem is, then, to find a possible use of such residues.

Therefore, the subsector should adopt drastic measures to mend this situation in order to maintain the production level, improving, at the same time, the management of natural resources and limiting the contaminating substances to a minimum.

The search for innocuous technologies for the environment and, particularly, technologies of low or null waste production has advanced rapidly in industrialized countries with successful results.

In other words, a relatively small investment in activities to fight against contamination could avoid serious or irreparable damages to the environment.

Consequently, countries like ours could learn a lot from the industrialization experiences in which an increasingly emphasis is made on the application of innocuous technologies for the environment.

There is no information yet regarding whether the subsector is performing pre-treatment to its effluents and/or solid or gaseous waste before leaving the industrial plants.

Although it is said that there are some industries which do it, they are useful as an experience and background, but they are not representative of all the subsector as a context.

What is mentioned above will occur as long as the normative entity responsible for the subsector (MITINCI) does not count with legal provisions to control the non-occurrence of such facts. With respect to this, MITINCI has subscribed an agreement with AID to call for a consulting bidding in order to establish the regulations for the contamination indicators in the subsector, to elaborate a form applied to industry in terms of caution of the environment, and, using it, to perform an exploring survey at a pilot level. This study will take four months, i.e. MITINCI will start 1995 with permissible ranges of pollution and will supervise their strict fulfillment. (In the attached annex, you can find the reference terms of the study mentioned).

TABLE 8.7

QUALITY TOLERANCES OF WATER FOR INDUSTRIAL APPLICATIONS

INDUSTRY	TURBIDITY	COLOR	DISSOLVED OXYGEN	HARDNESS	ALKALINITY	pH	DISSOLVED SOLIDS	Fe + Mn	TYPE a/
Air-conditioning b/	--	--	--	--	--	--	--	0.5	A.B
Bakery c/	10	10	--	3	--	--	--	0.2	C
Boilers' feed									E
0-150 lbs/inch^2	20	80	2	75	--	8.0.	3000-1000	--	--
150-200 lbs/inch^2	10	40	0 2	40	--	8 5.	2500-500	--	--
200 lbs/inch and over	5	5	0	8	--	9.0	1500-100	--	--
Beer's elaboration d/									F
Light	10	--	--	--	75	6.5-7.0	500	0 1	C D
Brown	10	--	--	--	150	>7 0	1000	0.1	C.D
Canned.									
Legumes	10	--	--	25-75	--	--	--	0.2	C
In general	10	--	--	--	--	--	--	0 2	C
Soft drinks. e/	2	10	--	250	50	--	850	0.3	C
Pastrymaking f/	--	--	--	--	--	--	100	0.2	--
Cooling g/	50	--	--	50	--	--	--	0.5	A.B
Foods in general	10	--	--	--	--	--	--	0.2	C
Ice (Hard water) h/	1-5	5	--	--	30-50	--	300	0 2	C
Laundry	--	--	--	50	--	--	--	0 2	--
Plastics, clear, colorless	2	2	--	--	--	--	200	0.02	-
Paper and pulpa: i/									
Ground wood	50	20	--	180	--	--	--	1.0	A
Pulp for Kraft paper	25	15	--	100	--	--	300	0 2	--
Soda and sulfite	15	10	--	100	--	--	200	0.1	--
Clear paper, grade-HL	5	5	--	50	--	--	200	0 1	B
Pulp of rayon									
(Viscose)	5	5	--	8	50	--	100	0 05	--
Manufacturing Production	0.3	-	--	55	--	7 8-8 3	--	0.0	--
Tanned j/	20	10-100	--	50-135	135	8.0	--	0.2	--
Textiles:									
In general k/	5	20	--	20	--	--	--	--	--
For dyeing k/	5	5-20	--	20	--	--	--	0 25	--
Cleaning wool l/	--	70	--	20	--	--	--	1.0	--
Cotton bandage	5	5	--	20	--	--	--	2 0	--

Note:

a/ A = non-corrosive
B = no slime formation
C = according to the general norms for drinking water
D = Na Cl, 275 mg/l,
E = Al_2O^3, 5-0, S; SiO_2, 40-5; CO^3, 200-40, HCO^3, 50-5, OH, 50-30, F-Ca, 100-500; CaSO4, 100-500, no odors

b/ Water with algae and odors of hydrogen sulfide are very inconvenient for the air-conditioning

c/ Some hardness is desirable

d/ Waters for the distillation should meet the same general requirements that for the beer elaboration.

e/ Clear water. without odors and sterile for syrup and carbonation Water consisting in characters.

f/ Hard sweets require pH of 7 0 or higher, because the low values favors the sacarosa's inversion causing sticky products

g/ The corrosives' control is necessary as well as the organisms' control such as sulfur and iron bacteries which tend to form slime

h/ $Ca(HCO_3)_2$ is particularly problematic. $Mg(HCO_3)_2$ tends to a greenish color. CO_2 helps to avoid cracking Sulfates of Ca, Mg and NA, should be,each one, minor than 300 mg/l.

i/ The uniformity of composition and temperature is desirable. Iron is inconveenient, since ccellulose absorbs the iron from the diluted solutions Magnesium is very inconvenient, obstructs the tubing and is oxidized to permanganate by the chlorine causing a reddish color

j/ Excessive iron, manganese, or turbidity create spots and decolorations in the fur and leather tannery.

k/ Constant composition. residual aluminium 0.5 mg/l.

l/ Calcium, magnesium, suspended matter and soluble organic matter, could be counter-productive.

Source : American Water Association, Water quality and treatment.

TABLE 8.8

SPILLING POINTS BY TYPE OF INDUSTRIAL ACTIVITY IN SOME RIVERS OF PERU

BASIN	CIIU	DESCRIPTION	SPILLING POINTS	POLLUTING a/
Chira-Piura	3115	Animal and vegetable oils and fats		0
		Distillation, rect. of alcohol, alcoholic drinks		
Chicama	3131		2	0
		Balanced foods for animals		
Moche			1	0
		Milling industry of grains		
		Packing and conservation of fruits and	1	0
Santa	3122	legumes	1	0
		Paper industry and paper products		
Fortaleza	3116	Basic chemicals	1	0
	3113	Synthetic resins, plastic materials and artif.		
		fibers	1	1
	3411	Vehicles	1	1
		Meat preparation and conservation		
Chillón	3511	Milling industry grains	1	0
Rimac	3513	Beer and malt	1	0
		Yarn, fabric and finishes		
		Leather shoe industry	1	0
	3843	Elaboration of dairy products	1	0
	3111	Paper industry and paper products	1	0
		Basic chemicals	1	0
	3116	Synthetic resins, plastic materials and art.	1	0
	3133	fibers	3	1
		Paints, varnishes and lacs		
	3211	Tyrees and inner tubes	1	0
	3240	Non-metallic mineral products	1	1
	3112	Elaboration of dairy products		
	3411		1	0
			1	1
			2	1
Majes-Camaná	3511	Beer and malt	2	0
Tambo	3513	Oil refining	1	0
Chili			1	0
			1	0
Amazonas	3521		1	1
	3551			
	3699			
	3112			
	3112			
	3112			
	3133			
	3530			

Source: Cadastre of spillings. General Direction of Environmental Health - DIGESA

a/ 0 = Organic , 1 = Inorganic

TABLE 8.9

MINING-INDUSTRIAL-FISHING SPILLING VOLUME
BY PERU'S DEPARTMENTS

REGION	DEPARTMENT	SPILLING VOLUME (thousand m^3)	RANKING
Coast	Tumbes	n.a.	--
	Piura	58,542	1
	Lambayeque	1,514	14
	La Libertad	5,278	11
	Ancash	10,221	8
	Lima-Callao	55,407	2
	Ica	43,789	3
	Arequipa	5,783	10
	Moquegua	26,250	7
	Tacna	36,088	5
Highlands	Cajamarca	2,660	12
	Huánuco	1,224	16
	Pasco	28,829	6
	Junín	39,933	4
	Huancavelica	7,112	9
	Ayacucho	850	18
	Apurímac	72	20
	Cuzco	931	17
	Puno	1,570	13
Jungle	Loreto	1,306	15
	Ucayali	715	19
	Madre de Dios	n.d.	--

n.a. = not available
Source : General Direction of Environmental Health - DIGESA

8.4 INSTITUTIONAL STRUCTURE OF THE SECTOR

8.4.1 Legal framework

a) Decree Law No. 25761 which declares the sector in reorganization and restructuring (October 1, 1992).
b) Decree Law No. 25831, Organic Law of MITINCI (October 25, 1992).
c) Supreme Resolution No. 065-92 approves the Regulations of Organization and functions (ROF) and the Personnel Assignation Table (November 10, 1992).

8.4.2 Object and scope

The Ministry of Industry, Tourism, Integration and International Commercial Negotiations (MITINCI) is a technical normative organism from the Executive Power which has the functions of formulating and supervising the fulfillment of the national scope policies in matters of industry, tourism, integration, and international commercial negotiations, in coordination with the municipal and regional authorities and in agreement with the State general policy and the development plans.

Likewise, in coordination with the regional authorities, it formulates the plans and programs corresponding to matters of its competence, as well as supervises and evaluates their execution.

MITINCI has within its functions the following:

a) To propose policies and norms of environmental and natural resources preservation in relation with the industrial and touristic activities.
b) To strengthen the market within the free-competition and intellectual protection framework.
c) To strengthen the micro, small, and medium enterprises of the touristic and industrial activity.
d) To establish the mechanisms that permit to execute the different schemes of integration, economic and social cooperation in the Latin American area and in the bilateral and multilateral negotiations at the international level.

Likewise, it has to control, together with the Ministry of the Interior, the chemical inputs which could be bound to other purposes, such as the elaboration of basic paste of cocaine.

8.4.3 General framework

The Industry Subsector is having a very dynamic reconversion period with the object of consolidating the efficient and competitive industries in order to assure their growth and presence in the market. Due to such process, many productive units are starting to orient themselves to the external market.

It is worth to mention the recovering of the economic activity in general, and especially of the subsector's production levels. During 1993, it increased in 9.3% in relation to the previous year, showing a favorable tendency during the first months of year 1994.

In the 1994 January-March period, the industrial production levels increased in approximately 15.3% in relation to the same period of the previous year. The utilization

rate of the sector's installed capacity also reflects a recovery and it has a 57.9% higher than the 52.9% obtained in May of last year.

According to the figures from the Ministry of Labor and Social Promotion (MTPS), the number of man-hours lost during the 1994 January-June period amounts to 389,415 against the 1,107,910 man-hours in the similar period of 1993. Furthermore, the private sector's estimations show recovery in the population's buying power, as well as an important increase in employment (10% in the last twelve months).

However, there are still some factors which put pressure on the industrial sector, such as the taxes and finances, the contraction of the domestic demand, and the exchange lag. These factors are being gradually overcome.

In relation to the tax matter, it is worth to emphasize the consolidation of the tax reforms that imply the rationalization and simplification of taxes, diminishing the number of taxes which affected the formal industry.

The reduction of inflation levels is allowing the progressive reduction of the financial cost and a better possibility of recovering the exchange rate.

In the medium and long term, the great challenge is to reach a prominently export sector which may contribute to the generation of foreign currency and employment that the growth model requires. Industries must compete not only with the import products, but and above all with the international export market. This means that we should look for the development of an industrial sector comprising micro, small, medium, and large enterprises that be linked and that be competitive both in the national and international markets.

8.4.4 Support to the industrial enterprises

To support the export sector, the diversee customs mechanisms have been improved, such as the Temporal admission, Replacement in Franchise, which has facilitated the delays in red tape and a better coordination of the sector with the Superintendency of Customs (SUNAD). It is also worth to mention that during the February 1993-June 1994 period, about 760 and 680 files of Temporal Admission and Replacement in Franchise, respectively, have been evaluated and approved.

With the purpose to give flexibility to the obligations assumed by the industrial export enterprises with the non-traditional contracts signed with the State, Legislative Decree No. 784 was given and 400 non-traditional export industrial enterprises took refuge in it.

Likewise, with respect to the matter of professional formation and workers' training in the diverse industrial activities, a new National Service Law of Training in Industrial Work (SENATI) has been approved that will permit its consolidation at a national level.

In relation to smuggling, subvaluation and falsification, the sector is working in coordination with other sectors and institutions for the implementation of diverse actions and norms oriented to counteract such activities.

There is an international commercial policy that seeks to increase our commercial flow through bilateral agreements with the countries of the Regional Andean Group (GRAN), Latin American Industry Association (ALADI), MERCOSUR, etc.

The increase of the public expense oriented principally to the construction and reparation of the road, power and sanitation infrastructure, besides the execution of diverse programs of social character and high levels of investment as a result of privatization, will all have a multiplying effect upon the employment and revenues and will help to reactivate the domestic market and, consequently, to encourage the demand of products from industrial origin.

8.4.5 Support to the small and micro enterprises

The importance of the small enterprise is reflected in its quantity (more than 99.9% of the enterprises are small), its generation of employment (it represents more than 75% of the GEP), and its contribution to the economy (30% of the GDP). All this has determined the need for MITINCI to develop a supporting strategy to these groups of enterprises.

The Program of Small and Micro Enterprises (PYMES) developed by MITINCI started on January 1994, having as its main goal to design a policy and strategy of support to the small and micro enterprisees, compatible with the macroeconomic and social aspects of the country.

The initial proposals have been submitted to more than 400 institutions at a national level and there have been many meetings with the interested people. The development of these encounters and the principal contributions of the private and public sectors have permitted us to reformulate and pinpoint these objectives in order to submit them again to their critic and consensus.

The objectives of the Program are the following:

- To eliminate the entering barriers to the service markets that would allow PYME's business development.

- To promote the competition in the service markets, of the sector encouraging its expansion, description and quality, seeking a higher individual and collective competitiveness.

- To inject the activity of the small enterprise in the development of a competitive export industrial sector, by means of mechanisms of subcontracting and participation.

The strategy to support PYMES in order to strengthen its competitive capacities is posed in three fields:

- To take advantage of the existence of a group of public and private institutions at a national level that are working on diverse development programs for PYMES.

- To revise in the light of PYMES' reality, the normative aspects, such as tax, finance, and register.

- To obtain for PYMES access to the services of consulting, training, technical assistance, commercialization, and information. Through the service modules designed in the Ministry (which are kind of entrepreneurial promotion guided by

a qualified group of persons), adequate conditions will be created so that the existing institutional offers from the different regions could be oriented to the real demand of the subsector.

Likewise, the micro and small enterprises of different economic activities, including the industrial activity, receive the support of MITINCI through the following promotional mechanisms:

- Agreement subscribed with the College of Notaries of Lima and Callao for the establishment and formalization of enterprises.

- Free advice for the attainment of the Unified Register and Municipal License of Operation.

- With the purpose of modernizing the handicraft activity in an integral way, orienting its production to the export, MITINCI has elaborated a discussion and agreement document which will permit to institutionalize adequately the public and private promoting system, the formalization of the institutional programs and the rational and adequate application of the resources.

- On the other hand, with the object of divulgating adequately the promotional events and emphasizing those of national concern, diverse training events, national and international fairs have been organized and supported.

8.4.6 Organization

MITINCI organic structure (organization chart) is presented next. Like the rest of the Ministries, it counts with its advising and supporting organs, and also with a General Office of Internal Inspectorate which sometimes acts as the Internal Control Organ in the private enterprise. It also has a General Secretariat which acts as a General Administration Office. It also counts with decentralized organisms and institutions, such as: FOPTUR, CONAFRAN, CENFOTUR, and INDECOPI, whose attributions and general norms are within the framework of the provisions mentioned in section 8.4.1 Legal framework.

As line organs, there are 2 ViceMinistries: first, Industry, and, second, Tourism, Integration, and International Commercial Negotiations. They have one (1) and two (2) National Directorates, respectively. MITINCI National Directorates operate as a technical normative entity and they are three:

National Directorate of Industry.
National Directorate of Tourism.
National Directorate of Integration and International Commercial Negotiations.

Under each one of these National Directorates there are a number of Directorates that, in the case of the General Directorate of Industry, are:

Directorate of Normative Affairs.
Directorate of Chemical Products and Supervised Products.
Directorate of Industry and Handicrafts.

Under the first mentioned, we find the subdirectorate of Environmental Supervision and Control, which is the MITINCI branch that norms and supervises the economic agents assigned to the subsector and takes care of their strict fulfillment in environmental aspects. Also, in order to give it more autonomy, in the short term this sub-directorate could be granted the rank and scopes that the other Directorates, that depend on the General Directorate of Industry, have. On the other hand, it would be given human and material resources and equipment for the complete fulfillment of its functions.

8.4.7 Human resources

The Ministry is going through a reorganization period, due to the administrative rationalization that experimented months ago and which reduced its payroll from 2500 to 150 government employees. This has caused that many branches do not have the operating capacity to fulfill the functions which they performed before the introduction of the rationalization process.

Such limitation of personnel under the minimum operative number is not overcome yet, in spite of having hired employees under the non-personal services modality in some areas because they lack the required knowledge and experience for processing, classifying and directing official activities and/or files.

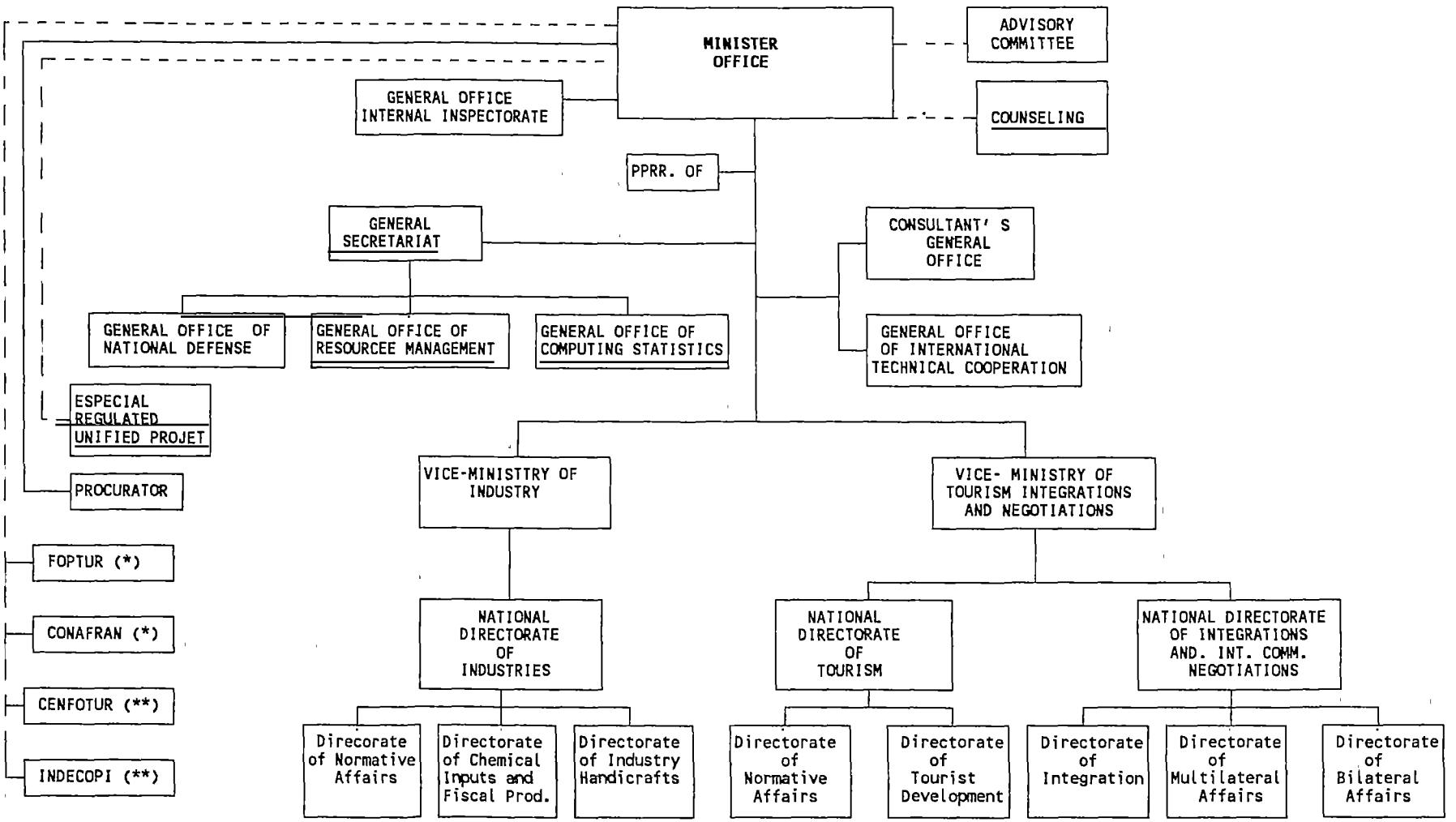
This situation is observed in the majority of the Ministry branches. In that respect, the personnel department has agreed with a consulting firm so that it will be the one which makes up the personnel list, evaluate and qualify the job posts in accordance with the qualifications of the personnel that it has at present. At that point, a training program for the subsector employees will, supposedly, be prepared.

It is important to mention that a private entity and coanimator of the sector's horizon, such as the National Society of Industries (SNI), is better furnished in several fields. Consequently, it deserves a greater and closer collaboration with the ruling entity because that would result in a number of benefits, such as greater objectivity, time could be used more efficiently, quicker and more coordinated actionswould be taken for the country's benefit and, therefore, everybody's well-being.

There are other private institutions that will collaborate with MITINCI and do a coordinated job with largely satisfactory results. These are:

- Exporters' Association (ADEX)
- National Confederation of Private Entrepreneurial Institutions (CONFIEP)
- National Confederation of Traders (CONACO)
- Association of Small and Medium Entrepreneurs (APEMIPE)
- Chamber of Commerce of Lima
- Chamber of Commerce of Callao

STRUCTURAL CHART OF MITINCI



(*) Autonomous Decentralized Ascribeed to the Sector

(**) Decentralized Institutions

8.5 PRESERVATION OF ENVIRONMENTAL AND NATURAL RESOURCES

8.5.1 Generalities

With respect to the subsector's policy, the predominant guidance is the commercial opening and the international competitiveness. Unlike other political junctures, the current one comes with an environmental consciousness. A concern is increasingly observed regarding the cleanliness of the production processes, i.e. that they present minimum levels of contamination in air, water, and soil. In this context, the competitiveness exigencies get stricter and the fulfillment of the environmental regulations will become a necessity.

On the other hand, due to the lack of regulations of the Code of Environment and Natural Resources, the subsector has given priority to the need of elaborating a diagnosis of the environmental contamination produced by the industrial activities in Peru, as well as to propose basic regulations which should consider the environmental costs and its distribution on the basis of a solid empirical knowledge, that could be implemented by MITINCI.

For that purpose, an integral participation is considered, not only of the State, but above all of the very entrepreneurial subsector, from the academic sector and from the NGO's so that acting together they could design the environmental regulation and studies of the environmental impact on the subsector.

8.5.2 Intersectorial support

As soon as the studies above mentioned are finished, the Ministry of Health through the General Directorate of Environmental Health, in accordance with the provisions stated in Chapter III of the General Law of Water (Decree Law No. 17752 of July 24, 1969) "About the sanitary authority and its attributions", will be the entity in charge of studying, qualifying and classifying the water courses in the country, according to the use they are destined to, making the necessary studies and compilation (Article 79), as well as watching for the strict fulfillment of the general provisions related to the pourings that could contaminate or pollute the country's waters, applying the corresponding sanctions to violators.

When noting a rapid population, industrial and agricultural development, a thorough analysis of the situation of the residual water discharge in our environment leads us to conclude that it is necessary to establish national programs of control of water contamination, which, in turn, comprise the following basic components:

a. Control of the contamination of the water courses and bodies in the country.
b. Control of the discharges of residual, domestic, industrial and agricultural waters.

Likewise, parallel to these basic components, the control of the quality of supply water to guarantee its potability should be considered.

On the other hand, the accelerated development and the growing urbanization and industrialization in the country have led us to face the significantly and potentially serious problem of the progressive contamination of the courses and bodies of superficial water. If we take into account the existing relation between this problem and the water resources' preservation, the food sources, the recreational areas and the drinking water supply, as well

as the disposal of residual waters and solid residues, we could conclude that all these should constitute the fundamental aspect for fighting against contamination.

8.5.3 Prevention and control of the environment contamination

In this section, we mention specific problems, like the ones referred to plaguicides, toxic substances, ionizing radiations and water, soil and air contamination.

a. Plaguicides

The chemical products of immediate application in agriculture are being handled in an undistinguished way. There is not a detailed list of products that are imported and/or manufactured in our market. There is neither a list of specialists in toxicology in the health sector, of norms and other means for the identification and control of the plaguicides.

b. Toxic substances

The health problems caused by chemical substances become evident in the production processes of the extracting mining and related industries, in the mining-metallurgic transformation industries, in the diverse manufacturing industries (chemicals, metalmechanics, of fertilizers, explosives, batteries, accumulators, tannery, paper factories, cement factories, fishing and chemical industries), and in the substances and waste used by narcotrafficking.

c. Ionizing radiations

In Peru, risks are shown by the exposition of the X-ray equipment operators, cobalt bombs, and other instruments of the medical therapy. In the industrial sector, the risk is lower because of the limited use of the radiation sources.

d. Water contamination

In our country, the fluvial, littoral and continental water contamination is significant.

The main sources of the littoral water contamination are the discharges of the waste water coming from the fish meal factories generally located in bays and in small ports or in their surrounding, and the discharges of domestic drainage of the urban areas that are poured into the sea.

In the case of the continental water, in many rivers and lakes the main problem is the watersheds of the mining industry and the domestic and industrial drainage. They especially affect the basins of the Rimac, Mantaro, Santa, Locumba, Moche rivers, and so on. Narcotrafficking is contaminating the Amazon basin rivers in the zone of Alto Huallaga.

e. **Soil contamination**

Among the main factors that influence the soil contamination, we have the solid waste, mainly due to the use of sewerage water in agriculture without a sanitary treatment, the indiscriminating use of chemical products in agriculture, such as fertilizers and plaguicides, the residual products of industries (toxic substances).

f. **Air contamination**

Activities related to the control of air contamination in Peru are losing rank. There is a lack of suitable personnel, working equipment and legislation that look at the problem in an integral way.

The air contamination problems in the country are located and related, mainly, to the extractive, mining, fishing industries and refineries and to the automotive park.

8.6 BASIC OUTLINES OF THE ENVIRONMENTAL HEALTH POLICIES AND STRATEGIES

8.6.1 Generalities

"It is emphasized that most of the countries in the region, except Brazil and Peru, that have promulgated national standards" have adapted them directly from those applied in the United States, perhaps giving minimum considerations to their economic realities and development priorities.

The Latin American developing countries differ from the industrialized nations, where most of the research is done, in that the developing countries should allot their limited financial resources to a major number of basic public works and to economic development projects.

It is important that the planner perform a detailed revision of local guidelines or standards in force (if any) to assure that the priorities of local economic development be taken into account properly.

Control systems, such as the submarine emissions, are within the biggest capital expenses for disposal of sewage, though the total costs of construction, operation, and maintenance of submarine emissions are considerably minor compared with the secondary treatment of the sewage with disposal in the littoral.

Consequently, the decision of designing the system for other standards of water supply that are not minimum must be supported by a proven need or by a local or national political decision.

The setting up of objectives of water quality (standards) depends on the uses given, or planned to give, to the water of the area, so it is a specific subject for each location.

The coliform levels, floating matter, fats and oil are generally key parameters in the designing of control systems for municipalities. While the toxic substances and temperature are generally more important for the industrial discharges. Other parameters, such as nutrients and dissolved oxygen are not usually a main concern, unless the discharge is made in a littoral or in a shallow bay that lacks water for dilution.

The most severe criteria of coliforms are associated with the areas of shellfish harvest. Some shellfish, such as oysters, clams, mussels, etc. feed themselves by filtering water, and, therefore, tend to concentrate contaminants providing a favorable environment for the continuous growth of harmful organisms.

8.6.2 Outlines

- All the inhabitants in the country have the right to have adequate environmental conditions.

- The complexity of the environment subject requires a multisectorial and multidisciplinary treatment.

- Development and preservation of the environment should be compatible.

- Peru's degree of industrial development generates its own environmental problems and requires its own solutions, norms and criteria.

- Peru's development needs demand permissible limits of the environmental damage within certain ranges in order to avoid the irreversible deterioration and degradation of the natural resources, so not to compromise the future of the country's population.

- Divulgation, education, participation, and social agreement are fundamental requisites.

- Prevention and reduction of contamination, encouraging the development of clean (innocuous) technologies with minimum waste.

- The environmental variable (protection of the environment and natural resources) must be definitely incorporated into the policy of social development of the country.

8.6.3 Strategies

As strategies of implementation, we should look for the following:

- Participation of the involved sectors (public, private and communitarian) which act and have competence in what would be called the SYSTEM FOR THE PRESERVATION OF THE ENVIRONMENT.

- Integration, coordination, and optimization of their members by a multisectorial and multidisciplinary organism.

- Gradualism in the recovery and preservation of the current environment situation of non irreversible characteristics.

- Taking into account the accepted permissible limits, there is no possibility of new contamination or deterioration.

The policy of environmental preservation to be defined together with the health policy should be the guiding framework for the objectives and strategies of **environmental health in the country.**

8.7 INVESTMENTS IN THE ENVIRONMENT

As seen in Table 8.10, the public investment executed in the 1982-1991 decade, in favor of the environment, experiments a decrease rate of 46%.

TABLE 8.10
EVOLUTION OF THE PUBLIC INVESTMENTS EXECUTED IN ENVIRONMENT
(Thousand US $ of 1988)

YEAR	MINISTRY OF HEALTH (MINSA)				SEDAPAL		SENAPA	ESMLL	TOTAL
	WATER	SEWERAGE	SOLID WASTES	ENVIRONMENTAL POLLUTION	WATER	SEWERAGE		SOLID WASTES	
1982	1,880	0.095	na	na	10,765	5,411	11,77	0 000	29,921
1983	3,074	0.653	na	na	5,822	7,518	7,16	0.002	24,232
1984	4,241	0.450	na	na	6,759	6,958	16,43	0.000	34,839
1985	3,057	0.178	na	na	7,738	7,822	6,30	4 096	29,193
1986	6,438	0.919	0.056	0.505	15,836	5,415	10,07	6.273	45,519
1987	6,105	0.967	0.048	0.434	13,511	4,038	19,73	0.069	45,791
1988	3,547	0.325	na	0.000	16,438	6,791	7,93	1.330	36,366
1989	2,151	0.226	0 059	0.334	8,188	7,001	5,03	0.154	23,943
1990	0,429	0.026	0.075	0.426	7,344	3,902	8,46	0.026	20,698
1991	0,160	0.033	0.025	0.185	11,503	5,480	0,92	2.104	20,492

The classification of such investments shows that 95% of this investment is for the sanitation sector (drinking water and sewerage) being 4.6 and 0.6% the investments in solid waste and environmental contamination, respectively.

SUMMARY

CONCEPT	INVESTMENT	%
. SANITATION	294,796	94.8
. SOLID WASTE	14,317	4.6
. ENVIRONMENT POLLU	1,084	0.6
TOTAL	310,992	100.0

This unfavorable evolution in investments in environment and health is explained to some extent because, at present, there is no National Plan of Development. The organism in charge, National Institute of Planning (INP), was deactivated at the beginning of 1992. The last medium-term national plan of development was elaborated by INP in 1986, and covered the 1986-1990 period. Such plan was the guide for the formulation of the government's policy during the 1986-1987 period. It was elaborated by INP technical team in consultation with the proper ministries and with the participation of commissions from those ministries.

In 1990, with the current government, a National Plan was formulated, but was neither approved nor published.

The National Program of Public Investment 1993-1997 is in ultimate stage. It is being elaborated by the recently implemented Investment Unit of the ViceMinistry of Economy and Finance. The elaboration of such program is based largely on the prior national programs of investment.

The last program in force was that of 1986-1990. When the government changed, the INP National Directorate of Investment Scheduling elaborated a proposal of the program for the 1992-1996 period. This program was referred to the public sector with an indicative character and comprised the government ministries, the public enterprises, and the investments to be made by the regional governments. Likewise, it highlighted the urgency of having an adequate project portfolio at the pre-investment level in order to submit them to the international financial community.

As indicated, the activity of formulating a National Program of Public Investments and having a follow-up and assessment is just being retaken and, in many aspects, the team in charge has lost the accumulated institutional experience. During 1992, with the deactivation of INP, its files, data, and personnel were, as a result, distributed among various branches of the public sector, having many of the professionals resigned to the service.

With respect to the sector development plans, these have problems of validity, approval and/or updating. On one hand, the national policies of each sector used to be expressed in the National Plans of Development and, therefore, their fulfillment encouraged the execution of the sector plan.

On the other hand, the INP deactivation meant the disappearance of the National System of Planning and this created a crisis inside the ruling instances of each sector planning.

There is no environmental sector plan. The environmental subject has not been assumed, in an integral way, by a governmental organization. However, there are short-term development plans for several branches that perform activities concerning the environment.

The solid waste does not have a guiding plan. This activity is operatively executed by the municipal governments, which perform them in accordance with their resource possibilities, but not under a temporary plan.

In environment, the following institutions participate: the Health Ministry (through the National Institute of Environmental Preservation and the General Directorate of Environmental Health - DIGESA), the National Superintendency of Sanitation, a branch of the Ministry of the Presidency, SEDAPAL (in process of privatization), Ministry of Economy and Finance, Ministry of the Presidency (ViceMinistry of Social Infrastructure), the Non-Governmental Organizations (NGOs), and the municipal governments.

As observed, there is no coordination entity that would allow to relate the different institutions that participate in the **process of environmental investment** with the object of concentrating resources, to avoid overlapping, and to support activities with a regional distribution.

8.8 FINAL COMMENTS

The major achievement of the new economic policy still seems to focus on the stabilization and on the essential economic and institutional reforms. There are signs of an economic recovery and of the proximity of an external financing, which has already started to concentrate.

Both point out to the proximity of a rise in the funds availability for investment (process of privatization of public enterprises). It is an important moment to think over the capacities and conditions in which the investment process is developed in both sectors.

The conditions in which the institutions are found are not the most adequate to optimize the investment process. The State is in restructuring process, which implies deep changes in its organizational structure. Such changes are not yet defined an applied on the whole.

The institutions linked to the environmental and health investments are not an exception to that situation. There are problems of elimitation of functions, lack of available information, and dismissal of personnel with experience. On the whole, all this produces the loss of the institutional memory. The institutions do not have a project portfolio with priorities.

We should add to that the existence of the State decentralization process, which began in 1990 and continues within a crisis context. Such process has produced, in the entities which were decentralized, a loss of information about the performance of their organisms out of the capital. Further more, these institutions have a severe lag in their internal information.

Due to the lack of clarity in property rights about the surface waters in the country, the economic agents overuse this resource as a receiving source of waste. This generates negative external problems because the contamination produced by this pouring damages the use of surface water for other purposes. Because the market is unable to correct the negative external problems by means of prices, inefficient resource assignation is produced in the society towards the pollution activities. To correct this inefficiency, it is necessary, therefore, to have some kind of regulation.

To establish an efficient supervision and control system that assure the granting of licenses for pouring, according to the factors above mentioned, and the opportune detection and investigation of violators is a must. So the following should be done:

- Establish a legal regulation about the environment that puts an end to the present overlapping of functions. In this sense, it should create the environmental authority in the country as an independent and trans-sectorial entity, represented by both the public and the private sector, whose objective should be to put in effect a national environment policy.

- Provide the environmental authority with an adequate budget that would permit to achieve the tasks of monitoring the water quality in the country, as well as to have human and physical capital to watch over the effective fulfillment of the environmental regulation stated.

- Analyze the effectiveness of the license system and the mechanism of regulation of surface water contamination when pouring sources are not specific. This condition is probably necessary for the cases of contamination in the Jungle.

CHAPTER IX

HYDROENERGY

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CHAPTER IX

HYDROENERGY

9.1 HISTORICAL ANALYSIS OF THE ELECTRICAL SUB-SECTOR

9.1.1 Brief Institutional Historical Description

The electricity like a public service starts in Lima in 1886 when the Peruvian Electric Construction and Supply Company inaugurates the lighting of the Main Square and of some streets in Lima downtown; later on it was extended to homes. Other 3 companies (Santa Rosa, Santa Catalina and Piedraliza) where founded in the following years, in order to give electricity service to Lima and Callao. They merged to form the Associated Electrical Enterprises in 1906, which afterwards became the ELECTROLIMA Enterprise that nowadays has been divided into the following enterprises:EDELNOR, EDELSUR, EDEGEL, UEN CAÑETE and UEN HUACHO, BARRANCA and SUPE.

In 1890, the government put out a decree declaring free the installation and exploitation of electric lighting because difficulties arose with the concessionary enterprise.

In 1905, the Electric Society is founded in Arequipa in order to give this service to this city. In the following years, small electricity enterprises are organized in departamental capitals and in others, the municipal governments are the ones in charge of supplying it to the cities.

This situation continued during the first half of the century without a legal order that could norm this activity. Law No. 12378, better known as The Law of the Electrical Industry, is given in 1955. It regulates and impels the electrification growth in the country giving appropriate incentives for private investment. In 1962,by means of the Law 13979, the National Electric Services are created to exploit the many electric central stations subordinated to the Government and to supply with electricity the setttlements where the action of the private capital or municipal governnments were not effective.

In 1972, the Electricity Normative Decree Law No. 19521 is given. It states that " the electric energy supply for public service is of public necessity, utility and security because it is basic for the social-economic development of the country. For this same Decree, the government is the one in charge of the generation, transmission, distribution and commercialization of the electric energy for public service"; leaving the Energy and Mining Ministry as a governing and regulatory entity and the Electricity Public Enterprise of Peru - ELECTROPERU as an organism in charge of this governmental enterprise activity.

The National Electrical Services, the Electric Energy Coorporation of Mantaro and the Peruvian Coorporation of Santa were brought together to form ELECTROPERU. The last two were in charge of the water resources exploitation of the Mantaro and Santa rivers, respectively. By means of the capitalization, on behalf of the Government, of the public domain possessions, as well as the purchase of shares owned by foreign investors, the private enterprises became Associated State Enterprises, maintaining its functional and administrative status.

"The General Electricty Law", Law No. 23406 promulgated in 1982, establishes that the government is responsible for the public service of electricity supply and for the enterprise structure based on a Main Enterprise (ELECTROPERU), a state property which is in charge of the electrical activities all over the country through Regional Enterprises for Public Services of Electricity and branch enterprises that could have up to a maximum of 10% of private capital. It also classifies the installations required for the supply of electric energy in the Systems of Generation, Transmission and Interconnection, Distribution and Utilization; and establishes regulated electrical rates.

The law that rules the electrical activity at present is Law No. 25844 " "Law of Electrical Concessions", promulgated on November 6th, 1992 which orders the development of generation, transmission, distribution and commercialization of activities by Peruvian or foreign, natural or legal persons and establishes a regimen of free prices for the supply of electricity when it can be done in competitive conditions and a regulated price system if it is required because of the nature of that supply. It also orders the governmental participation in the protection of the Environment and of the Cultural Patrimony of the Nation, as well as the rational use of the natural resources in electrical activities.

The Industry and Electricity Direectorate is established as a body of the Ministry of Promotion and Public Works in 1960. This body becomes the General Energy Directorate and the General Industry Directorate in 1963.

The Ministry of Energy and Mines begins its function like a governing and normative organ of the Electricity, Hydrocarbons and Mining subsectors on April 1st, 1969.

The Organic Law of the Energy and Mines Sector is established by Decree Law No. 25962 on December 7th, 1992. It determines the scope of the sector and the present organic structure and functions of the Energy and Mines Ministry and its branch offices.

9.1.2 Historical description of the use of the water resource in the energy generation

In Peru, the use of the water resource for the generation of electric energy goes all the way back to 1884, year in which the first hydroelectric central station was built in the Tarijas mining center in the district of Jangas belonging to the province of Huaraz.

On November 1st, 1907, the hydroelectric center of Yanacoto was inaugurated. There, a fall of 78m. and a volume of 15 cubic m./s were used for a power of 4,800 KW, with 4 groups of 1,200 KW each. In 1924, its capacity was extended to 9,200 KW. This central station was used until May 30th, 1960, when the hydroelectric station of Huampaní began to operate.

The hydroelectric central station of La Oroya was inaugurated in 1914 with a capacity of 9,000 KW and the central station of Pachachaca started its operations on December of 1917 with an installed power of 12,000KW. These central stations belonged to the former Cerro de Pasco Mining Company.

The hydroelectric central station of Callahuanca located in the valley of the Santa Eulalia river and with a capacity of 36,000 KW was inaugurated on May 7th, 1938. Its capacity was extended to 67,000 KW, with a fourth group of 31,000 KW in 1958. At present, this central station is named after its designer, the engineer Pablo Boner.

In 1940, the central station of Malpaso was built by the Cerro de Pasco Mining Company with a capacity of 54,000 KW, which was the biggest one in Peru at that time.

The central station of Yaupi started working in 1957 and its capacity was extended in 1968.

The central station of Cañón del Pato started operations in the department of Ancash in 1958.

The hydroelectric central station of Moyopampa was built between 1947 and 1951 in the valley of the Rímac river by the Andean Hydroelectric Energy Enterprise (Hidrandina) with a capacity of 42,000 KW enlarged by 21,000 KW in 1951.

The Gino Bianchini Huampaní hydroelectric central station was inaugurated on March 30th, 1960 with a capacity of 31,000 KW, using the lowest available fall in the Rimac-Santa Eulalia fluvial system.

Between 1957 and 1962 the works of the Marcapomacocha Derivation Project were built to get and dam the waters from the Andean Atlantic watershed and take them through a transandean tunnel of 13.7 km.to the Pacific watershed to be used in the generation of electric energy in the Callahuanca, Moyopampa and Huampaní central stations built before 1959, and in the Huinco central station built in 1960.

In 1964, the Huinco Hydroelectric Station started to work with a power of 274,000 KW.

The Cahua central station with a capacity of 40,000MW began to work in 1968.

The Matucana hydroelectric station started to operate using the waters of the Rimac river in 1971 with two generators of 60,000 KW each.

The Mantaro hydroelectric central station started working in 1973. After increasing its capacity in 1978 and in 1980 it has now a capacity of 786,000 MW, being the largest central station in the country.

The Restitución Central Station with a power of 270,000 MW was inaugurated in 1981.

In 1991, the Carhuaquero hydroelectric central station began to operate with three generator units that together sum a power of 75,000 MW.

In the present historical description, the summarized chronological sequence of when the principal hydrolelctric central stations began operations has been presented, although not of the small hydroelectric central stations that are operating at present.

9.1.3 Competition and impact on other sectors which use water

A.- From the analysis of the scarce existing information we reach the following conclusions:

a. The use of water for energy generation has not produced many cases of competition with other users because the water goes back to the river or channel from where it was taken; without being polluted and with less concentrations of sediments than at the moment it was picked up.

b. Some cases of competition with the agriculture sector have been presented. They have been treated in an isolated way, so there is not an integral information and a systematic information on the problem. The most serious case has been the use of waters from the Aricota lake (it is detailed later in the present chapter)

c. The existing hydroelectric central stations in the country to date, have been built without doing a previous Study of their Environmental Impact (EIA), because of the non-existance of legal regulations that would make these studies obligatory. Because of this, the evaluation of the negative environmental impacts which these electrical stations caused while being built and while in operation has not been possible.

Law No. 25844, Law of Electrical Concessions", establishes in clause (h) of article 24 that the elaboration of the EIA is a requirement in order to give a definite concession.

The "Regulations of the Environmental Protection in Electrical Activities"will be in force from June 9th, 1995. It will norm the interrelation of the electrical activities of generation, transmission and distribution systems with the environment under the concept of sustainable development.

In these Regulations are presented the scope of these studies (EIA), as well as other aspects that must be taken into consideration during its development to minimize the negative environmental impacts that the works would originate. It also requires the Adequation and Environmental Management Program (PAMA) and the Monitoring Program.

The Environmental Management Program consists of the necessary actions to avoid, minimize and/or compensate the negative environmntal effects, as well as maximize its positive effects.
The Monitoring Program allows to determine the environmental conduct in relation with the works of the project and the corresponding mitigation measures of environmental impacts.

d. For the construction of a hydroelectric central station there must also be a previous evaluaton if the preservation of the Cultural Patrimony of the Nation is affected.

A systematic information about the evaluations carried out in the existing hydroelectric central stations does not exist. As an isolated case the following can be mentioned: the modification of the forestat and the color used in the installations of the Machu Picchu Hydroelectric Central Station go against the whole landscape of the archeological ruins of Machu Picchu.

e. As it is appreciated in the Table of Annexed 9.1, the hydroelectric central stations operating at present, do not have the respective authorization for the use of water. This must have been requested before their construction.

B.- Problem about the use of water from the Aricota lake

The Aricota lake is found in the department of Tacna, and its waters are used to generate electric energy in the central stations in Aricota waterfall I and II with an installed power of 24 and 12 MW respectively.

The problem of the Aricota Lake is the continuous lowering of its water level, due to an existing unbalance between the feeding and the exploitation of this hydroenergetic resource.

For this reason, since 1982, the Aricota central stations I and II have only been used up to 65% of their Plant capacity (23 MW), having had an annual water deficit of 63 mcm during the eighties.

According to the analyses carried out, if the present rythm of exploitation continues (1.5 cubic m./s) and considering that the next years will be dry ones, a total collapse will occur in the short term which would bring regrettable consequences for the region considering that the hydroelectric energy is generated with the waters taken from the lake and that they are also used to cover the multisectorial necessities of the departments of Tacna and Moquegua. In other words, the present electric energy supply of these subregions would be affected, there would neither be water for human consumption nor for irrigating the fields of the Ilo, Ite and Locumba valleys and for La Yarada irrigation.

The hydroelectric central stations of Aricota I and II were designed to work as central stations to cover only thee demand at top hours (5 or 6 h/d). There was a projection of developing other hydroelectric central stations in the Vilavilani ravine, the ones that should operate like base central stations (24 h/d) to give better water resources to the valley and to the city of Tacna. However, these were not carried out, being a serious omission which has forced the Aricota central stations to work as base stations.

The exploitation of the Aricota lake was done with the construction of consecutive and equidistant tunnels with 20 m. of separation among them. Presently, tunnel No 5 is being used, and a dam has been built downstream from the Aricota central stations, for the purpose of managing better the water resource for agriculture.

It is necessary to take immediate corrective actions for the protection of the Aricota lake because a collapse could cause serious and irreparrable consequences for the departments of Tacna and Moquegua, such as:

- Total paralyzation of the Aricota I and II Central Stations operations, stopping the electric energy generation.

- No more water supply for the irrigation of about 8,829 ha that are under production at present. They are:

  - 3,429 ha in the Locumba and Ite valleys (waters below the Aricota lake).

  - 5,400 ha in boundary lines (La Yarada - Los Palos Irrigation) exploited with wells of underground water which work with electric energy from the Aricota central stations I and II.

- No more water consumption for human and industrial consumption in the city of Ilo (95,000 inhabitants).

- Damages would be caused to the agriculture of the Sama valley due to the lack of water.

- From the social-economic point of view, serious effects would be produced in the sub-regional and regional productive apparatus, with unpredictable repercussions in the social-economical activity of this borderline zone.

- The ecology of the influence zone of the projects would be affected by alterations produced by a lowering of the water volume from the lake.

9.1.4 Electric energy, characteristics and meaning of its consumption

Electricity is the most efficient and versatile way of transporting and using energy. Therefore, there is a better development of a country when the consumption of electric energy increases.

For this reason, the electric energy consumption per inhabitant and per year is recognized and evaluated as an indicator of wealth and development of a society, proving its close association with the growth of the Gross Domestic Product (GDP). There is a relation of the order of 1.5 to 2 times the amount of electricity consumption versus the gross domestic product.

An essential characteristic which must be taken into consideration is that the use given to electricity is of multiple applications, like:

a) A final consumer's good for lighting, heating, air conditioning, etc.

b) Input for the production of goods and services.

c) Essential factor for communications, the control of processes and the information management.

The energy versatility under the form of electricity, confirms the necessity of increasing its production as a basic policy of the government according to the world development.

Its availibility is a previous requirement for the increase of the productive activities. Because of this, it must be, on the one hand, directly supported by the Government according to the plans of integral development with an anticipation criteria, and on the other hand, its generation must be encouraged, especially hydroenergetic generation protected by the new legal framework.

The consumption of electric energy represents in our country, approximately 10% of the total consumption of all types of energy.

9.2 INSTITUTIONAL STRUCTURE

The organic Law of the Energy and Mines Sector and its Rules and Regulations establishes the present structure and functions of the Ministry of Energy and Mines, and inside it, the organs that have relation with hydroelectric energy generation.

9.2.1 Organic Structure of the Ministry of Energy and Mines

The Organic Structure of the Ministry of Energy and Mines is the following:

a) TOP MANAGEMENT, integrated by the Minister, Vice-Ministers and the General Secretary.

b) CONSULTANT BODIES: Consultant Comissions of Energy and Mines

c) CONTROL BODY, integrated by the General Inspectorate Office

d) ADMINISTRATIVE JURISDICTIONAL BODIES: Mining Council

e) ADVISORY AND SUPPORT BODIES: General Offoces of Legal Counseling, of Systems and of Resources and Services

f) NORMATIVE TECHNICAL BODIES, constituted by the General Directorates of Electricity, Mining, Hydrocarbons and Environmental Affairs

9.2.1.1 Technical Office of Energy

Consultant body of the Energy Vice-Minister's Office which has the following functions:

- Elaborate the Referential Plan of the Electricity Subsector.
- Advise in aspects related to the medium and long term national energetic policy.

- Establish periodically the national energetic balance.

The organic Structure of the Ministry of Energy and Mines is presented in graph 9.1.

9.2.1.2 Office of Electric Development Projects of Social Interest

It is a consultant body that depends on the Executive Directorate of Projects, and in turn this depends on the Minister's office, whose objective is to contribute to the fulfillment of electrification projects of social interest.

9:2.1..3 General Directorate of Electricity

It is the one in charge of producing the norms for the Electrical Sub-sector in the generation, transmission, distribution and commmercialization activities and the one to promote their development, as well as to control the application of the policy and the normativity of the sector.

The organization chart of the General Directorate of Electricity is presented in graph 9.2.

The General Directorate of Electricity has, among others, the functions of promoting the national use of energetic resources for the production of electricity and of controlling the application of the policies and regulations of the sector.

9.2.1.4 General Directorate of Environmental Affairs

Its objective is to regulate and promote the actions within the scope of environmental affairs related with the Energy and Mines Sector.

Among its functions, it has to propose policies and norms related to the conservation and environmental protection, as well as to promote the national use of natural resources integrating the ecosocial concept of programs, projects and activities.

9.2.1.5 Interinstitutional Relations

The Ministry of Energy and Mines maintains a relation of coordination with the other sectors entailed to the mining and energetic activities.

9.3 POLICIES, OBJECTIVES AND AIMS OF THE SECTOR

The Ministry of Energy and Mines being the governing and normative body of the sector, published in April of 1994 the Second Special Edition of the document "The Energy and Mines Sector towards a sustainable Development", where the present guidelines on the Sectorial Policy, Objectives and Strategies of the Sector for 1994 are stated. From there the points related to the use of the water resource for the generation of electric energy have been taken.

9.3.1 Guidelines of sectorial policy

The General Policy of the Energy and Mines Sector directs the government efforts towards the promotion of the private investment participation in the increase of electric supply, and hydrocarbon and mining production; acting directly in the extension of the rural electrical boundary and giving priority to the state intervention with social-economical impact criteria.

Likewise, this policy establishes the promulgation of rules which regulates the producer/consumer rational relation, guaranteeing the private investment, the conditions for a free competition and an efficient energetic-mining productive development, in harmony with the environment.

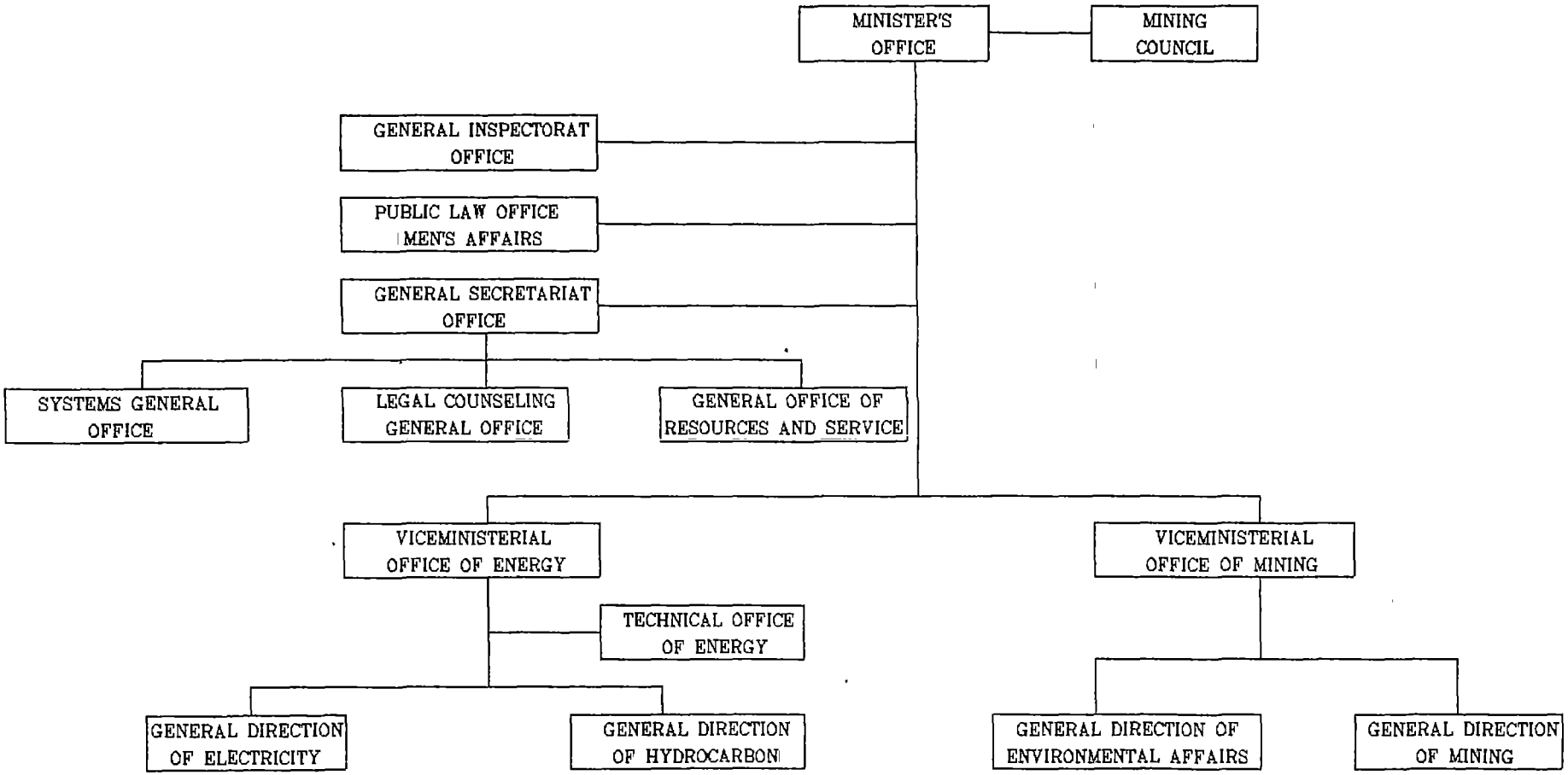
The electrical sub-sector will promote the participation of national and foreign private investment in the development of the activities related to the generation, transmission and distribution, so it can increase the energy supply substantially in order to satisfy the demand.

The generation of projects associated with small electric systems will continue to be carried out in order to extend the electric supply to the isolated zones and the urban areas in the interior of the country so as to reach an adequate social integration. Toward this end, the use of national technology and renewable energetic resources will be maximized.

Propitiate the environmental conservation in the areas of intense energetic/mining activity to maintain an adequate ecosystem for the development of life, promulgating the appropriate norms according to the the national reality and coordinating with the sectors involved, and making these norms known in an efficient way, supervising that they are followed.

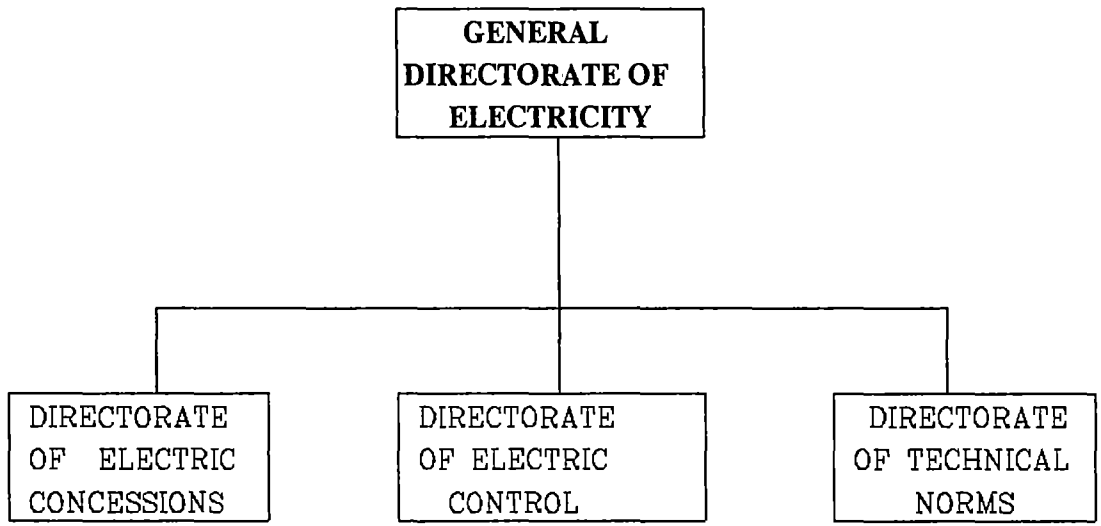
GRAPH 9.1

STRUCTURAL ORGANIGRAM OF THE ENERGY AND MINE MINISTRY



GRAPH 9.2

STRUCTURAL ORGANIGRAM OF THE ELECTRICITY DIRECTORATE



Note:

Regulations of the organic law of the sector

9.3.2 Objectives and Strategies of the sector for 1994

9.3.2.1 Electrical sub-sector.

OBJECTIVE 1

Complete the necessary norms for the incentive of the development and the competitiveness in the the electrical sub-sector.

STRATEGIES

1. Elaborate and promulgate the complementary norms of the electrical concessions and their Rules and Regulations.

2. Make the technical norms the same all over the country in order to allow the rationalization of the investment and the operative costs.

3. Propitiate the promulgation of the Geothermic energy Law in order to allow its development.

OBJECTIVE 2

Promote the national and/or foreign private investment in the electric energy generation, transmission and distribution activities, in the competitive and stable environment that is allowed by the new regulating framework.

STRATEGIES

1. Continue with the efforts of promoting the private investment in the increase of the electric generation,transmission and distribution.

2. Go on giving concessions in electric energy generation,transmission and distribution activities.

3. Continue with the legal clearing of the assets belonging to the public service of electricity enterprises.

4. Transfer the electric generation, transmission and distribution enterprises in charge of the government to the private sector.

5. Conclude with the consolidation wth the new rate system.

OBJECTIVE 3

Assure the supply of electric energy.

STRATEGIES

1. Evaluate the implemetation of a Cargo Bureau Center which will allow the efficient operation of the electric systems.

2. Continue with the maintenance of large hydroelectric central stations and thermic groups giving priority to the reparation of those that are in bad condition when it is justified.

3. Rehabilitate the interconnected electric systems of the country by means of a co-financing from the Eximbank of Japan and the IADB.

OBJECTIVE 4

Extend the electric supply in the urban and rural areas throughout the country.

STRATEGIES

1. Elaborate the Referential Plan of Electricity for a medium term.

2. Increase the rural electric generation in 53 megawatts and build 1,000 kilometers of electric sub-transmission for the interconnection of the distribution centers with interconnected electric systems.

3. Finish the Cachimayo-Abancay high tension line and move the thermal group from Tintaya to Ilo.

4. Build and incorporate the high tension lines of Tintaya-Socabaya and Chiclayo-Olmos to the interconnected system by means of a co-financing with the Eximbank of Japan and the IADB.

5. Reinforce the organization which will allow to optimize the governmental action in the rural electrification.

OBJECTIVE 5

Promote the research and the sustainable development.

STRATEGIES

1. Obtain and direct the resources of international cooperation for executing energetic programs, besides reinforcing the national organizations dedicated to promote the sustainable energetic development.

2. Promote the execution of the studies leading to the rational use of the resources and of the alternative energy sources like: wind generation, geothermic, solar and biogas.

3. Finalize the project that will allow to transfer the applicable activities of nuclear technology from the IPEN (Peruvian Institute of Nuclear Energy) to the Educational Sector.

9.3.2.2 **Environment**

OBJECTIVE 1

Implement an appropriate environmental policy for each of the sub-sectors.

STRATEGIES

1. Coordinate the participation of institutions and of Peruvian and foreign specialized personnel through nternational Technical Coorperation to elaborate the norms referred to the sector and its relation with the environment.

2. Finish the Rules and Reglulations for the environmental protection in the sub-sector of electricity.

OBJECTIVE 2

Evaluate the environmental impact, product of the energetic-mining activities to permissible levels according to the policy of sustainable development.

STRATEGIES

1. Execute 10 pilot projects of monitoring and environmental control of the mining-metallurgic activities, covering approximately 10% of the Peruvian territory.

2. Make an evaluation of the present levels of pollution and ecological risks like a consequence of the energetic-mining operations to conform the Environmental Data Bank.

3. Carry out the environmental evaluation of the informal mining in a national level.

OBJECTIVE 3

Contribute to the effort of creating a national conscience on environmental protection.

STRATEGIES

1. Sponsor with the help of the International Technical Cooperation: seminars, forums and other envents, in which institutional energetic-mining enterprises dedicated to the study of the environmental problem and governmental representatives will participate.

2. Promote the education of professionals abroad and implement the environmental information system.

9.3.3 Legal provisions of the energy and mines sector

A relation of legal provisions in force from the Electrical Sub-sector that are related to the water resource for the generation of electric energy are presented textually:

9.3.3.1 LAW OF ELECTRICAL CONCESSIONS DECREE LAW No. 25844

Article 3° concession is required for the development of each of the following activities:

a) The generation of electric energy which will use hydraulic and geothermic resources when the installed power is more than 10 MW.

Article 4° An authorization is required for developing thermoelectric generation and hydroelectric and geothermic generation which does not need a concession when the installed power is above 500 KW.

Article 9° The government is in charge of preserving the environment and the national cultural patrimony; it is also responsible for the rational use of the natural resources in the activities related to the generation, transmission and distribution of the electric energy.

Article 24° The definite concession allows the use of goods of public use and the right to obtain the right of way for the construction and operation of central stations for generation and related work, sub-stations and transmission lines, as well as distribution nets and sub-stations for the Electrical Public Service.

Article 25° The application for obtaining the definite concession will be presented with the following data and requirements will be presented to the Ministry of Energy and Mines:

b) Authorization for the use of natural resources of governmental property, when it corresponds.

h) Study of environmental impact.

Article 47° To fix the Bar Rates, each COES will calculate the amounts in the following way:

b) It will determine the operation program that will mininize the present cost of operation and of rationing for the period studied, considering, among others: hydrology, impoundings, fuel costs, as well as the up-dating rate referred to in article 79 of the present law.

Article 107° The concessioners and the enterprises dedicated to the generation activity, which use the energy and the profitable natural resources of the hydraulic and geothermic sources of the country, in accordance with the provisions of the present law, are subject to the payment of a unique retribution to the government for its use. The payments established by the Decree Law No. 17752, and their regulations and complementary provisions, will also be included.

Article 108° When a hydraulic resource assigned for a determined purpose requires to be used for electric generation or viceversa, the rights of the first must not be affected.

In that case, the management of the hydraulic resource will be done jointly by all of those who use it for different purposes.

9.3.3.2 Regulations of the Law for Electrical Concessions

SUPREME DECREE No. 009-93-EM

Article 29° The applications of temporal and definite concession, for authorizations and for oppositions will be presented to the Management following the administrative procedures established by the Ministry and the norms of the Law and of the Regulations.

Article 30° The applications for obtaiming temporal concessions, must be presented with the following data and requirements:

c) Copy of the application for obtaining the authorization for the use of natural resources of governmental property when it corresponds.

Article 66° If the application for obtaining the authorization, noted by article 38 of the Law, implies the use of natural resources of State property, the corresponding permission must be obtained.

Article 124° The clause b) of article 47 of the Law refers to an operation program which will be determined, considering the following aspects:

a) The hydrological conduct for the analysis period will be estimated by means of mathematical models based on probabilities, taking in consideration the available statistics.

b) The opportunity cost of the storaged water, of free availability, will be recognized in impoundings with hour, daily, monthly, annual and pluriannual capacity.

Article 213° In the application of what has been established in the article 107, the concessioners, which use the natural energy and resources resulting from the hydraulic and geothermic sources of the country, are subjected only to the payment of a single compensation for all concept in favor of the government. This compensation will be calculated according to the units of energy produced in the respective generation central station.

Article 214° The single compensation to the government, referred to in the former article, will be paid monthly following this procedure:

a) The responsible head for the central generator will prepare a self-evaluation of the retribution which corresponds to pay, taking into consideration the energy produced in the past month and 1% from the average price of the energy at a generation level.

b) The resulting amount must be deposited in the account that will be opened by the Ministry of Agriculture for the hydroelectrical resources, or by the Ministry of Energy and Mines in the case of geothermical resources.

c) The corresponding deposits will be made by the concessioners within the first 10 days of the following month.

The directorate will carry out annually the verification of the correct application of what is stated in the present article.

Article 215° The average price of the energy at generation level will be established and published by the Comission simultaneously with the Rates in Bar.

This value will be calculated, taking in consideration the consumption of a Kilowatt demand with the load factor of the respective system for the past year and with the value of the Bar Rates in force in which the basic price of the energy is calculated.

9.3.3.3 Regulations for the environmental protection in the electrical activities

SUPREME DECREE No. 29-94-EM

Article 5° During the execution of the electrical activities of generation, transmission and distribution, the Responsiblee Heads of Concessions and Authorizations (referred to in the articles 3 and 4 of the Law) will have the responsibility of environmental control and protection of these activities.

Article 13° In order to request a definite Concession, the applicant will present to the DGE of the Ministry a study of environment impact (EIA) according to clause h) of article 25 of the Law and to those given by the DGAA, without prejudice of what is provided in 19.

Article 24° The PAMA must identify, quantify and evaluate the treatment of:

b) Quality and flowing of surface and underground waters as a consequence of the polluted water discharges.

c) Water alteration in the underground courses.

Article 33° The applicants of Concessions and Authorizations must consider all the potential effects of its Electrical Proyects related to the quality of air, water, land and natural resources. The design, construction, operation and abandonment of Electrical Projects must be executed in a way to minimize the harmful impacts.

Article 37° The applicants of Concessions and Authorizations, and those who have projects in operation, must consider the potential effects of them on the surface and underground water levels. These projects will be designed, built and operated in a way to minimize the

adverse effects on the morphology of the lakes, water currents and other uses (drinking water, water supply, agriculture, recreation, esthetical quality, aquatic habitat, etc.) that will protect aquatic life.

Article 38° The applicants of Concessions and Authorizations, and those that are operating electrical projects must consider their potential effects on the aquatic ecosystem and the effects related to the biodiversity and the aquatic resources (fish, shellfish, algae, etc.). These will be designed, built and operated in a way to avoid the alteration of the habitat or the productive capacity of the valuable aquatic resources. Likewise, they must not produce negative impacts on the rare and endangered aquatic species.

Article 39° Installations in the natural course of the riverbeds, ravines or crossings for natural drainage of rainwater must be built avoiding the erosion of their beds or borders caused by the acceleration of water flows. Works that make the aquatic fauna migration impossible must be avoided.

9.4 EVALUATION OF THE HYDROENERGETIC POTENTIAL IN PERU

9.4.1 Generalities

In 1974, the Government of the Republic of Peru requested from the Government of the Federal Republic of Germany Technical Cooperation assistance for the elaboration of a Study of Hydroenergetic Potential Evaluation. The request was accepted and it was done by the Lahmeyer-Salzgitter Society.

The objective of the study was: to evaluate the hydroenergetic potential of the country for the formulation of all the technically feasible hydroenergetic projects in all the river basins of Peru, to determine the investment costs for the feasible projects and to classify them according to their technical and economical advantages. Other studies of higher technical level were carried out for projects which are of a medium and long term interest.

As additional results of the study, the gross or theoretical potential was evaluated for all the rivers of Peru,and a complete hydrological data bank of the country was produced, including hydrological information for each 10 kms of every river when national maps of 1:1,000,000 were availableand for each 50 km where these detailed maps were not available.

Because of the lack of maps and the not so favorable geological conditions, no projects were evaluated in the jungle area.

9.4.2 Results obtained in the study

According to the Inventory of Hydroelectrical Projects with Previous Studies, there are 138 projects larger than 5 MW in Peru. (See Fig.9.1)

The theoretical hydroelectric potential in Peru is of more than 200,000 MW; therefore, the technical or economical potential possible to obtain is of 58,937 MW which would generate an accumulated annual energy of 395,118 GWh (*) (see Figure9. 2-A and 9.2-B).

(*) 1 GWh = 10^6 KWh

Ten principal projects were chosen to be developed in a medium and long term. They are the following:

ENE 40 — With a power of 2,331 MW and an average energy of 19,556 GWH/year. Cost: 7.62 $/ MWh (*)

INA 200 — With a power of 1,335 MW and an average energy of 10,000 GWH/year. Cost: 8.9 $/MWh

MAN 250 — With a power of 482 MW and an average energy of 2,914 GWH/year. Cost: 16 $/MWh

MAN 200 — With a power of 315 MW and an average energy of 1,917 GWH/year. Cost: 17.2 $/MWh

MARA 440 — With a power of 678 MW and an average energy of 4,840 GWH/year. Cost: 11.8 $/MWh

URUB 320 — With a power of 941 MW and an average energy of 7,245 GWH/year. Cost: 10 $/MWh

HUAL 90 — With a power of 803 MW and an average energy of 5,672 GWH/year. Cost: 13.5 $/MWh

MO 10 — With a power of 276 MW and an average energy of 1,813 GWH/year. Cost: 17 $/MWh

HUA 20 — With a power of 185 MW and an average energy of 1,232 GWH/year. Cost: 25.4 $/MWh

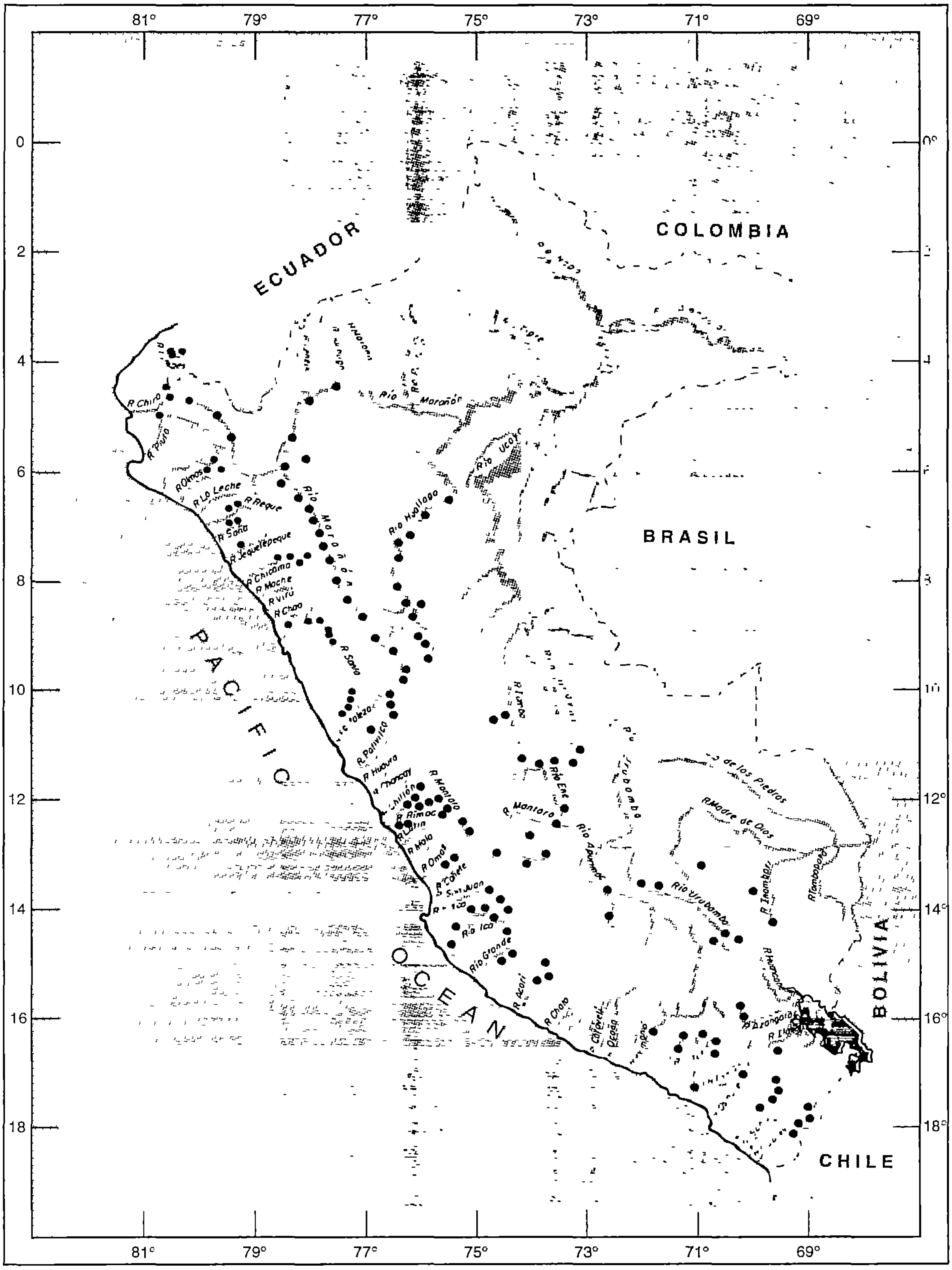
SAMA 10 — With a power of 348 MW and an average energy of 2,735 GWH/year. Cost: 13.7 $/MWh

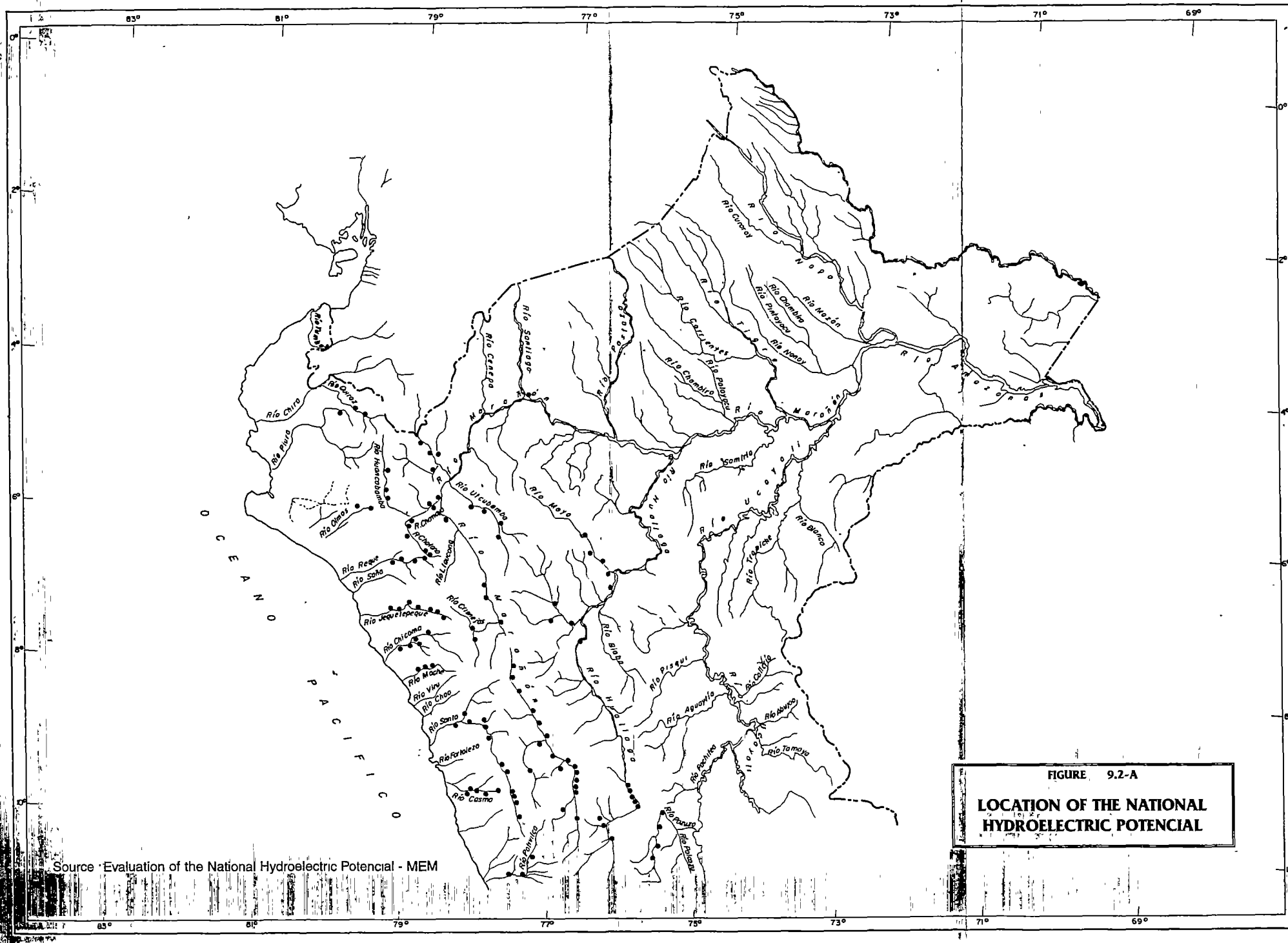
(*) 1 MWh = 10^3 KWh
(*) 1 GWh = 10^6 KWh

The location of the projects mentioned above is shown in figure 9.3.

FIGURE 9.1

HIDROELECTRIC CENTRAL STATIONS IN OPERATION OR PROJECTED

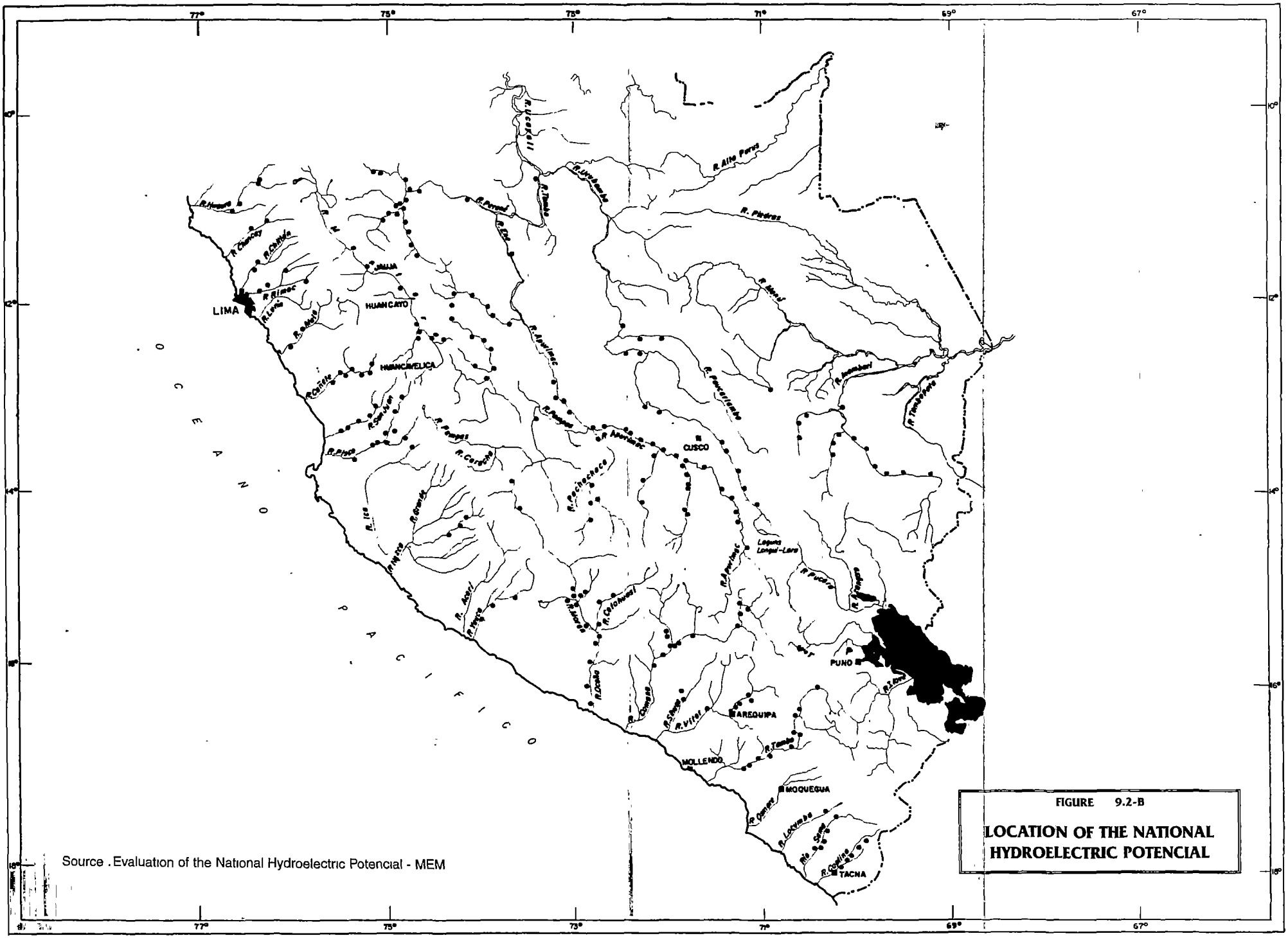




Source: Evaluation of the National Hydroelectric Potencial - MEM

FIGURE 9.2-A

LOCATION OF THE NATIONAL HYDROELECTRIC POTENCIAL



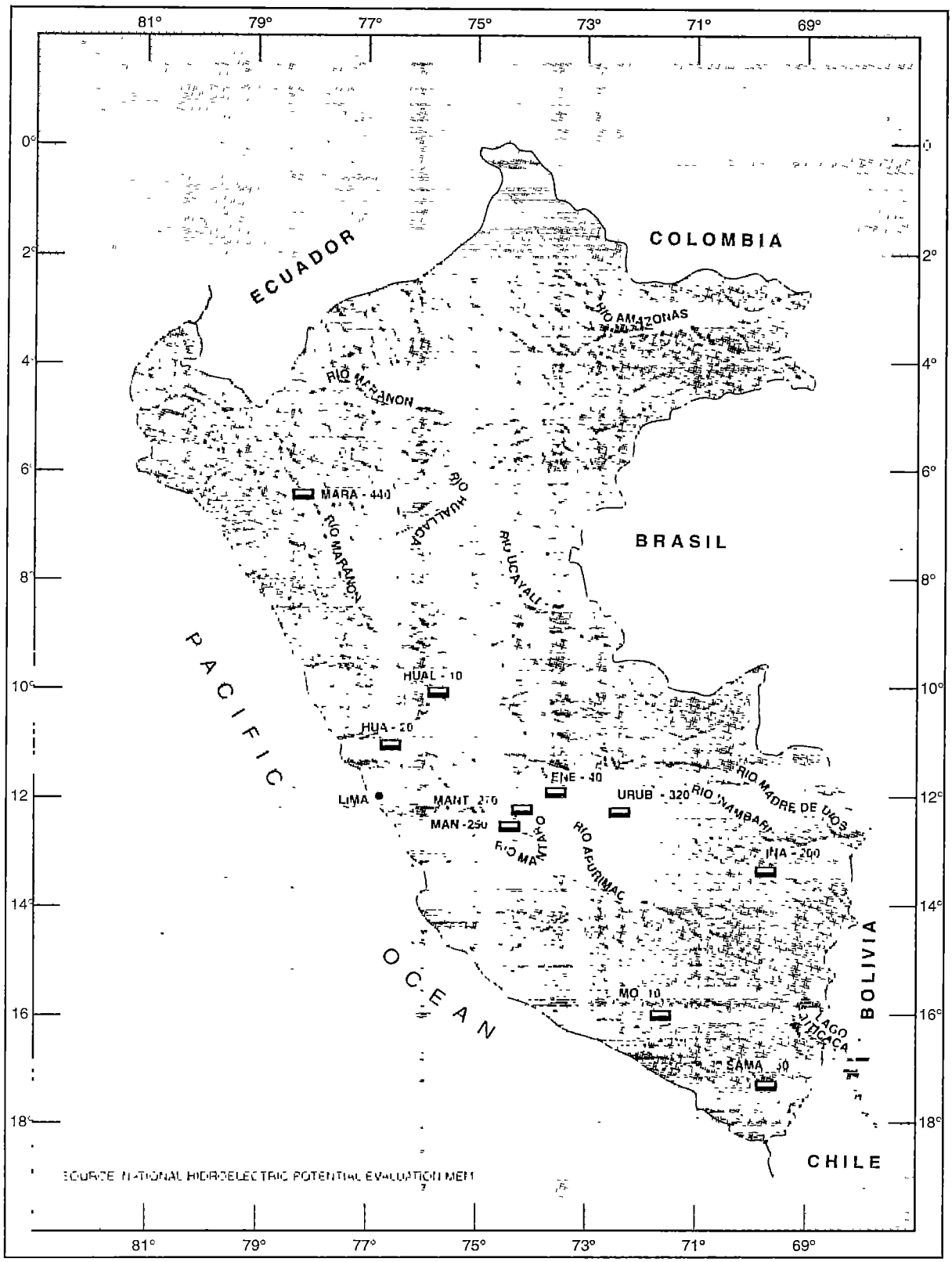
Source . Evaluation of the National Hydroelectric Potencial - MEM

FIGURE 9.2-B

LOCATION OF THE NATIONAL HYDROELECTRIC POTENCIAL

FIGURE 9.3

LOCATION OF THE TEN SELECTED PROJECTS



9.4.3 Recommendations formulated in the Study

The most attractive places with hydraulic resources in the country are found in zones where the cartography is scarce or non-existing. The lack of topography is an important obstacle if the decision of operating some projects in the short term is taken.

It is necessary to carry out geotechnical studies of the most attractive projects, giving priority to the schemes that have been evaluated with this limited geological infomation.

The present availability of hydrological data in Peru is scarce due to: inadequate nets of measurements in the main and secondary stations, the existence of large and frequent lakes in the registers, the uncertainty of the many stations regarding their physical characteristics and the precision and homogeinity of the registers, the poor coordination among the recollecting entities and the slow progress towards the comparison, verification and spread out of the available information. There are also no measurements of sediments, which is fundamental for hydroelectrical projects.

9.5 HYDROELECTRICAL GENERATION OF THE SECTOR

9.5.1 Development of the hydroelectric generation activities

According to Title I of the "Electrical Concessions Law", the activities of generation, transmission, distribution and commercialization of electric energy can be developed by national or foreign natural or legal persons, who must ask the Ministry of Energy and Mines, for a concession, authorization or simply inform them as it is explained in the following paragraphs:

An application for the concession of electric energy generation is required when using hydraulic or geothermic resources and having an installed power of more than 10 MW.

It is necessary to ask for authorization for developing the activity of hydroelectrical generation when the installed power is more than 500 KW and less than or the same as 10 MW. If the installed power is less than 500 KW, the generation can be carried out freely, following the technical norms and requirements of the environment and the Ministry must be the only one informed.

The Concessions for the generation activities can be Temporal or Definitive.

The Temporal Concession allows the employment of goods of public use and has the privilege to obtain the right of way imposition for carrying out studies of generation central stations. It is given for a maximum term of 2 years with the possibility of renewing it once more for the same period of time, if requested by the applicant.

The Definite Concession allows to employ goods of public use and have the privilege to obtain the right of way imposition for the construction and operation of generation central stations and related works.

The relation of concessions and authorizations of hydroenergetic generation is presented in Annexed 9.1

9.5.2 National demand of electric energy

The electrical demand elaborated for the formulation of the Referential Plan of Electricity 1993 is as follows:

The behavior of the electrical demand has been irregular the last few years, observing alternatively rates of increase and decrease due to the variation in the demand. For example in 1991 there was a growth of 6,97% while in 1989 the demand decreased in 6,5%, though between 1908 and 1990 the electrical demand at a national level grew with an average rate of 3,1%.

The year 1992 can not be used as a reference for the projection of the demand, due to the incidence of the extreme drought in the hydroelectrical supply, which led to a rationing of up to 30% with respect to the projection of the expected demand in 1992.

The projections of the electricity consumption in the country takes in consideration: the historical dynamics of the electrical demand growth, the present economical situation, as well as the foresights of economical growth of the country for the next few years; estimating a growth rate of the electrical energy consumption at a national level of 4,17% for the period 1994-2000 and of 3,43% for the period 2001-2007.

The national total consumption of electricity considers the public service as the self-builder of the interconnected and isolated systems in the country.

National Electrical Energy Consumption
(GWh)

Year	1993	2000	2007
Energy Consumption	12566	16727	21174

9.5.3 Generation of hydroelectric energy

The energy of the water resources is transformed into electric energy by means of the generator turbine set in the hydroelectric central stations in order to supply it to the Public Service of Electricity and to the self-producers of electric energy.

The statistical evolution of the installed power of the electric central stations of the Public Sector and of the self-producers,and the national total for the period 1972-1993 is presented in Table 9.1. It can be appreciated that the power generation of the hydroelectric central stations has increased in 232% during this period.

In Table 9.2, entitled " The Evolution of energy production in the country", we can see the increase of the energy production in the hydroelectrical central stations during the period 1972 - 1991.

At present, the installed capacity for the electric energy generation throughout the country reaches 4,188 MW, of which 2,447 MW are of hydraulic generation, representing the 58.4%, as it is appreciated in the following table.

NATIONAL INSTALLED CAPACITY (MW)

TYPE	HYDRAULIC	THERMICAL	TOTAL
Public Service	2177	720	2897
Self-producer	270	1021	1291
National Total	2447	1741	4188

At present, the generation of active energy with the use of water is given through:

a) The Hydroelectrical Central Stations of the Public Service of electricity classified in the following way:

- Central stations of Interconnected Systems, which are of greater capacity (medium nd large ones).
- Central Stations of Small Isolated Systems, which are small, mini and microcentral stations.

b) The hydroelectrical central stations of the self-producers generate electric energy for their own consumption demanded by the developed economical activity.

The present Law of Electrical Concessions establishes that the electric energy generation must be developed by the private sector. At present, the central stations from electric enterprises belonging to the government are in a privatization process.

9.5.4 Water resource used in electric energy generation

The objective proposed is to estimate the volume of the water resource that the great hydroelectric central stations annually use to generate energy, for which the following methodology is employed:

a) The most important hydroelectric central stations have been identified, giving data of their net fall, design volume, and generation units, among others. (See Tables 9.3 and 9.4)

b) The average electric energy production of the last 10 years has been estimated. (See Table 9.5)

c) The annual volume of water used for the production of the average annual energy has been calculated for each station, also considering the net fall.

The results obtained are presented in Tables 9.6 and 9.7, and in graphs 9.3 and 9.4.

9.5.5 Hydrometeorological infrastructure of the sector

Hydrometric Stations have been being implemented in the national territory by the Energy and Mines Sector with the purpose of quantifying and evaluating the water resources to generate electric energy.

The enterprise ELECTROPERU is in charge of this activity in the Energy Sub-sector. This enterprise created inside its former Technical Management, the Office of Hydrometeorological Service, which is at present a body of the Operations Management that operates giving services to third parties.

The enterprise CENTROMIN PERU S.A. develops the service of hydrometereology in the Mining Sub-sector.

The "Master File of Hydrometrical Stations" up to October of 1994 is enclosed in annex 9.2 and the " Availability of Fluviometric Data", "Availability of Pluviolmetric Data" and "Availability of Meteorological Data" tables are found in 9.3.

9.5.6 Expansion plan of hydroelectric generation for the public service of electricity

According to the Law of Electrical Concessions, its Regulations, and complementary dispositions; the Ministry of Energy and Mines has elaborated the "Referential Plan of Electricity 1993". It contains among others, the Programs of Generation Equipment for the Interconnected Electrical Systems of the country, to orient the economical agents about the future needs of equipment to cover the demand of electric energy, which would allow a continuous growth of the national economy.

With regard to the generation activity, an Expansion Plan related to an eminently good equipping program has been elaborated, which is a result of the analysis of multiple combined alernatives of thermoelectric and hydroelectric generation.

To satisfy the anticipated electric energy demand for a medium scenery, the best equipping alternative considers as advisable the installation of thermoelectric equipments to produce 500 MW and hydroelectric equipments to produce 583 MW in the planning horinzon between 1993 and 2007.

Thermical and hydroelectrical generation projects were presented in the programs of Generation Equipment. These are part of the program of best equipment to cover the anticipated demand for the 1993-2007 period.

The hydroelectrical generation projects that must be implemented between 1995 and 2007, as well as the year in which their operations must start, according to the Equipment Programs, are presented in Table 9.8.

The 1994 Investment Program of the Executive Directorate of Projects under the direction of the Promotion Office for Electrical Development of Social Interest, PRODEIS, which refers to the implementation of small hydroelectrical central stations of isolated systems located in areas of less economical development, is presented in Table 9.9.

9.5.7 Financing of hydroelectric central stations

The scarce financing obtained for the construction of hydroelectric central stations being built during the past decade, delayed the equipping for the generation of electric energy and created difficulties in the supply of its demand in the country.

In this context, the concept of governmental monopoly of this activity led during this period, to the use of financing resources which principally came from external sources, the government and enterprises' own resources.

Looking at it retrospectively, we can determine that the external resources were very scarce, due to the international policy adopted at that time . Internally, this scarcity was caused by the approval of a policy of subsidies of prices, together with an inefficient management, which led the electric enterprises to a gradual process of decapitalization.

TABLE Nº 9.1
EVOLUTION OF THE INSTALLED POWER IN THE COUNTRY (MW)
(period 1972 - 1991)

YEAR	PUBLIC SERVICE (1)			SELF-PRODUCERS (2)			TOTALES		
	HYDRAULIC	THERMAL	TOTAL	HYDRAULIC	THERMAL	TOTAL	HYDRAULIC	THERMAL	TOTAL
1972	810.9	264.7	1075.6	245.9	608.5	854.4	1056.8	873.2	1930.0
1973	1038.1	282.0	1320.1	240.1	593.7	833.8	1278.2	875.7	2153.9
1974	1149.3	281.9	1431.2	239.5	594.9	834.4	1388.8	876.8	2265.6
1975	1156.3	311.5	1467.8	240.9	650.0	890.9	1397.3	961.5	2358.8
1976	1156.0	339.0	1495.0	249.8	771.0	1020.8	1405.8	1110.0	2515.8
1977	1163.1	350.0	1513.1	249.6	777.0	1026.6	1412.7	1127.0	2539.7
1978	1158.3	342.1	1500.4	250.5	819.4	1069.9	1408.8	1161.5	2570.3
1979	1385.4	369.6	1755.0	249.0	835.5	1084.5	1634.4	1205.1	2839.5
1980	1614.3	444.3	2058.6	254.5	862.5	1117.0	1868.8	1306.8	3175.6
1981	1665.6	456.8	2122.4	255.7	884.0	1139.7	1921.3	1340.8	3262.1
1982	1665.6	533.3	2198.9	257.6	886.5	1144.1	1923.2	1419.8	3343.0
1983	1666.3	626.6	2292.9	260.6	899.9	1160.5	1926.9	1526.5	3453.4
1984	1739.3	660.2	2399.5	260.6	901.7	1162.3	1999.9	1561.9	3561.8
1985	1926.7	668.1	2594.8	260.6	901.7	1162.3	2187.3	1569.8	3757.1
1986	1947.7	675.7	2623.4	269.9	979.6	1249.5	2217.6	1655.3	3872.9
1987	1949.4	706.3	2655.7	269.9	967.9	1237.8	2219.3	1674.2	3893.5
1988	2091.0	717.0	2808.0	278.0	1002.0	1280.0	2369.0	1719.0	4088.0
1989	2093.3	722.4	2815.7	284.3	1014.1	1298.4	2377.6	1736.5	4114.1
1990	2119.0	722.4	2841.4	275.7	983.7	1259.4	2394.7	1706.1	4100.8
1991	2119.0	722.4	2841.4	275.7	983.7	1259.4	2394.7	1706.1	4100.8
1992	2177.0	722.4	2899.4	275.7	1021.0	1296.7	2447.0	1741.0	4188.0
1993	2177.0	722.4	2899.4	275.7	1021.0	1296.7	2447.0	1741.0	4188.0

TABLE Nº 9.2
EVOLUTION OF ENERGY PRODUCTION IN THE COUNTRY (GWH)
(period 1972 - 1991)

YEAR	PUBLIC SERVICE			SELF-PRODUCERS			TOTALES		
	HYDRAULIC	THERMAL	TOTAL	HYDRAULIC	THERMAL	TOTAL	HYDRAULIC	THERMAL	TOTAL
1972	3231.1	294.1	3525.2	1207.7	1556.4	2764.1	4438.8	1850.5	6289.3
1973	3567.1	324.7	3891.8	1201.5	1561.6	2763.1	4768.6	1886.3	6654.9
1974	3980.3	335.2	4315.5	1240.0	1719.6	2959.6	5220.4	2054.8	7275.2
1975	4281.2	384.5	4665.7	1188.8	1631.7	2820.5	5470.0	2016.2	7486.2
1976	4623.4	408.5	5031.9	1174.3	1704.9	2879.2	5797.7	2113.4	7911.1
1977	4868.0	481.6	5349.6	1159.0	2118.4	3277.4	6027.0	2600.0	8627.0
1978	5004.6	485.2	5489.8	1193.8	2081.2	3275.0	6198.4	2566.4	8764.8
1979	5383.0	577.9	5960.9	1315.3	1989.1	3304.4	6698.3	2567.0	9265.3
1980	5748.3	640.2	6388.5	1264.1	2386.1	3650.2	7012.4	3026.3	10038.7
1981	6607.8	601.3	7209.1	1319.3	2150.3	3469.6	7927.1	2751.6	10678.7
1982	6917.0	668.1	7585.1	1420.3	2292.3	3712.6	8337.3	2960.4	11297.7
1983	6696.8	698.1	7394.9	1357.9	1858.2	3216.1	8054.7	2556.3	10611.0
1984	7278.2	799.5	8077.7	1330.0	2312.1	3642.1	8608.2	3111.6	11719.8
1985	7593.7	785.8	8379.5	1802.2	1933.6	3735.8	9395.9	2719.4	12115.3
1986	8454.4	819.1	9273.5	1785.4	1918.7	3704.1	10239.8	2737.8	12977.6
1987	9209.0	924.1	10133.1	1729.0	2181.2	3910.2	10938.0	3105.3	14043.3
1988	9084.0	952.3	10036.3	1644.4	2308.3	3952.7	10728.4	3260.6	13989.0
1989	8848.6	754.2	9602.8	1677.0	2467.4	4144.4	10525.6	3221.6	13747.2
1990	8780.0	768.0	9548.0	1532.1	2324.9	3857.0	10312.1	3092.9	13405.0
1991	9846.0	637.0	10483.0	1532.1	2324.9	3857.0	11378.1	2961.9	14340.0

TABLE Nº 9.3
HYDROELECTRIC CENTRAL STATIONS OF THE NORTHERN CENTRAL INTERCONNECTED SYSTEM

POWER STATIONS	LOCATION Department Province District	Net Head (m)	Design Flow (m3/sg)	No of Unity	Power (MW)		Annual Energy (GWh)	Plant Factor
					Installed	Effective		
Mantaro	Huancavelica Tayacaja Colcabamba	748	96.00	7	796	560	4, 763.30	0.80
Restitucion	Huancavelica Tayacaja Campo Armino	258	96.00	3	217	199	1, 670.30	0.88
Carhuaquero	Cajamarca Chota Carhuaquero	458	19.50	3	75	75	556.30	0.82
Cahua	Lima Cajatambo Manas	215	22.00	2	40	40	301.00	0.86
Canon del Pat	Ancash Huaylas Huayanca	414	48.00	6	150	150	1, 002.00	0.76
Huinco	Lima Huarochiri San Pedro	1200	25.00	4	258	240	936.50	0.40
Matucana	Lima Huarochiri San Jeronimo	980	14.80	2	120	120	707.50	0.67
Callahuanca	Lima Huarochiri Callahuanca	436	20.00	4	68	68	509.00	0.86
Moyopampa	Lima Lima Chosica	474	17.90	3	63	63	509.00	0.92
Huampani	Lima Lima Lurigancho	170	21.80	2	30	25	211.00	0.80
Malpaso	Junin Yauli La Oroya	75	80.00	4	54	45	252.70	0.53
Oroya	Junin Yauli La Oroya	213	6.00	3	9	9	54.10	0.69
Pachachaca	Junin Yauli Yauli	213	8.16	4	12	9	42.60	0.41
Yaupi	Pasco Oxapampa Yaupi	469	26.60	5	108	1, 000	874.00	0.92
TOTAL			501.76	52	2, 000	2, 603	12, 389.3	

Source: Master Plan of Electricity – ELECTROPERU

TABLE N° 9.4
HYDROELECTRIC CENTRAL STATIONS OF THE SOUTHERN INTERCONNECTED SYSTEM

POWER STATIONS	LOCATION Department Province District	Net Head (m)	Design Flow (m3/sg)	No of Unity	Power (MW)		Annual Energy (GWh)	Plant Factor
					Installed	Effective		
Aricota I	Tacna Tarata Curibaya	617.1	4.60	2	24	23	117.00	0.61
Aricota II	Tacna Tarata Chintari	311	4.60	1	12	12	67.40	0.65
Machupicchu	Cusco Urubamba Machupicchu	345	37.90	5	110	90	759.00	0.79
Charcani I	Arequipa Arequipa Charcani	27	7.60	2	1	1	10.68	0.86
Charcani II	Arequipa Arequipa Charcani	19	6.00	3	1	1	5.63	0.87
Charcani III	Arequipa Arequipa Charcani	57	10.00	2	5	4	31.89	0.81
Charcani IV	Arequipa Arequipa Charcani	117	15.00	3	14	7	94.13	0.75
Charcani V	Arequipa Arequipa Charcani	690	24.00	3	135	135	588.27	0.50
Charcani VI	Arequipa Arequipa Charcani	69	15.00	1	9	9	56.04	0.73
TOTAL				22	311	282	1,730.04	6.57

Source: Master Plan of Electricity, 1992 - ELECTROPERU

TABLE Nº 9.5
HISTORICAL GENERATION OF ENERGY (GWh/year)

POWER STATION	CAÑON DEL PATO	CAHUA	HUAMPANI	MANTARO	CALLAHUANCA	MOYOPAMPA	HUINCO	MATUCANA	RESTITUCION
1977	466 51	0.00	142 48	1,425 34	398 61	427 42	667 23	546 20	0.00
1978	466 51	0 00	120 40	1,604 79	394 76	405.84	719.12	509.74	0.00
1979	538.59	0 00	134.72	1,847.66	376.89	416.11	722 01	536 76	0 00
1980	568 34	285 97	137.47	2,240.02	354 80	412 62	716 11	568.95	0.00
1981	512 40	255 76	135.70	2,930 96	378 42	414 34	828.28	570 19	0.00
1982	608 07	263 43	156.77	3,188.66	393 70	418.31	764.94	541.85	0 00
1983	563.42	230 16	137.71	3,230 68	331 90	378 90	792 51	587.50	0 00
1984	672 44	283 25	146 32	3,122 22	424 61	420 39	910 02	663 83	53 20
1985	747.62	293 35	163.87	3,419 54	429.57	427 03	868.06	571 00	551.80
1986	779 57	250 07	144 08	4,188 09	437 53	421 57	878.26	621 10	951.84
1987	782 95	288 09	148 90	4,939 10	447 11	408 14	810 44	630 38	1,003 06
1988	873 98	297 03	144 23	4,524.69	455 41	410 85	931 88	662.71	891.44
1989	837 02	278.60	150 32	4,025 16	444.95	428.49	972.89	646.18	655 87
1990	837.05	254 25	127 77	4,745 17	383.77	389 69	554 16	607 67	867.74
1991	779.85	201 24	154 71	4,789 37	456 79	430.68	816 25	631 51	1,022 20
1992	848 35	195 69	137.72	3,159.30	374 10	367.86	434 70	562.22	897 50
1993	787 08	227 62	143.49	3,887 63	463.71	412.10	863.26	690.73	1,195 19
AVERAGE	686 46	257 46	142 74	3,368 73	408.62	411 20	779 42	596 97	808 98

TABLE Nº 9.6
ANNUAL USE OF WATER FOR HYDRAULIC GENERATION
NORTHERN CENTRAL SYSTEM

POWER STATION	ENERGY AVERAGE (GWh/year)	VOLUME (thousands of million m3)
CAÑON DEL PATO	686.46	272.34
CAHUA	257.46	196.69
HUAMPANI	142.74	137.92
MANTARO	3,368.73	738.74
CALLAHUANCA	408.62	153.94
MOYOPAMPA	411.20	142.49
HUINCO	779.42	106.68
MATUCANA	596.97	99.04
RESTITUCION	808.98	513.03
TOTAL	7,460.58	2,360.87

FIGURE 9.3

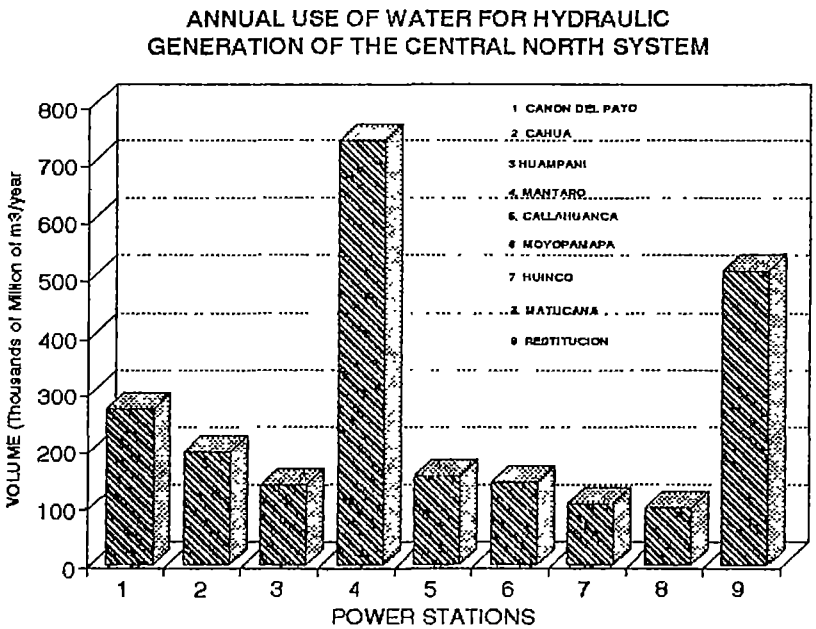


TABLE Nº 9.7
ANNUAL USE OF WATER FOR HYDRAULIC GENERATION
SOUTHERN SYSTEM

POWER STATION	ENERGY AVERAGE (GWh/year)	VOLUME (thousands of million m3)
MACHUPICCHU	476.08	226.65
CHARCANI V	331.69	78.96
TOTAL	807.77	305.61

FIGURE 9.4

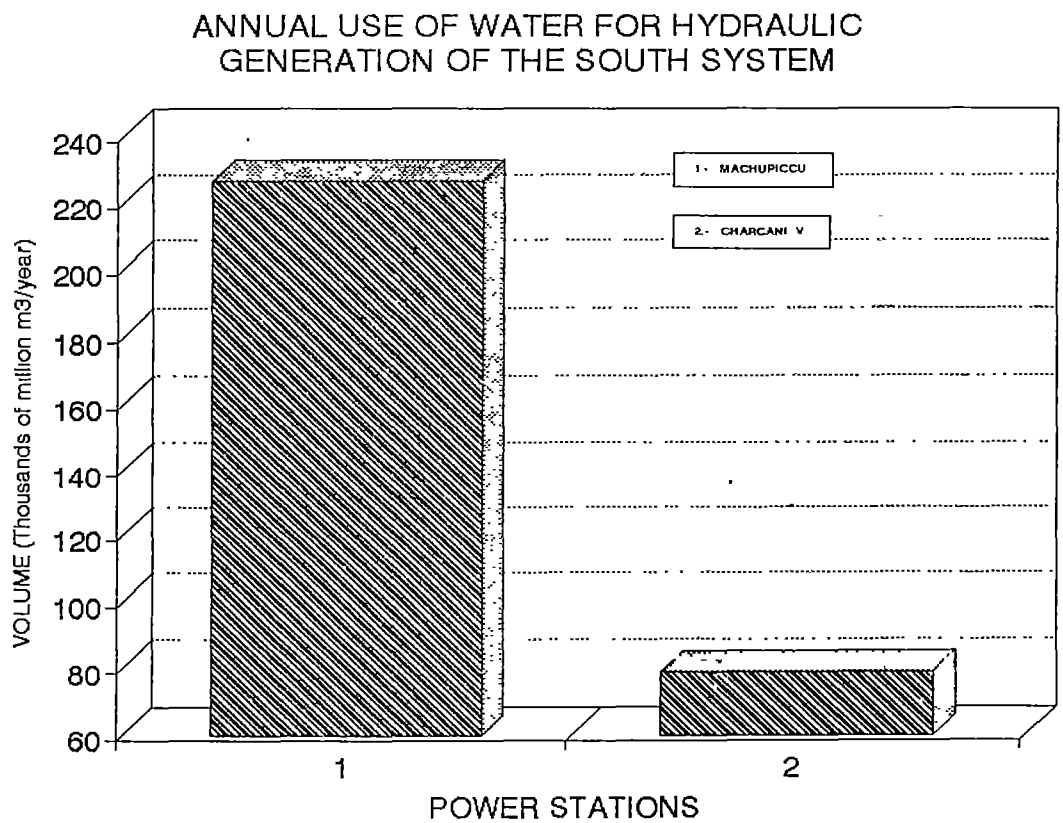


TABLE Nº 9.8
HYDROELECTRIC PROJECTS-EQUIPMENT PROGRAM 1993 - 2007

PROJECT	LOCATION Department Province District	Power (MW)		Year Planned to enter into operation
		Installed	Effective	
Improvement of Intake and Sand Clearance H.P.S. Ca on del Pato (1)	Ancash huaylas Huallanca	0.0	4.0	1994
Reservoir Yuracmayo (2)	Lima Huarochiri Yuracmayo		25.9	1995
H.P.S.Carcani V Regulation Bridge Cinsel (4)	Arequipa Arequipa Charcani	0.0	75.0	1996
Dam Sibinacocha (5)	Cusco	0.0	18.0	1996
Reinforcement Rio Chili (6)	Arequipa Arequipa Sumbay	0.0	15.4	1998
Enlargement H.P.S. Ca on del Pato (3)	Ancash Huaylas Huallanca	60.0	118.6	1999
H.P.S. Vila Vilani	Moquegua	37.7	37.0	1999
H.P.S. Jicamarca	Lima Lima Lurigancho	104.0	103.0	2000
H.P.S. Chaglla	Huanuco Huanuco Chaglla	440.0	420.0	2003
H.P.S. San Gaban	Puno Carabaya San Gaban	80.0	80.0	2003
H.P.S. Quishuarani	Cusco Canchis Sicuani	81.3	81.3	2005
TOTAL		803.0	978.2	

(1) The contribution of this project includes the Reinforcement of Chillicocha Lagoon
(2) Increase of the effective power in 26 MW for the system of existing power statio of ELECTROLIMA
(3) The effective power includes the existing groups
(4) Increase of the power on end, HPS Charcani V
(5) Increase of the guaranteed power in the low water period, HPS, Machupicchu
(6) Base increase in the Generation System

Source: Referential Plan of Electricity 1993, Ministry of Energy and Mines

TABLE Nº 9.9
INVESTMENT PROGRAM 1994 - MEM

ITEM	HYDROELECTRIC POWER STATION	PROVINCE	DEPARTMEN	FLOW (m3/s)	NET ELEVATION (m)	POWER (MW)
1	CHOTA	CHOTA	CAJAMARCA	1.4	164	1.7
2	HUAMACHUCO	HUAMACHUCO	LA LIBERTAD			
3	CANTANJE	CELENDIN	CAJAMARCA	0.65	314	1.5
4	TARABAMBA	PATAZ	LA LIBERTAD	1.32		2.3
5	POMABAMBA	POMABAMBA	ANCASH			0.7
6	HUAROS	CANTA	LIMA			0.8
7	YASO	CANTA	LIMA			0.1
8	CHURIN	OYON	LIMA			0.2
9	CATAHUASI	OYON	LIMA			0.1
10	SANDIA	SANDIA	PUNO	1.1	217	2.2
11	PACHIZA	M. CACERES	SAN MARTIN	0.415	135.08	1.0
12	LLUSITA	V. FAJARDO	AYACUCHO	1.0	298	2.2
13	POZUZO	OXAPAMPA	PASCO			2.4
14	CHALHUAMAYO	SATIPO	JUNIN	1.8	240	3.2
15	SAN FRANCISCO	LA CONVENC.	CUSCO	2.5	75	1.2
16	QUIROZ	AYABACA	PIURA	2.4	85	1.7
17	CHOCOCO	UNION	AREQUIPA	1.48	91	0.8

Source : Promotion of Electrical Development of Social Interest (PRODEIS) - MEM

The setting has suffered substantial variations in the present context and since the application of the Law of Electrical Concessions in the internal front, there has been a modification in the former concept of governmental monopoly by giving more importance to the participation of national and foreign private capital.

At present, the financing of the electric activities can take place in the following ways:

a) External Resources: loans or investments
b) Internal Resources: loans or investments of the private sector
c) Own resources of the Enterprise
d) Resources from the Public Treasury

The resources of the Public Treasury are being managed through the Office of Electrical Development of Social Interest (PRODEIS) of the Executive Directorate of Projects in the Ministry of Energy and Mines, which has as an objective to contribute to the financing of electrification projects of social interest, that are generally located throughout the country in isolated areas of depressed economy.

9.6 SUPPORT PROGRAM OF INSTITUTIONAL DEVELOPMENT

At present, the Institutional Development Program is being executed in the Energy and Mines Sector. This program is called Energy and Mining Technical Assistance Loans (EMTAL), which is being financed by the World Bank.

With respect to the Electricity Sub-sector, a financing ofUS$ 2,700,000.00 has been assigned to the program mentioned above for a period of three years, to develop the following activities:

- Information system plan of the Sub-sector as a whole.
- Procedures to give concessions for the generation, transmission and distribution of electric energy activities (model of a concession system)
- Model of a system for control activities under the direction of the General Directorate of Electricity.
- Promotion of investments in the Electricity Sub-sector.
- International Consultancy for the development of electrical norms.
- Training Program for the personnel.

9.7 LIMITATIONS IN THE ELECTRICITY SUB-SECTOR

9.7.1 Of Information

The present process of Governmental function reductions, as well as the transference of its entrepreneurial participation to the private sector has originated discontinuity in the storing, canalization and processing of information related to the production of electric energy in a national level; however, this situation is improving because the General Directorate of Electricity and the Commission of Electric Rates are implementing a mechanism to gather information.

With respect to the statistical information compiled before 1993, it has been impossible to locate it totally, because the offices of different Electricity Sub-sector entities, which carried out the function of gathering and systematizing the information, have stopped to implement them. That is why it has not been possible to have access to the files because their location was unknown. It would be convenient to recover this information, in order to make it possible for the interested public to have a free access to them.

9.7.2 Norms

Neither Tome II of the National Code of Electricity related to the System of Generation, nor the technical norms from the Ministry of Energy and Mines have been elaborated yet. This will apply to the development of projects related to hydroelectrical generation.

This has resulted in the development of projects with the free criteria of the consultant, resulting in some cases with deficiencies during the operations of the hydroelectrical central stations.

Likewise, the Law of Electric Concessions and its Regulations provides the development of norms for various aspects of the Electricity Sub-sector. However, up to now they have not been regulated and that causes limitations in the leadership activity of the General Directorate of Electricity.

9.8 DIAGNOSIS

9.8.1 General Frame

The generation of electricity with water resources began in Peru in 1884 with the objective of supplying electricity to mining centers and basically for public service.

The majority of the most important hydroelectric central stations which generate electric power for public service, have been built by the government, and the central stations which provide it to the mining activity have been generally built by the private sector; situation which shows that the production of electricity for consumers has been preponderantly done by the government, while in the private sector the electric power has been considered as an input for production, and not as a business in itself.

9.8.2 Institutional Analysis

A new legal framework was promulgated in 1993. This restructured the activities of the Electricity Sub-sector, with the objective of promoting the privatization of the generation, transmission and ditribution of the electric energy with the participation of national and foreign investors; it will also promote the private investment in the increase of electricity offer.

Regaarding the restructure of the activities of the Electricity sub-sector, the execution of some of them have not taken place so far. Among them:

- The compilation and statistical processing, and the diffusion of the hydrometereological information which exists in the electric enterprises of the sub-sector.

- Treatment of the technical information which has been developed in the enterprises during the last decades, as well as its availability for using them in future energetic projects to be executed in the country.

- The financial participation of the government for the electrification of isolated settlements and rural areas of depressed economy.

- The cases in which the government would have to invest in great long term electrical projects to guarantee an adequate growth in the national supply of electric energy, if their is no convenient response from the private sector.

- The situation of the electric installations if they are not bought by the private sector whether their management and operation are given by concession.

- Analysis of the environmental impact and its effect in the cost of the electric energy.

9.8.3 Analysis of the use of the water resource in the electric subsector.

Concerning the use of the water resource in the generation of electric energy, the following can be stated:

- It has been generally used without evaluating its competition and impact on other sectors.

- The competition of use with other sectors is not very significant, since the water resource almost always goes back to the river or canal from where it was taken.

- The most serious negative impact caused to the environment is the use of the waters from the Aricota Lake (department of Tacna), which had a volume of 800,000 cubic meters of storaged water in 1967 that has been reduced to 33,000 cubic meters in 1992. The gradual lowering of the water level in the lake has caused the flora and fauna to slowly disappear; besides the microclimate has varied in its area of influence and there is a non-supply risk of electric energy and drinking water in the Tacna and Moquegua departments, among other consequences.

- At present, there are hydroelectric central stations that operate without having authorization for using the water resource, and most of them are built by other governmental organizaations. For this reason, we consider that there must exist a national autonomous decentralized authority, in charge of supervising the adequate use and preservation of the water resources. Likewise, the Government must abide by and see that others also abide by the law.

- The present availibility of hydrological data is scarce in the country, due to the inefficient net of hydrometereological stations among other things. As a consequence the operative continuity of the hydrometereological stations, which are under the direction of the governmental electric enterprises, must be guaranteed after they are privatized. Furthermore, this information must be available for the persons who are interested in it.

9.8.4 Analysis of human resources

The bodies of the Electric Sub-sector belonging to the Ministry of Energy and Mines have a total of 113 workers, distributed in the following way:

General Directorate of Electricity:	41 workers
Executive Directorate of Projects:	66 workers
Technical Office of Energy :	6 workers

As can be appreciated, the General Directorate of Electricity, which is the technical, normative and controlling body, has less personnel than the Executive Directorate of Projects.

The General Directorate of Electricity must increase its staff for the execution of their normative activities and statistical information processing coming from the electric enterprises.

ANNEXED 9.1
CONCESSIONS AND AUTHORIZATIONS FOR THE ACTIVITY OF ELECTRICITY GENERATION.

ENTERPRISE	HYDROELECTRIC POWER STATION	Conc. of Author.	OBERVATIONS
	MATUCANA	Def. Conc.	
	HUAMPANI	Def. Conc.	
	MOYOPAMPA	Def. Conc.	
ELECTROLIMA	CALLAHUANCA	Def. Conc.	
	HUINCO	Def. Conc.	
	JICAMARCA	Temp. Conc	
	TAMBORAQUE	Temp. Conc	
	PLATANAL	Temp. Conc	
	CANTA	Autorz.	WATER USE AUTHORIZATION MISSING
	MATARA	Autoriz.	
ELECTROSURESTE	CHUMBAO	Autoriz.	
	MACHUPICCHU	Temp. Conc	
	PICHANAKI	Autoriz.	
	QUICAPATA	Autoriz.	
	CHAMISERIA	Autoriz.	
ELECTROCENTRO	SICAYA HUARISCA	Autoriz.	
	INGENIO	Autoriz.	
	CHANCHAMAYO	Autoriz.	
	CONCEPCION	Autoriz.	
	MACHU		
	POZUZO		WATER USE AUTHORIZATION MISSING
	SAN GREGORIO	Autoriz.	WATER USE AUTHORIZATION MISSING
	CHARCANI I	Autoriz.	WATER USE AUTHORIZATION MISSING
	CHARCANI II	Autoriz.	WATER USE AUTHORIZATION MISSING
	CHARCANI III	Autoriz.	WATER USE AUTHORIZATION MISSING
SEAL	CHARCANI IV	Def. Conc.	WATER USE AUTHORIZATION MISSING
	CHARCANI VI	Autoriz.	WATER USE AUTHORIZATION MISSING
	ONGORO	Autoriz.	WATER USE AUTHORIZATION MISSING
	SIGUAS I	Autoriz.	WATER USE AUTHORIZATION MISSING
	HUATIAPILLA	Autoriz.	WATER USE AUTHORIZATION MISSING
	RESTITUCION	Def. Conc.	
	CHARCANI V	Def. Conc.	WATER USE AUTHORIZATION MISSING
	MANTARO	Def. Conc.	
ELECTROPERU	CANON DEL PATO	Def. Conc.	
	CAHUA	Def. Conc.	
	CARHUAQUERO	Def. Conc.	WATER USE AUTHORIZATION MISSING
	ARICOTA II	Def. Conc.	
	ARICOTA I	Def. Conc.	

Continuation Annexed 9.1

ENTERPRISE	HYDROELECTRIC POWER STATION	Conc. or Author	OBERVATIONS
	POMABAMBA	Autoriz.	WATER USE AUTHORIZATION MISSING
	SHIPILCO	Autoriz.	WATER USE AUTHORIZATION MISSING
	HUAYUNGA	Autoriz.	WATER USE AUTHORIZATION MISSING
	CHICCHE	Autoriz.	WATER USE AUTHORIZATION MISSING
HIDRANDINA	MARIA JIRAY	Autoriz.	WATER USE AUTHORIZATION MISSING
	YAMOBAMBA		REPORTED
	CORLAS CASCAS		REPORTED
	HUAYCHACA		REPORTED
	CACHICADAN		
	ANDAMARCA		REPORTED
	CORACORA		REPORTED
	CHAVINA		REPORTED
	CHIPAO		REPORTED
ELECTROSUR MEDIO	LARAMATE		REPORTED
	INCUYO		REPORTED
	PAUSA		REPORTED
	QUERCO		REPORTED
	TANTARA		REPORTED
	TICRAPO		REPORTED
	GUINEA MAYO	Autoriz.	WATER USE AUTHORIZATION MISSING
	BUENOS AIRES	Autoriz.	WATER USE AUTHORIZATION MISSING
	CHAUPE PUCARA		REPORTED
ELECTRONORTE	FRANCESITA		REPORTED
	TACABAMBA		REPORTED
	ACHAMAQUI		REPORTED
	LEIMEBAMBA		REPORTED
ELECTRO ORIENTE	TABALOSOS		REPORTED
	SAN JOSE DE SISA		REPORTED
	MONTERO		REPORTED
	SICATE		REPORTED
	CHALACO		REPORTED
ELECTRO NOR OESTE	STO. DOMINGO		REPORTED
	CANCHAQUE		REPORTED
	ZAPALACHE		REPORTED
	EL COMUN		REPORTED
	OXAWUAY		REPORTED

ANNEXED 9.2
MAIN FILE OF THE UP-TO-DATE HYDROMETRIC STATIONS (OCT/84)

NAME	RIVER	PROVINCE	DISTRICT	ENTERPRISE
SHANAO	MAYO	LANAS	SHANAO	SENAMHI
SAN CRISTOBAL	SISA	SAN MARTIN	SAN CRITOBAL	SENAMHI
REQUENA	BIABO	SAN MARTIN	BIAVO	SENAMHI
RIO CAJAS	CAJAS			SENAMHI
GERA	MAYO	MOYOBAMBA	JEPELACIO	SENAMHI
LAGUNA SAUCE	LAG. SAUCE	SAN MARTIN	SAUCE	SENAMHI
DESAGUE LAGUNA	LAG. SAUCE	SAN MARTIN	SAUCE	SENAMHI
PTE. TARUCA	HUALLAGA	HUANUCO	STA.MAR.VALLE	SENAMHI
PISAC	URUBAMBA	CALCA	PISAC	SENAMHI
CHILLCA	URUBAMBA	URUBAMBA	OLLANTACTAMBO	MFPO
PTE SAN MIGUEL	URUBAMBA			MFPO
PAUCARTAMBO	PAUCARTAMBO			SENAMHI
CHILLCA	URUBAMBA			MFPO
LA ANGOSTURA	APURIMAC	CAYLLOMA	CAYLLOMA	SENAMHI
SAN FRANCISCO	APURIMAC			ELECTROPERU
DIQUE ORCOCOCHA	LAG. ORCOCO	CASTROVIRREYN	PILPICHACA	SENAMHI
VISCAPALPA	PAMPAS	CANGALLO	PARAS	SENAMHI
PAMPAS	PAMPAS	ANDAHUAYLAS	CHINCEROS	SENAMHI
RAYUSCA	URUBAMBA	VICTOR FAJARDO	SANCOS	SENAMHI
HUASAPAMPA	SONDONDO	LUCANAS	AUCARA	SENAMHI
LOS LIBERTADORES	LOS LIBERTADOR	CASTROVIRREYN	PILPICHACA	SENAMHI
URUBAMBA	URUBAMBA	VICTOR FAJARDO	HUANCASANCOS	SENAMHI
TUNEL CERO		CASTROVIRREYN	PILPICHACA	DIR AGU RIEG
UPAMAYO	MANTARO			ELECTROPERU
RIO PALLANGA M-1	PALLANGA	YAULI	CARHUACAYAN	SENAMHI
HUARON M-2	HUARON	YAULI	CARHUACAYAN	SENAMHI
CARHUACAYAN N-3	CARHUACAYAN	YAULI	CARHUACAYAN	SENAMHI
CASARACRA	TISHGO	YAULI	PACCHA	ELECTROPERU
PTE. CHULEC	MANTARO	YAULI	PACCHA	ELECTROPERU
HUARI	HUARI	YAULI	YAULI	ELECTROPERU
RUMICHACA M-4	RUMICHACA	YAULI	CARHUACAYAN	SENAMHI
PTE. STUART	MANTARO	JAUJA	JAUJA	ELECTROPERU
PACHACAYO	PACHACAYO	JAUJA	CANCHAYLLO	ELECTROPERU
PINASCOCHA	PINASCOCHA	JAUJA	CANCHAYLLO	ELECTROPERU
CONCHAS TUNEL	CONCHAS	JAUJA	CANCHAYLLO	ELECTROPERU
ANGASMAYO	CUNAS	HUANCAYO	JARPA	SENAMHI
CHUPURO	MANTARO	HUANCAYO	CHUPURO	ELECTROPERU
YULAPUQUIO	VIRGEN	HUANCAYO	CHONGOS ALTOS	ELECTROPERU
PONGOR	MANTARO	TAYACAJA	CALCABAMBA	ELECTROPERU
QUILLON	QUILLON	HUANCAVELICA	HUAYLLAHUAUR	ELECTROPERU
VILLENA	MANTARO	TAYACAJA	CHINCHIHUASI	ELECTROPERU
CHINCHI	HUANCAVELICA	HUANCAVELICA	LA MEJORADA	ELECTROPERU
LA COBRIZA	MANTARO	TAYACAJA	SN PEDRO CORI	ELECTROPERU
ALLCOMACHAY	HUARPA	HUANTA	LURICOCHA	ELECTROPERU
HUAPA	OPAMAYO	ANGARAES	LIRCAY	ELECTROPERU
SANTA ELENA	SICRA	ANGARAES	LIRCAY	ELECTROPERU
MOYA	MOYA	HUANCAVELICA	MOYA	ELECTROPERU
YANACOCHA	CUNAS	HUANCAYO	JARPA	ELECTROPERU
LA MEJORADA	MANTARO	HUANCAVELICA	MCAL CACERES	ELECTROPERU
CHICHE	HUANCAVELICA	HUANCAVELICA	MCAL CACERES	ELECTROPERU
ANGASMAYO2	CUNAS	HUANCAYO	CHONGOS ALTOS	ELECTROPERU
CANIPACO	CANIPACO	QUILLABAMBA	LUCUMA	ELECTROPERU

NAME	RIVER	PROVINCE	DISTRICT	ENTERPRISE
UPAMAYO	SAN JUAN	HUANCAYO	JARPA	CENTROMIN-PER
MALPASO	MANTARO	TAYACAJA	ANCO	CENTROMIN-PER
COLORADO	COLORADO			CENTROMIN-PER
SAN JUAN	SAN JUAN			CENTROMIN-PER
HUARON	HUARON			CENTROMIN-PER
CUTOFF	YAULI			CENTROMIN-PER
POMACOCHA	YAULI			CENTROMIN-PER
HUASCACOHA	HUASCACOHA			CENTROMIN-PER
MARCAPOMACOHA	CUSHA			ELECTROLIMA
CANAL MARCAPOMA				ELECTROPERU
CANAL ANTACASHA				ELECTROPERU
CANCHAYOC	ANTACASMA			ELECTROPERU
MARCAPOMACOCHA				DIR AGU RIEG
CORPACANCHA				ELECTROLIMA
CHINCHI	HUANCAVELICA			ELECTROPERU
VILLENA	MANTARO			ELECTROPERU
UPAMAYO	MANTARO			ELECTROPERU
HUALLAMAYO	PAUCARTAMBO			CENTROMIN-PER
CHILCAS	HUACHON			CENTROMIN-PER
SANTA ISABEL	SANTA ISABEL			CENTROMIN-PER
YUNCAN	PAUCARTAMBO			CENTROMIN-PER
MANTO	MANTO			CENTROMIN-PER
PONGOA	SATIPO			ELECTROPERU
PTO. OCOPA	PERENE			ELECTROPERU
PTO ASHANINGA	ENE			ELECTROPERU
SANTARO	TAMBO			ELECTROPERU
MUELLE FISCAL IQ.	AMAZONAS			SENAMHI
ALGARROBO	CHAMAYA			ELECTROPERU
MAGUNCHAL	MAGUNCHAL			ELECTROPERU
MANGUITO	UTCUBAMBA			ELECTROPERU
EL MILAGRO	UTCUBAMBA			ELECTROPERU
TNTE PINGLO	SANTIAGO			ELECTROPERU
BORJA	MARANON			ELECTROPERU
MUYO	HUYO			ELECTROPERU
RAQUIA	HUALLAGA			ELECTROPERU
BLANCO	HUALLAGA			ELECTROPERU
AMBO	HUERTAS-HUALL			ELECTROPERU
	LLAGA SUP			ELECTROPERU
MOLINOS	HUERTAS-HUA			ELECTROPERU
	LLAGA SUP			ELECTROPERU
CHAGLLA	HUALLAGA			ELECTROPERU
CHINCHAVITO	CHINCHAVO-			ELECTROPERU
	HUALLAGA			ELECTROPERU
PEREZ	HUALLAGA			ELECTROPERU
CORPAC	HUALLAGA			ELECTROPERU
BELLA	MONZON-			ELECTROPERU
	HUALLAGA			ELECTROPERU
TOCACHE	HUALLAGA			ELECTROPERU
CAMPANILLA	HUALLAGA			ELECTROPERU

ANNEXED 9.3

AVAILIBILITY OF FLUVIOMETRIC DATA

RIVER	STATION	STATION ALTITUDE MASL	ENTERPRISE	OPERATION START
Santa	Recreta	3.990	ELECTROPERU	1953
Santa	La Balsa	1.880	ELECTROPERU	1953
Santa	Condorcerro	450	ELECTROPERU	1957
Santa	Puente Carretera	18	MINISTRY OF AGRICULTURE	1931
Pachacoto	Pachacoto	3.700	ELECTROPERU	1953
Yanayacu	Querococha	3.980	ELECTROPERU	1953
Olleros	Olleros	3.550	ELECTROPERU	1970
Quillcay	Quillcay	3.042	ELECTROPERU	1970
Marcana	Chancos	2.840	ELECTROPERU	1953
Llanganuco	Llanganuco	3.850	ELECTROPERU	1953
Paron	Paron	4.100	ELECTROPERU	1953
Colcas	Colcas	2.050	ELECTROPERU	1953
Cedros	Cedros	1.990	ELECTROPERU	1953
Quitaracsa	Quitaracsa	1.480	ELECTROPERU	1953
Manta	Manta	1.920	ELECTROPERU	1953
Tablacacha	Chuquicara	500	ELECTROPERU	1954
Collota	Huillca	4.200	ELECTROPERU	1977

Source: Integral Study for the exploitation of the Basin of Santa River
HIDROSERVICE, Sep. 1994

ANNEXED 9.3

AVAILIBILITY OF PLUVIOMETRIC DATA

STATIONS	OPERATION START	OPERATION END	OBSERVATIONS
Corongo	1964	1976	Daily raralized
Conococha	1948	1969	Totalizer paralized
Santiago de Chuco	1964		Daily operation
Recuay	1964	1970	Totalizer paralized
Santa	1964		Daily operation
Querococha	1953		Daily w/rain gauge
Conchucos	1964		Daily operation
Lampas Alto (2)	1958		Daily operation
San Lorenzo	1965	1972	Daily raralized
Lampas Bajo	1957	1968	Daily raralized
Punta Mojon	1952		Totalizer in operation
Safuna	1969	1975	Daily in operation
Huaraz	1952		Daily w/rain gauge
La Rinconada	1956	1961	Daily paralized
Anta	1971		Daily in operation
Huancapeti	1952		Totalizer in operation
Collota	1952		Totalizer in operation
Pachacoto	1952		Totalizer in operation
Recreta	1952		Totalizer in operation
Yungay	1952		Totalizer in operation
Caraz	1952		Totalizer in operation
Llanganuco	1952		Totalizer in operation
Chancos	1952		Totalizer in operation
Quiruncancha	1952		Totalizer in operation
Cedros	1945	1950	Totalizer in operation
Mollepata	1963		Daily in operation
La Pampa	1945	1961	Daily paralized
Ticapampa	1951		Totalizer in operation
Schacaypampa	1952		Totalizer in operation
Quitacocha	1952		Totalizer in operation
Paron	1948		Totalizer in operation
Huancamarcanga	1971		Totalizer in operation
Tocanca	1952	1965	Totalizer paralized
Hidroelectra	1945		Daily in operation
Yanacocha	1952		Totalizer in operation
Cachicadan	1963		Daily in operation
Cahuish	1952		Totalizer in operation
Huilca	1973		Rain gauge in operation
Yuamaray	1981	1983	Daily paralized
Chuquicara			Daily in operation
Punta Callao	1983		Totalizer in operation

ANNEXED 9.3

AVAILIBILITY OF METEOROLOGICAL DATA

STATIONS	OPERATION START	OPERATION END	OBSERVATIONS
Lampas Alto	1958		In Operation
Recuay	1964	1970	Paralyzed
San Lorenzo	1965	1980	Paralyzed
Querococha	1965		In Operation
Lampas Bajo	1957	1968	Paralyzed
Conococha	1957	1968	Paralyzed
Huaraz Col Libertad	1949	1955	Paralyzed
Huaraz Electroper Inie	1965		In Operation
Huaraz Electroper Oficina Laguna	1977		Thermopluviometric
Tingua	1935	1942	Paralyzed
Caraz	1964	1973	Paralyzed
Safuna	1969	1972	Paralyzed
Huilca	1973	1980	Paralyzed
Hidroelectra	1954		Thermopluviometric
Quitacocha	1952	1966	Paralyzed
Corongo	1965		In Operation
Conchucos	1964		In Operation
Santiago de Chuco	1964		In Operation
H. de la Rinconada	1955	1960	Paralyzed
Santa	1965	1969	Paralyzed
Anca	1971		
Yuamaray	1981	1983	Paralyzed

CHAPTER X

OTHER USES OF WATER

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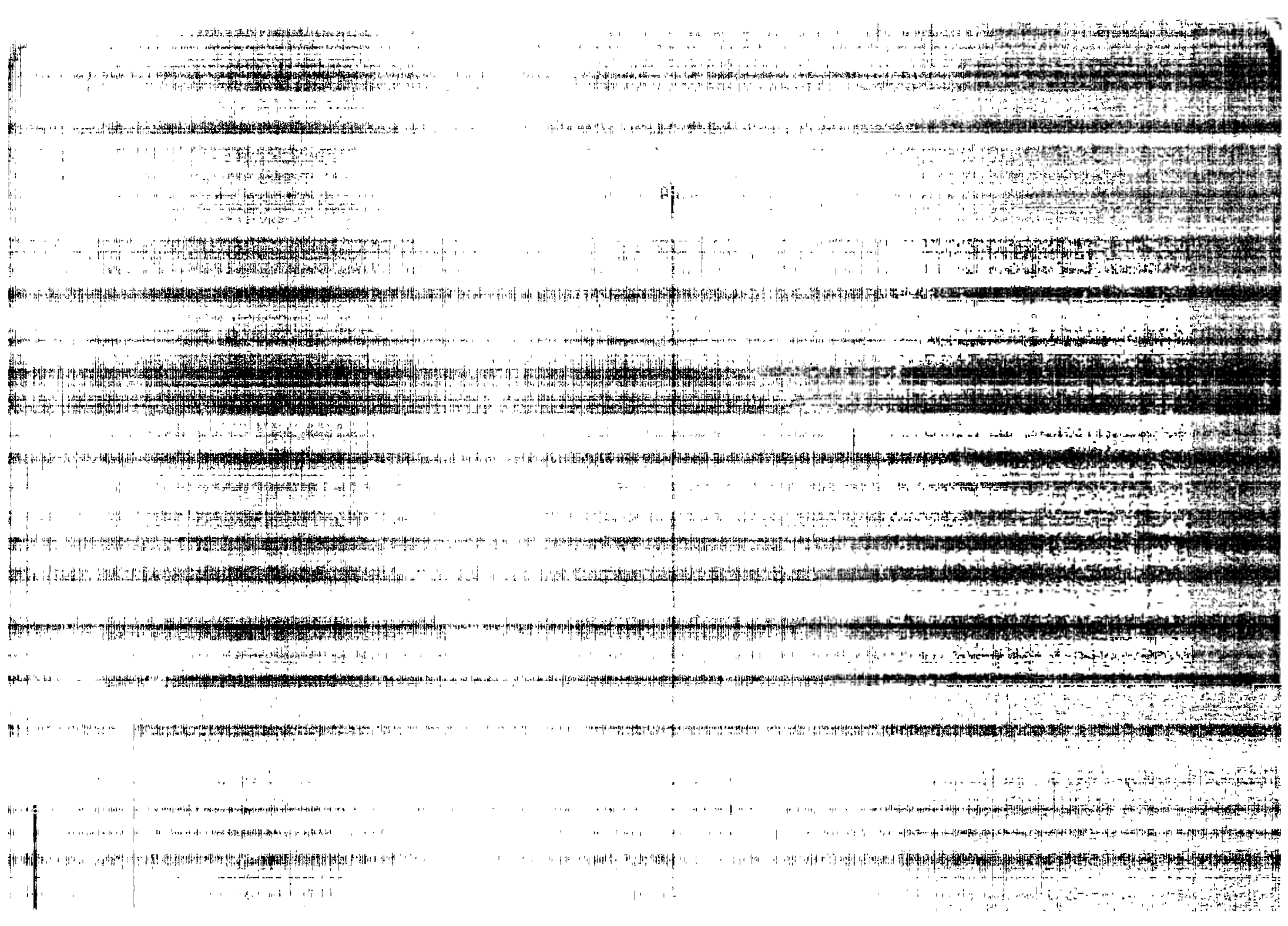

CHAPTER X

OTHER USES OF WATER

10.1 NAVIGATION

Transportation is a very important activity since it makes possible the integration between the different peoples and cities of our country. The transportation sector is composed of the infrastructure itself as well as of the passenger and load traffic; this can be by air, water or land. The type that concerns us is the water transportation because this kind of transportation uses the water resource for its purposes.

The water transportation in our country is subdivided into ocean, river, and lake transportation. The principal ports and coves of the country are presented in Figure 10.1 where 15 ports and 28 coves in the Peruvian littoral can be observed.

In the Figure 10.2 the river network of Peru is presented. The river transportation takes place in the Amazonia rivers since they are plentiful and navigable. The principal fluvial ports are that of Iquitos, corresponding to the Amazon River, the fluvial port of Pucallpa, corresponding to the Ucayali River, and the fluvial port of Yurimaguas, corresponding to the Huallaga River.

The mobilized shipment through water transportation was of 4,767 thousand tons, in the export service; 2,922 thousand tons, for the import, and of 2,363 thousand tons in cabotage. The import shipment was mainly unloaded in the Callao Port, while the export shipment was unloaded in the ports of Callao and Pampilla, principally, as it is shown in the statistics of 1993 (Table 10.1).

Such statistics regarding the quantity of water transportation units (Table 10.2) reports the following data: 30 units corresponding to the ocean transportation, 514 units corresponding to river transportation, and 5 units corresponding to lake transportation, both of state and private property,; the chief kinds of ships are: freighters, tankers, bulk ships, and semi-container. It is worth mentioning that there is an additional number of river and lake transportation units that have not been registered in the respective government's offices.

One of the major pollution problems caused by the commercial and navigation activity in Peru is oil load and unload operations in Callao and Talara;; these originate spillings of diverse magnitude becoming polluting agents for those bays.

TABLE 10.1

MOBILIZED LOAD BY MEANS OF WATER TRANSPORTATION

MEANS OF TRANSPORTATION	S E R V I C E thousands tons								
	EXPORT			IMPORT			CABOTAGE		
	1991	1992	1993	1991	1992	1993	1991	1992	1993
			(*)			(*)			(*)
SEA	9802	8847	4756	6094	6988	2873	12005	12956	2363
TALARA	413	464	144	443	365	351	1605	1857	952
PAITA	172	144	95	90	135	29	68	30	10
ETEN	--	--	--	--	--	--	268	127	--
PACASMAYO	--	--	--	--	--	--	16	--	--
CHICAMA	--	--	--	--	--	--	--	--	--
SALAVERRY	197	92	46	358	282	142	305	1	100
CHIMBOTE	546	454	384	1	129	119	212	420	268
SIDER PERU	173	125	--	--	--	--	320	3	--
SUPE	56	102	56	--	24	--	75	76	47
HUACHO	112	86	59	--	4	--	--	--	--
CHANCAY	--	--	--	--	--	--	--	--	--
CALLAO	2275	1836	1091	2818	4012	1862	1453	1017	400
GRL.SAN MARTIN	201	263	228	270	168	131	92	59	30
MATARANI	184	208	57	284	403	187	85	576	45
MATARANI A BOLIVIA	--	--	--	--	--	--	--	--	--
ILO	79	127	60	22	5	1	158	185	145
ILO SOUTHERN	335	263	147	25	22	50	387	314	122
BAYOVAR	56	18	--	--	--	--	3301	3693	--
PIMENTEL	--	--	--	--	--	--	--	--	--
SAN NICOLAS	2945	2473	2389	--	--	1	36	180	244
LA PAMPILLA	2058	2192	--	1325	1290	--	3487	3737	--
CONCHAN	--	--	--	12	101	--	137	174	--
MOLLENDO	--	--	--	446	48	--	--	507	--
NEGRITOS	--	--	--	--	--	--	--	--	--
RIVER	13	5	11	21	24	49	948	1118	0
IQUITOS	5	5	4	--	24	25	728	920	--
PUCALLPA	--	--	--	--	--	--	211	134	--
YURIMAGUAS	8	--	7	21	--	24	9	64	--
TOTAL	9815	8852	4767	6115	7012	2922	12953	14074	2363

Source : Ministry of Transport and Communications, 1992

(*) : Preliminary figures as to June 30

FIGURE 10.1

PORTS AND INLETS IN THE PERUVIAN LITTORAL

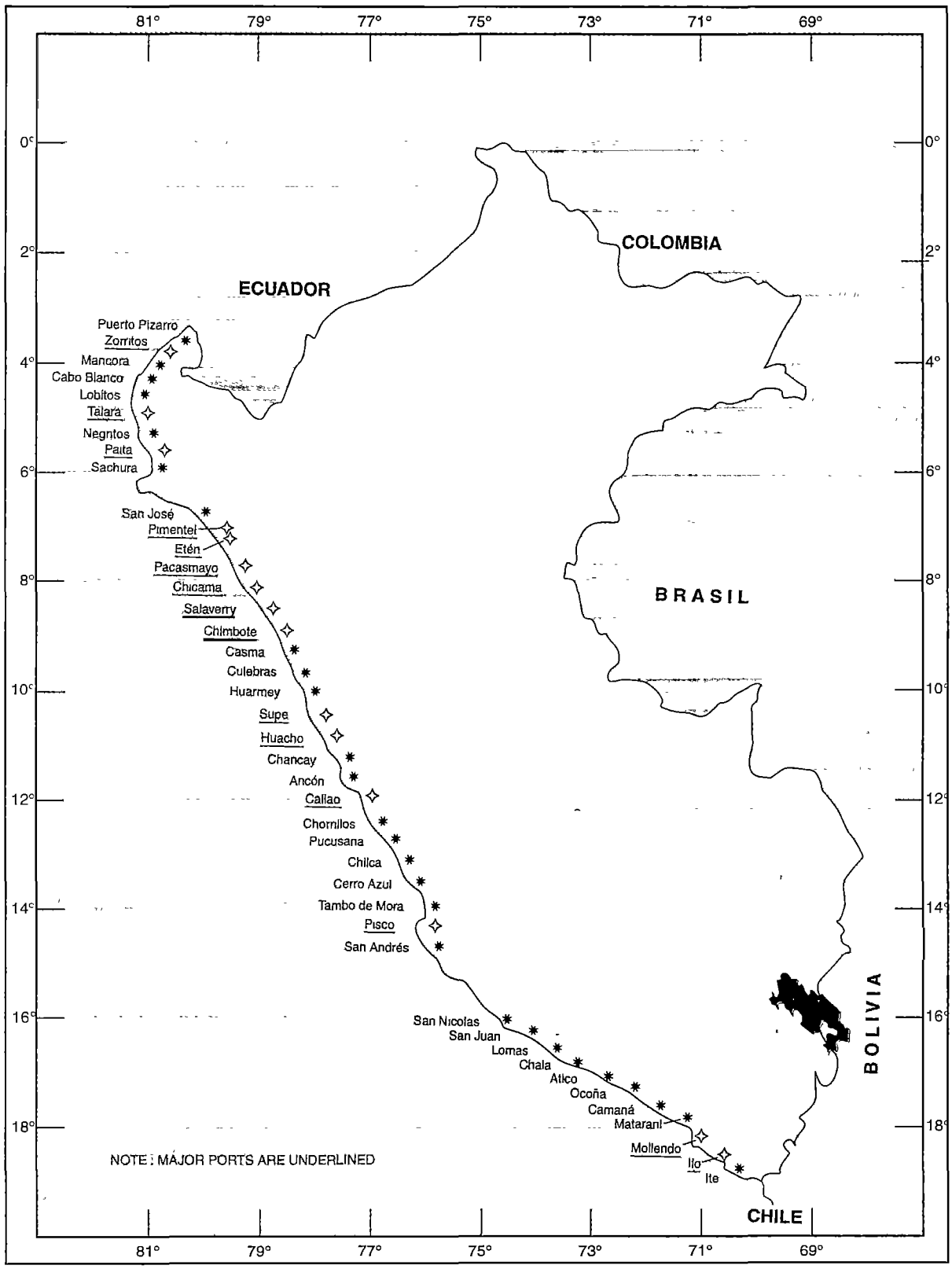

FIGURE 10.2

RIVER NETWORK OF PERU

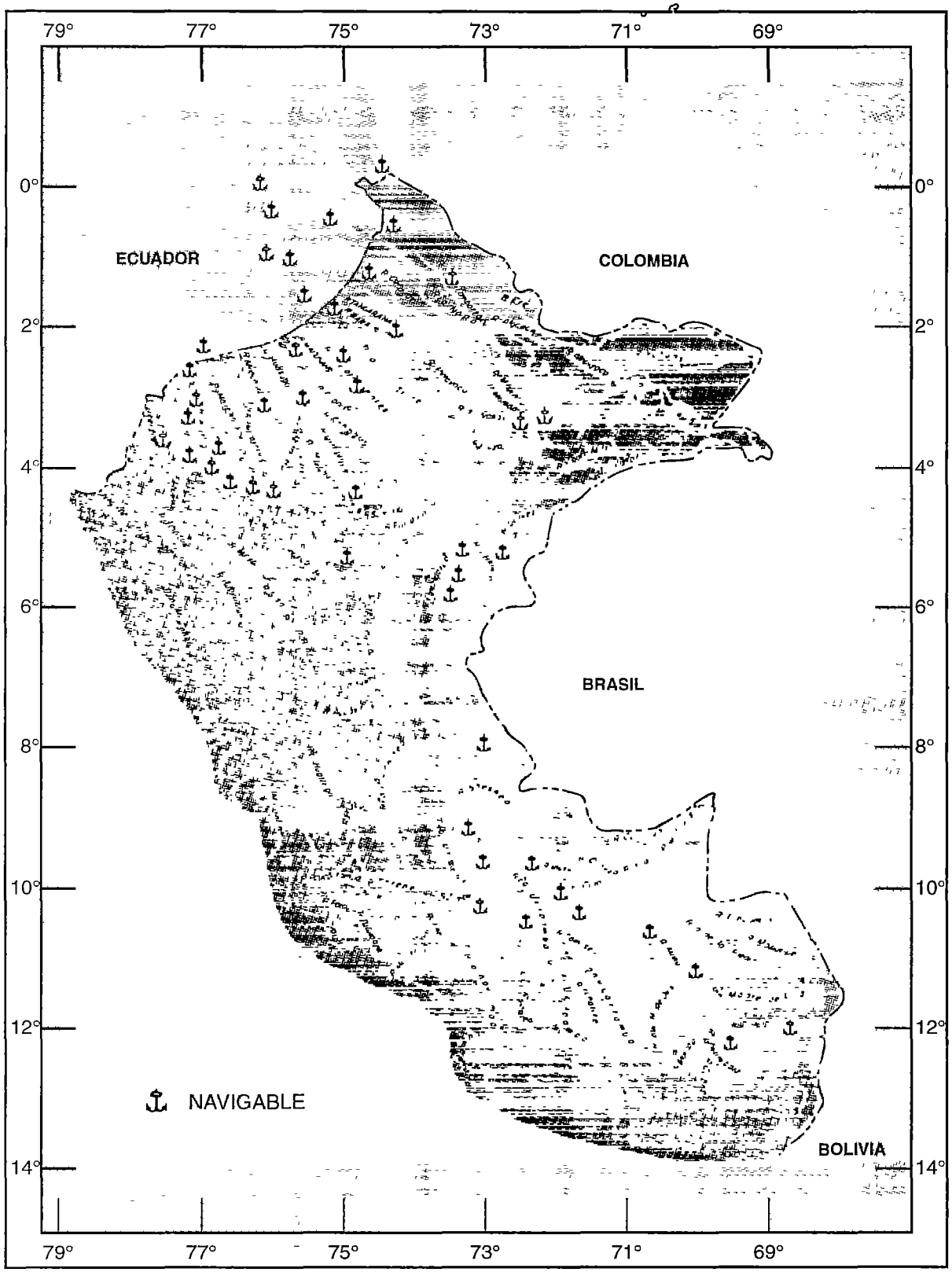

TABLE 10.2

WATER TRANSPORTATION FLEET

PROPERTY KIND OF SHIP	UNITS							
	1986	1987	1988	1989	1990	1991	1992	1993
SEA	57	55	53	52	51	30	34	30
STATE	25	26	26	25	25	9	19	15
FREIGHTER	10	10	10	10	10	2	6	4
GAS SHIP	1	1	1	1	1	1	1	1
BULK SHIP	3	3	3	3	3	1	1	--
MULTIPURPOSED	1	1	1	--	--	--	--	--
SEMI-CONTAINER	1	1	1	1	1	1	1	--
TANKER	9	10	10	10	10	4	10	10
PRIVATE	32	29	27	27	26	21	15	15
FREIGHTER	14	13	12	11	10	9	4	3
REFRIGERATOR	1	1	1	1	1	1	1	1
BULK SHIP	7	5	5	5	5	3	2	2
MULTI-PROPOSITO	1	1	--	--	--	--	--	--
SEMI-CONTAINER	4	4	3	4	5	4	4	--
TANKER	4	4	4	4	3	3	3	--
ROLL ON ROLL	1	1	1	1	1	1	1	1
TOURIST	--	--	1	1	1	--	--	8
RIVER	548	492	509	516	515	512	525	514
PRIVATE	548	492	506	513	512	512	525	514
PRIVATE TOURIST	--	--	3	3	3	--	--	--
LAKE	3	3	81	81	81	3	3	5
STATE	3	3	3	3	3	3	3	3
PRIVATE TOURIST	--	--	78	78	78	--	--	2
TOTAL	608	550	643	649	647	545	562	549

SOURCE : Ministry of Transport and Communications, 1992

10.2 TOURISM

Peru has a great variety of tourist attractions such as monumental patrimonies inherited from our ancestral cultures and a diversity of natural settings which permit to develop an activity capable of becoming an important agent in the generation of foreign currency and employment.

The many environments, ecosystems and natural landscapes attract the attention of those who want to perform special activities such as: archaelogy, ecotourism, adventure sports, scientific research, among others.

Peru, together with other five countries of Latin America, has been qualified as a country of "mega diversity" by the scientists. Around 5.5 million of hectares are legally protected by the National System of Conservation Units. Among these, the best known units worldwide are: the National Park of Manú, the National Reserve of Paracas, the Reserve of Pacaya - Samiria, and the historical sanctuary of Macchu Picchu.

On the other hand, the rivers and lakes of the country are not only used as a means of transportation. According to the experts, Peru is a privileged country for the practice of rafting because of her rivers of diverse types and difficulty degrees, with rapids such as, for example, those of Colca and Cotahuasi Canyons in Arequipa, the Huallaga, the Apurimac and the Urubamba in Cusco.

The rafting activity is considered as attracting the greatest interesting the world nowadays; it is part of the so-called adventure tourism together with the high-sea fishing, that means navigation offshore, and the surfing (adventure tourism). It constitutes the most developed tourist activity in the world today and the one receiving more possibilities of growth.

10.2.1 Thermal and mineral-medicinal water source

Another possibilty to exploit the water resource in the country is through thermal and mineral-medicinal waters. At present there are few, badly exploited, resorts of mineral-medicinal waters in the country, but the potentiality of the tourist explotation of thermal waters is promising, as long as the Tourism Sector policies encourage and promote it abroad.

According to the national cadastre, there are around 800 mineral-medicinal sources; 301 of which are registered, 101 are under study, and 56 exploited; 67% of them are found in the Highlands, 28% are in the Coast and 5% in the Jungle.

The principal medicinal resorts, having service infrastructure, are: the Baths of Monterrey and the Baths of Chancos in the department of Ancash; the Baths of Yura and Jesus in the department of Arequipa; the Baths of The Inca and Laguna Seca in the department of Cajamarca; the Baths of Churin and Chiclin in the department of Lima.

Another way to use this kind of water in Peru is through bottling plants of mineral water; there are for example:

- Yura, Socosani and Jesus in the department of Arequipa (mineral and syrupy)
- San Mateeoln Lima (mineral)

- Chuquitantaln Lima (oil-mineral)
- Chuschucoln Tacna (mineral)
- Llocllopampaln Junin (mineral and syrupy)

Table 10.3 shows the water resource contrbution to the Tourism sector through the transportation of foreigners by geographical zone and type of transportation.

10.3 AQUICULTURE

Few years ago, the cultivation of aquatic animals was reduced to fish and, consequently, only the term pisciculture was mentioned. This term remains, although the cultivation of other species was started, such as crustaceans, algas, molluscs, and other invertebrata. Then, when other species were treated, the term mariculture was employed; and, finally, in order to embrace all kind of cultivations in the water, the term aquiculture or aquaculture was proposed to the scientific community.

The interest in the aquiculture in Latin America can go back to the last years of the decade of the 1930s, when several countries imported trouts from the Northern Hemisphere to start their cultivation in specialized stations and, at the same time, eggs and fries were imported to be sown in rivers and lakes of mountainous regions. The progress so far is quite slow, though the interest has notoriously increased, and the number of species under study has been multiplied several times, including autoctonous and imported species.

The pisciculture in Peru was started with the import of trouts, their sowing in rivers of the Highlands and the settlement of state stations to raise fries. It was an extensive pisciculture that started in 1939. Later on, this policy changed when it was decided to study diverse species of the Jungle for their cultivation and imported species for their adaptation to our environment.

A pisciculture program was created in the Agrarian University of La Molina in order to train engineers in this field of knowledge; then, the Ministry of Fishing decided to foster the pisciculture as regards research and production in different parts of the country, such as in the Callejón of Huaylas in the department of Ancash, in the fluvial port zone of Pucallpa and Iquitos, and others of lesser importance. Due to the lack of interest by part of the last rulers and their policies, this process suffered a deceleration in its qualitative and quantitative aspects.

According to the experts, the aquiculture in the country is classified and developed as follows:

10.3.1 Marine Aquiculture

There exist two important projects related to marine cultivations in Peru. One of thse projects is located in Tumbes and is executed by a number of private enterprises dedicated to the cultivation of prawns. The larvae and young fish are collected from the estuaries and carried to artificial ponds until they reach a commercial size; it is a fattening operation as compared with stockraising. At present, prawns fattened in the ponds of Tumbes are being exported.

At the same time, some official institutions (The Sea Institute, the former Ministry of Fishing) and private institutions are carrying out studies aimed to reproduce the complete biological cycle in the laboratory.

TABLE 10.3

ENTRANCE OF FOREIGNERS BY MEANS OF TRANSPORTATION

GEOGRAPHICAL ZONE ORIGIN		MEAMS				
	AIR	LAND	RIVER	SEA	LAKE	TOTAL
NORTH AMERICA	47,962	3,240	149	90	3	51,444
CENTRAL AMERICA	7,255	404	7	314	--	7,980
SOUTH AMERICA	47,549	25,276	367	146	1	73,339
EUROPE	63,306	11,387	262	5,751	85	80,791
ASIA	12,046	1,698	15	929	15	14,703
AFRICA	408	148	5	4	--	565
OCEANIA	1,782	1,284	75	4	--	3,145
NOT SPECIFIED	41	4	--	--	--	45
TOTAL	180,349	43,441	880	7,238	104	232,012

LEAVING OF NATIONALS BY MEANS OF TRANSPORTATION

GEOGRAPHICAL ZONE DESTINATIOR		MEANS OF				
	AIR	LAND	RIVER	SEA	LAKE	TOTAL
NORTH AMERICA	147,708	55	1	17	--	147,781
CENTRAL AMERICA	20,681	3	--	35	--	20,719
SOUTH AMERICA	75,573	102,922	761	138	56	179,450
EUROPE	28,698	--	2	166	--	28,866
OCEANIA	50	--	--	--	--	50
NOT SPECIFIED	--	--	--	619	--	619
TOTAL	272,710	102,980	764	975	56	377,485

Source : Ministry of Industry, Domectic Trade, Tourism and Integration

The other project, under the responsibility of the Agrarian University of La Molina, is being executed in Pisco-Paracas; its objective is to study the life cycle of large mussels, shear oyster and the razor clams, as well as to carry out experiments regarding their cultivation. This project was started at the end of 1980 and at present shows some positive results. It represents, however, the first experience in this field and has received financial assistance from Canada.

It is necessary to accept that the Coast does not have many sheltered places so as to undertake big projects of mariculture, being the zones of Tumbes and Pisco-Paracas the most advisable. The are other possibly interesting zones, but they need a previous study; this is the case of the bay of Independencia, the south of the cove of Sechura, the south of the port of Chimbote, among others.

10.3.2 Aquiculture in the Coast

In the Coast, the water of the rivers and lakes is not very abundant and, therefore, profitable cultivations must be made. The river shrimp is the species that has mostly attracted the researchers' interest; however, the problem concerning the controlled development of the larvae has not been solved so far. What is being done is just to fatten the young fish gathered in the mouths of the rivers and carried to ponds.

The experts have recommended the cultivation of the river shrimp of the North, a variety existing in the rivers of the departments of Tumbes and Piura, also the cultivation of the species called "camotillo" or "monengue" and the "mojarra"; these two species have been recommended because of their resistancee and white meat.

Finally, the Agrarian University, at its campus, and the Sea Institute, at its station in Huachipa, both in the Coast, have made experiments related to the cultivation of species introduced and species of "tilapias" and carps. The results of these experiments, however, have not been published.

10.3.3 Aquiculture in Cold Waters

In this kind of waters, exclusively the cultivation of trouts and, in particular, the rainbow trout, is made. The trout is a fish imported from the Northern Hemisphere since the decade of the 1940s for the purpose of sowing them in the rivers of the Highlands providing the inhabitants with a protein rich food, cheap, and of good-guality. In order to accomplish this objective, pisciculture stations were created whose principal task was, until 1970, to obtain fries, to care them adequately and, then, sow them in the Highlands rivers.

Since the creation of the Ministry of Fishing in 1970, a policy for the promotion of trout cultivation in specialized farms was started; and credits and facilities were granted to corporate enterprises, communities, etc. so they could carry out projects. Some of these projects were abandoned and could not be finished; but other were successful and Peru started to export trout as a result of this. One problem the pisciculture faces is to obtain adequate artificial food for the trout cultivation and at a low price.

In Lake Titicaca, in the department of Puno, successful experiments related to the cultivation of trouts in cages are being carried out, especially by private enterprises which claim to produce and sell 100 tm/year of different species.

In 1981 an assessment of the piscifarms settled in the Mantaro valley was made, finding out that of the 66 piscifarms existing in the department of Junín, only 12 of them were in use.

The installed production capacity is of 329 tm/year, but it only covers 20%. The most serious aspect is that several piscifarms stop operating due to vandalism actions, technical-administrative problems, and water or profitability problems. At present, it is expected that, due to the changes in the national policy, this activity should grow on the short-term.

The cities with the greatest consumption of trouts are: Lima, Huancayo, Jauja, La Oroya, Tarma, Cusco and Arequipa.

For the export of trouts, it is necessary to meet the market's demands; the United States of North America wants them frozen and, sometimes, boned; while the Andean market accepts them in bags and by units. Peru exports trouts to USA, Brasil, Venezuela, Colombia, Ecuador, and Uruguay.

10.3.4 Aquiculture in Warm Waters

As it can be supposed, an attempt to develop the aquiculture in warm waters of the Peruvian Jungle has been made. Today, the actvities are more dedicated to research under the responsibility of some institutions, the following can be mentioned, among them: the Sea Institute of Peru (IMARPE) having its head-office in Iquitos, the Institute of Tropical and Highland Research of San Marcos University (IVITA) with its head-office in Pucallpa, the Amazonia University of Iquitos and The Agrarian University of La Moliina. At present, only experimentation can be mentioned, since a significant progress, far from an intensive aquiculture, has not been made.

10.3.5 Aquiculture and Pollution

The pollution problems related to aquiculture are very varied; they can refer to the deposition of minerals in the water that is the most common problem in our country; they can refer to the spilling of oil and hydrocarbons in general; to the effect of urban wastes of all kind (solids, deetergents, insecticides, plastics); to the fumes emitted by fish meal factories, and the liquid products they expel polluting several bays of Peru.

The pollution by minerals is the most frequent and the most studied regarding the continental waters of our country; one of the damages it causes is the destruction of the fauna of the lakes, lagoons and rivers making their waters useless for aquiculture projects. On the other hand, this kind of pollution has become endemic and dangerous in some ports of Peru (Chimbote, San Juan and Ilo, principally). It is known the serious pollution existing in the Mantaro river and its tributaries as well as in the following rivers: Huaron, San Juan, Carhuyacán, Yauli, Moche, Hualgayoc, Santa, Huancapet, Sinto and part of Huallaga; also Lake Junín is polluted by the mining tailings.

With regard to the Rimac river, the river that provides the Peruvian capital with water, two kinds of pollution can be found: one in the high basin due to the release of mining tailings, and the other in the low basin up to the outlet in the ocean; this zone receives the discharge of domestic drains coming from populations located at the Rímac's banks and, very especially, from Metropolitan Lima.

The main pollution problems in Peru are:

- Releases of tailings from the mining industry in the basins of the Mantaro, Rímac, and Locumba rivers and Lake Junín.

- Domestic wastes from Lima and Callao that pollute the near beaches because they are not duly treated.

- Releases from the fishing industry that pollutes the bays of Chmbote, Chancay, Callao, Pisco and Tambo de Mora.

- Release into the sea of petrochemical wastes from the Talara complex.

- Oil load and unload operations iin the Callao and Talara that cause spillings of diverse magnitude.

The alternatives proposed by the last governments to avoid the pollution caused by the mining tailings have to do with demanding the mining enterprises the construction of a series of works such as, for example, tailing grounds, tributary conditioning, pumping of acid waters, and treatment plants.

CHAPTER XI

USE OF WATER AND ENVIRONMENT

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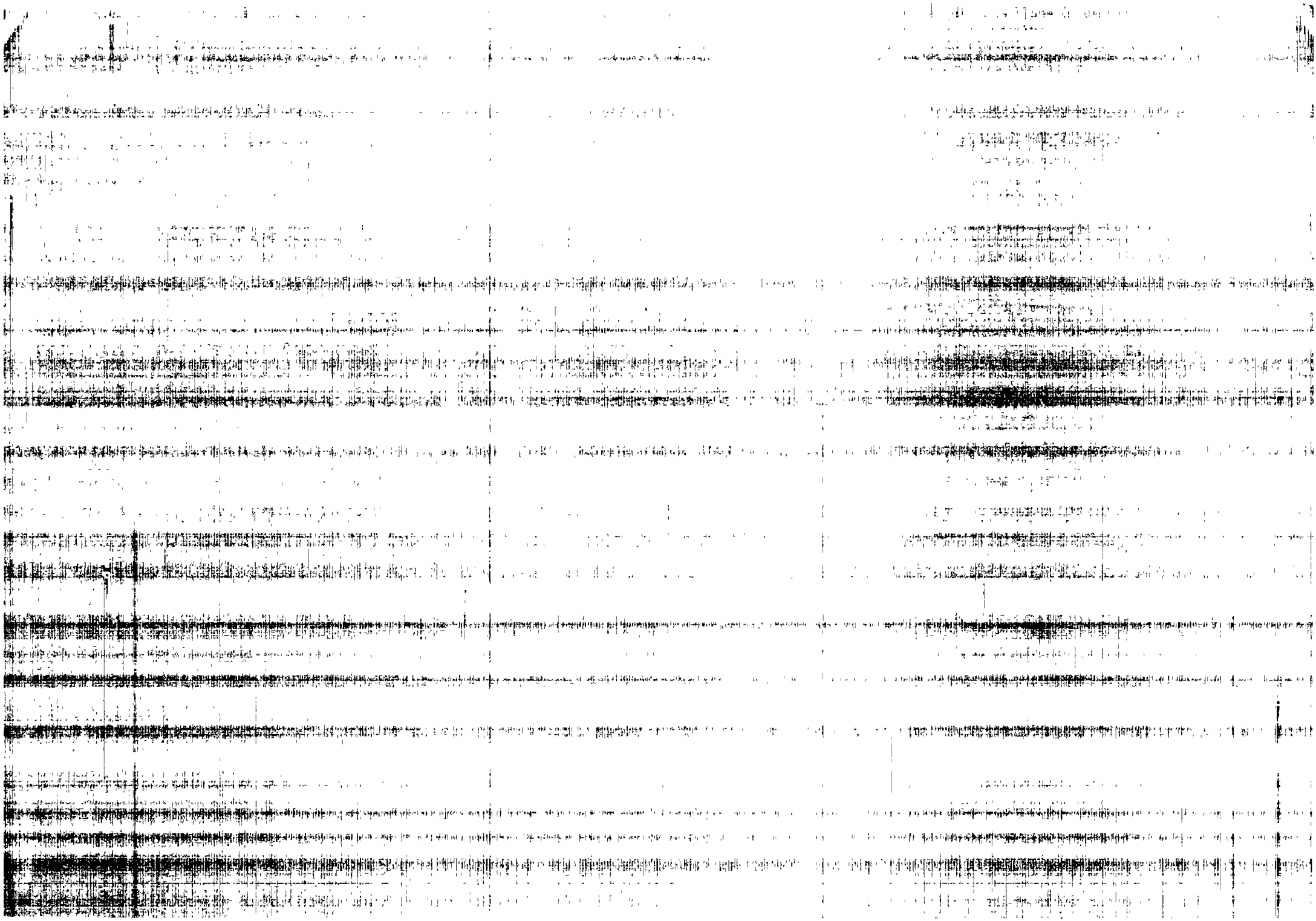

CHAPTER XI

USE OF WATER AND ENVIRONMENT

11.1 THE ENVIRONMENTAL CONTENT OF THE WATER RESOURCE IN PERU

The water resource potential existing in Peru has been assessed by some state institutions as, for example, the former National Office of Natural Resources Assessment (ONERN), with the objective of planning a rational use and management of the water. The studies carried out have permitted to identify the principal hydrological charactersitics of the national territory, for example, the runoff volume of the surface waters is 2,043,548.26 mcm/year; the storage capacity in lakes and lagoons is 52,168.52 mcm/year. On the other hand, it is widely known the variability and irregular spatial distribution of the water in the three hydrographical watersheds of the country.

It can also be pointed out that Peru has the driest and most humid zones of the planet; likewise, the mean annual surface runoff produced in the country represents almost 5% of the total discharge of the rivers in the world.

11.1.1 Surface Water Potential

The assessment of the surface wayer potential in the country has been made by estimating the parameters: "runoff volume" (water flowing on the surface) and "feasible exploitable volume" (total physical regulation capacity of a basin or watershed).

The "runoff volume" has been determined by estimating the average annual discharge of all the rivers of the country. It has been established that Peru has a mean annual surface runoff volume of 2,043,548.26 mcm equivalent to an average flow of 64,800 m^3/seg.

Of this volume, 1.69% of the total corresponds to the Pacific Watershed (34,624.24 mcm/year); in the same way, 97.81 % of the total volume drains into the Atlantic Watershed (1,998,751.68 mcm/year), and 0.50% of the total volume drains into the Titicaca Watershed (10,217.74 mcm/year).

The "feasible exploitable volume", defined as the total physical regulation capacity of a basin or watershed, has been estimated nationwide in 51,168.52 mcm/year. Of this volume, 43.95% corresponds to the Pacific Watershed (20,951.82 mcm), 57.68 corresponds to the Atlantic Watershed (29,514.67 mcm) and 1.37% to the Titicaca Watershed (701 mcm). Of the volume considered for the Atlantic Watershed, 8,921.83 mcm (30% of the volume) are feasible to be used in the Pacific Watershed through transfer of waters.

11.1.2 Underground Water Potential

The underground water potential evaluated by the Ministry of Agriculture through its General Direction of Waters and Soils has made possible to determine the volume of "exploitable reserves" for the Pacific Watershed that amounts to 2,739.3 mcm; likewise, the volume of exploitation of underground waters has been estimated in 1508 mcm for the Pacific Watershed; this volume is much lower for the Atlantic Watershed and the Titicaca Watershed.

11.1.3 Hydroelectric Potential

The hydroelectric potential of the country has been quantified in the study "Assessment of the National Hydroelectric Potential" (Ministry of Energy and Mining 1979); it establishes that Peru has a "theoretical Potential" of 206,102 MW and a "technical potential" of 58,364.4 MW (really exploitable potential in the country). Likewise, the installed power for that period amounts to 1,391.6 MW (2.38% of the exploitable technical potential).

With relation to the distribution of the technical potential by hydrographical watersheds, it can be said that the Atlantic Watershed has 78.4% of the national total, the Pacific Watershed has the remaining 21.6%, and a minimum corresponds to the Titicaca Watershed.

11.2 WATER USE IN THE COUNTRY

The volume and principal characteristics of the water use in the country have been assessed by the Study "National Inventory of Actual Use of Water" and by the Basic Situational Study of the Water Resources in Peru, (DGAS,1992).

Such studies establish that the "consumptive" water used in the processes reaches 18,972 mcm/year and the water used for "non-consumptive" purposes (energy sector) reaches 11,139 mcm/year, totalling 30,111 mcm/year.

Among the principal productive sectors in Peru, the consumption of water in the agricultural sector has a preponderant place reaching 85.74% of the total volume of "consumptive use" (16,267 mcm/year); next, according to their importance follow: the population sector (6.66%0 the industrial sector (6.09%), the mining sector (1.09%), the livestock sector (0.42%).

With regard to the geographical distribution, the Pacific Watershed reports the greatest volume of annual use (consumptive and non-consumptive) that represents 68.90%; the Atlantic Watershed has 30.71%; and, finally, the Titiicaca Watershed has 0.39%.

11.2.1 Pacific Watershed

In the Pacific Watershed, the annual total volume of water used reaches 20,746 mcm; 79.54% of which is of consumptive use and 20.46% corresponds to a non consumptive use.

Regarding the consumptive use, the agricultural sector is the principal user of the water resource with the 86.05% of the total, following in order of importance, the industrial sector with 6.7%, the population sector with 6.17%, the mining sector with the 0.92%, and the livestock with the 0.17%.

The major use of water in the agricultural sector is found in the basin of Chancay-Lambayeque; while the major volume of population use occurs in the basin of the Rímac river. The mining use registers its major volume in the basin of the Osmore river: the major industrial use occurs in the basin of the Rímac river; the major livestock use in the basin of Chira-Piura; and the major volume of energy use in the basin of Vitor-Chili.

11.2.2 Atlantic Watershed

In this watershed, the total volume of water used amounts to 9,248.0 mcm; 74.40% of which corresponds to a consumptive use and the remaining 25.60% corresponds to a non consumptive use (energy).

The agricultural use represents 84.33% of the consumptive use volume of the watershed, followed by the population use with 9.63%, the mining use with 2.24%, the industrial use with 2.07%, and the livestock use with 1.73%.

The major agricultural use occurs in the region of the Marañon (part of Cajamarca and Piura); the major population use has place in the basin of the Mantaro river (Huancayo and Cerro de Pasco); the major mining use also has place in the region of the Mantaro (between Huancayo and Cerro de Pasco); in the same way, the major industrial use happens in the same basin of the Marañon (part of Cajamarca and Piura); the major energy use occurs in the zone of Huancavelica and Ayacucho in the basin of the Mantaro.

11.2.3 Titicaca Watershed

The total volume of water used in this watershed amounts to 115.7 mcm a year; 87.1% of which corresponds to a consumptive use and the remaining 10.9% to a non consumptive use.

The major volume of consumptive use corresponds to the agricultural sector (68.9%), following in descending order the population use (17.3%), the livestock use (9.3%), the industrial use (2.8%) and the mining use (1.6%).

The major volumee of consumptive use can be observed in the basin of Maure river, followed by the volume registered in the basins of the Ilave, Ramis, Huancané and Coata rivers.

11.3 WATER POLLUTION IN PERU

11.3.1 Deterioration of the water resource

The deterioration of the environmental conditions of the water resource in the country is mainly caused by the pollution that affects the principal water courses and bodies of water, as a receiver of the noxious spillings resulting from the diverse socio-economic activities developed in the country.

This situation appreciably limits the use and subsequent water exploitation altering negatively the natural habitat of the hydrobiological resources, the irrigation of crops, the domestic use, the livestock and industrial use, the generation of hydroelectric energy (deterioration of electromechanical equpment) and recreation activities.

11.3.2 Principal causes of water pollution in Peru

The study called "Environmental Profile of Peru" undertaken by the former ONERN in 1986 permitted to identify the principal characteristics of water pollution in the country.

The surface water pollution is a consequence of the releases caused by the diverse socio-economic activities in the country:

- pollution by domestic releases.
- pollution by releases of the mining-metallurgical industry.
- pollution by industrial releases.
- pollution by agrichemical products.
- pollution by hydrocarbons.

In the agricultural sector, the pollution by releases of the mining-metallurgical industry has the greatest impact, due to its magnitude (territorial extension) and incidence levels, changing the water physical-chemical conditions; next, according to their importance, are: the domestic releases of settled populations, and the others mentioned above.

a. Pollution by releases of the mining-metallurgical industry

- The mining-metallurgical industry employs an annual water volume equal to 113,994,000 m^3; water is used at different stages of the process such as: reactant, dust control, refrigeration and waste hauling towards confinement places. This situation causes the release of the "tailings" affecting the composition of the surface waters.

- The tailings contain in solution metals such as copper, lead, zinc,iron, cadmium, among others, resulting from the neutralization and precipitation processes to remove impurities. This metal content surpasses, in certain cases, the permissible limits stipulated by the General Law of Waters (DL No 17752).

  In some places of the country, these tailings have given rise to a critical situation for the high Andean lakes, for example, Junín, Huancracocha, Quiulacocha, Morococha, Huascacocha and Yanamates in the Central Andes.

- The release volume of mining tailings that the water courses receive varies according to the production volume and the technology employed during the explotation, concentration, refining and smelting processes. The water course having the major release of tailings is the Locumba river, with more than 51 mcm/year. Next, the Rimac river with more than 16 mcm/year which represents 1.8% of the volume of its natural discharge.

b. Pollution by domestic releases

- The discharge of wastes originated by the cities and inhabitated centers settled near the drainage courses, without previous treatment, can cause an excess of organic load consumptive the oxigen in the waters and surpassing the self-purification capaciity of the rivers.

- According to the statistics registered by the Pan American Center of Health Engineering and Environment Sciences (CEPIS), body of the Pan American Health Organization (PAHO), 22 m^3/s of wastes are generated in Peru proceeding from approximately 2,600 cities that have drinking water and sewerage enterprises. Of this total, only 60 cities treat their wastes before their final disposal.

- Some of the cities that discharge a considerable volume of domestic releases towards the sea are: Lima-Callao, capital city, which discharges an average volume of 1,036,800 m^3/year towards the sea; this means an organic load of 87,500 t of biochemical demand of oxygen per year; the city of Chiclayo with a discharge volume of 25,920 m^3/year and an organic load estimated in 3,900 t of biochemical demand of oxygen per year; the locality of Chimbote with a discharge volume equal to 14,688 m^3/day and an organic load of 1,900 t of biochemical demand of oxygen per year.

- The utilization of wastes without previous treatment for irrigation of crops of short stems can cause transmissible diseases such as the typhoid fever and other related ones. In this sense, the stabilization lagoons, built in diverse places of the country, constitute, with an adequate management, solution alternatives for the reuse of the waters in agriculture and aquiculture.

c. Pollution by agrichemicals

- The inadequate and excessive utilization of agrichemicals such as organochlorated and organophosphorated plaguicides, herbicides and inorganic fertilezers, originates the hauling of toxic residues by effect of rains or absorption in the soil towards the irrigation channels and surface water courses.

- The information available reveals situations of pollution by nitrates in diverse points of the Rímac basin, attributable to the excessive use of fertilizers in the existing agricultural areas. Likewise, a similar situation is found in the basins of Piura, Chancay-Lambayeque, Chillón, Mala, Cañete, Acari, Vitor-Chili rivers.

- According to information recordeed by the Pan American Center of Human Ecology and Health, an average of 329 kg of plaguicides is employed in Peru per square kilometer per year of cultivable area; this figure is above the one used in other countris of Latin America.

d. Pollution by hydrocarbons

- During the process of oil prospection, exploration and exploitation, situations causing water resource deterioration occur such as the felling and clearing of vegetation that produce water erosion.

- In the same way, during the process of oil extraction and desalination, highly polluted liquid subproducts are generated, for example, the brines of the crude oil (from 2 to three barrels by each barrel of processed oil) containing sulphates, bicarbonates and chlorides; also, oily waters with petroleum residues, organic compounds and dissolved gases in the brines are generated.

- In 1982, according to estimates registereed in the "Environmental Profile of Peru", an equivalent to 113,369,200 barrels of brines were discharged into the rivers of the Northern Jungle.

- In 1983, according to research made by the Pacific University, a total of 6.6 million barrels of hard waters were discharged into the Pastaza and Tigris rivers in the department of Loreto.

11.3.3 Impacts and Consequences on the Agriculture

- In the department of Cajamarca, there is soil and cultivation pollution in the countryside of Bambamarca by effect of the surface runoff of the tailing grounds belonging to the Hualgayoc mines.

- In the department of La Libertad, valley of Santa Catalina, the waters of the Moche river transport a total volume of mining discharges equal to 2,168,368 mcm/year affecting around 500 ha of soils, which have been deteriorated by the accumulation of sodium and aluminum bases. Other 12,000 ha in this valley present the same pollution situation due to the releases of mining centers located in the high part of the basin.

- In the basin of the Moche river there are 3,000 ha of natural meadows in process of deterioration caused by the pollution of the tailing channels wastes that are hauled by rain waters.

- In the department of Ancash, the Santa river receives 1,293,917 mcm/year of tailings proceeding from mining centers situated on its basin; this affects the irrigation waters for cultivations in the surrounding valleys.

- In the department of Junín, there are approximately 21,800 ha of agricultural soils polluted by irrigation waters of the Mantaro river; these waters contain high concentrations of heavy metals: iron, manganese, zinc, lead carried by drainage waters from the mines; and by evacuation of wastes from the metallurgical processes, principally of the Foundry of La Oroya.

- In the high basin of the Mantaro river, there are concentrating plants situated in the zones of Pasco, Morococha, Yauli, Azulcocha and Tambo, which directly discharge in the lakes of Quiulacocha and Huascacocha, and in San Juan, Mantaro and Yauli rivers; this discharge originates metal concentrations in the natural waters that surpass the permissible limits provided by the Law of Waters (iron, lead and arsenic).

11.3.4 Impacts of the mining spillings

- The mining spillings alter the physical-chemical quality of the waters. This situation has as a result the extinction of ichthyological species: shrimp, trout. Likewise, such waters transport excessive material in suspension originating the crusting of the agricultural soils when these waters are used for irrigation; this, in turn, causes a reduction of the infiltration speed and of the oxygination of the arable layer.

- The use of water for population purposes implies a higher cost to make it potable: disiinfection, coagulation, sedimentation, filtration. The excess of solid particles in suspension in the waters used to generate hydroelectric energy deteriorates the generation equipment.

11.4 HYDRAULIC EXPLOITATION PROJECTS AND THEIR IMPACT ON THE ENVIRONMENT

Any development projec that involves the exploitation and use of natural resources of a particular zone causes, to a larger or lesser extent, alterations in the environment, whether of a positive or negative kind.

In this sense, the hydraulic exploitation projects, when using the water resource for irrigation and/or hydroelectric energy generation purposes, cause diverse effects on the environment. These effects need to be assessed through the Studies of Environmental Impact, in order to mitigate the negative impacts; this step has been omitted in the last projects under study and/or executed in the country.

11.4.1 Inventory of Hydraulic Projects

In 1989, the Ministry of Agriculture, through the Special Project "National Plan of Irrigation" (PLANIR), prepared an Inventory of Irrigation Projects nationwide, including both the projects under study and those under construction and/or operation.

According to such study, a total of 620 irrigation projects were inventoried (considering as such those with more than 50 ha); 348 of these projects were under study (311 with executed studies and 37 with studies under execution), and the remaining 272 were at a construction level (96 under construction and 176 fully operating).

These irrigation projects represented at that time a total of 573,215 ha under irrigation; 838,407 ha with projects under construction, and 1,343,967 ha under study (148,153 ha with studies under execution and 1,192,814 ha under construction and execution).

The irrigation projects carried out by the National Institute of Development (INADE), at present under the administration of the Ministry of the Presidency, mostly consider the hydroelectric exploitation; these are greatly significant because of their physical magnitude and economic importance.

In the study of PLANIR (1989), a total of 13 projects under the responsibility of INADE were inventoried; these projects comprised a total of 498,828 ha, whether under construction and/or study.

11.4.2 Environmental Impact of Hydraulic Projects

The big development projects using the water resource in the country have been planned and/or executed, for the most part, without considering the negative effects they could have on the environment, both physical-natural and socioeconomic.

These projects characterized by the development of principal hydraulic infrastructure works (large dams, irrigation channels of considerable length, agricultural development in zones of appreciable extent, installation of hydroelectric plants, etc.) have had diverse impacts, such as the occupation of zones with important archeological ruins, the moving of entire populations and communities, the deterioration of landscape and of the physical conditions of the surroundings (soils, waters, forestry, etc), changes in the biological cycle and the habitat of the existing fauna species.

At the present time, by virtue of the existing norms and principally due to the demand of the international organizations financing projects in the country, it has been set up as a norm the need to carry out assessment studies of the environmental impact for each hydraulic exploitation project which, because of its magnitude, implies a possible alteration of the environment where it is located.

11.4.3 Viable Environmental Alternatives

The negative environmental effects arisen during the execution and operation of the hydraulic projects of certain magnitude justify the need to consider the analysis of environmentally viable alternatives that permit to obtain the envisaged benefits avoiding the deterioration of the environmental conditions in the zone.

Some of the alternatives considered as viable in the projects of water resource exploitation are the followiing:

- **Irrigation improvement:** The optimization of the water use means to avoid its waste, when there is an excess, and to regulate its use, when there is a shortage, by means of irrigation techniques. This optimization will permit to increase the productive yields of the agricultural zones, at present irrigated, without having to execute civil works of great importance and high cost which have considerable impacts on the environment.

- **Re-use of sewage:** The wastes have an appreciable volume, especially in the region of the Coast of the country where most populated localities are located. The elimination of these wastes constitutes an environmental problem difficult to solve. However, the adequate sewage treatment, through estabilization lakes, permit to solve the environmental pollution problems as it makes possible to reuse these waters for irrigation of selected crops and the fish cultivation by means of adequate existing technology.

  According to information published by the Pan American Center of Health Engineering and Environment Sciences (CEPIS), in August of 1994, Peru had 4,300 ha irrigated with sewage; only 14% of which is iirrigated with waters previously treated in order to reduce the concentration of coliform bacteria and pathogenic elements. It is possible, therefore, to develop a greater number of projects of this kind having into consideration the avaailable resource.

11.5 ENVIRONMENTAL MANAGEMENT RELATED TO THE WATER RESOURCE

Nowadays, the management of the natural resources and environment, in general, as well as of the water resources, in particular, shows a series of characteristics that make it necessary to constantly try to perfect it, both at the public sector level and the private sector level.

In September of 1990, the Legislative Decree No 613 related to the "Code of the Environment and Natural Resources" was promulgated for the purpose of regulating, in an integral and coherent way, the environmental management in the country.

In November of 1991, the Legislative decree No 757, referring to the "Law for the Promotion of Private Investment" was promulgated. By virtue of this decree several articles of the Code were

derogated in order to facilitate the national and foreign private investment in the country. Likewise, the grouping by sectors of the environmental management is established by determining that the the Ministries are in charge of exerting the "competent environmental authority" for the activities of their sector, regarding the matters related to the application of the provisions of the above mentioned Code.

Accordingly, each productive sector must fix the tolerable pollution levels, and also define the activities that, because of their nature, can cause damages to the environment and, therefore, need a study of the Environmental Impact before authorization to function is given.

The water resource, when used in the various productive activities (miniing, industry, agrindustry, transportation, housing and building, hydrocarbons, large irrigations, etc.) touch different intersectorial competences that must be cordinated and made duly compatible, in order to regulate and promote the adequate management and exploitation of such resource in the country. Today, a new bill for a General law of Waters is under discussion; this will replace the law in force dating from 1969. Such bill in intended to achieve an adequate management of the water resource compatible with the uses and needs of all the sectors, under the concept of sustainable use.

It is important to mention the role of the local Governments (Municipalities) that have specific functions regarding the use and conservation of the soil and water resources in their respective teritorial jurisdiction, according to the "Regulations of Territorial Conditioning, Urban Depelopment and Environment". In this sense, such institutions need to be reeinforced regarding the environment conservation, in general, and of the water resource conservation, in particular.

CHAPTER XII

POPULATION MOBILIZATION AND AWARENESS DEVELOPMENT WITH REGARD TO WATER

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CHAPTER XII

POPULATION MOBILIZATION AND AWARENESS DEVELOPMENT WITH REGARD TO WATER

12.1 ENVIRONMENTAL EDUCATION RELATED TO THE WATER RESOURCE

The education sector is gradually assuming the environmental education subject in the country, by introducing the environmental subject in the curricula and, by programming activities leading to the awakening of the sensitiveness and awareness in the community in general.

In 1988 an Agreement between the Ministry of Education, the former National Office of Natural Resources Assessment (ONERN) and the Peruvian Association for the Conservation of Nature (APECO) was subscribed for the purpose of developing the Environmental Education in Educational Centers and selected communities of the country.

This agreement permitted to make progress in the curricular reform of the education in Peru; thus, matters and subjects related to the need to preserve and use rationally the environment and the natural resources, in order to protect health and improve the population standard of living, were introduced. This agreement concluded in 1991 but was renewed in 1993 with the participation of the National Institute of Natural Resources-INRENA which has assumed, among other, the functions of the former ONERN.

In this sense, it is necessary to emphasize the environmental management in the education sector through the proposal of programs for each region in particular.

As regards the water resource matter at the superior educational level in the country, the Peruvian universities offer a series of professional careers related to the water resource study and the environment conservation including the water resource evaluation. Among the related careers the following can be mentioned: Agricultural Engineering, Civil Engineering , Sanitary Engineering, Fluid Mechanics Engineering, Environnmental Engineering, Geographical Engineering, etc., which are offered by the public and private universities totalizing 52 throughout the country.

It would be convenient that the Government finance the University institutions for the training of professors abroad in matters related to the environment management and conservation. These professors will commit themselves, at their return, to work in teaching and research. On the other hand, specific items should be available to finance researh and assistance programs in the public sector having the direct participation of the techers trained abroad.

12.2 COMMUNITY PARTICIPATION IN DRINKING WATER, SANITATION AND IRRIGATION PROJECTS

The community's organized participation in the development and execution of water exploitation projects shows different levels in the country, according to the economic and sociocultural conditions of each region.

The agricultural activity, that is the principal user of the water resource in Peru according to the registered consumption volume, has the greatest organized participation thanks to the establishment of the Boards of Users in each Irrigation District of the country whose jurisdictional limit is given by the hydrographical basin delimitation.

Through thee Boards of Users, the community takes part in the administration, operation,improvement and maintenance of the irrigation infrastructure, as well as in the collection of the water tariff and the administration of these funds within the extent of their jurisdiction.

In the Andean region, the community directly participates in the management of the natural resources, including the water resource for agricultural and population use, as an inherent part in their sociocultural formation and perception of the natural environment where they live.

The Peruvian State, executor of the principal hydraulic exploitation works in the country, is currently encouraging a greater participation of the community in development projects; to this end, it is necessary to increase the population's sensitization regarding the management and rational use of the water resources of their region, in particular, and of the country, in general.

12.3 NON GOVERNMENTAL ORGANIZATIONS (NGO's) RELATED TO THE MANAGEMENT WATER RESOURCES

There are a great number of Non Governmental Organizations(NGOs) in the country that are performing activities related to the management and conservation of the natural resources and environment, including aspects of water resource management.

Some of these organizations are: "The Peruvian Foundation for the Conservation of Nature" (FPCN), and the "Peruvian Association for the Conservation of Nature" (APECO) which perform tasks related to natural resource and environment management, with the assistance of foreign financial resources; organizations such as the American Cooperation of Remittances Everywhere (CARE-PERU) and CARITAS-PERU that execute social assistance projects satisfying the community's needs, often under the foods for work modality, at the different sectors level.

There also professional organizations dedicated to the promotion of specific activities related to the water resource; this is the case of the "Peruvian Association of Health and Environmental Engineering" (APIS), the "Institute for the promotion of Water Management" (IPROGA), the "College of Engineers of Peru", etc.

The activities that are being carried out by the diverse Non Governmental Organizations have special importance for the water resource development and management but present advantages and disadvantages. One advantage is the great flexibility in the disposal of the funds; this way, the projects are executed more rapidly, also because of the reduced burocracy. Also, some of these organizations work closely related to the users-direct beneficiaries satisfying their demand accordingly.

One disadvantage is that they do not take into consideration the national objectives and do not always meet the users' real needs. On the other hand, there is no control of the technical activities and economic expenses that these organizations are making.

The ideal is to achieve the integration of the diverse programs and projects under execution in the context of the national development.

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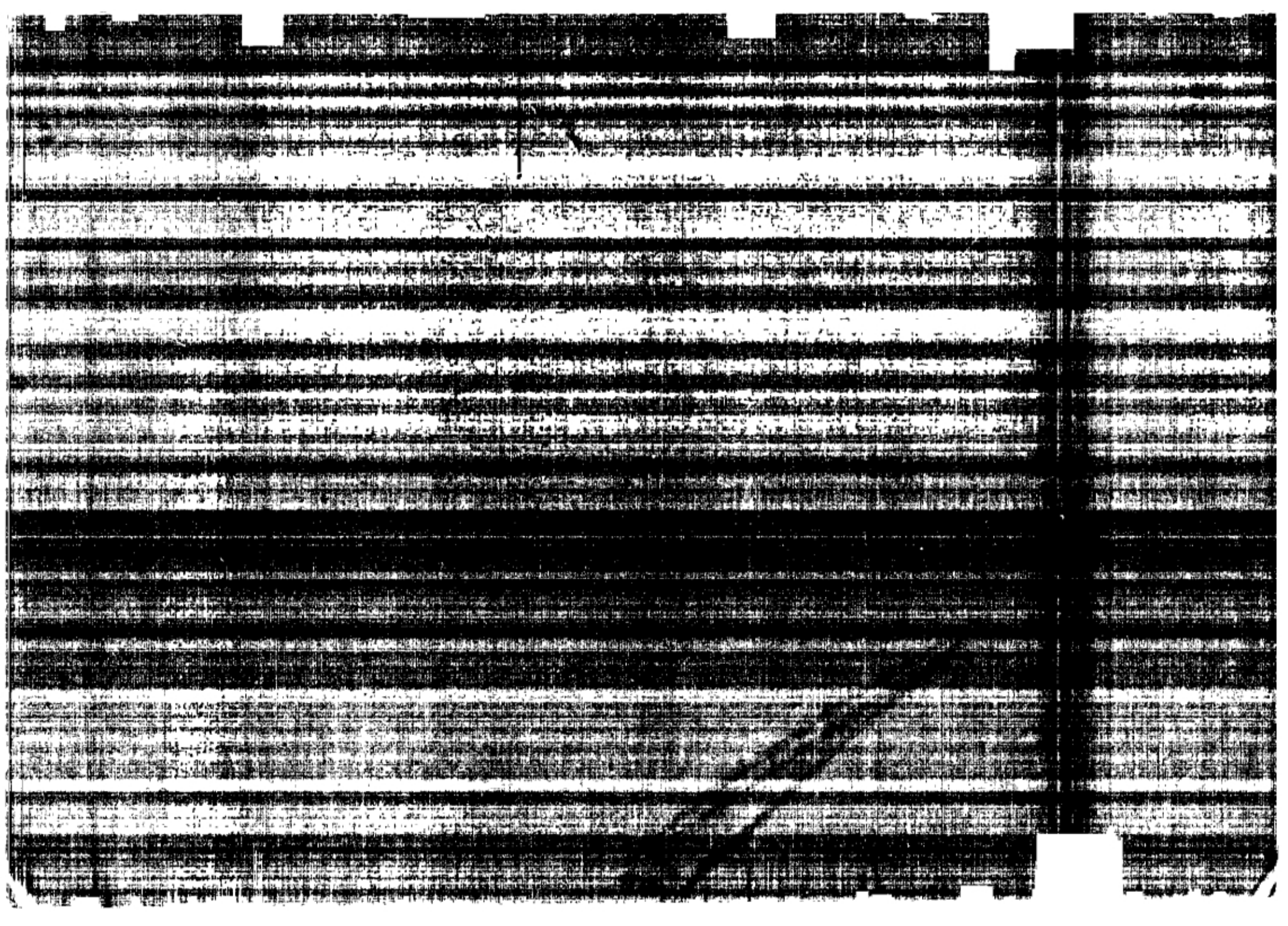

ACRONYM LIST

AACH	:	Autonomous Authority of Hydrographical Basin.
APECO	:	Peruvian Association for Nature Conservation.
APEMIPE	:	Small and Medium Enterpriser Association.
APIS	:	Peruvian Association of Environmental and Sanitary Engineering.
BCR	:	Central Reserve Bank of Perú.
IADB	:	Inter American Development Bank .
CARE PERU	:	Cooperative for American Remittances Everywhere.
CEDEX	:	Center of Studies and Experimentation of Public Works - Spain, Madrid.
CEPIS	:	Pan-American Center of Sanitary Engineering and Environment Sciences.
CONACO	:	National Confederation of Traders.
CONFIEP	:	National Confederation of Private Business Institutions.
CORTAPA	:	Regulating Commission of Drinking Water and Sewerage Tariffs.
CHAVIMOCHIC	:	Irrigation Project of the Chao, Virú, Moche and Chicama Rivers.
DBO	:	Biochemical Demand of Oxygen.
DGAA	:	General Directorate of Environmental Affairs.
DGAS	:	General Directorate of Waters and Soils.
DGM	:	General Directorate of Mining.
DIGESA	:	General Directorate of Environmental Health.
EIA	:	Study of Environmental Impact.
ELECTROLIMA	:	Electrical Enterprise of Lima.
ELECTROPERU	:	Public Enterprise of Electricity of Perú.
EPS	:	Rendering of Services Enterprises of the Sanitation Sector.
FPCN	:	Peruvian Foundation for Nature Conservation.
IMARPE	:	Sea Institute of Perú.
INADE	:	National Institute of Development.
INEI	:	National Institute of Statistics and Computing.
INRENA	:	National Institute of Natural Resources.
MA	:	Ministry of Agriculture.
MEM	:	Ministry of Energy and Mines.
MITINCI	:	Ministry of Industry, Tourism, Integration and International Commercial Negotiations.
MTPS	:	Ministry of Labor and Social Promotion.
ONERN	:	National Office of Natural Resource Assessment.
OPS	:	Pan-American Health Organization.
NGO	:	Non-Governmental Organization.
PAMA	:	Adjustment Environment Program.
GDP	:	Gross Domestic Product
PLANIR	:	National Plan of Irrigations.
PRODEIS	:	Promotion Office of Electrical Development of Social Concern.
PRONADRET	:	National Program of Drainage and Soil Recovery.
PRONAMACHS	:	National Project of Hydrographical Basin Management and Soil Conservation.
PYMES	:	Program of Small and Micro Enterprises.
SEDAPAL	:	Drinking Water and Sewerage Service of Lima.
SENAMHI	:	National Service of Meteorology and Hydrology.
SENAPA	:	National Service of Drinking Water and Sewerage.
SENATI	:	National Service of Training in Industrial Work.
SSS	:	National Superintendency of Sanitation Services.

SUNAD	:	National Superintendency of Customs.
ha	:	Hectare
kg	:	Kilogram
Km	:	Kilometer
Km^2	:	Square kilometer
m^3	:	Cubic Meter
mcm	:	Million of Cubic Meters
GWh	:	Giga Watt-hour
KWh	:	Kilo Watt-hour
MWh	:	Mega Watt-hour
tm	:	Metric Ton
gmt	:	Gross Metric Ton
tmf	:	Fine Metric Ton
tml	:	Long Ton
%	:	Percentage

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