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DRAFT ENVIRONMENTAL REPORT
ON
PERU

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DRAFT ENVIRONMENTAL PROFILE ON PERU October 1979

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0.0 INTRODUCTION AND SUMMARY

Located on the Pacific Coast of northwestern South America and occupying some 1,284,640 square kilometers Peru is just slightly larger than the territories Oregon, California, Nevada and Arizona combined.

Peru is divided into three distinct geographic regions: the arid, desertic coastal region (Costa), the cool mountains and plateaus of the Andes (Sierra) and the generally warm, wet hills and lowlands of the Amazon basin (the Selva).

population

The population of Peru has been increasing at the rapid rate of from 2.8% to 3.0% in recent years. Although population density in the country as a whole is not high, population density in the Sierra and Costa, which together represent only about 40% of the total land, is much higher, while population in relation to arable land is about 340 persons per square kilometer. About 44% of the population is under 15. An estimated 50% of the total population--predominantly in the rural areas of the Sierra--live in extreme poverty without adequate supplies of either food or water, and large numbers of these are afflicted by malnutrition and other serious health conditions. Literacy rates, as high as 84% in urban areas, are only 48% in rural areas, where schools are few and teachers are in short supply. Rapid growth of urban centers such as Lima, which are unable to supply adequate living conditions or employment to migrants from rural areas, has led to the creation of a massive urban poverty problem. Unfavorable economic conditions in recent years has futher exacerbated the problems of poverty, disease, and illiteracy by causing cutbacks in programs designed to relieve these conditions.

water resources

The bulk of Peruvian water resources is in the vast Selva region of the country, which is veined with rivers that form part of the great Amazon basin. Water resources in the Sierra and particularly the Costa regions are considerably much less plentiful. About 95% of water currently used goes toward irrigation, mostly in the Costa region. Hydroelectric installations, moreover, supply about 70% of the electricity produced in Peru. The basic problem with water resources arises from a disparity between the location of population and economic activity and that of the resource. An increasingly larger percentage of the Peruvian population is located in the arid coastal zone, where rainfall is meager and irrigation is necessary for almost all agricultural activity. Supplying the expanding water needs of this area involves expensive operations for diverting water from the rivers originating in the Sierra and flowing toward the Amazon both to agricultural areas and to urban centers such as Lima and Callao.

Pollution of water resources from the dumping into rivers of unprocessed municipal wastes and mine tailings is one of the major environmental problems of Peru. Wastage of both municipal water and irrigation water because of faulty or inadequate supply systems is another problem.

soils

A large percentage of the soils of Peru are considered suitable only for grazing or forestry. This is reflected in land use figures, which indicate

that only about three percent of the land is presently cultivated. Rich agricultural soils occur chiefly in the alluvial valleys of the otherwise desert Costa region, where the most productive agriculture activity is now situated. The soils of the Sierra have been overworked and have lost much of their limited fertility. The soils of the vast and predominantly undeveloped Selva region, while not yet subjected to extensive surveys, are considered low in fertility once the forest vegetation which they naturally support is removed. Problems with soils include erosion in all regions but especially on the overworked slopes of the Costa and Sierra regions, salinity in the heavily irrigated Costa, and drainage problems in the wet lowlands of the Selva. Deforestation, followed by overgrazing and removal of the protective vegetation cover, have left the slopes of the Costa and the inter-Andean valleys of the Sierra particularly susceptible to water erosion. Desertification, following soil erosion and degradation is a significant problem. Soil erosion in the wake of the clearing of forests for cultivation and grazing is also becoming a problem in the Selva. Soil erosion, apart from decreasing the productive value of land, has also brought about the massive sedimentation of the dams, spillways, and distribution channels of irrigation systems.

forests

An estimated 60% of Peru is still forested. Most of this forest cover is in the region of the Selva. Both the Costa and the Sierra have been heavily deforested as a result of land clearing, timbering operations, and the collection of wood for firewood and charcoal production. Commercial exploitation of the vast forest resources of the Selva has begun only recently and has been concentrated chiefly on the removal of a relatively small number of valuable wood species. Although massive resources still remain, valuable woods such as mahogany, tornillo, and Spanish cedar have been virtually eliminated as a resource in some areas of intense logging activities. Loss of forest cover in the Selva has also come about as a result of slash and burn agriculture and, more recently, because of forest clearing for agricultural colonization projects.

wildlife

The diverse ecological systems of Peru have in the past supported a rich and varied wildlife, but wildlife numbers throughout the country have declined as a result of hunting often in conjunction with the loss of habitat as lands are converted for grazing, cultivation or other economic activities. Many Peruvian species such as the chinchilla and vicuna of the Sierra are endangered because they have been heavily hunted for their skins. In the Selva, where wild animals have traditionally served as the major source of protein for Indian communities, the introduction of modern firearms and new settlers have contributed to the rapid drop in animal numbers.

coasts and beaches

Peru's coastline, characterized by abundant fish life and by the birds of the famous guano islands, also offers offshore petroleum resources. Exploitation of the guano islands was heavy during the 19th century, at which times centuries of deposits were removed for use as fertilizer in

European countries. Peru's coastal waters are today increasingly subject to pollution from municipal, industrial, and mining wastes.

fisheries

Peru has abundant supplies of fish both in its coastal waters and in its freshwater lakes and rivers. Peruvian fisheries were not highly developed until the 1950's and 1960's, the period of the fishing boom off the Peruvian coast. Based almost entirely on the huge numbers of anchovies in Peruvian coastal waters, the boom catapulted Peru into the position of the world's largest fishing nation by the later 1960's, with a total catch exceeding 12.5 million tons in 1970. This boom ended abruptly in 1972, after the appearance of warm currents which drove away the cold water anchovies. It is believed that the heavy fishing of the 1970's has prevented the rapid recovery of the anchovy fishery by cutting down the numbers of anchovies available for spawning.

The fish of Peru's inland waters have been a traditional source of food for Indian groups of the remote Amazon region. The introduction of new settlers into this area has put a strain on its this resource, causing a decline in the population of valuable fish such as the paiche. The numbers of fish in Lake Titicaca are also reported to have declined as a result of overfishing and certain fishing practices. The Peruvian government has only recently begun developing programs for improvement, development, and conservation of its fish resources.

Fish and other aquatic life have been adversely affected by water polluted by mine tailings as well as by industrial and municipal wastes.

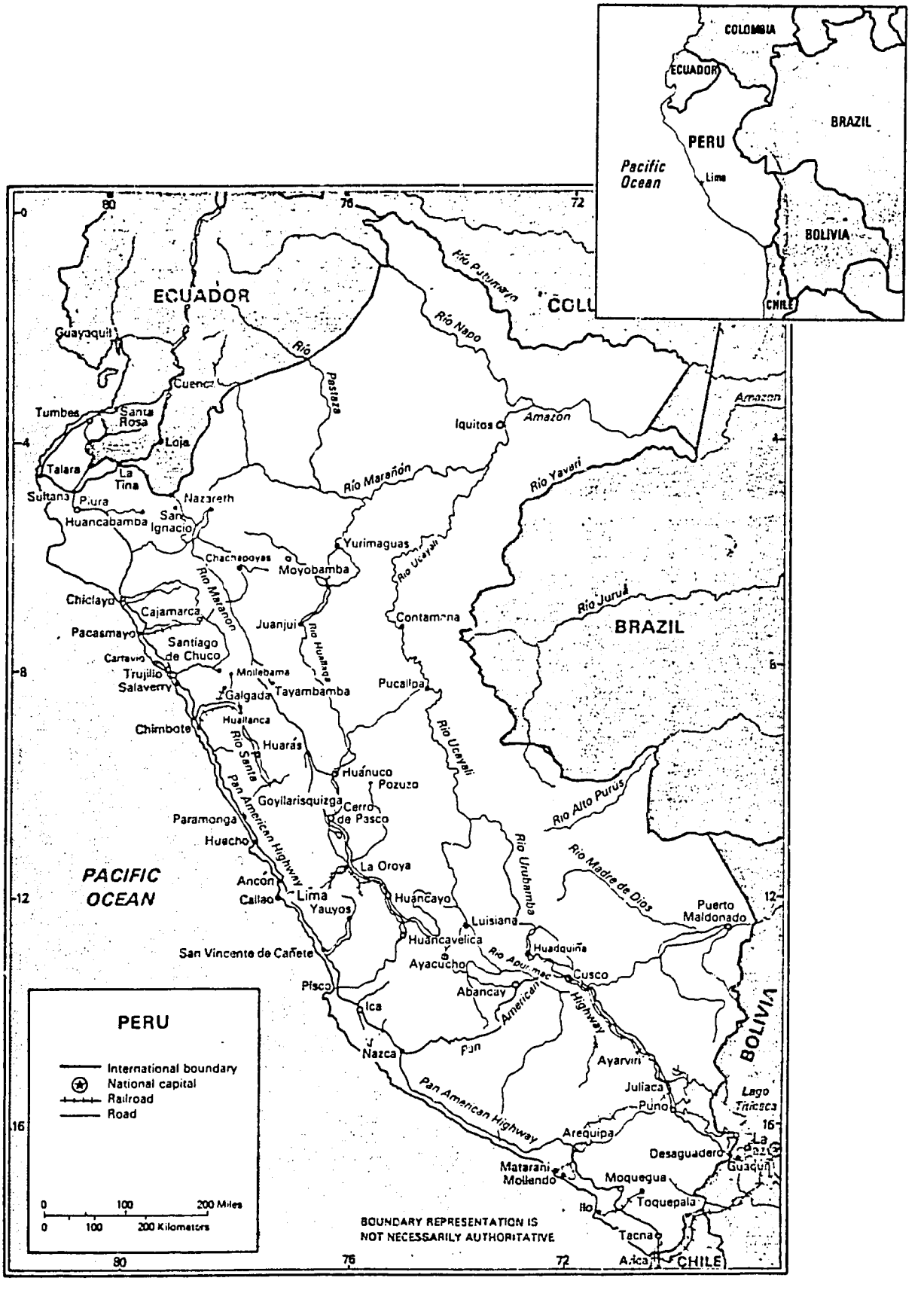
minerals

Peru's major mineral resources are copper, iron, silver, lead, and zinc. All of these minerals are developed. Oil has been exploited both on the northern coastal areas since the early part of this century and, in more recent years, in the Amazon region of the country. Both air and water pollution from mining operations are major environmental problems in Peru. Pollution of the waters of the rivers flowing to the Amazon basin from petroluem extraction operations in that area of the country may also become a problem.

government measures

Peru is committed to the rational development of its natural resources and has also made a major effort to ensure that the wealth of the country is equitably distributed and that the lot of the poor is improved. Various offices of the Ministry of Agriculture and Nutrition bear responsibility for water, forests, soils, and forest resources, while ONERN (the National Office for Evaluation of Natural Resources) is charged with studying the resource base and setting policy for resources development. The control of pollution problems is the responsibility of an agency of the Ministry of Health. The implementation of government programs in these as in other areas has been severely hampered by the economic woes that have beset Peru in the present decade.

Numerous laws and regulation cover natural resources and their development. Major laws cover water resources, forests and wildlife, fisheries, and the development of minerals. Enforcement of these measures often appears less than adequate.


COLOMBIA
ECUADOR
BRAZIL
PERU
Pacific Ocean
Lima
BOLIVIA
CHILE
ECUADOR
COLL
Río Putumayo
Río Napo
Río Pastaza
Amazon
Iquitos
Río Marañón
Río Yavari
Río Ucayali
Río Juruá
BRAZIL
Río Alto Purús
Río Madre de Dios
Río Urubamba
Río Apurímac
Río Huallaga
Río Mayo
Río Santa
Pan American Highway
Guayaquil
Cuenca
Tumbes
Santa Rosa
Loja
Talara
La Tina
Sullana
Piura
Huancabamba
San Ignacio
Nazareth
Yurimaguas
Chachapoyas
Moyobamba
Chiclayo
Cajamarca
Juanjui
Contamana
Pacasmayo
Santiago de Chuco
Cartavio
Trujillo
Salaverry
Mollebamba
Tayambamba
Pucallpa
Galgada
Huallanca
Chimbote
Huarás
Huánuco
Pozuzo
Goyllarisquizga
Cerro de Pasco
Paramonga
Huacho
La Oroya
PACIFIC OCEAN
Ancón
Callao
Lima
Yauyos
Huancayo
Luisiana
Puerto Maldonado
Huancavelica
Huadquiña
San Vincente de Cañete
Ayacucho
Cusco
Pisco
Abancay
Ica
Nazca
Ayaviri
Juliaca
Puno
Lago Titicaca
Arequipa
La Paz
Desaguadero
Guaqui
Matarani
Mollendo
Moquegua
Toquepala
Ilo
Tacna
Arica
CHILE
BOLIVIA
PERU
International boundary
National capital
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Road
0 100 200 Miles
0 100 200 Kilometers
BOUNDARY REPRESENTATION IS NOT NECESSARILY AUTHORITATIVE
80
76
72
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4
8
12
16

1.0 POPULATION CHARACTERISTICS

Located on the Pacific Coast of northwestern South America and occupying a territory of 1,284,640 square kilometers, Peru is just slightly larger than the territories of Oregon, California, Nevada, and Arizona combined. The population of this country, nearly half of which is of Indian stock, was 13,567,939 at the time of the last census (1972); this population was estimated to have grown to 17.3 million as of 1979 (see below).

Rapid population growth is a major problem in Peru, which is presently unable to provide basic needs for large numbers of its population, about half of which are living in poverty, with inadequate housing and with insufficient supplies of both food and water.

1.1 GENERAL POPULATION STATISTICS (From World Population Data Sheet 1979)

Total population: 17.3 million

Rate of natural increase: 2.8

Amount of time to double population: 25 years

Population in the year 2000: 29.5

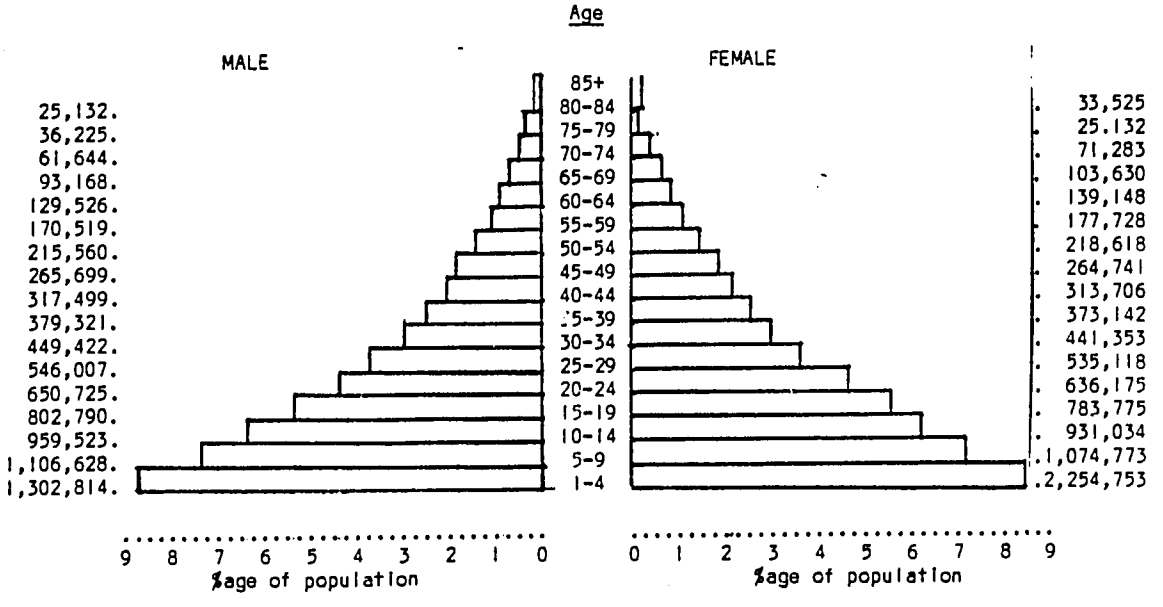
Population under 15: 44%

Population over 64: 3%

Urban population: 62%

PQLI: 65

AGE/SEX PROFILE (1973)
(Based on total population of 14,920,000 as reported in the U.N. Demographic Yearbook 1976)



1.2 Population density, distribution and growth

Present overall population density is about 13 persons per square kilometer. As indicated by the map on page 2a, in 1972 the population density of the great eastern region of the country (here generally referred to as the Selva but also frequently called the Oriente or the Montana), was generally lower than 2 persons per square kilometer, while population in the Lima district was as high as 106 persons per square kilometer.

Population distribution by geographical region (Costa, Sierra, Selva) is indicated by the graph on page 2a.

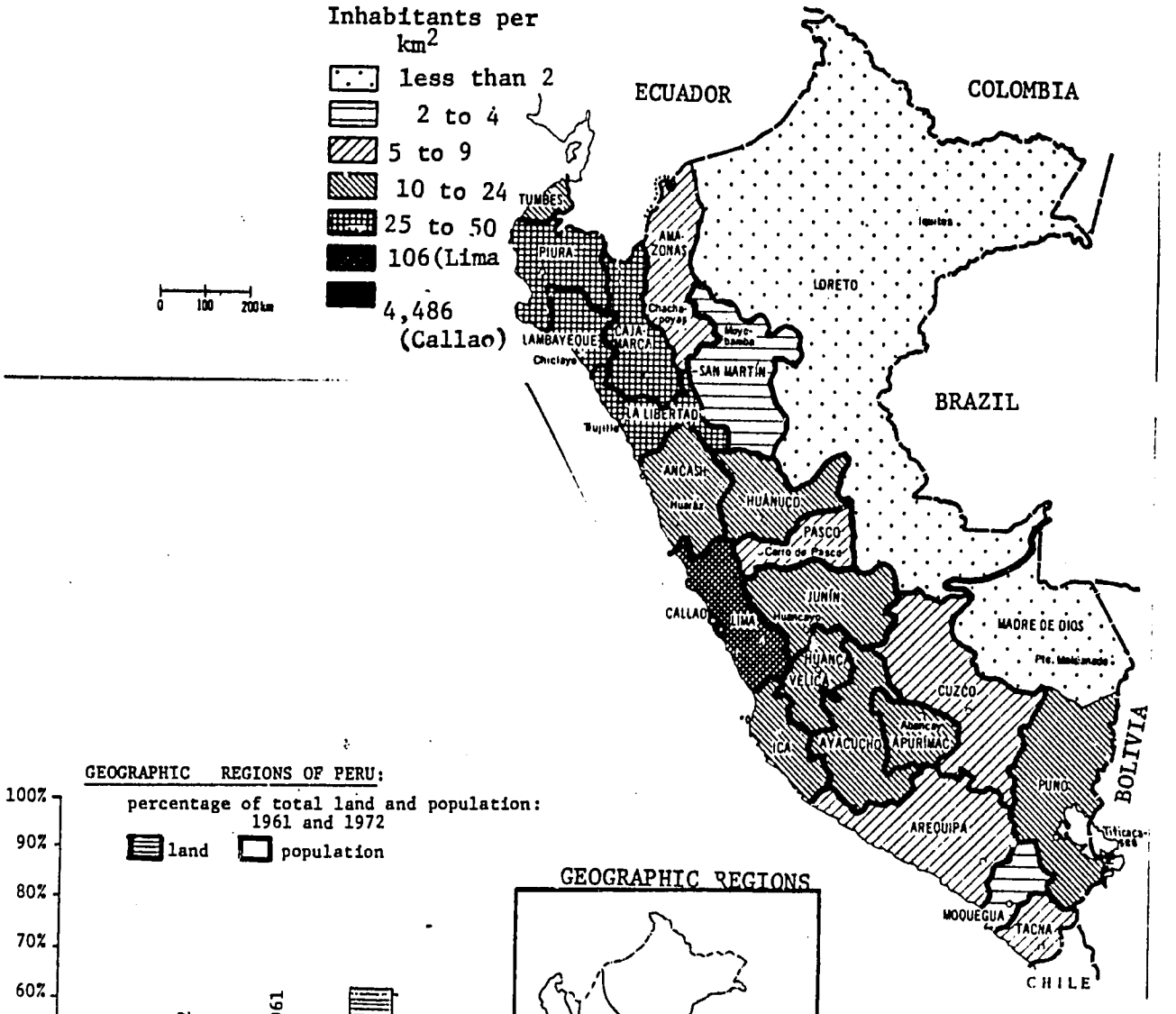
Shifts of population from the still highly populated Sierra region into the Costa has put a heavy burden on the limited resources of that region, especially on water supply.

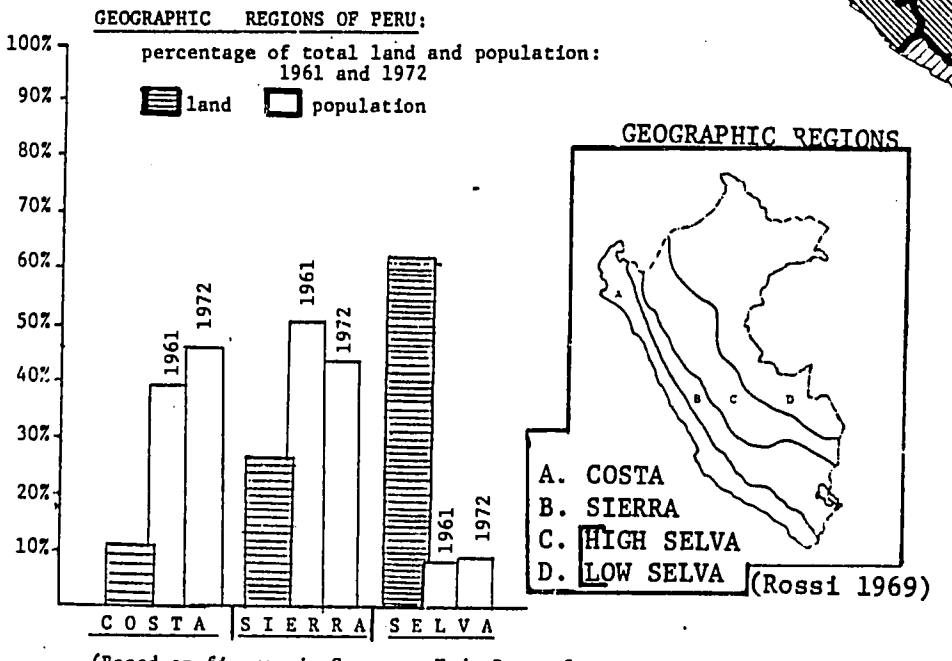
The table below indicates population growth by administrative district between 1961 and 1972; districts are shown on the map on page 2a. Also indicated are the percentage of land occupied by particular administrative districts and the percentage of total population living within the district.

Population Growth by Administrative District (1961-1972)
total population 14,122,000(adjusted 1972 census figure)
total area: 1,284,640 square kilometers

	area sq.km.	%of land	% in geo. region: costa	sierra	selva	population (in thousands) 1961	1972	pop.density density 1961	1972	% o population 1961	1972	%growth 61-72
NORTE												
Amazonas	41,297	3.2	39.0	35.0	26.0	129	213	3.1	5.2	1.2	1.5	65.1
Ancash	36,308	2.8	2.8	30.4	69.6	606	755	17	21	5.8	5.3	24.7
Cajamarca	35,418	2.8	10.0	70.0	20.0	787	957	22	27	7.5	6.8	21.6
La Libertad	32,241	2.5	38.0	62.0	--	609	808	26	35	5.8	5.7	32.7
Lambayeque	16,586	1.3	93.6	6.4	--	354	533	21	32	3.4	3.8	50.8
Piura	33,067	2.6	82.2	17.8	--	692	888	21	27	6.6	6.3	28.2
Tumbes	4,732	.037	100	--	--	57	79	12	17	0.55	0.56	38.3
CENTRO												
Ayacucho	45,303	3.5	--	96.0	4.0	430	479	9.4	11	4.1	3.4	11.4
Callao	74	.005	--	100	--	219	334	2,959	4,486	2.1	2.4	
Huancavelica	22,871	1.8	--	100	--	316	347	14	15	3.0	2.5	9.9
Huanuco	35,515	2.8	--	39.1	60.9	355	432	10	12	3.4	3.1	21.6
Ica	21,251	1.7	--	81.2	18.8	261	373	12	18	2.5	2.6	43.0
Junin	32,354	2.5	--	38.3	61.2	549	720	17	22	5.3	5.1	31.8
Lima	33,895	2.6	35.4	64.6	--	2,093	3,595	62	106	20.1	25.4	
Pasco	21,854	1.7	--	27.8	72.2	151	185	6.9	8.5	1.4	1.3	22.8
SUR												
Apurimac	29,655	2.3	--	100	--	304	321	15	16	2.9	2.3	5.8
Arequipa	63,528	4.9	5.0	37.0	63.0	407	561	6.4	8.8	6.1	4.0	38.2
Cuzco	84,184	6.6	--	56.1	43.9	648	751	7.7	8.9	6.2	5.3	15.9
Madre de Dios	78,403	6.1	--	--	100	35	25	0.3	0.3	0.34	0.18	0.5
Moquegua	16,175	1.3	31.0	69.0	--	53	78	3.3	4.8	0.51	0.55	46.5
Puno	72,382	5.6	--	82.4	17.6	727	813	10	11	7.0	5.8	11.8
Tacna	14,767	1.1	49.4	50.6	--	68	100	4.6	6.8	0.65	0.71	46.8
ORIENTE												
Loreto	478,336	37.2	--	--	100	411	541	0.9	1.1	3.9	3.8	31.4
San Martin	53,064	4.1	--	11.7	88.3	170	234	3.2	4.4	1.6	1.7	37.2

POPULATION DENSITY BY ADMINISTRATIVE DEPARTMENT: 1972





(Based on figures in Germany, Fed. Rep. of 1978 and "Population and Development" 1977.)

1.3 Rural-urban population distribution

Population by rural-urban (in thousands)*
(an urban area is defined as one with more than 100 occupied dwellings)

	1961	1972	1976	1977	1978
Urban	4,874 47.2%	8,058 59.5%	9,258 56.6%	9,652 57.2%	10,057 57.7%
Rural	5,446 52.8%	5,480 40.5%	7,113 43.4%	7,237 42.8%	7,365 42.3%

Population in selected cities*

	1961	1972	1976
Lima	1,755,000	3,303,000	3,500,000
Callao	156,000	297,000	500,000
Arequipa	135,000	202,000	450,000
Trujillo	100,000	240,000	360,000
Chimbote	60,000	159,000	240,000
Piura	43,000	126,000	180,000
Chiclayo	96,000	188,000	175,000
Huancayo	64,000	127,000	170,000
Cuzco	80,000	121,000	170,000
Iquitos	58,000	110,000	70,000

Growth of urban locations has been one of the most prominent demographic phenomena of Peru in the 20th century. In 1940, Peru had some 51 towns with populations of 5,000 or more, accounting for 22.4% of the total population; by 1972, however, there were some 123 towns of this size, accounting for 47% of the total population (Cole and Mather 1978:96). If the definition of urban employed for Peru in the United Nations Demographic Yearbook is employed (those persons living in communities with more than 100 occupied dwellings), urban population in 1972 was as high as 59.5% of the total population. An estimated 39% of the total urban population is located in Lima (World Bank 1979:Table 20).

Growth in urban population has been accompanied by a decline in the rural population, recently estimated at only 38% of the total ("Population and Development"1977:17), in contrast to 65% in 1940. Recent estimates (WPDS/World Bank 1979)indicate an urban population for Peru of as high as 62-63%.

The growth of urban population, especially in those urban centers with more than 20,000 inhabitants has been attributed predominantly to their attractions as the main political, administrative cultural, business and service centers, where the highest paying jobs are to be found. Unfortunately, however, although rural people migrate toward the towns in the hope of improving their lot, urban centers are frequently unable to supply

*Figures from Germany, Fed Rep of. Federal Statistical Office 1978:14-15.

either the expected employment or the housing necessary for these newcomers. Many of these people, therefore, remain unemployed or underemployed and are forced to lived in insanitary shantytowns surrounding the cities. An estimated 2.5 million urban inhabitants live in conditions of absolute poverty (A.I.D./Lima 1979:13).

The Peruvian government, in an attempt to improve the lot of urban newcomers, has organized the poverty-stricken squatter settlements around the cities into new towns (pueblos jovenes); within these towns the government has granted residents the legal title to their land, assisted them in building and strengthening their political and organizational structure, and promoted housing cooperatives and sites and services projects (A.I.D./Lima 1979:15).

1.4 Ethnic, religious, linguistic composition of the population

Indian groups, estimated to account for about 50% of the total population of Peru, include the Quechua and, in the vicinity of Lake Titicaca, the Aymara. In the eastern lowlands dwell the still nomadic forest Indians, the Pano and the Tupi, who have little contact with the remainder of the population. The numbers of these Indians is estimated to have declined from 100,830 persons in 1961 to 39,800 in 1972 (U.N. Demographic Yearbook).

About a third of the population is comprised of mestizos, persons of mixed Indian and European blood. "Europeans," persons principally of Spanish descent, make up from 10-12% of the population, while blacks and orientals (Chinese and Japanese) together account for less than five percent.

There has tended to be a direct relationship in Peru between ethnic group, language, region of residence, and economic and social position. The Spanish monolingual population, which has also been the social, economic, and educational elite of Peru, is concentrated in the Costa region and in the urban areas, while the Quechua and Aymara monolingual speaking population, concentrated in the Sierra, belongs overwhelmingly to the poor and uneducated lower levels of Peruvian society.

The lot of the Indians of the Sierra is described by R.F. Watters in a 1971 monograph. He presents a community of predominantly Quechuan Indians, eking out a living on small plots in the southern Sierra. Only about 30% of the community had any knowledge of Spanish; about 65% were illiterate; and only about 0.5% of the population had received more than three years education (Watters 1971:216).

The state language was, until 1975, Spanish; however, a law of May 27, 1975 also raised Quechua, which is spoken by some 3.5 persons in the Sierra, to the status of a official language. Also of some prominence, although not yet blessed with official status, is Aymara, which is spoken in the area of Lake Titicaca. There are numerous other Indian languages which are of only local importance. Many of the speakers of Indian languages (an estimated three million) speak no Spanish, and for these people, large numbers of whom live in poverty, the Spanish language remains a barrier to education and advancement.

The greater part of the population is Roman Catholic, although nature religions, heavily mixed with Christian practices, are widespread among the Indians of the sierra.

1.5 Educational characteristics of the population (World Bank 1979 and A.I.D. Lima 1979:7)

		1960		1976
Adult literacy rate:		61%		72%
			urban:	84%
			rural:	48.1
			women :	33%
			men :	58%
Percentage of population with more than 4 years of schooling	:	--		55%
			urban:	61%
			rural:	22%
Numbers in primary school as %age of age group:	Total:	83%		110%
	Male:	95%		115%
	Female:	71%		107%
Numbers in secondary school as %age of age group :	Total:	15%		49%
Numbers in higher education as %age of population 20-24:	Total:	4%		14%

NOTE: Primary school age is generally considered to be ages 6 to 11; where, as in Peru, there is universal primary education and some pupils may be either older or younger than the standard 6 to 11 years used as a base for this calculation, percentages may exceed 100%.

Education is compulsory and free for children between the ages of 7 and 16. In addition to the public schools are those operated by churches as well as by industrial and mining firms and agricultural cooperatives. Because of a shortage of teachers, schools in rural areas are less well attended than those in the towns. Furthermore, the education provided for the rural population is almost exclusively primary; secondary

and technical schools are available in only a few district capitals in the rural regions. In addition to a paucity of schools in the mountainous areas in which they live, language is an significant barrier for the Quechua and Aymara-speaking children of the Sierra, many of whom do not continue their education beyond the first year or complete primary school (A.I.D./Lima 1979:8). The effects of the disparities between urban and rural educational opportunities on literacy rates are reflected in the above table.

In an effort to reduce the rate of illiteracy and to increase the rate of school attendance, the government in 1972 passed an education law which provided for extensive educational reforms, including: preschool programs; adult education; and obligatory two to three year apprenticeship training for pupils beginning in the fifteenth year.

Secondary education is divided into humanistic and technical branches. About a fifth of the students on this level are participating in programs providing agricultural, industrial, or commercial training.

University education and the new secondary education programs are discussed in section 2.6.

1.6 Health characteristics of the population (World Population Data Sheet 1979)

1.6.1 Basic health statistics

Life expectancy at birth: 55 [the fourth highest in South America]

Crude birth rate: 40 per 1,000 population

Crude death rate: 12 per 1,000 population

Infant mortality: 115 per 1,000 live births (1975)
[the fourth highest in South America]

Child death rate ages 1-4 (1972): 16.3 per 1,000 population

Number of physicians per 10,000 population (1976): 6.2

Number of hospital beds per 1,000 population (1976): 2.1

Daily per capita calorie supply (1973): 2,350

Per capital protein per day (1973): 64.0

1.6.2 Major health problems

The leading causes of death, especially among children under five years of age, who account for 15% of all deaths in Peru, are communicable, infectious and parasitic diseases (PAHO 1978b:314). Diarrheal diseases are responsible for 21% of deaths of children under one year of age.

Tuberculosis is among the five most frequent causes of death; its incidence is estimated at 200 per 100,000 inhabitants. The most frequent causes of death from diseases preventable by vaccination are whooping cough, measles, and tetanus.

Triatoma infestation is widespread, while a focus area for plague occurs in the North-Western Region, and areas in which leprosy is endemic are found in the Eastern Region and the South-Eastern Region (PAHO 1978b:309).

The vectors of Chagas disease, a trypanosomic infection, are present in 17 of the 23 department of Peru, but the areas of greatest concentration are the southeastern departments of Tacna, Moquegua, Arequipa, and Ica and the northeastern departments of Cajamarca, Amazonas, and San Martin. (PAHO 1975:311).

There are reported to be epidemic outbreaks of yellow fever, hepatitis and leishmaniasis, but they do not cover a broad geographical area (PAHO 1978b:309).

Noncommunicable disease such as high blood pressure, rheumatic fever and cancer are becoming increasingly important as causes of both illness and death (PAHO 1978b:314). Silicosis is a problem among the mining population (Salud Ocupacional [Lima], vol. 19, nos. 1-4 (1974):17-28).

malaria

About 5.5 million Peruvians live in areas subject to malaria. The incidence of this disease, the object of a eradication program that was initiated in 1957, was reduced from 308 cases per 100,000 population in 1957 to 45 cases per 100,000 in 1968, only to rise to 260 cases per 100,000 in 1975. The upsurge of malaria cases has been attributed to difficulties in administering the program and an increase in the cost of materials and equipment, resulting in the decline in both quantity and quality of insecticides used for mosquito control (PAHO 1978b:314).

malnutrition

Although there have been no nation-wide nutrition surveys to indicate the extent of nutritional deficiencies, it has been estimated that in some areas protein-calorie malnutrition affects 52% of those under five years of age (PAHO 1975:311). Malnutrition affects both rural and urban dwellers. The most severly affected rural areas are in the southern sierra, the lower selva, and the rural part of the central sierra, areas containing a population of some 4.5 million persons. An estimated 70% of all rural families are calcium deficient, 56% have deficiencies in rhiboflavin and carotene, and 54% do not satisfy acceptable caloric intake levels.

Urban malnutrition is especially severe in the Lima area, where an estimated one-half of the population with caloric deficiences lives. In 1972 19% of the child population of Lima were malnourished, and since then economic problems have resulted in further decreases in the amounts of calories and protein consumed by the middle and lower economic groups in that city. In 1978, the caloric intake of the poorest groups in Lima was estimated to be only 62% of the daily requirement. Some 400,000 persons in the Lima slums go to bed hungry (AID/LIMA 1979:3-4).

Malnutrition occurs because people simply do not get enough food to eat--particularly cereals, vegetables, milk, eggs, and fats, a situation aggravated by decline in agricultural prroduction, continued high population growth rate, and the decline of real income.

altitude problems

Peculiar to the Sierra region of Peru as a high-altitude area are health problems associated with adjustment to life in mountainous areas. These problems arise particularly when workers are brought from the lower areas of the Costa region to labor in the mines of the Sierra. Problems of adjustment also occur when those accustomed to life at high altitudes are brought into low-lying regions in conjunction with colonization and re-settlement programs.

1.6.3 Health services

As of 1975 Peru had 337 hospitals, 533 health centers and 1,115 health posts. The Ministry of Health administered 103 hospitals, 344 health centers, and 994 health posts. The remaining medical facilities were administered by the Social Security Administration, the armed forces, agricultural cooperatives, charities, and other public and private entities. (PAHO 1978b:308).

The distribution of health facilities and services in Peru is heavily in favor of the urban population. Only limited health services are available to the some 6.2 million rural people of Peru. Over 70% of the medical personnel is in Lima, while the remaining 30% is located overwhelmingly in departmental or provincial capitals. The distribution of hospital beds is also unequal: about half are in Lima and the remainder in the departmental capitals. Whereas there are 4.4 hospital beds per 1000 residents in Lima, there are only 0.6 beds per thousand residents in Apurimac and Puno, two of the most outlying departments. Health services in these rural areas, which include paramedical attention, are inadequate. (AID/LIMA 1979:5-6).

The government's General Guidelines for Health Policy, issued in 1976, take cognizance of the need for a more equitable distribution of health care services than presently exists. In 1975, the government established ten health regions, with the utlimate goal of obtaining technical-administrative self-sufficiency at the regional level. Particular attention and financial support are being directed to the Eastern Region (Iquitos) because of its importance as a development area; efforts are being made to help reduce communicable disease mortality through the expansion of health coverage (PAHO 1978b:308).

One facet of the government's efforts to bring health care to outlying areas, is a civil service program for students in the health sciences instituted in the mid-1970's. During the first to years of this program, which requires graduates to work in an area in which their services are required, about 2,000 students of medicine, dentistry, midwifery, nursing and pharmacy worked in remote rural communities for periods ranging from six to twelve months (PAHO 1978b:309).

Also essential for the extension of health services, is the Manpower Training and Research Program of the Ministry of Health, which covers the university training of personnel in medicine, dentistry, nursing, sanitary engineering, and veterinary medicine. There are seven academic programs in human medicine, five in dentistry, five in veterinary medicine, and three in pharmacy and biochemistry. There are nine schools for the training of nurses and 12 nursing programs, 2 programs for midwives, and one program for sanitary engineers (PAHO 1979b:309).

Within training programs being carried out by the health regions, the Ministry of Health has placed special emphasis on the training of health auxiliaries, including refresher courses for those already in service; a total of 1,200 health auxiliaries participated in such programs between 1973 and 1976 (PAHO 1978b:309).

1.6.4 Water supply and sanitation

Sanitary services, including the supply of potable water, are inadequate, particularly in rural areas, although lack of sanitary services is also characteristic of urban slums and shanty towns, which contain an estimated 30% of the population of Lima (PAHO 1978b:309). In Lima, water in cyclinders is sold in those areas where no running water is available at a cost of 16.7 times that of running water (A.I.D./Lima 1979:7). Domestic water for most rural households comes from either river water or underground springs, all of which exhibit some degree of contamination (AID/LIMA 1979:6). Unsanitary conditions bear a large share of the responsibility for the spread of disease vectors (PAHO 1978b:315).

Per capita daily water consumption as recorded for urban locations average 265 lpd (liters per day), ranging from 79 lpd for Puno in the mountains to 470 for Lima; per capita consumption for shanty towns and rural areas averages only 80 lpd. It is expected that total water consmption, especially in the cities, will grow faster than population (Saettone and Porter 1979: Annex I:110).

It has been estimated that if Lima increases its population to 12,000,000 by the year 2,000 and if water consumption per capita consumption is held at 470 liters per day (lpd), the city will suffer a water deficit of 699 MCM per year, thus requiring either a limitation on per capita daily consumption or the importation of water from the Atlantic watershed (Saettone and Porter 1979: Annex I, page 110).
Plans are now being considered for increasing Lima's water supply by pumping water from the Mantaro River in the central Sierra to a storage point in a lake at Marcapomacocha, west of the river, from which it could then be piped to Lima (a certain amount of Mantaro water is already

being diverted to Lima from another location in the Mantaro River watershed). Lima's present system suffers extensive wastage as a result of damaged and inadequate fittings; as of late 1977, the Empresa de Saneamiento de Lima (the Sanitation Board) was giving top priority to the repair of these faults in the system. (WER October 10,1977:6).

The Peruvian government, recognizing the importance of adequate water supply and sewerage services in urban areas, has established programs for improving these services with considerable financial support from the InterAmerican Development Bank (PAHO 1978b:309).

Water supply and sewerage service (December 1976: from PAHO 1978a:Table 27).
Population in thousands.
[Percentages based on an estimated population of 16,387,000]

Total population:	house connections:	5,320	(32.4%)
	easy access:	2,032	(12.4%)
	Total:	7,352	(44.8%)

% of total population: 44.8%

Urban population: (9,269)	house connections:	5,071	(54.7%)
	easy access:	1,580	(17.0%)
	Total:	6,651	(71.7%)

% of total urban population covered: 71.7%

Rural population: (7,118)	house connections:	249	(3.5%)
	easy access:	452	(6.4%)
	Total:	701	(10.9%)

% of total rural population: 10.9%

Sewage disposal:	urban:	4,621	(48.9% of urban population)
	rural:	12	(0.17% of rural population)
	Total:	4,633	(28.3% of total population)

Waste disposal

Of the 300 urban localities (those with more than 2,000 inhabitants) only 55 are reported to have acceptable refuse transportation and elimination systems, and the inadequate disposal of refuse is a problem (PAHO 1978b: 309).

According to the Pan American Health Organizations, Peru in 1978 started drawing up national solid waste management plans (PAHO: Annual Report of the Director 1977-78).

Government programs in the environmental health services

Joint programs under the Institute of Occupational Health, the Department of Sanitary Engineering, and the Department of Environmental Health, all within the Ministry of Health, as well as programs conducted by agencies

under the Ministry of Housing and Construction are aimed at improving environmental health conditions. Such programs, which fall into the two basic subfields of basic sanitation and the control of environmental hazards and pollution, cover: water supply and sewage disposal; solid waste; water, air, and soil pollution; radiation protection; and occupational health.

1.7 Family Planning and Birth Control

Peru's official population policy was set forth in a decree issued in February 1977. While providing for and permitting birth control measures, the policy prohibits public or privates organizations devoted exclusively to family planning, stipulating that birth control services must be provided by clinical centers which integrate family planning with comprehensive health services; the decree also prohibits both sterilization and abortion. ("Family Planning Organizations..." 1979: 11).

Couples are, however, given the right to "decide in an informed, responsible and free manner" the size of their families.

The task of coordinating all health and family planning services, both public and private, now falls to a Department of Health and Population, recently created with the Ministry of Health to implement population policy goals.

2.0 ORGANIZATIONS WITH INTEREST IN THE ENVIRONMENT AND NATURAL RESOURCES

2.1 CENTRAL GOVERNMENT ORGANIZATIONS

Governed since 1933 under a frequently amended Constitution, Peru in 1968 was the scene of a military coup that resulted in the establishment of a strong centralized government headed by a military president (Gen. Juan Velasco Alvarado) that dissolved congress, abolished elections, and ruled by decree. The Velasco government introduced a policy aimed at the "revolutionary transformation" of Peruvian society through measures such as land redistribution, nationalization of foreign enterprise, state control of major industry, utilities and financial institutions, and education reform. In 1975, after a period of recession and general economic unrest, a second coup brought Velasco's Prime Minister, Francisco Morales Bermudez, to the presidency. Under Morales private enterprise has been generally restored and, to a large extent because of the unfavorable economic situation that has prevailed in the last several years, the pace of the revolution has been slowed. In 1977-78 the government's program of severe economic austerity resulted in strikes and massive protests. However, a general election has been held to elect a constitutional assembly to draft a new constitution, and general elections are scheduled for 1980. The largest number of seats in the constitutional assembly are held by the moderate-left Popular American Revolutionary Alliance.

Several government ministries and offices have responsibilities related to environmental and natural resources. The most important of these are, the Ministry of Agriculture, whose responsibilities cover a wide range of areas, including forests, wildlife, and water resources, the Ministry of Health, whose Institute of Occupational Health is charged with most pollution control operations, the Ministry of Energy and Mines, charged with the regulation of mineral and petroleum exploitation, the Ministry of Fisheries, and ONERN, a policy-making body under the Office of the Prime Ministry, which is charged with evaluating the natural resources of the country. Within the recently elected constitutional assembly is a natural resources committee that has been preparing a natural resources article for the new Peruvian constitution (WER Nov. 20, 1978:2).

One of Peru's biggest problems is the inability of the government to administer its programs and natural resources, a situation which may perhaps be aggravated by the government's fiscal austerity program. Peru has a considerable and varied resource base, including both renewable and nonrenewable resources. However, because of poor management or the absence of management, problems have arisen with overfishing, pollution from mining operations, soil depletion, and desertification (Lausche 1979).

OVERVIEW OF AGENCIES INVOLVED IN ENVIRONMENT AND NATURAL RESOURCES BY SECTOR

GENERAL NATURAL RESOURCES POLICY, PLANNING, EVALUATION & COORDINATION

ONERN: Oficina Nacional de Evaluacion de Recursos Naturales

WATER

Ministry of Agriculture and Nutrition
- General Irrigation Office (2.1.1.1)
- General Directorate for Water and Soils (2.1.1.4)

Ministry of Housing and Construction
- [Water Supply and Water Standards] (2.1.4)

Ministry of Health
- Department of Environmental Health (2.1.3.2)
- Institute for Occupational Health (2.1.3.3)

AIR

Ministry of Health
- Institute for Occupational Health (2.1.3.3)

SOILS

Ministry of Agriculture and Food
- General Directorate for Water and Soils (2.1.1.4)

FORESTS

Department of Agriculture
- General Directorate for Forestry and Wildlife
  - Forestry Directorate (2.1.1.3.1)

WILDLIFE

Ministry of Agriculture and Food
- General Directorate for Forestry and Wildlife
  - Conservation Directorate (2.1.1.3.2)

FISHERIES

Ministry of Fisheries (2.1.2)
- IMARPE (2.1.2.1)

MINERALS

Ministry of Energy and Mines (2.1.5)

2.1.1 Ministry of Agriculture and Nutrition (Ministerio de Agricultura y Alimentacion)

Budget for 1979: 5.9% of total budget*

Formed in 1978 from the earlier independent Ministries of Agriculture and Nutrition, the structure of the Ministry is detailed in Decree Law No. 22232 of July 11, 1978.

As the chief government agency for the agricultural sector, the Ministry has a broad field of responsibility, including: agricultural land; forests and uncultivated land; the waters of rivers, lakes, and aquifers; forest resources; wild plants and animals; cultivated plants; livestock breeding; and activities relating to the exploitation and management of the above resources.

The Ministry's functions, which include both development and conservation of the land, water, and forest resources, cover: the development of the agricultural structure; the social and economic advancement of the "campesino" (small farmer), as well as the development of agroindustrial and forestry enterprises and, in general, the integral development of the rural sector; manpower and organization in the agricultural sector; evaluation, rational utilization, and conservation of natural resources within the agricultural sector; the increase of both agricultural and forestal areas; the production, marketing, and processing of the raw materials of the sector; basic food industries, etc.

The general outline of the structure of the Ministry is indicated in the Chart on page 13a. Only those offices whose functions are of particular interest for natural resources development and conservation will be considered below.

2.1.1.1 Oficina General de Irrigaciones (General Irrigation Office)

The Office is the technical and administrative body responsible for the formulation, supervision, control and execution of irrigation projects and the administration of the National Water Institute (Shane 1978).

2.1.1.2 Direccion General de Reforma Agraria y Asentamiento Rural (General Directorate for Agrarian Reform and Rural Settlement)

The Directorate is concerned with implementation of the agrarian reform program as well as with the proper use of agricultural land. It is charged with the promotion, organization, etc. of cooperatives and campesino enterprises.

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* NOTE: 1979 budget figures presented below are calculated on a total government budget of 576,752.3 million soles (roughly 2.6 billion dollars), as stipulated in the central government budget law that was published in the government gazette, El Peruano, of December 28, 1978. Included in this figure are both current and capital expenditures as well as debt payment.

MINISTRY OF AGRICULTURE AND NUTRITION

High Directorate
- -Minister
- -Chief Director

Control Body
- -Inspector General

Consultative Body
- -Agricultural Advisory Council (Consejo Consultivo Agrario)

Advisory Bodies
- -Sectorial Planning Office
- -General Legal Advisory Office
- -General Rationalization Office

Nutrition Bodies
- -General Administrative Office
- -General Office for Public Relations and Information
- -Sectorial Statistics Office
- -General Rural Cadastral Office
- -General Irrigation Office
- -General Engineering Office
- -General Office for Technical Communication

Line Organs
- -General Directorate for Agrarian Reform and Rural Settlement
- -General Directorate for Forestry and Wildlife
  - Program Office
  - Legal Advisory Office
  - Office of Budget and Statistics
  - Office for Forestry and Wildlife Assessment
  - Conservation Directorate: Sub-directorate for Flora and Fauna; Sub-directorate for Conservation Units
  - Forestry Directorate: Sub-directorate for Reforestation; Sub-directorate for Management of Forests; Sub-directorate for Forest Seeds (Semillas Forestales)
  - Forest Extraction Directorate: Sub-directorate for National Forests; Sub-directorate for Forest Exploitation
  - Directorate for Primary Processing and Marketing: Sub-directorate for Primary Processing; Sub-directorate for Marketing
  - Directorate for District Forestry Activities
- -General Directorate for Waters and Soils
- -General Directorate for Ariculture and Livestock
- -General Directorate for Marketing

Executive Organs
- -Regional Directorates
- -Special Projects.

Associationed Decentralized Agencies
- -National Center for Training and Research in Agrarian Reform (CENCIRA:Centro Nacional de Capacitacion e Investigacion para la Reforma Agraria)
- -Public Corporation for Agrobusiness Services (EPSA)
- -National Institute for Agricultural Research (INIA: Instituto Nacional de Investigacion Agraria)
- -ENACO: National Coca Corporation

2.1.1.3 Direccion General Forestal y de Fauna
(General Forest and Wildlife Directorate)

Below the central government structure indicated here are regional authorities with subdirectors who head the forestry districts that are the actual operating units.

2.1.1.3.1 Dirrecion de Silvicultura
(Forestry Directorate)

Director: Mr. Romero, Director de Silvicultura

With functions relating to the whole scope of forest maintenance and utilization, the Forestry Directorate is also charged with the program of reforestation, which is being looked upon as a means of providing jobs for the unemployed and underemployed.

One of the chief constraints facing the forestry sector is the lack of technical personnel in the forestry field. This makes it difficult for the Forestry Directorate to execute projects. There are eleven professionals on the staff but as of early 1979 no funds to cover technical support needs. Low salaries (even the Director of the Directorate makes only about $300 a month) tend to discourage capable professionals and technicians, who are attracted by more lucrative jobs in private industry, leaving few persons to handle administrative and technical matters for the government (Lausche 1979).

The Forestry sector suffers, furthermore, from the preference given to the farming and livestock sectors within the Ministry of Agriculture, under whose aegis the Division falls. The importance of the farming and livestock sectors for Peru means that the lion's share of the Ministry's funds is directed to these divisions, which tend to be either unsympathetic with or uncomprehending of the importance of forestry activities in areas such as the prevention of desertification, a significant problem in Peru (Lausche 1979).

The Directorate is in need of assistance to build up its reforestation programs (thus offering people employment in rural areas and discouraging continuing movement toward the cities), and to supply technical assistance in the forestry sector. Additional expertise is required not only in the actual planning and execution of forestry projects but in performing financial functions, such as the handling of forestry receipts in connection with forestry exploitation. The shortage of qualified personnel to handle these receipts is hampering the ability of the Directorate to raise revenues (Lausche 1979).

2.1.1.3.2 Dirrecion de Conservacion (Conservation Directorate)

This directorate is charged with the supervision of wildlife reserves and national parks. Emphasis here is on the conservation of ecosystems, the establishment of national parks, and the creation of small historic areas.

2.1.1.4 Direccion General de Aguas y Suelos
(General Directorate for Waters and Soils)

The Directorate is charged with regulating, directing, promoting, supervising and controling both the conservation and use of water resources, as well as with the conservation of soils. Chief responsibility for the implementation of the 1969 Water Law falls to this Directorate, which also is empowered to both issue and revoke water use permits.

2.1.1.5 Direccion General de Agricultura y Crianzas
(General Directorate for Agricultura and Livestock)

2.1.1.7 Decentralized Agencies under the Ministry of Agriculture and Food

2.1.1.7.1 Centro Nacional de Capacitacion e Investigacion para la Reforma Agraria
(CENCIRA--National Center for Training and Research in Agrarian Reform)

2.1.1.7.2 Instituto Nacional de Investigacion Agraria (INIA)

The INIA is charged with applied research and agricultural experimentation involving agriculture, livestock, forestry, wildlife, agro-industry, and waters and soils.

The INIA has agricultural research stations at Tulumayo and Lambayeque.

2.1.2 Ministerio de Pesqueria (Ministry of Fisheries)

Budget for 1979: 0.7% of total budget

The Ministry was established by Decree Law 18026 of December 16, 1969. The function of the Ministry is to set policy for and to regulate the rational utilization of Peru's fishery resources.

2.1.2.1 Instituto del Mar de Peru (IMPARPE)(Marine Institute of Peru)

General Valle y Gamarra s/n
Callao 5--Peru

Budget for 1979: 0.08% of total budget

Affiliated with the Ministry of Fisheries, the Institute is responsible for conducting scentific and technical research on fish and other living resources in both salt and fresh water.

IMPARPE's functions include: the preparation of fishing statistics; the maintenance of a permanent inventory of the biological resources of Peruvian waters; and research in the exploitation and preservation of Peruvian marine resources. Its various departments cover biological, oceanographical, technological, economic, and statistical research. Its research also extends to methods of preserving fish.

Specific research performed by IMARPE determines the fishing system,

the length of fishing seasons, the days of the week on which fishing is permitted, the number of boats, and the average and total number of catches. IMPARPE therefore scientifically analyzes data such as: the weight and length of the fish; the temperature, salinity, and movement of water masses, and the number of eggs and plankton in a specific area. IMARPE also prepares maps of the aquatic "climates" of the Peruvian seas.

IMARPE maintains laboratories in Paita, Chimbote, Callao, Ilo, and Pisco

A representative from the Institute serves on the Peruvian Man and the Biosphere Committee.

.1.2.2 Laboratory of Marine Biology
Mollendo

The laboratory performs studies on ocean flora and fauna in the marine area of southern Peru.

2.1.3 Ministry of Health (see also 1.5.3)

Budget for 1979: 4.0% of total budget.

2.1.3.1 Department of Sanitary Engineering

2.1.3.2 Department of Environmental Health

Responsible for the protection of water against pollution; the Department coordinates with the Directorate of Waters and Soils of the Ministry of Agriculture and Nutrition, the granting of licenses, authorizations or permits for all kinds of water use (UNWC 1976:28).

[It is not certain if this office is to be identified with the Department of Environmental Health Standards, which, according to a June 1979 article in World Environmental Report, has recently signed an agreement with the United Nations Environmental Program (UNEP) to study the biological effects of mine tailings in water (WER June 18, 1979: 2).]

2.1.3.3 Institute de Salud Ocupacional (ISO)
(Institute of Occupational Health)
Las Amnapolas No. 350
Lima 14

Total 1979 budget for all Institutes of Health: 0.05% of total budget

The institute is the organization charged with the study and control of air pollution in Peru (for details on the activities of the Institute, see section 4.9: Air and the Atmosphere).

A representative serves on the MAB programme committee.

Department of Air Pollution (since 1969)

Chemical Laboratory of Air Pollution (since 1969)
(Gastanaga Coll 1974:36-37)

Division for the Preservation of Water Resources

Formerly under the Department of Sanitary Engineering (2.1.3.1), the Division was transferred to the Institute de Salud Ocupacional, effective January 1, 1975. The Office is concerned with water quality at the national level. It is composed of several departments with responsibilities for Mapping and Evaluation, Pollution Studies, and laboratory work.

2.1.4 Ministry of Housing and Works

Budget for 1979: 1.0% of total budget

The Ministry is responsible for standards and the execution of plans in all spheres relating to drinking water and sewerage services.

The National Program for Water Supply is under this Ministry, and the General Directorate for Sanitary Works and the Sanitation Enterprises of Lima, Trujillo and Arequipa are agencies of this Ministry.

2.1.5 Ministerio de Energia y Minas (see also 2.6.9)
Calle Zepita, Edificio Ferrand
Lima
Fields: regulation of minerals and petroleum

Ministry budget for 1979: 2.6% of total budget

Electricity sub-sector:
- deals with the normative aspects as well as planning and promotion and control through the Electricity Board and the Sectoral Planning Office;
- ELECTROPERU: the State body responsible for the business aspects of the electricity industry
- INIE: Institute for Energy Research and Electrical Services: carries out studies and controls the projects being executed.

Mining sub-sector
- Empresa Minera del Peru: has created a technical office charged specifically with solving problems involved supplying the water needs created by large-scale mining projects; (UNWC 1976:29).
- Office of Electricity, Bureau of Sectoral Planning

Direccion General de Hidrocarburos

2.1.6 Ministry of Education (see also 2.6.7)

Ministry Budget for 1979: 10.5% of total budget

The Ministry of Education directly controls all subuniversity levels of public education and is authorized to regulate the curriculum and materials used by private institutions. All of the funds for public universities are channeled through the Ministry of Education. The Ministry is also responsible for the programs at the Escuelas Superiores de Educacion Profesional, schools which supply combined vocational and educational training beyond the ninth grade.

2.1.6.1 Consejo Nacional de la Universidad Peruana (CONUP)

The Council provides guidance for all universities within Peru. A representative of CONUP is on the MAB Programme Committee.

2.1.7 Ministry of Industry and Tourism

2.1.7.1 INTINTEC: State Office for Technological Research

Provided for in the General Law of Industries (1970) and formally established by legislation promulgated in 1972, ITINTEC is a multiple-function organization designed to develop technological capabilities in Peruvian industries. INTINTEC is assigned the function of promoting, supervising, and carrying out industrial technological research; of preparing national technical norms and standards and improving quality control in industry; and of performing such additional task such as providing technical information for industry. With additional functions accruing to it through a reorganization of the Ministry of Industry and Tourism in 1974, ITINTEC has become the executive agency for the formulation and implementation of industrial technology policy in Peru. In performing its functions INTINTEC is to take advantage of existing research capabilities in businesses, universities and research institutions; it is also to decentralize its activities and thereby to create a nationwide network of entities for the generation of technology. The first of these centers was scheduled to open in 1978 (Sagasti 1979: 124-125).

Among projects funded by ITINTEC for 1975 were 89 projects submitted by industrial enterprises; 22.5% of these dealt with metals working; 22.5% with food beverages, and tobacco; 12.4% with chemical products; 12.4 with textiles; 11.2% with rubber, leather, and plastics; and the remainder with nonmetallic mineral products, wood and cellulose products, machinery and electronic products, and pharmaceutics and cosmetics (Sagasti 1979: 132).

Among more recently reported ITINTEC research projects is one involving research into solar water heaters and windmills in the Southern Andes (WER March 12, 1979).

2.1.7 Decentralized Organizations under the Office of the Prime Minister

2.1.7.1 Oficina Nacional de Evaluacion de Recursos Naturales (ONERN)
(National Office for Evaluation of Natural Resoruces)
Calle 17 No. 355
Urb E. Palomar,
San Isidro
LIMA

ONERN budget for 1979: 0.02% of total budget

Established: April 1962

Originally under the Minister of Development and Works and later part of the National Planning Institute, ONERN, by a decree of May 1973, was officially declared a Decentralized Body of the Presidency under the control of the Prime Minister.

Functions: charged with carrying out an inventory and an integrated evaluation of the natural resources of the country, with the object of development

ONERN's capacity is mainly in the policy area, since it lacks the technical ability to implement recommendations and the authority to require implementations of its recommendations (Lausche 1979).

Research program:
- to perform integrated studies of the natural resources of the country, directed toward economic and social development;
- to collaborate with the National Planning Institute (Instituto Nacional de Planificacion) in the formulation of policy for the use and conservation of these resources;
- to perform studies within the national scope, relevant to the interdependence between man and the natural environment;
- to propose alternatives programs which would promote the preservation of the natural environment

For the past decade ONERN has been actively working to identify the natural resources of Peru and has developed considerable expertise in the course of this work. More recently ONERN, with A.I.D. assistance, has begun working on a preliminary analysis of the environmental impacts produced by agriculture, cattle raising, fisheries, industry, and urban development along the Peruvian coast. Later stages of this work are to involve the development of project design criteria, environmental assessments, specific environmental protection plans and general policies on reforestation, watershed protection, wildlife preservation and environmental education (A.I.D./Peru 1978:137).

With assistance from U.S.A.I.D., ONERN has since 1976 been using LANDSAT technology to conduct an inventory of stands of valuable

aguaje palm in the Peruvian Amazon. The grant project was to evaluate both digital and visual interpretation of Landsat data for the identification and mapping of aguaje palm and other forest species. General location of palm stands was determed by visual interpretation, while digitial classification provided greater accuracy of actual boundary lines. (Remote Sensing...).

Staff: Director General: Ing. Jose Lizarraga Reyes
Assistant Director: Ing. Carlos Zamora
Chief of the Office of Communications: Ing. Luis Masson

By one recent report, the ONERN staff consists of a small, competent group of scientists (Lausche 1979).

Individual division of ONERN, as listed in the 1978 Directory of the Prime Minister's office, include the Directorate of Integrated Studies and of Natural Resources Data (Direccion de Estudios Integrados y Especificos de Recursos), the Directorate of Studies for the Preservation of the Environment (Direccion de Estudies para la Preservacion del Medio Ambiente), and the Office of Natural Resources Mapping (Oficina de Cartografia de Recursos Naturales).

Facilities: -remote sensors and cartographic laboratories
-facilities for investigation of the environment on the arid coast of Peru;

Publications: ONERN has published many studies, including studies of the coastal areas and an inventory of the resources of the the Rio Tambo zone of the Gran Pajonal area of the High Selva.

ONERN and Environmental Impact Assessment

In the absence of an acceptable environmental assessment for the Subtropical Lands Development Project to be funded by A.I.D. (a requirement for A.I.D. funding), ONERN has reportedly conducted its own environmental protection assessment for the project; it was felt by the A.I.D. Mission in Lima that ONERN would be capable of conducting environmental impact assessments (Lausche 1979). ONERN's study takes into account Peruvian laws and policies and relevant data, (Lausche 1979), but the initial stage of the study, essentially a framework document lacking in the necessary detailed descriptions of the project area, is basically a "general discussion of some of the existing environmental conditions in the area and very non-specific trends of what could happen in the future" (Lausche 1979). Nevertheless, an evaluator of the ONERN study found that Peru has a "realistic potential for substantial country participation [in environmental assessments] in the immediate future." (Lausche 1979).

Future plans for ONERN

A.I.D. is considering as part of its 1980-81 budget grant to Peru, the posssibility of a $0.5 million grant to ONERN for institution building. A.I.D. hopes thereby to encourage ONERN to do more resource inventory on the eastern slopes of Peru (an A.I.D.-designated assistance area), where there is significant desertification, and to develop baseline information on soils, forests, exploitation, etc. The grant might also provide training to upgrade ONERN's technical abilities.

There has also been some discussion of the establishment under ONERN of an Office of Environmental Control, with a small staff of professionals, to actually carry out the specific recommendations on development sites as ONERN better defines specific measures for certain areas.

2.1.7.2 Servicio Nacional de Meteorologia e Hidrologia (SENAMHI)
Av. Republica de Chile No. 295
Lima
1-Peru

SENAMHI budget for 1979: 0.02% of total budget

Units of SENAMHI include the Directorates for Meteorological, Hydrological and Agrometeorological Studies and the National Meteorological Center.

SENAMHI is responsible for the execution and co-ordination of all national activities falling within its sphere. Most of the relevant information collected by SENAMHI is centralized in a computerized data bank (using "advanced computational methods")(UNWC 1976:28).

SENAMHI is currently working with assistance from the French government on the development of solar energy; there are plans to install experimental solar equipment in Puna--near Lake Titicaca--to test the feasibility of using solar energy for irrigation operations in the Sierra (WER September 26, 1977:2).

2.1.7.3 Instituto Nacional de Estadistica (INE)
(National Institute of Statistics)
P.O.B. 2095
Av. 28 de Julio 1056
Lima

As the government statistical office, INE, founded in 1975, is involved in population, housing, economic, and agricultural censuses and also plans the national statistical policy. It publishes various statistical bulletins. Statistical work in the agricultural area is also carried out by the Statistical Office of the Ministry of Agricultural and Nutrition.

2.1.8 Multisectoral Organizations under the Office of the Prime Minister

2.1.8.1 Consejo Nacional de Investigacion (CNI)
Avda. Del Parque Norte Nos. 1172-1174
CORPAC - San Isidro
Lima

CNI, the National Research Council, was set up in 1968, to establish a science and technology policy for the country (see Sagasti 1979:121).

Units of CNI include the Department of Science and Technology, the National Institute of Physics, and the Institute of Advanced Technology. The CNI also maintains the Center for Scientific and Technological Information and Documentation.

A CNI representative has served on the Peruvian MAB Committee.

2.1.9 Instituto Nacional de Planificacion (INP)
Av. Republica de Chile no. 262
Lima
1-Peru

Budget for 1979: 0.1% of total budget

As the central technical body of the National Planning System, INP is charged with advising the government on the adoption and implementation of overall national development policy.

The sectoral and regional planning offices of the INP are responsible for proper co-ordination among the different levels of the public administration and the politico-administrative subdivisions of the country.

INP works in conjunction with ONERN in matters of natural resources planning.

A representative from the Institute serves on the Peruvian Man and the Biosphere Committee.

2.2 Local Government

Peru is divided into 23 departments and the constitutional department of Callao. These departments are further subdivided into 148 provinces and 1,662 districts. Each department is headed by a prefect, each province by a subprefect, and each district by a governor. All of these local government units are, however, only administrative subdivisions of the central government; these are no local popular governments. Municipal governments are responsible for matters such as local water supply and sanitation.

For each department there exists a Development Commission, established by law. Development Commissions also have been set up for some provinces.

Special status is accorded to Indian communities, which have autonomous self-governing institutions with legal status but limited powers. In the mid-1970's there were some 5,000 Indian communities with powers to

elect and remove their own officials. Under the 1975 Forest and Wildlife Law, Indian communities are permitted to continue their traditional hunting practices in the forest areas.

2.3 NON-GOVERNMENTAL ORGANIZATIONS

Local environmental groups have been active protesting the plans of MineroPeru, the state controlled mining corporation, to establish a zinc refinery at Cajamarquilla, not far from Lima. This is the most controversial environmental issue in Peru today (WER June 18, 1979:3).

2.3.1 Asociacion Peruana para la Prevencion y Control de la Contaminacion del Aire

Moquegua 336
Of. 206
LIMA

2.3.2 Asociacion Peruana de Defensa Contra la Contamninacion Ambiental

(Peruvian Association for Defense against Environmental Contamination)
Cusco 610, Of. 203
Lima

Among its recent activities the Association has been working to convince authorities to include environmental topics in the school curriculum. As part of its effort to arouse envionmental interest among young people it has started "Clubs for the Protectors of Nature." It has also been conducting a campaign to increase the efficiency of waste collection in Lima (uniterra, November 1978: 7).

2.3.3 Pro Defense de la Naturaleza--PRODENA (For the Defense of Nature)

Avenida Nicolas de Pierola 742, Of. 703
Edificio Internacional

PRODENA is the local branch of the World Wildlife Fund. Its head, Felipe Benavides, has been particularly vocal in protesting government actions hostile to wildlife, such as the 1978 decision of the Ministry of Fisheries to destroy sea lions said to be interfering with fishing activities (WER April 24, 1978:3-4).

As the local branch of the World Wildlife Fund, PRODENA has been instrumental in securing funds from the I.U.C.N. for projects such a study to determine the numbers of sperm whales off the Peruvian coast (WER November 7, 1977:6).

2.3.4 ECO-the Peruvian Ecological Front

In its early organizational stages in late 1978, ECO has set itself the task of making the public ecologically aware of the side effects of development: endangered species; industrial pollution; the need for reforestation of the jungle; and the stricter control of oil exports to prevent possible oil spills. Plans are for regional committees throughout the country with headquarters in Pucallpa, a town located in the jungle region, which is to be the object of a major part of the organization's conservation efforts.

Initially to be under the wing of PRODENA (see above), whose director, Felipe Benavides, has been the moving force in forming the new organization, ECO has issued a manifesto stating that conservation is the collective responsibility of government, private organizations, industry, and individuals. It is asking the government to: give priority to conservation of wildlife and natural resources; pass appropriate laws to protect the environment; ensure that ecological principles are considered in all development projects; include conservation in education programs at all levels; and cooperate in international conservation programs (WER, Nov. 20, 1978:1-2).

2.4 INTERNATIONAL ARRANGEMENTS

Peru has received considerable technical and training assistance in health care and health related fields such as water supply and sanitation from the Pan American Health Organization (PAHO). The location in Lima of the headquarters of CEPIS (the Pan American Center for Sanitary Engineering and Environmental Sciences)--built largely with funds provided by the Peruvian Government-- has been of special benefit to Peru. Providing technical assistance, training, investigation, and documentation in its fields of speciality, CEPIS has cooperated extensively in research projects covering sewage treatment, water purification, water pollution of rivers and canals, and air pollution monitoring. Furthermore, since 1975 CEPIS has been holding in its Lima headquarters courses in areas such as air quality monitoring and water treatment technology for developing countries. Because CEPIS is located in Lima, Peru has been particularly able to benefit from these courses as well as from the documentation and information services which CEPIS has begun to make available. CEPIS also provides ongoing assistance for Peruvian air pollution control programs (PAHO 1978a: 74-78).

In mid-1978 Peru signed the Amazon Pact, an agreement among Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Surinam, and Venezuela for the rational development of the Amazon Basin. The countries concerned have agreed to give proper consideration in development efforts to such environmental factors as: the rational use of natural resources, the need for rational planning of flora and fauna utilization by promoting scientific research, and exchange of information and co-operation to improve measures aimed at conserving the ethnological and archaeological richness of the Amazon region. The countries anticipate that they may have to recruit assistance from international agencies in order to carry out projects and programs. One purpose of the Pact is to announce to the world that the Amazon countries are capable of responsibly developing the region in a rational and ecologically sound manner (uniterera, July 1978: 1).

With regard to wildlife protection, Peru, along with Argentina, Ecuador, Bolivia, and Chile, is a signatory of the 1969 La Paz treaty, which promises total ten-year protection for the endangered vicuna (see 4.5) was promised. The meeting to decide on possible extension of the treaty was scheduled for September 1979 (Tinker 1979:263).

Peru and Bolivia have recently signed an agreement to carry out research in Lack Titicaca with the object of forming an binational company to start trout farming. The project, which involves the transplanting of 600,000 young trout to various parts of the lake, is scheduled to begin at the end of 1979. Funds for the project ($300,000) come from the Andean Development Corporation (WER July 16, 1979:5).

2.5 EDUCATIONAL INSTITUTIONS AND TRAINING

Peru has 33 universities, the oldest of which (San Marcos) was founded in 1551, but by far the largest number of which (26) have been established since the early 1960's. All universities operate under the guidance of the Consejo Nacional de la Universidad Peruana (CONUP). Twenty-three of the universities are public and the remaining 10 are private; all support for the public and much of that for the private universities come from the central government budget. Although a university education is theoretically open to all capable of passing an entrance examination, the number of applicants has far exceeded the number of students actually gaining admission to the universities. In 1976, for example, only 24.5% of the some 168,637 applicants became university entrants (Saettone and Porter 1979: Annex 9:17).

Completion of university education appears to be quite low. In 1975, the total number of students matriculating at Peruvian universities was 180,857, of which 40,840 were new entrants. In that same year, however, only 8,525 university graduates were produced, some 21% of the number of entrants (Saettone and Porter 1979: Annex 9:17).

Of the 33 Peruvian Universities, two are specifically agricultural institutions (Univeridad Nacional Agraria "La Molina" in Lima and Universidad Nacional Agraria de la Selva in Huanuco), one is an engineering university (Universidad Nacional de Ingeneria in Lima), and four are technical universities (Universidad Nacional Tecnica de Cajamarca, Universidad Nacional Tecnica del Altiplano in Puno, Universidad Nacional Tecnica del Callao, and Universidad Nacional Tecnica de Piura. The table of page 25a indicates the graduates of all institutions with training in technical fields relevant to energy development as well as to natural resources planning and development.

educational reform

Educational reform in Peru was instituted following the revolution of 1968, principally under the Education Reform Law of 1972. The reform was aimed at redirecting educational opportunities away from the elite groups and toward providing education that would improve the economic prospects of the great majority of Peruvian society. The early efforts emphasized literacy and education at the primary levels. On the secondary level there was instituted a system designed to provide secondary graduates with practical, job-related skills that would enhance their employment opportunities. This reform involves the replacement of the traditional primary, elementary, and secondary school pattern with a system consisting of nine years of basic education followed by three years of combined vocational and academic training in special schools called Escuelas Superiores de Educacion Professional (ESEP). This system, established in 1975, now covers 16 institutions and reaches about 20% of the students between 10th and 12th grade, but plans

UNIVERSITY TRAINING IN TECHNICAL FIELDS OF INTEREST TO ENERGY DEVELOPMENT AND RESOURCES DEVELOPMENT (from Saettone and Porter 1979: Annex 9: Table 9)

Academic Curriculum	No. of Grads.*1975	No. of Professional Certifications**1975	No. of Univ. Offering the Curriculum 1976	Advanced Degree Programs: Degrees Conferred in 1975
1. Architecture	236	91	6	
2. Biology	124	109	11	M.S.(0);Ph.D.(0)
3. Statistics	6	14	5	M.S. (0)
4. Structures				
5. Physics	14	15	5	M.S.(0);Ph.D.(0)
6. Mathematical Physics	9	1	1	
7. Geophysics	0	0	1	
8. Hydraulogy	0	0	1	
9. Applied Hydro Mechanics	M.S. only	M.S. only	1	M.S.(0)
10. Engineering Science	0	0	1	
11. Eng. - Administration	0	1	1	
12. Eng. - Civil	248	154	8	M.S. (0)
13. Eng. - Industr. & Elect. Control	3	0	1	
14. Eng. - Electrical	2	2	4	M.S. (0)
15. Eng. - Electronics	56	5	2	M.S. (0)
16. Eng. - Forest	17	15	3	
17. Eng. - Geophyscial	0	0	1	
18. Eng. - Geological	36	26	4	
19. Eng. - Industrial	156	30	10	M.S. (0)
20. Eng. - Mechanical	66	4	3	
21. Eng. - Elec-mechanical	136	2	3	
22. Eng. - Fluid-Mechanical	0	2	1	
23. Eng. - Metallurgical	13	2	8	
24. Eng. - Mining	32	16	9	
25. Eng. - Petroleum	0	1	1	M.S. (0)
26. Eng. - Chemical	259	153	10	M.S. (0)
27. Eng. - Systems	0	0	2	M.S. (0)
28. Planning	0	0	1	
29. Chemistry	19	28	8	

*Completed Academic Requirements Only
**Completed Academic, Civil Service, Thesis, and Certification Examination

call for a complete conversion to this sytem by 1980. Among the first group of graduates of the ESEP system in 1978, were those with training in construction and topography (389), electricity and electronics (663), minerals and metallurgy (493), mechanics (1,164), and petroleum (259) (Saettone and Porter 1979: Annex 9:17).

Other efforts to broaden education include the Centros de Capitacion Professional Extraordinaria (CECAPEs), which seek to provide specific vocational education both part-time and on-the-job in skilled and semi-skilled fields ranging from beautician to computer programming, and the Servicio Nacional de Appredizaje y Trabajo Industrial (SENATI--National Service of Apprenticeshipe and Industrial Labor), supported by an assessment of all companies with more than 15 employees, which provides job-related training for workers from the unskilled to middle-management level. Unlike the other programs considered, SENATI does not come under the Ministry of Education (Saettone and Porter 1979: Annex 9:19-20).

The success of Peru's efforts to broaden education has been dependent on foreign assistance. The creation of the existing batch of ESEPs, for example, has been heavily supported by foreign assistance, and the creation of the next batch is dependent on a loan from the IBRD. In general, Peruvian educational reform on all levels is suffering from financial problems, which severely darken the outlook for the success of the program.

2.5.1 Universidad Nacional Agraria "La Molina"
Aptdo. 456
Lima
Founded: 1902

The University has Academic Programs in: Agriculture; Sciences; Agricultural Engineering; Food Science; Fisheries; Zootechnics; Forestry; and Economics and Planning.

Individual departments are: Biology; Human Sciences; Rural Construction; Economics and Planning; Statistics; Physics and Meteorology; Phytotechnics; Horticulture; Forestry Science; Forestry Management; Mathematics; Agricultural Mechanization; Nutrition; Pisciculture and Oceanography; Animal Breeding; Chemistry; Marine and Land Resources; Animal Health; Plant Pathology; Soil Science; Food Science and Agronomy; and Fishery Technology.

The University has created a Forestal Map on the scale of 1:1,100,000 which details the distribution, quality, and quantity of the different types of trees of the Sierra, Costa, and especially of the Selva; the map is to serve as the basis for rational development of forest resources.

2.5.1.1 Centro de Investigaciones de Zonas Aridas (CIZA)
Apartado 3307 456

LIMA

Established: 1976 through reorganization; it absorbed the earlier Instituto de Antropologia y Agricultura Precolombina (1965-1975) CIZA is under the Universidad Nacional Agraria

Scope of interest

Primary and secondary productivity, water capture techniques from advective fog, geomorphology and hydrology, human affairs through time in the Peruvian desert coast

Field work:

CIZA has performed field work in the mist slopes (lomas) and extreme desert flats and hills along the central coast. Its pilot area has been the Lomas de Lachay, 105 kilometers north of Lima, where the climate is extremely arid desert with foggy winters. Its work has involved not only observations of vegetation in these areas, but also reconstruction of pre-Columbian terraces.

In Piura, studies have involved the ecological effects of irrigation.

Staff

Director: Dr. Carlos Lopez Ocana
Co-Director: Dr. Frederic Engel
Anthropolgy: Dr. Miriam Valleyjos Engel
Desert Ecology: Lope Ocana
Soil science: Dr. Amara Zavaleta
Hydrology: Dr. Medardo Molina
Zoology: Dr. Antonia Brack

Facilities

Laboratories for botany, zoology, soil science, and hydrology (at the University)
Laboratories for archaeological and anthropological analysis as well as photographic and topography facilities
Field station at Lomas Lachay

Working space without equipment is available at CIZA.

Publication: Cuadernos (quarterlies)

2.5.2 Universidad Nacional de Ingeneria (UNI)
Lima Peru

UNI was founded in 1896 as the Escuela Nacional de Ingenieros del Peru.

The University has Academic programs in: Architecture, Town Planning, and Fine Arts; Science; Economics; Civil Engineering; Geological, Mining and Metallurgical Engineering; Petroleum and Petrochemical Engineering; Chemical and Manufacturing Engineering; and Sanitary Engineering.

The Department of Sanitary Engineering collaborates in the work of the WHO International Reference Centre for Community Water Supply (IRC) (WHO-IRC 1976).

The UNI, with technical assistance from the University of Grenoble in France, has started a research program to study ways of utilizing solar energy on a massive scale (WER March 12, 1979).

Carlos Bustamente, a lecturer on pollution control at UNI, has been among the Peruvian scientists urging the government to take strong action against air pollution in Lima (WER Aug. 14, 1978:5).

2.5.3 Universidad Nacional Mayor de San Marcos de Lima

The oldest and largest University in Peru, San Marcos, founded in 1551, has faculties in: Mathematics and Physics; Chemistry and Chemical Engineering; Geology and Geography; Biology; Pharmacy and Biochemistry; Veterinary Science; Medicine; Dentistry; Social Science; Law and Political Science; Philosophy, Psychology and Art; Linguistics, Literature and Philogy; Education; Administrative Science and Accountancy; Economics; Engineering; Metallurgy; and Physical Education.

2.5.3.1 Centro de Investigacion de Recursos Naturales

2.5.3.2 Instituto de Biologia Andina
Apartado 5073
Lima
Founded: 1930

Affiliated with the Faculty of Medicine, the Institute performs research on, among other things: the physiology of the inhabitants of the Andes and their resistance to high altitudes; acclimatization and fertility of animals taken to high altitudes; ecology; and sociological problems. The Institute has laboratories in Lima, Morococha and Puna as well as a mobile laboratory for research in the Andes.

2.5.3.3 Instituto de Medicina Tropical

2.5.3.4 Instituto de Zootecnica

2.5.3.5 Museum of Natural History "Javier Prado"
Lima

The Museum includes in its collection the Herbario San Marcos, with 250,000 specimens largely of Peruvian Flora; there are departments of Zoology, Botany, and Geology and a library of 5,000 volumes.

2.5.4 Universidad Nacional de San Agustin Arequipa

A representative of the University serves as project leader for MAB programme project no. 4

2.6.1 Academia Nacional de Ciencias Exactas, Fisicas y Naturales
Casilla 1979
Lima
Established: 1939

2.6.2 Sociedad Quimica del Peru (Peruvian Chemical Society)
Apdo. 891
Lima

2.6.3 Estacion Altoandina de Biologia y Reserva Zoo-Botanica de Checayani
(High Andean Biological Station and Zoo-Botanical Reserve of Checayani)

Established: 1953

Owned and operated by the Macedo Ruiz family, the Station, with a plant and animal reserve of 500 hectares and a lake of 800 hectares, specializes in biological research on the Higher Andes, particularly Lake Titicaca and the surrounding area.

The Station, headed by Dr. Hernando de Macedo Ruiz, is involved, among other things, in the preservation of endangered species. The Station is presently sheltering a rare yellow tail monkey (Lagothrix flavicauda), found in 1974, and has plans set up a breeding colony for the animal when a mate is found.

2.6.4 Instituto Geografico Militar
Avenida Andres Aramburu 1198
Apartado 2038
Lima
Fields: Cartography
Established: 1921

The Institute has published topographical, physical, and political maps of Peru.

2.6.5 Geographic Society of Lima (Sociedad Geografica de Lima)

Founded in 1888 by Supreme Decree, the Society has, since 1891, published a Bulletin, now appearing twice yearly, which contains articles and shorter items pertaining not only to geography but also to ecology and environmental pollution. It also publishes the Anuaria Geografico del Peru. The Society is governed by a Directive Council composed of representatives of various state technical offices.

2.6.6 Servicio Aerofotografico Nacional
Base Aerea las Palmas
Barranco, Lima
Fields: Cartography

2.6.7 Instituto Geofisico del Peru
Casiilla 3747
Lima
Director: Alberto Giesecke
Field: geology

Established: 1919

The Institute, one of the Institutes of Higher Learning of the Ministry of Education, has specialist laboratories for meteorology, ionospheric physics, geomagnetism, seismology and gravimetry, solar activity, satellite observations, and ionosphere and exosphere observation. It also performs research on air pollution.

2.6.8 Instituto Cientifico Tecnologico Minero
Malecon Balta 758, Miraflores
Lima
Presidente: Alberto Benavides
Field: geology

2.6.9 Instituto de Geologia y Mineria (INGEOMIN)
Paz Soldan 225
San Isidro, Apartado 889
Lima
Fields: Geology, minerals and petroleum regulation

Established: 1967

Attached to the Ministry of Energy and Mines, the Institute maintains laboratories for analysis of minerals.

2.6.10 Petroleos del Peru (PETROPERU)
Paseo de la Republica no. 3361
San Isidro
Lima
Fields: minerals and petroleum regulation

2.6.11 Instituto Peruano de Energia Nuclear (IPEN)
Luis Aldana 120, Urb. Santa Catalina
Lima
Presidente: Juan Barreda Delgado
Field: nuclear energy development

2.6.12 Direccion de Hidrografia y Navegacion de la Marina (DHNM)
Calle Saenz Pena no. 590, La Punta (Callao)
Casilla Postal no. 80 - Callao
Fields: cartography, hydrology

2.6.13 Institute Peruano de Estudios del Desarrollo
(Peruvian Institute for Development Studies)
Carabaya 515, Of. 600, Edificio Wiese
Lima
Fields: city and regional planning.

2.7 MONITORING AND ACQUISITION OF BASELINE DATA

natural resources

ONERN is said to have completed an inventory of the land and water resource base for the Costa and some selected areas in the Selva and Sierra, but large areas in the two latter regions remain to be inventoried (A.I.D./Lima 1979: 46).

ONERN has employed Landsat Data to conduct an inventory of Aguaje Palm stands in its remote and nearly inacessible Amazon regions. The project, carried out with U.S.A.I.D. financial assistance, was to evaluate both digital and visual interpretation of Landsat data. Visual interpretation was to indicate the general location of the palm stands, while digital interpretation was to provide more accurate information on actual boundary lines. The accuracy of these Landsat classifications is reported to have suggested to the Peruvian government the use of Landsat on a operational basis for this resource inventory ("Remote Sensing...": see also forestry section). Training in the use and interpretation of Landsat data is also being conducted in Peru.

air pollution monitoring

Four air pollution monitoring stations, functioning as part of the REDPANAIRE system of the Pan American Health Organization, are located in Lima. Three are operated by the Institute of Occupation Health (se 2.1.3.3) and the fourth by a program of the sanitary engineering faculty of the National Engineering University (UNI) (Centro Panamericano...1976:38).

3.0 LEGISLATION RELATING TO ENVIRONMENT AND NATURAL RESOURCES

Following the coup of 1968, the Peruvian National Congress was suspended. Legislation is currently issued by decree of the ruling military junta. The National Congress will be reinstituted following national elections in 1980.

Constitutional provisions?

In 1978, in preparation for return to civilian rule, a constitutional assembly was elected, which has prepared a draft constitution that re-received approval in early 1979. This draft includes a natural resources section, recommending rational exploitation of resources while "maintaining an ecological balance and avoiding every form of environmental contamination" (WER April 23, 1979: 2).

3.1 WATER Legislation

3.1.1 Decree-Law No. 17.752: General Water Act (Decrete-Ley No. 17.752: Ley General de aguas). 24 July 1969.
El Comercio, Lima, 26 July 1969;

Title I: General Provisions

All waters are declared the property of the State; there is to be no private ownership of waters, and the use of water is to be authorized only if it is compatible with public interest and national development. The state is therefore to: formulate general water policy; plan and administer water use; inventory and evaluation potential uses; conserve, prevent contamination of, and increase water resources; and conduct and update all surveys dealing with water resources.

The provisions of the Act extend to all waters, including marine waters up to 200 miles off the coast, atmospheric water, and water derived from rainfall.

The state owns the water-associated land such as: coastal land between the low and high water marks; river beds or channels; areas under snow or glaciers; islands in all waters; and artificially reclaimed land.

Water use permits are required by all persons, including public sector bodies for all water use except that intended for the satisfaction of private needs.

Rates are to be paid for use of water for irrigation purposes.

Title II: Conservation of Water Resources and Prevention of Their Contamination

Regulations are to be issued to ensure the efficient use of available

water resources, and measures are to be introduced to prevent water wastage through runoff, seepage, evaporation, flooding, improper use, etc.

It is prohibited to discharge any solid, liquid or gaseous wastes that may contaminate waters so as to damage or endanger human health or the normal development of the flora or fauna or jeopardize their use for other purposes. Wastes may be discharged if: they have been subjected to the necessary treatment; it can be demonstrated that the nature of the receiving waters permit natural purification; if such wastes dumped into the sea can be demonstrated not to prejudice other uses of the sea; in other cases to be authorized under the Regulations.

The Health Authorities are to issue instructions for the implementation of the Title; they are to establish limits for harmful substances as may be contained in wastes; and they may request the Water Authority to withold supply in cases where regulations have been contravened.

Title III Water Operations

Water uses are declared contingent upon circumstances, including resource availabilities and are to be governed by the needs arising from specific purposes.

The priority order for water uses is: primary needs and to supply population centers; animal husbandry; crop irrigation; power generation and industrial and mining uses; and other uses.

Water uses are to be authorized by means of permits, authorizations, or licenses. The issuance of water use permits, etc. is contingent, among other things, on the condition that the use does not result in water contamination.

Conditions for agricultural water use are set in articles 42 to 50. The Water Authority is to prepare cropping and irrigation plans which take into consideration the hydrological and agricultural characteristics of each district. Groundwater resources available in irrigation districts are to be taken into account in cropping and irrigation plans. Rationing or other sharing schemes may be set up for the use of both natural and man-made watercourses as well as to restrict water uses, whenever it threatens to damage agriculture or other land.

Articles 51 to 54, which cover water use for power, industrial and mining purposes, declare all natural waterfalls to be state property and require those using water for mining operations to dispose of mineral wastes in special areas and to ensure that such wastes do not contaminate either agricultural water or presently or potentially useful land.

Title IV Groundwater

In cases where groundwater is to be used for irrigation, uses are to be authorized on a priority basis; the advantages and feasibility of these uses are to be demonstrated in appropriate technical and economic

studies. The water authority may, however, waive the submission of such studies when minimal amounts of groundwater are tapped to supply the needs of farm families.

The tapping of groundwater is to be authorized only if (1) is does not bring about physical or chemical phenomena detrimental to the conditions of the catchment area, its water tables, or the surface area comprised within radius of influence of the well, if this well affects land held by third parties; and (2) the other wells or sources do not suffer interference from the tapping.

Rules or orders dealing with: withdrawal rates; modifications in systems; and communal use of groundwater are to be issued.

Persons discovering groundwater in the course of activities such as petroleum exploration are to notify the water authority of their findings and may not use this water without the appropriate permit, authorization, or license.

Title V Mineral and Medicinal Waters

The Ministry of Health is charged with the investigation of sources of mineral and medicinal waters, exercises control over them, and and is responsible for the issuance of licenses for their use.

Title VI Ownership of Banks of Watercourses and Associated Land

Where property borders on the natural beds of watercourses, the marginal strip of land necessary for inspection and, where appropriate, for the primary use of water, navigation, transit, fishing or other service, is to be kept free.

Title VII Surveys and Works

Articles 85 through 102 set forth provisions covering water use structures and the conditions under which they may be built. The priorities for water use struture for agricultural water use are: ensuring the adequacy of facilities for metering, catchment, distribution and control of water; regularization of the water supply to land: drainage of crop land; reclamation by means of drainage of land that has ceased to be productive or where the productivity has deterioriated as a result of a rise in the water table; and irrigation.

Title VIII Servitudes

Title IX Extinction of Water Uses, Offenses, Nonfeasance, and Penalties

Water use rights may be withdrawn or may lapse, if, among other things, water rates are not paid for two successive years, the holder has not used the water in question with the relevant cropping and irrigation plan, or the holder has otherwise failed to confirm to the provisions of this law.

Penalities: -administrative penalties for contravention of the law or its regulations range from 300 to 50,000 soles; water supply may be withheld until the fine is paid or other conditions are met;

-additional administrative fines (50 to 100,000 soles) may be assigned for offenses such as unlawful impoundment or diversion of water; unauthorized withdrawal of water from lakes, lagoons, ponds, or other natural water bodies or from groundwater sources; and so forth;

-criminal prosecution for water pollution(Article 122): persons who contaminate surface or groundwaters so as to cause harm to human health, the community, or the flora or fauna, and who commit an offence under any of the pertinent provisions of this Act, or other provisions laid down by the competent authority in order to prevent such contamination are to be punished as provided for in Article 274 of the Criminal Code and are obliged to make good any damage or impairment so caused.

Title X Administrative Jurisdiction

Administrative jurisdiction falls generally to the Ministry of Agriculture and Food [General Directorate for Waters and Soil], except for those sections dealing with mineral or medicial waters or with public health matters. The Ministry of Agriculture and Food may delegate power to directors of agricultural areas.

The initial administrative body for deciding questions under the act is the technical administration of the irrigation district.

The High Council for Water Affairs* is to be the consultative body of the executive in matters relating to priority use rights and other questions of an intersectoral character where water is concerned.

3.1.1.1 Regulations under the General Water Law

Supreme Decree 261-69-AP of December 2, 1969, issues the Regulations on Titles I, II, and III of the General Water Law
E.P. Dec. 15, 1969**

Supreme Decree 41-70-A of February 20, 1970, issues additional Regulations under Title III of the General Water Law: Use of water for irrigation purposes and the proper use of water resources
E.P.

Supreme Decree 397-70-AG of November 6, 1970 adopts rules concerning Irrigation in Urban Expansion Zones
E.P. November 10, 1970

*This organization could not be identified.

*E.P.= El Peruano, the government gazette in which laws and regulations are published.

Decree Law 22226 of July 4, 1978 repeals Law 4391 on water tax as amended by laws 11195 and 111467.
E.P. July 5, 1978

3.1.2 Decree Law 22073 of January 17, 1978 approves the convention concerning the International Hydrographic Organization, adopted in Monaco 4/30/67.
E.P. 1-18-78

3.1.3 Supreme Decree of February 4, 1965 to Approve the Regulations Relating to Sanitary Control of the Contamination of Natural Watercourses
E.P. February 22, 1965

The Decree specifies that effluents from sewer systems, industrial liquid wastes, and solid residues of household or industrial origin may be discharged into watercourse only after they have been treated in such a manner as to prevent the pollution of the receiving waters. It also states that the Ministry of Public Health and Social Welfare [now the Ministry of Health], through its technical environmental sanitation offices, is to classify the country's watercourses according to criteria established in the decree. The discharge of wastewaters or solid wastes into watercourses is not permitted without express authorization from the General Directorate of Health; disposal and treatment plans also require approval by the Directorate. Municipal Councils are subject to these provisions. The Decree also covers the discharge of metallic wastes by mining enterprises.
[NOTE: This decree has in all probability been superseded by regulations under the 1969 General Water Law (see 3.1.1.1 above).]

3.1.4 Decree Law of Dec. 24, 1973 (Expropriating the Cerro de Pasco Mining Corporation)
E.P. December 3, 1973

This law cites polluting activities of the Cerro de Pasco Company as part of the reason for its expropriation. The government accuses the company of polluting the waters of Lake Huascacha and those of the Rimac, Mantaro, and San Juan Rivers and of failing to correct the environmental contamination caused by its smelting and metallurgical installations in the city of La Oroya.

3.2 FORESTS

3.2.1 Forestry and Wildlife Law, Decree Law No. 21147, May 13, 1975 (Ley Forestal y de Fauna Silvestre)

This is the major law covering both forest resources and wildlife.

Title I: General provisions

Forest resources are declared to be within the public domain.

This law is to regulate the conservation of forest resources and wildlife. Forest resources are defined as: lands whose chief use is

forests; trees and all forest flora; and forest fauna, which includes all species which live wild in the natural regions of the country and all domestic species which live wild.

The Ministry of Agriculture is responsible for the control of all forests and wildlife with the exception of fish life.

Lands designated as forest are not to be used for agricultural purposes.

Enterprises engaged in forestry operations are to pay fees equivalent to no less than 33% of their annual income.

Title II: Forests and Conservation Units

Forests, defined as plant communities dominated by trees, are classified as Natural Forests and Cultivated Forests. Natural forests are further classified as:

National Forests
- forests reserved exclusively for the production of timber, other forest products and wildlife, whose utilization is to be carried out directly by and exclusively for the state;

Open Access Forests
- forests for production of timber, other forest products and wildlife, whose exploitation may be carried out by any person receiving proper authorization;

Protected Forests
- forests which serve principally for soil and water conservation; these areas are to be left undisturbed;

Conservation Units
- conservation units are the areas necessary for the protection, conservation, and management of wildlife and those areas which are of special significance because of their historic, scenic or scientific value.

  There are four classes of conservation units:
  - National Parks
    - these are areas designated for the undisturbed protection and propagation of natural plant and animal communities;
  - National Reserves
    - there are areas designated for the protection and propagation of species of wild animals whose conservation is in the national interest; the development of these products is to be carried out by the state; exceptions may be made where such reserves impinge on agricultural land;
  - National Sanctuaries
    - areas designated for the undisturbed protection of a species or of a specific plant or animal communites or of natural areas of scientific or scenic interest;
  - Historical Sanctuaries
    - areas designed to preserve in an undisturbed manner areas of historical interest.

Private land may be expropriated for the establishment of conservation units.

Title III Reforestation

Reforestation is declared to be in the public interest and a national necessity.

Reforestation is defined as the establishment of forest areas for either protection or production. It is to be carried out only in areas defined as suitable chiefly for forests. The Ministry of Agriculture is to determine those areas which require protective reforestation.

The conditions under which reforestation contracts are to be granted by the Ministry of Agriculture and Food are laid down in Article 23. Those landowners in areas adjoining reforestation areas are to be given absolute priority in the granting of such contracts.

Title IV Forest Products and Wildlife

Forest Removals

Forest products are defined as all exploitable parts of the forest flora. These products are further classified as either in a natural state or processed.

Forest extraction extends to: the collection of food plants, ornamental plants, medicinal, or industrial plants for use in natural or processed form. Such extraction falls into three categories: subsistence (for direct family consumption); scientific; and industrial/commercial.

Scientific extraction, requiring the authorization of the Ministry of Agriculture, is to be carried by study projects working in the national interest.

The order of priority for industrial/commercial extraction is as follows: public-interest enterprises or native (Indian) communities; public enterprises; farming communities, public welfare agricultural communities, and cooperatives; private enterprises; and small extractors.

All timber removals as well as removal of other forest products require an authorization from the Ministry of Agriculture stating the amount and species to be removal and specifying reforestation programs.

Extraction of wood within native (Indian) communities is to be done only by these communities; but if this is to be performed on an industrial/commercial scale, contracts are necessary.

Contracts are also necessary for small enterprises covering areas of less than 1,000 hectares. Reforestation is required of holders of these as of all forest extraction contracts.

The Ministry of Agriculture is to esablish annually the prices of natural forest products to be extracted.

The Minister of Agriculture is authorized to declare prohibitions on endangered plant species. A Supreme Resolution is required for the export of endangered species for scientific purposes

On the Integrated Management in Rural Settlements

Articles 61-63 cover the role of forestry and wildlife in settlements established under Decree Law No. 20653: The Law on Native Communities and the Agricultural Development of the Selva and the High Selva.

On Processing and Marketing

Processing and marketing of forest products in rural settlement zones come under the Ministry of Agriculture; such activities outside of such zones come under the jurisdication of the Ministry of Industry and Tourism. Industries involving the processing of wildlife products come under the Ministry of Agriculture. The establishment or expansion of enterprises for processing forest or wildlife products requires authorization of the Ministry of Agriculture and the Ministry of Industry and Tourism.

The export of both forest products and wildlife in their natural state is prohibited (Article 69).

Operators of establishments for the processing of forest products and wildlife may acquire only those raw materials whose removal has been authorized by the Ministry of Agriculture.

Title V: On Promotion and the Tax System

The Ministry of Ariculture is to establish or foster services relating to: integrated technical assistance; forestry equipment; the testing and conservation of both forest and wildlife products; the marketing of products; and the promotion of industries for processing forest and wildlife products.

Special assistance is to be granted to those rural people living in frontier areas whose activities involve forestry and wildlife.

Forest enterprises established in the Region of the Selva are to receive special government financing.

Title VI: Offenses, Penalties and Control

Offenses include:
- setting of forest fires;
- clearing of land for agriculture or animal grazing without permission of the Minister of Agriculture;
- removal of plants or animals outside of the zone for which permssion has been granted;
- the destruction, hunting, capturing, or marketing either in Peru or

abroad of endangered species of plants and animals;
-unauthorized establishment of processing plants;
-the keeping of living animals under unsanitary conditions;
-causing the death of productive rubber or other resin-yielding trees through abuse during exploitation.

Fines for listed offenses range from 1,000 to 100,000 soles, depending on the gravity of the offense. Those offenses covered under the Penal Code are to be prosecuted before the proper authorities.

The hunting, capturing, etc. of endangered species are to be considered criminal offenses.

3.2.2 Regulations under the Forests and Wildlife Law

Supreme Decree 161-77-AG of March 31, 1977 adopts the regulation of chapters I and IV, title IV of D.L. 21147 regarding forestal extraction and transportation

[Not available for this report.]

Reglamento de Ordenacion Forestal del Decreto Ley No. 21147 (D.S. No. 159-77-AG of 31-03-77).

[Not available for this report.]

3.3 SOILS

3.3.1 Forestry and Wildlife Law, Decree Law NO. 21147, May 13, 1975 (Ley Forestal y de Fauna Silvestre

Title II provides for the establishment of protected forests, which are to be left undisturbed for the purposes of soil conservation and watershed protection.

3.4 WILDLIFE

3.4.1 Forestry and Wildlife Law, Decree Law No. 21147, May 13, 1975 (Ley Forestal y de Fauna Silvestre

Title II establishes classes of conservation units (national parks, reserves, etc.). See 3.2.1 above.

Title III, Chapter II

Removal or Hunting of Wild Animals

Wild animals are within the public domain and their extraction or hunting is subject to rules and regulations as laid down by the General Directorate of Forest and Wildlife with the aim of the rational utilization of resources.

Extraction of wildlife products comprises hunting or capturing these animals as well as collection of their eggs or remains.

Hunting falls into five categories: subsistence; sport; sanitary (killing of dangerous species); scientific; and commercial. Sport hunting requires a license from the Ministry of Agriculture. Sanitary hunting is to be carried out only by personnel authorized by the Ministry of Agriculture, except in the case of imminent danger. Commercial hunting may be conducted only under personal intransferable contracts granted by the Ministry of Agriculture

The Minister of Agriculture is to set annually the prices for natural animal products.

Removal of wildlife from the territory of Native Communities (Indians) is to be carried out only be members of those communities, who, however, require authorization from the Ministry of Agriculture for commercial hunting.

Hunting season is to be regulated by the General Directorate of Forests and Wildlife, taking into consideration factors such as the protection of wildlife.

The Minister of Agriculture is authorized to specify by Supreme Decree those endangered species which may not be hunted. The removal of endangered species or the export of specimens thereof for scientific research must be authorized by Supreme Resolution.

The Ministry of Agriculture is empowered to issue Supreme Resolutions declaring certain public lands as areas for sport hunting.

The Ministry of Agriculture is authorized to establish by Supreme Resolution Communal Reserves for the conservation of wildlife to the benefit of the local population for whom these animals are a traditional food source.

3.4.2 Regulations under Forestry and Wildlife law relating to wildlife

Supreme Decree 158-77-AG of March 31, 1977, issues the regulation on conservation of the wild flora and fauna
E.P. May 6, 1977

Supreme Decree 160-33-AG approves the regulation on conservation units of D.L. 21147 (title II)
E.P. April 7, 1977

3.4.3 Degree Law 21670 of October 26, 1976 approves the agreement with Brazil on Conservation of the flora and fauna of the Amazon territories, signed in Lima on November 7, 1975.

3.5 COASTS AND BEACHES

3.5.1 Civil Code, paragraph 2, article 822

Property of the State includes the territorial sea and its shores and an adjoining area to be determined by law.

3.5.2 Supreme Decree 781 of August 1, 1947

National sovereignty and jurisdiction extend to the continental and insular submarine shelf adjacent to the mainland or island coasts of the national territory. National sovereignty and jurisdiction are exercised over the sea adjacent to its coasts, regardless if its depth, to a distance necessary to reserve, protect, conserve, and utilize the natural wealth and resources of any kind in or under the sea.

Peru is to exercise control and protection at a distance extending 200 marine miles from the coastline.

3.5.3 Laws dealing with petroleum exploitation declare the continental shelf as as national reserve subject to special rules (see 3.7.2).

3.5.4 Supreme Decree of October 7, 1960 Regulating the Sanitary Control of Beaches and Ancillary Establishments

3.5.5 Supreme Decree of February 11, 1965 no. 38-65-DGS to supplement the Regulations for the Sanitary Control of Beaches
E.P. February 25, 1965 IDHL: vol. 17, 1966

The decree states that Health Zones in coastal areas are responsible for controlling the discharge of industrial effluents into the sea, through the intermediary of the competent technical office for envivronmental sanitation. It requires industrial plants to treat their effluents before discharging them onto the beaches and to discharge them into the sea in such a manner as to reduce their harmfulness to a minimum. The decree also contains the technical requirements for the treatment of effluents. Plans for industrial discharges into the sea or estuaries or for the treatment of these wastes prior to discharge must be approved by the General Directroate of Health on the basis of a report from the approriate technical office and from the Division of Environmental Sanitation.

3.5.6 Ministerial Resolution 0282-77-PM/ONAJ of December 12, 1977
E.P. December 18, 1977

Creates a multisectorial commission to carry out a study on protection of the continental shelf

3.5.7 Supreme Decree 027-77-EM/SG of November 16, 1977
Regulates the entry and circulation in Peruvian waters of vessels propelled with nuclear energy or carrying equipment or instruments which use nuclear energy, or of conventional vessels transporting radioactive nuclear materials.
E.P. January 12, 1978

3.6 FISHERIES

3.6.1 Decree Law 18,810 of March 25, 1971 (General Fishing Law)

The government of Peru is to exercise ownership of marine species contained in the jurisdictional sea for 200 miles. Fishing is declared a public utility and a social necessity, and the state is inspector of the fishing industry because it also administers marine resources. Provisions cover: marketing of fishery products; granting of fishing rights; investment incentives; treatment of foreign capital; fishing communities; and profit sharing.

Fishing rights extend to:
- owners of fishing vessels, who are natural or juridical persons whose fishing vessels are registered with the harbor masters; they are authorized to fish anywhere on the Peruvian coast;
- fishing enterprises, which may be public (state owned); private; or autonomous semipublic (governered by special laws);

Fishery products:
- fish meal and fish oil are marketed exclusively by the state through a public enterprise;

Fisheries research:
- private fishing enterprises must set aside 25% of their net income, tax free, at the close of each fiscal year for use in scientific and technological research to be carried out by the Minsitry of Fisheries through the Institute de Mar.

Implementation:
- the Ministry of Fisheries, with necessary assistance from the Ministry of Industry and Trade, the Ministry of Mining, the Ministry of Telecommunications, and the Ministry of Aeronautics.

3.6.1.1 Regulations under the General Fishing Law

Various regulations have controlled matters such as the fishing season and restrictions on fishing for certain species, such as the anchovy. At latest report regulations had restricted anchovy fishing to the waters off the southern coast of Peru.

Supreme Decree 011-71-PE of June 25, 1971 approve the regulation of the general fishing law
E.P. July 21, 1971

Supreme Decree 018-75-PE of December 30, 1975 approves regulation of the Comision Consultiva del Ministerio de la Pesqueria, created by law 18121
E.P. January 2, 1976

Directorial Resolution of 236-77-PE/DGE of May 13, 1977 sets up conditions to be met by fishing enterprises wishing to engage in the extraction of hydrobiological resources
E.P. May 16, 1977

3.7 MINERALS

3.7.1 Mines

3.7.1.1 Decree-law 18,880 of June 9, 1971, General Mining Law

The law covers all activities related to the use of mineral and fossil matter contained in the soil and subsoil of the national territory, including the sea, continental shelf and sea bottom, with the exception of petroleum and similar hydrocarbons, guano deposits, and mineral-medicinal water. Various chapters of the law cover: ownership of mines and mineral substances; mining concessions; rights and obligations of concessionaires; taxation; rights of the state; associated state mining enterprises and special mining enterprises; other benefits to mining enterprises; technical assistance; small-scale mining producers; applications for mining concessions; mining contracts; labor communities; mining companies; and workers' social benefits.

Ownership: mineral deposits are the inalienable and imprescriptible property of the State regardless of the nature of the substances they contain;

Scope of mining activities: prospecting is unrestricted throughout the national territory, except in cultivated lands, archeological zones, and wherever mineral rights already exist;

Activities covered: reconnaissance, prospecting, exploration, exploitation, development, refining, marketing and transportation;

Water: the holder of a mining concession may make use of whatever water is necessary for the domestic use of his personnel and for concession operations as well as of the mineral substances contained in the water, and he has the right to inspect neighboring concessions whenever floods, landslides or fires may be imminent.

See also 3.1.1 (General Water Law), Title III, which requires mining operations to dispose of their wastes in such a way as to prevent water contamination.

3.7.1.2 Decree Law 21791 of February 15, 1977 approves the organic law of the Instituto de Geologia y Minas (INGEOMIN), created by Decree Law 21094. E.P. February 16, 1977

3.7.2 Petroleum

3.7.2.1 General petroleum law

Petroleum exploration, exploitation, etc., is governed by several laws. The Supreme Decree of June 10, 1952, as amended, extends to all rights acquired prior to February 19, 1969; the concessions systems provided in the law was abolished by the Decree-law 17,440 of February 19, 1969, which, in conjunction with Decree-law 18,440, Decree-law 18,883, Decree

-law 19,482 of July 25, 1972, Decree-law 19,438 of June 14, 1972, and other legislation, governs post-1969 activities related to petroleum exploitation. Decree-law 18,939 and other legislation provide for tax exemptions and other benefits designed to encourage exploration and exploitation of petroleum in the Selva zone of Peru.

Ownership: deposits of petroleum and similar hydrocarbons (asphalt, natural gas, etc. but not coal or helium gas) are inalienable and imprescriptible property of the State.

Exploitation: Under Decree Law 17,440 the exploitation of the basic petroleum industry is the exclusive reponsibility of the State.

Water: A concessionaire may utilize the water, timber, gravel, sand, and other building materials found on the concession.

National reserves: Certain areas are to be set aside as national reserves and are subject to a separate concession system; these include the continental shelf zone of Peru.

3.7.2.2 Supreme Decree 15-68-MA of August 2, 1968 adopts measures to avoid oil pollution of sea waters by petroleum.
E.P. September 4, 1968

3.8 AIR AND GENERAL POLLUTION CONTROL

As reported in 1974 (see Gastanaga Coll 1974:38), a law on the Prevention and Control of Air Pollution was being drafted with the cooperation of the Institut de Salud Occupacional of the Ministry of Health. As of mid-1978, no such law appears to have been actually issued.

3.8.1 Law on the Control of Emission and Harmful Wastes (1962).
(Ley de Control de Emanaciones y Residuos Nocivos, No. 14084)

3.8.2 Law no. 16583 (see Gastagna Coll 1974:38).
-Apparently sets up the commission for the study of Pollution in the Valley of the Tambo River.

3.9 AGRICULTURE, LAND USE, LAND REFORM, DEVELOPMENT

3.9.1 Act No. 17.716: The Land Reform Act (Decreto-Ley No. 17.716, Ley de Reforma Agraria). 24 June 1969.

The stated purpose of the Act is to "transform the agrarian structure of the country and replace the system of very large landholdings (latifundios) and very small holdings (minifundios) by an equitable system of land ownership, tenancy and exploitation by instituting...a framework of agrarian legislation which will guarantee social justice for the agricultural sector, increase the output and productivity of the land, raise and assure the incomes of the farming population, so that the land represents for the person working it a basis of economic stability, the foundation of his well-being and a guarantee of his dignity and freedom."

More specificially, the law sets maximum limits for land holdings in the various regions of the country (150 hectares in the Costa, with, however, a limit of 200 hectares for owners sharing 10% of profits with employees; in the Sierra 15 to 55 hectares for irrigated land and double the amount for non-irrigated land). The maximum holding for forest land was fixed at 1,500 hectares. All lands in excess of these amounts are subject to expropriation. Expropriated lands were not to be redistributed as individual packets but rather to be reorganized into cooperatives called Social-Interest Agricultural Societies.

The law also: prohibits farming units smaller than three hectares, imposes rent controls for tenants not exceeding 10% of the gross income from the land, and abolishes the exchange of personal services for the use of land.

For administrative purposes, the law establishes the Direccion General de Reforma Agraria y Asentamiento Rural within the Ministry of Agriculture. Land reform zones are also established with Land Reform Zonal Directors responsible for administration within their areas. The law also establishes agrarian reform courts, whose decisions may not be appealed.

3.9.2 Decree Law of June 10, 1976
-defines the geographical limits of the agrarian zones of the Ministry of Agriculture
E.P. June 14, 1976

3.9.3 Decree Law 21419 of February 10, 1976
-declares that agricultural lands cannot be used for purposes of urban expansion.

3.9.4 Supreme Decree 012-76-VC of April 13, 1976
-regulates Decree Law 21419 and 21461, establishing rules for distinguishing agricultural from non-agricultural land.

3.9.5 Decree Law 21487 of May 11, 1976
-law on administrative organization for the development of the Complejo de Bayovar (Bayovar Industrial Complex)
E.P. May 12, 1976 and June 26, 1976

3.9.6 Supreme Decree 026-76-PM of November 30, 1976
-creates the Comite Departamental de Desarrollo de Lambayeque to coordinate and promote the Development of this department
-Similar decrees have created such committees for other departments of Peru.
E.P. December 1, 1976

3.9.7 Treaty on Amazon cooperation signed in Brasilia on July 3, 1978 by Bolivia, Brazil, Colombia, Ecudar, Guyana, Peru, Surinam, and Venezuela
-deals with rational development of the Amazon Region.
E.P. July 4, 1978.

3.10 HEALTH, TOXIC SUBSTANCES, SANITATION, AND WATER SUPPLY

3.10.1 Law 11,672 of December 31, 1951

-creates the National Health and Social Welfare Fund, an agency entrusted with carrying out works and services designed to improve the health of the country, to promote protection of the health of the inhabitants, and to support public welfare
-the law requires the Ministry of Public Health and Social Welfare to establish a system of health and social welfare units

3.10.2 Supreme Resolution no. 193 of April 30, 1962 regulating the Import and Marketing of Agricultural Pesticides

E.P. June 5, 1962

The resolution requires that the export and sale of agricultural pesticides and similar substances be subject to the prior authorization of the Agricultural Inspection and Control Directorate. The resolution covers: the functions and responsibilities of the technical advisors, the maintenance of registers and the entry of pesticides; procedures for requesting the entry of pesticides; requirements for entry and use of experimental products; information to be placed on labels and on advertising material; inspection of pesticides; and violations and penalties.

3.10.3 Health aspects of pesticide use

It has recently been reported that the Peruvian government has issued a law designed to combat mismanagement of toxic chemicals by fumigators and exterminators. Under the law all companies using insecticides and disinfectants such as DDT and cyanogen will be expected to fulfill legal requirements concerning personnel, equipment, and techniques. All companies are to register with the Environmental Health Department of the Ministry of Health, which will also be responsible for approval of storage facilities, techniques, and equipment. A spokesman for the department of environmental health said that complimentary legislation will be issued in the near future (WER July 30, 1979:5).

3.10.4 Supreme Decree 016-76-AL of October 25, 1976-

-contains regulations on sanitation for the import and export of vegetable products and byproducts.

3.10.5 Supreme Decree 013-77-SA of November 29, 1977 approves the regulation for the use of inorganic products removed from trash

E.P. January 22, 1978.

3.10.6 Supreme Decree 041-77-VC of September 29, 1977

-regulates the Empresa de Sanamiento de Trujillo (ESAT) (Trujillo Sanitation Board.
E.P. October 3, 1977
[similar regulations control such organizations for other municipalities].

3.11 ENERGY, NUCLEAR POWER, AND RADIATION

According to an item in World Environment Report, February 13, 1978). the Peruvian government has passed legislation designed to ensure than all sea transport of nuclear material will be monitored. Any ship categorized as nuclear (nuclear-powered or carrying radioactive equipment) must obtain permission to enter Peruvian waters (within 200 miles of the Peruvian coast) and must present a detailed report on any loading or unloading to be carried out in Peru (WEP Feb. 13, 1978:8). (See 3.5.7)

3.11.1 Ministerial Resolution 0818-77-EM/DGH of November 25, 1977 approves the regulation on the sale of kerosene for home use.
E.P. December 3, 1977

3.11.2 Supreme Decree No. 1 of November 16, 1955 creates the Atomic Energy Board, to deal with matters involving radioactive substances.

3.11.3 Presidential Resolution 986-77-IPEN-AJ of November 10, 1977 -issues basic rules on nuclear safety and protection against radiation.
E.P. November 20, 1977.

4.0 RESOURCES OF PERU

4.1 Topography and Climate (See rainfall maps on page 48a and table indicating rainfall and evaportranspiration for Meteorological Stations in the major geographic region on page 48b.)

Peru is divided into three distinct regions defined by geographical, topographical, and climatic factors: the Costa region is formed by the Pacific littoral and the Andes below 2,000 meters; the Selva (sometimes called the jungle, the Montana (forest) or the Oriente) comprises the low-lying tropical rainforest country of eastern Peru (the Low Selva) and the eastern slopes of the Andes below 2,000 meters (the High Selva); the Sierra comprises the Andean heights and valleys lying between the Costa and the Selva. The limits of these areas were officially defined by legislation enacted by the Peruvian government in 1960.

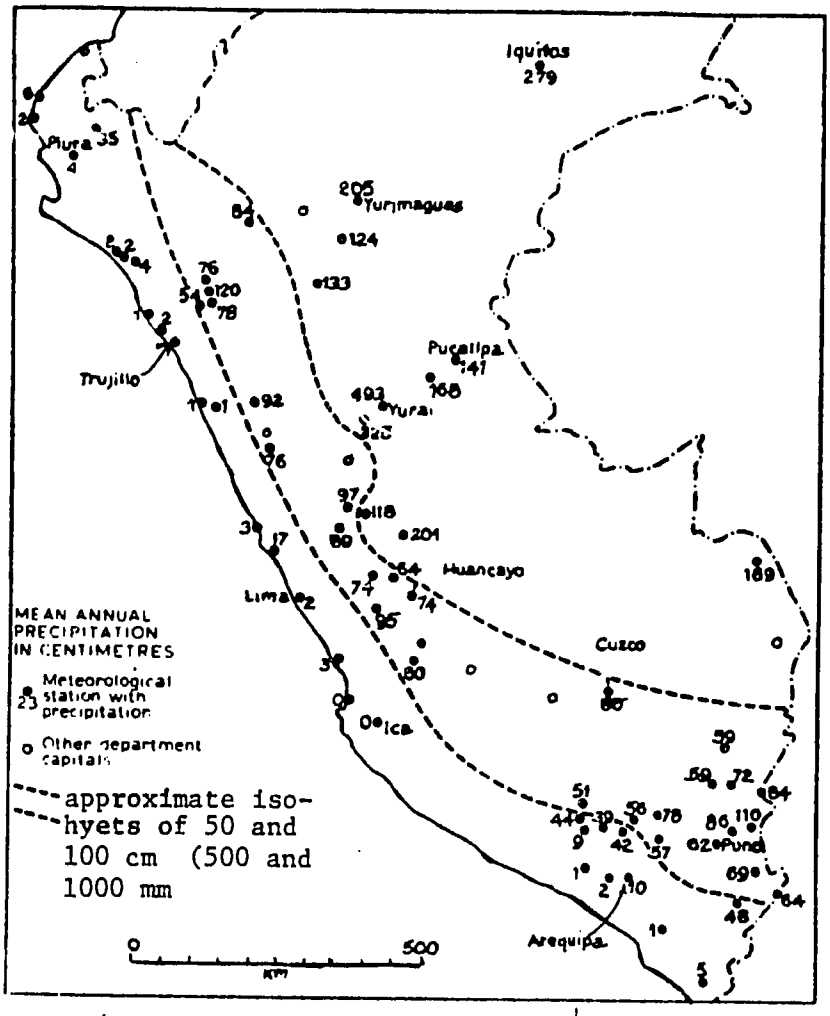
Costa

The Costa, which comprises about 11% of the total land mass of Peru, consists of dry flat plains and sand dunes below 260 meters elevation (the Low Costa) and dry Andean foothills up to 2,000 meters (High Costa). Most of the coastal area is a desert, broken by occasional fertile valleys along the banks of rivers that provide important irrigation water. The Costa is broadest in the North, the dune region of the Sechura Desert, and relatively broad in Lima Department. In many areas, however, the Costa is reduced to a thin strip by spurs of the Andes that drop abruptly almost to the shore; from Ica department to the Chilean border, the Costa is almost completely eliminated by a coastal range attaining heights of up to 1,000 meters.

The climate of the Costa is dominated by the Peru or Humboldt Current, a cold ocean current running northeast from the Antarctic along the western coast of South America from northern Chile to northern Peru. The colder branch of this current, with temperatures of from 14 to 17 C, emerges from the depths of the ocean at the coast of northern Chile, producing air temperatures ranging during the year from 18 degrees to 22 C, a full six degrees lower than those along the Atlantic Coast of Brazil at the same latitude.

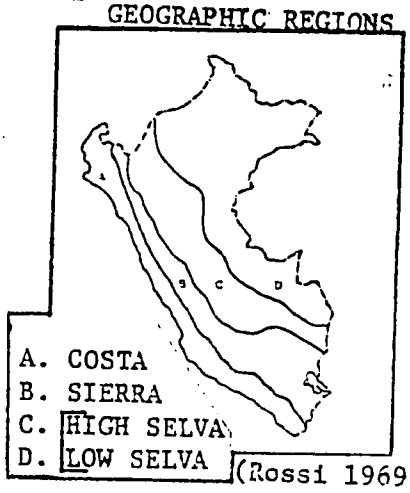
Coastal winds, blowing predominantly from the southwest, bring the cold moisture-laden air from above the cold current across the warmer land area, where it is heated, undergoes a decrease in relative humidity, and rises. Since colder air above the warmer air mass prevent it from rising above about 800 meters and the slopes of the Andes prevent it from moving eastward, the coastal area is characterized by a static cloud layer which, from June to October may extend far out to sea, accompanied by a fine mist (garua). Although this mist usually occurs at higher elevations, even obscuring the sun during the winter months, it may sometimes occur at sea level as well. High temperatures in the summer months prevent fog formation. The mist of the garua provide moisture to the land in some areas of the otherwise arid Costa, where rainfall levels average as little as 10 millimeters per year. Because

MEAN ANNUAL PRECIPITATION IN CENTIMETERS

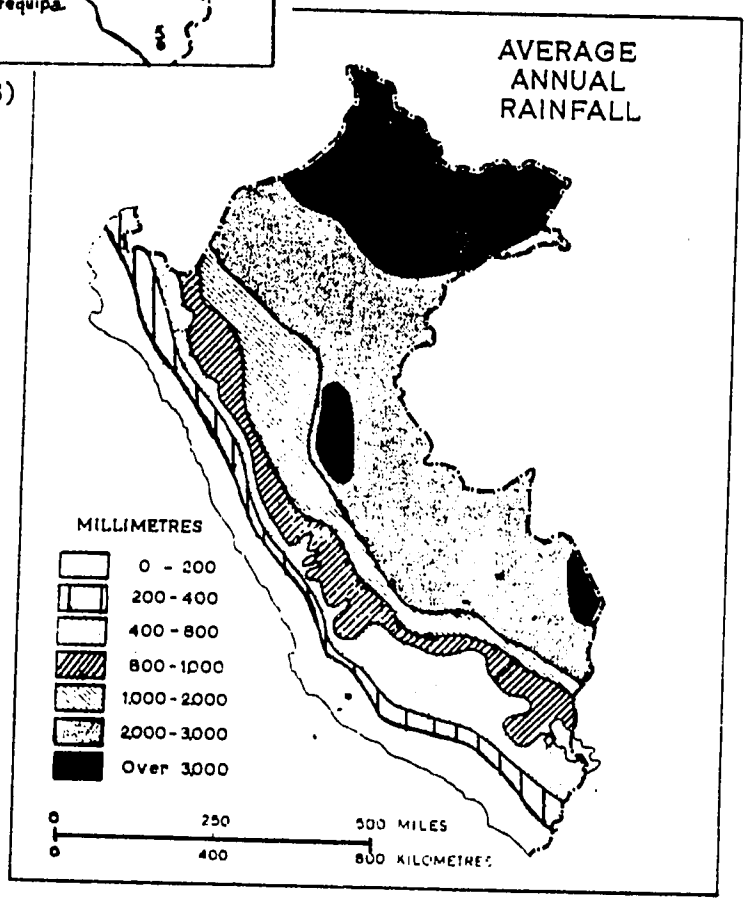


(Source: Cole and Mather 1978)

GEOGRAPHIC REGIONS



(Rossi 1969)



MEAN MONTHLY RAINFALL*, TEMPERATURE**, AND EVAPOTRANSPIRATION*** for Selected Meteorological Stations in Peru (Temp. in Centigrade, Rainfall and Evapotranspiration in millimeters)

REGION, Station and alt. in m.	January			February			March			April		
	Temp.	Rain.	Evap.	Temp.	Rain	Evap.	Temp.	Rain	Evap.	Temp.	Rain	Evap.
COSTA												
Lima(111)	21.4	0.8	90	22.2	0.3	90	22.4	0.8	90	19.8	0.3	80
Lambayeque(18)	25.1	1.0	90	26.3	7.1	120	26.2	7.1	120	24.6	3.0	90
Cartavio	23.1	1.0	80	24.1	3.0	90	23.8	1.0	80	22.0	0.0	70
SIERRA												
Cajamarca(2,622)	14.6	95.0	60	14.1	113.3	80	14.2	136.1	70	13.8	108.0	70
Cuzco(3,249)	12.0	158.2	80	11.4	128.3	80	11.9	126.5	90	11.4	37.6	90
Huancayo(3,350)	12.1	136.1	140	12.0	125.7	130	11.7	115.8	110	11.6	50.8	40
Arequipa(2,525)	14.1	31.0	80	14.3	25.9	80	14.5	29.0	90	13.4	1.0	100
SELVA												
Tingo Maria(665)	22.5	423.9	110	22.1	403.4	100	22.4	469.4	110	72.1	13.83	110
Iquitos(126)	32.0	261.1	110	--	199.9	100	--	270.0	110	--	12.36	100

	May			June			July			August		
	Temp.	Rain	Evap.	Temp.	Rain	Evap.	Temp.	Rain	Evap.	Temp.	Rain	Evap.
COSTA												
Lima	17.5	1.3	60	15.6	3.3	40	9.7	4.8	40	15.0	6.4	30
Lambayeque	22.8	1.0	80	20.9	1.0	60	19.6	0.0	60	19.3	0.0	50
Cartavio	21.0	0.0	60	66.6	0.0	50	18.3	0.0	50	18.0	0.0	50
SIERRA												
Cajamarca	13.9	37.1	80	13.2	12.7	70	13.1	4.8	90	14.0	8.6	90
Cuzco	10.2	0.9	00	9.5	5.3	100	8.8	1.0	100	10.2	8.1	100
Huancayo	10.2	21.8	20	9.8	8.1	10	9.3	5.1	10	10.2	11.1	10
Arequipa	12.7	0.00	120	11.2	0.0	110	11.5	0.0	100	12.1	0.0	110
SELVA												
Tingo Maria	22.4	216.7	120	21.8	175.2	130	22.0	156.7	110	22.6	112.0	130
Iquitos	--	257.0	90	--	172.0	100	30.8	177.0	100	--	138.0	120

	September			October			November			December		
	Temp.	Rain	Evap.	Temp.	Rain	Evap.	Temp.	Rain	Evap.	Temp.	Rain	Evap.
COSTA												
Lima	15.4	4.6	40	16.2	2.0	60	17.4	1.0	60	19.1	0.5	70
Lambayeque	19.7	1.0	60	20.2	1.0	70	21.2	1.0	90	22.7	2.0	90
Cartavio	17.9	0.0	50	18.2	1.0	50	19.0	0.0	60	20.7	1.0	70
SIERRA												
Cajamarca	14.5	30.4	80	14.3	86.9	80	14.6	71.9	90	14.3	77.5	80
Cuzco	11.5	24.1	100	12.3	42.7	100	12.9	80.5	110	12.4	128.0	90
Huancayo	11.9	40.4	40	12.4	71.4	70	12.7	68.8	60	12.2	93.5	80
Arequipa	12.9	1.0	120	13.4	0.0	110	56.1	1.0	110	13.5	5.1	90
SELVA												
Tingo Maria	22.5	183.6	130	22.7	340.9	120	26.6	288.8	120	23.4	289.1	110
Iquitos	--	204.0	130	--	218.9	120	--	270.0	120	--	246.1	110

	YEAR TOTAL AVERAGES		
	Temp.	Rain	Evap.
COSTA			
Lima	18.0	25.9	75
Lambayeque	22.9	24.9	98
Cartavio	20.4	7.8	76
SIERRA			
Cajamarca	14.0	782.3	95
Cuzco	10.9	749.3	113
Huancayo	11.2	748.8	72
Arequipa	13.1	94.0	122
SELVA			
Tingo Maria	22.5	3,409.7	140
Iquitos	31.9	2,726.9	131

*From Saettone and Porter 1979, Annex 5: 18, (converted into Centigrade)
**From Saettone and Porter 1979, Annex 5: 17, (converted into millimeters)
***From Saetton and Porter 1979, Annex 8: 94

of these conditions agriculture in the Costa, which accounted for as much as 26% of cultivated land in 1970, takes places almost exclusively under irrigation.

Sierra

The Sierra encompasses the heights of the mountain ranges of the Andes, which cut through Peru in a north-south direction, and the valleys and and high plateau country (altiplano or puna) which run between them. The three major Andean ranges are: the Cordillera Occidental (which for the most part runs along the coast), the Cordillera Central (a discontinuous series of mountain ranges generally paralleling the Cordillera Occidental at a distance of from 80 to 120 kilometers in the north and turning inland to form the eastern rim of Lake Titicaca in the south), and the Cordillera Oriental (a series of lower mountains fringing the Amazon to the west). The highest elevation in the Sierra region is Mount Huascaran (6,768.1 meters) in the Cordillera Occidental.

This area, the center of the ancient Inca empire, provides habitation for Indians mostly in the high mountain valleys. Rainfall, carried by clouds blown across the continent from the Atlantic Ocean, is heavier than in the Costa (over 1200 mm in some areas), reaching its highest levels between the central and eastern cordilleras, but some areas in high valleys and deep gorges receive only meager rainfall because of the deflection of moist air by the mountains. Rainfall is heaviest during the summer months from September to April, with a marked dry season during the winter months (see maps and table, pages 48a and 48b).

Temperatures in the sierra drop quite low in the winter months, frosts occurring on an average of 25 days a months above 4,000 meters. Permanent snow lies on the higher peaks, mostly above 4,500 meters. Temperatures vary with altitude but there is little seasonal variation in local average temperatures; however, temperatures may drop dramatically at night--from 18 degrees C to freezing in a few hours.

Selva

The Selva, which accounts for an estimated 63% of the total territory of Peru, consists of the Low Selva, below 600 to 900 meters (the area of the Amazon rain forest) and the High Selva, a transitional area of from 100 to 160 kilometers in width running between the Andes and the rain-rainforest of the Low Selva. The High Selva is characterized by great variations in vegetation, conditioned by rainfall, relief, and soils. Because of the steep nature of most of the slopes of the High Selva, agricultural possibilities are limited. The Low Selva is a gently rolling, forested plain covered with vegetation so dense that rivers are the principal transportation routes.

Rainfall in the Selva averages 3,960 millimeters annually in Tingo Maria in the High Selva and is somewhat lower in the Low Selva, where it averages 2,540 millimeters per year spread out over 200 days. In contrast to the Sierra, the Selva experiences no dry season. Temperatures in the low Selva are quite high, averaging 21 degrees C throughout the year at Iquitos on the Amazon, with midday readings occasionally exceeding 38 degrees C.

Adverse weather conditions

Peru is frequently subject to droughts and other weather conditions which adversely affect agricultural production. In 1977, for example, lack of rainfall and frosts in the central and southern sierra of Peru affected the produxtion of some crops, paricularly potatoes, yuca (cassava), and wheat (CEPAL 1977:728).

Associated with disruptions of the cold Humboldt Current such as those brought about by the periodic occurrences of the warmer El Nino current (see 4.6.2) are heavy rains in the normally arid coastal area.

Disasters associated with geological and topographical features

Earthquakes have periodically caused widespread destruction and death in Peru, chiefly in the Costa and Sierra regions. Lima and other large cities of the Costa region are in continual damage from earthquakes. Earthquakes having a magnitude of 5.3 and higher occured in 1947, 1951, 1952, 1954, 1955, 1957, 1970, and several times in 1974. The most destructive earthquake in recent years was in May 1970. This quake, with an epicenter just off the coast near Chimbote, triggered both massive and smaller landslides which destroyed villages, cut off transport routes, and killed thousands of people. In the town of Yungay alone, 18,000 people lost their lives (Saettone and Porter 1979: Annex 1:119).

4.2 Water Resources

General

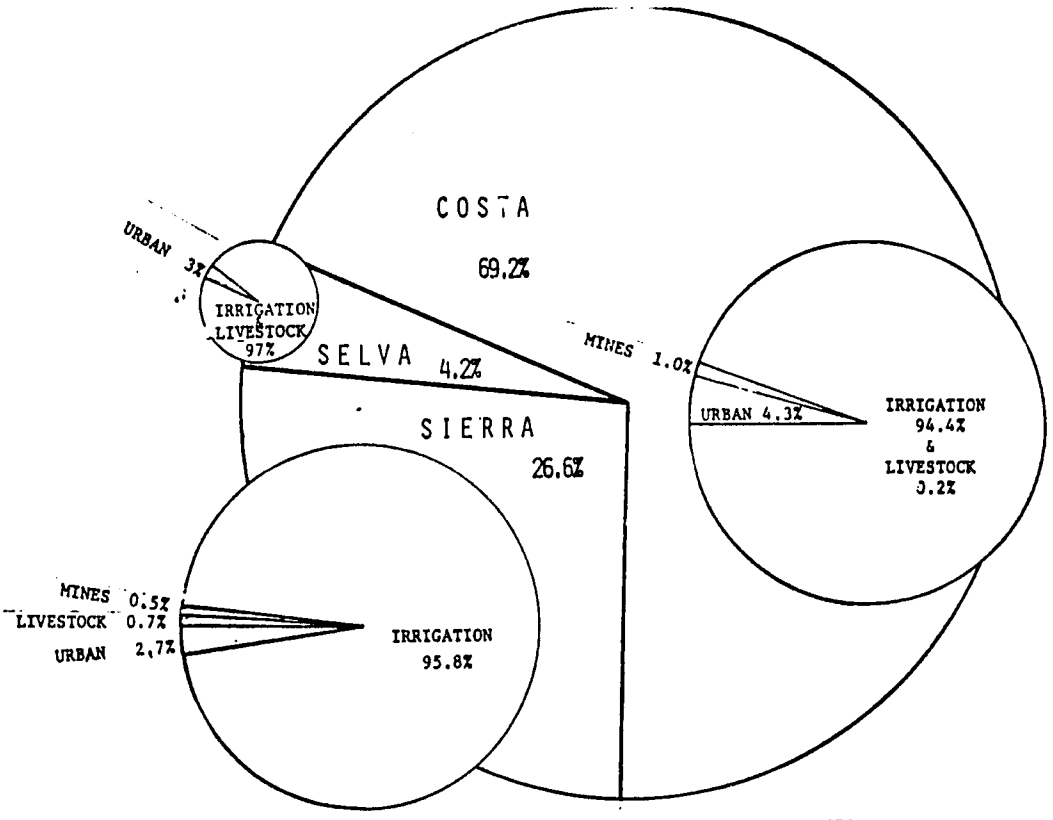
Peru's major water problems arise from the disparity between location of water supplies and that of population and economic centers. The Costa region, for example, which controls only about 2.3% of the nation's water resources, contains 46% of the total population and accounts for about 70% of water usage. Ironically, as one moves eastward across the Andes and into the lowlands of the selva, rainfall and water resources increase, while population, economic activity, and, consequently, demand for water decrease.

A recent report indicates that water supplies in the Costa region are reaching full development for irrigated agriculture, municipal, industrial, and hydropower needs. If development is to continue in this area, water will have to be imported from the eastern slopes of the Andes (Saettone and Porter 1979: Annex 5, 1). Presently, water supplies in the Costa are supplemented by transmountain diversion of water from the Maranon and Mantaro Rivers sytems of the Amazon watershed (Saettone and Porter 1979: Annex 5, 28). The government hopes that its policy of industrial decentralization will relieve pressures on water supply in the Costa region by halting migration to Costa cities and diverting it to other areas (UNWC 1976:26).

Recent estimates of total water availability range from 791,580 MCM per year to 1,494,679 MCM per year (Saettone and Porter 1979: Annex 1:101-105). Water utilization from all sources in Peru has recently been estimated at 24,300.19 million cubic meters (MCM) annually (Saettone and Porter

1979: Annex V, 29; and Annex I, 104). This usage by region and by purpose within region, based on data from Saettone and Porter indicated by the diagram below.

PERCENTAGE OF WATER USE BY REGION
AND BY PURPOSE WITHIN REGION



Based on data in Saettone and Porter 1979, Annex 5, page 29

4.2.1 Surface Waters

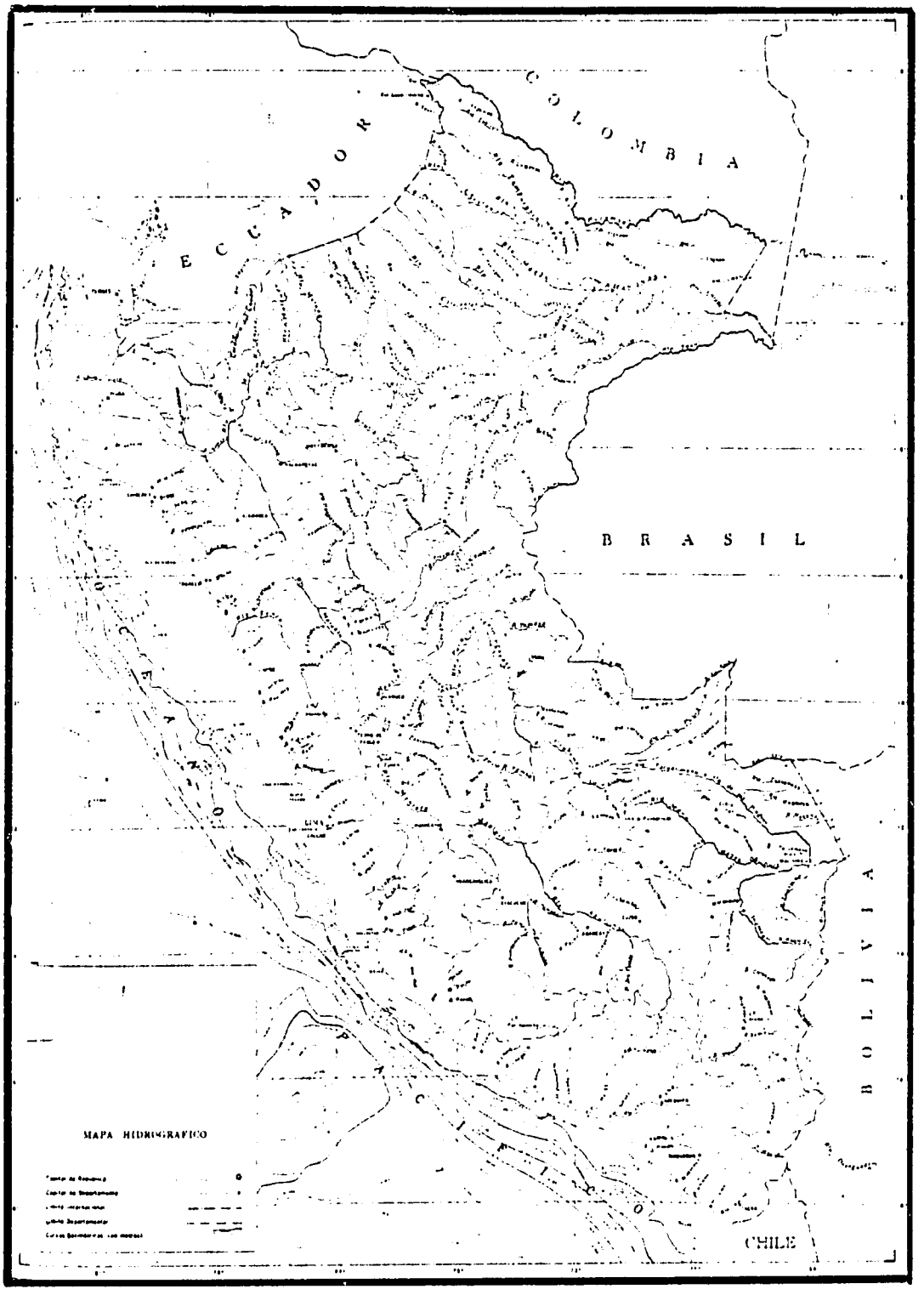
4.2.1.1 Rivers (see map on page 51a)

4.2.1.1.1 The resource (CEPAL 1977, Table 1)

Peru has 271 national river basins and 1,014 international river basins, which receive runoff from an estimated average 1,690 mm of rainfall per basin per year. Peruvian River basins fall into three groups: those draining to the Pacific, those draining to the Amazon, and those draining into Lake Titicaca in southern Peru.

RIVERS AND COASTAL ZONE OF PERU

(from Penaherrera 1969: plate 35)



PACIFIC

River basin areas covering an estimated 229,000 to 277,000 square kilometers drain from the Andes to the Pacific Ocean (CEPAL 1977, Table 1; Saettone and Porter 1979: Annex 5, Table 4). The estimated annual flow of these rivers is 40 billion cubic meters, of which 25% is used for agricultural purposes, while the remaining 75% is lost in the sea. River flows are highest from February through April and lowest during July through September.

Rainfall in these Pacific-draining basins is generally less than 600 mm per year (Saettone and Porter 1979: Annex 5, 16).

Of the some fifty-two Peruvian rivers draining to the Pacific all flow westward, with the exception of the longest, the Santa River, which flows about 160 kilometers from north to south before dropping through a deep canyon to the Pacific. Most of these rivers are between 100 to 200 kilometers in length, none exceeds 320 kilometers, and only about ten have year-round flows; the remainder are seasonal in nature, becoming swollen and turbulent during the rainy months. Flowing through Lima and dividing the city in two is the Rimac River, from which the city derives its name.

Water availability in the Pacific watershed area has recently been estimated at from 29,949 MCM (Lahmeyer International as reported in Saettone and Porter 1979: Annex 1: 104) to 33,971,83 MCM per year (as estimated by ONERN and reported in Saettone and Porter 1979: Annex 1: 104).* Present total storage capacity is estimated at 2.5 billion cubic meters, and the potential net storage capacity is 6.5 billion cubic meters (UNWC 1976:26).

AMAZON (Atlantic watershed)

Originating in the highlands of the Sierra, are the rivers which drain to the Amazon Basin. This watershed area has gradually moved to within 100 miles of the Pacific. The areas covered by these rivers, the largest and most important in Peru, have been estimated at from 952,000 to 1,024,450 square kilometers (CEPAL 1977, Table 1; Saettone and Porter 1979: Annex 1: page 104). Average rainfall in these basins is over 2,000 mm per year, reaching as high as 3358 mm in the Madre de Dios river basin.

The largest of the Amazon-draining rivers is the Maranon River, which flows northward from Lake Lauricocha, almost reaching the Ecuador border, before turning eastward and flowing through Lorato Department to join the Amazon; for three months of the year the river rises at least nine metres to flood the lowlands of northeastern Peru. Parallelling the course of the Maranon but separated from it by the Cordilliera Central, is the Huallaga River. The Ucayali-Apurimac system flows some 2,738 kilometers from the southern highlands of Peru to join the Amazon near Omaguas in Loreto Department. Both the Apurimac and the Urubamba, which join to form the Ucayali, cut great gorges through the central cordillera.

In southern Peru there also originate a group of rivers which, in contrast to the Ucayali-Apurimac system, flow due east to join either the Purus

*The Lahmeyer International figure, based on detailed analysis of each river basin, has been judged the more accurate (Saettone and Porter 1979:Annex 1:104).

River in Brazil or the Beni (and eventually the Madeira) in northern Bolivia. These are also part of the great Amazon system.

Estimates of average annual water availability in the Amazon watershed area range from 362,526 MCM (Lahmeyer International as reported in Saettone and Porter 1979: Annex 1, 104) to as high as 1,437,001.5 MCM (as estimated by ONERN and reported in Saettone and Porter 1979: Annex 1, 104).*

TITICACA BASIN

An estimated 35,000 square kilometers of river basin drain to Lake Titicaca in southern Peru. The largest of these is the Ramis River with a basin area of 14,444 square kilometers and an annual runoff of 2,643 MCM. The streams in this basin receive an average of 720 mm of rain per year. (Saettone and Porter 1979: Annex 1: 104).

Estimates of water availability in the Titicaca Basin per year range from 6,630 MCM (Lahmeyer International as reported in Saettone and Porter 1979: Annex 1, 104) to 23,705.4 MCM (as estimated by ONERN and reported in Saettone and Porter 1979: Annex 1: 104).*

4.2.1.1.2 Utilization of rivers

4.2.1.1.2.1 Navigation

There are approximately 8,600 kilometers of navigable rivers in the Amazon basin system, where, because of dense forest growth, rivers have traditionally formed the chief transportation routes. The navigability of many streams is frequently interrupted by rapids on the slopes of the higher elevations of the Selva (National Intelligence 1979; Weil 1972:40).

4.2.1.1.2.2 Irrigation

Cultivated and irrigated land in Peru (CEPAL 1977:Table 6)
(in millions of hectares)

territory	cultivated	harvested	irrigated*	percentage
128.50	3.10	1.7	1.25	40%

Irrigation and livestock watering account for over 95% of the water used in Peru, and rivers supply over 90% of this water. By one recent ONERN estimate as much as 46.7% of the water available each year in the Pacific watershed is used for irrigation (Saettone and Porter 1979: Annex 1, 104).

Most of the irrigated territory of Peru is in the Costa Region, where rainfall levels are so low as to make non-irrigated agriculture virtually

*See footnote, page 52.
**Recent ONERN estimates indicate 1.13 million hectares of irrigated land (Saettone and Porter 1979: Annex 5, 104).

impossible. Here, features of the landscape necessitate costly and complicated engineering work to regulate and divert nearby basins or rivers for irrigating the coastal land. Very strict legal provision to regulate water use and establish priorities are also reguired (UNWC 1976:27). There is, however, an estimated 10 million cubic meter shortage of irrigation water; this stems from the uneven hydrological system of the slope and the lack or inadequacy of dams and other regulatory works (UNWC 1976:26).

As of 1967, only 0.1% of agriculture in the Costa region was practiced under rainfall; in that year, about 20% of the cultivated land of the Sierra was irrigated, while only about 9% of the agricultural land in the Selva required irrigation. As of 1976 a total of 1,250,000 hectares of land were irrigated, with the overwhelming majority of irrigation water being used in the Costa region (UNWC 1976:27). By a 1978 ONERN estimate 68.9% of irrigation water is used in the Costa; 26.8% in the Sierra; and 4.3% in the Selva (Saettone and Porter 1979: Annex 1: 104).

The seasonal nature of much of the irrigation water used in coastal agricultural has forced the Peruvian government to attempt to divert water from the Amazon watershed to Pacific-flowing Andean river for used in Costa irrigation projects. A pilot project begun in April 1975 in La Joya along the Chilean border in the south, had, between April 1975 and late 1976, brought nearly 3,000 of a projected 7,300 hectares under cultivation (this is a colonization project involving 431 state-selected families). Results from the early stages of this project encouraged the government to plan another project for the irrigation of some 55,400 hectares in nearby Majes region; this projects involves the gradual resettling of some 10,000 farms families, beginning with 500 in 1980 (WER[1-17-77]:1). [The dams and their companion reservoirs are located in three strategically separate areas along the river, total storage capacity is about 400,000 cubic yards.]

In the higher regions of the Sierra and in the High Selva surface runoff from the eastern slopes of the Andes is used to for irrigation as well as for community water supplies; from 250,000 to 357,000 hectares are thus irrigated (UNWC 1976:26; Saettone and Porter 1979: Annex 1, 104).

4.2.1.1.2.3 Hydroelectric power

Installed Hydroelectric Power
(1977: from Saettone and Porter 1979: Annex 5,4)

Installed Capacity	Total elec.	Installed hydro. as % of total	Elec. generated (1977: in GWh) Hydro	Total	Hydro as % of total
1,406.5	2,542	55%	5,825.3	8,155	71.4%

The total potential hydropower of Peruvian Rivers from all three watersheds is estimated at 194,128 MW (15.4% from the Pacific watershed, 84.3% from the Amazon watershed, and 0.29% from the Titicaca watershed). The estimated achievable hydroelectric development, taking into account such factors as present economics and geographic and topographic re-

strictions is about 58,000 megawatts (about 30% of the total potential). (Saettone and Porter 1979: Annex 5: 3, 33).

Existing hydroelectric development is concentrated in the Pacific coastal area to meet metropolitan and industrial demands in that area. The Tumbes, Piura, Chira, Santa, Chili, Rimac, and Hauara are among the rivers of the Pacific watershed tapped for hydroelectric power. Large installations in the Sierra, such as the hydroelectric station on the Mantaro River with an installed capacity of 342 MW generates electricity which is transmitted to Lima and Pisco on the coast (Saettone and Porter 1979: Annex 5:3,32).

Because hydropower potential is so great in Peru and, furthermore, because water used for hydropower can also be used for irrigation, municipal, and industrial purposes, the Peruvian government is presently emphasizing the development of hydropower over fossil fuels in its energy plans (Saettone and Porter 1979: Annex 5, 5-6). Whereas most of the present installed hydroelectric capacity is provided by large power-plants designed to serve large centers, the Peruvian Institute of Technological and Industrial Investigation (INTINTEC) has initiated studies on the possibility of mini-hydroplants of from 5 to 50 kilowatts to provide electricity to rural areas. A pilot plant is now being developed to serve a rural community near Canta about 100 kilometers northeast of Lima (Saettone and Porter 1979: Annex 5: 42-44).

4.2.1.1.2.4 Mining

Only an estimated 0.85% of water use is accounted for by Peru's mining operations, predominantly in the Costa region (see diagram on page 51).

4.2.1.1.2.5 Municipal water supply

Surface water from the Sierra, in conjunction with groundwater, is used to supply domestic water for Lima and other urban areas of the Costa region. This water is stored in reservoirs (chiefly lakes) before being piped to the cities. These systems, however, suffer severely from water losses from damaged and inadequate fittings. Fears that Lima's present water system will be insufficient by the end of the century, have led the government to consider a scheme whereby water would be pumped from the Mantaro River in the central sierra, to a lake at Marcapomacocha, west of the river for eventual convenance to Lima (WER[10-10-77]:6).

4.2.1.1.2.6 Fisheries (see 4.7).

4.2.1.1.3 Pollution of rivers

The pollution of rivers from municipal, industrial, and mining wastes is one of the major environmental problems faced by Peru.

Much of the municipal waste in Peru is dumped untreated into rivers which also serve as sources of irrigation water.

Pollution caused by copper mines in the Andes affects the River Locumba, in the southern department of Tacna on the Chilean border, which, according to a recent study, has a higher level of magnesium that permitted by international standards. In northern Peru, in the vicnity of Trujillo in La Libertad Department, it has been ascertained that the River Moche is heavily polluted with magnesium, cadmium, iron, and zinc at levels currently prohibited under Peruvian legislation. It has been suggested that pollution could be cut if mine tailings were treated prior to being dumped (WER[12-5-77]:6). Other rivers suffering from mine-related pollution are the Hualgayos (Cajamarca), the Huancapeti and Santa Rivers (Ancash), the Rimac (Lima), and the Mantaro (Junin).

According to the Director of Environmental Sanitation in the Ministry of Health, the Mantaro River may now be considered dead because of its mineral content. The river now runs red because of iron slag used by two copper concentrators in La Libertad Department to recover copper by sedimentation of the mining water. The mingling of acid water from the sedimentation plant with mineral-rich mine washings results in especially severe pollution. While no mercury has been found in the Mantaro, quantities of cadmium and quartz, both highly toxic, have been found. Concern over the quality of the waters of the Mantaro is particularly high as a result of a plan now being considered to divert waters from this river for domestic use in Lima ("UN to Aid..."1979:25-26).

In response to severe pollution problems along the Mantaro River and other rivers, which monthly receive 154 million cubic meters of mineral washings from a total of 98 mining concentrators, the United Nations has recently announced plans to set up an Epidemiological Vigilance Project to monitor waters polluted by mineral washings ("UN to Aid..." 1979:25-26).

4.2.1.2 Lakes

4.2.1.2.1 The resource

The Peruvian government has identified a total of 12,201 natural lakes, only 6,855 of which have actually been surveyed. 3,896 of these lakes fall within the Pacific watershed system, 7,441 within the Atlantic, and 841 within the Lake Titicaca system. Only 23 have closed basins (Saettone and Porter 1979: Annex 5, 26-27). Generally considered as an inland sea rather than as a lake is Peru's largest body of inland water, Lake Titicaca, which it shares with Bolivia. Covering about 8,300 square kilometers, with maximum depths of 365 meters, the Lake is fed by a group of rivers originating in the southern Sierra.

4.2.1.2.2 Utilization of lakes

Lakes in the highlands of Peru serve the important function of providing storage capacity for stream regulation. A number of these lakes have been converted to storage reservoirs for hydropower, irrigation, urban, industrial and minings uses through the construction of dams, tunnels, canals, and pumping plants. A survey by ONERN has indicated that 186 lakes with a total usable capacity of 3,028 million cubic meters (MCM)

have been developed as storage reservoirs. An additional 342 lakes with a total usable capacity of 3,952.84 MCM are being studied. The largest capacities for storage regulation in natural lakes occur in the Locumba River Watershed (906 MCM), the Camana River watershed (95 MCM), and the Rimac River (83.87 MCM), all of which are with the Pacific drainage system (Saettone and Porter 1979: Annex 5, 19-20).

Lake Titicaca also serves as an important transportation link between Peru and Bolivia and is also the basis for a thriving fishing industry, while other lakes are also important as sources of fish for local consumption.

4.2.2 Groundwater

4.2.2.1 The resource

No thorough survey of groundwater resources in Peru appears to have been conducted.

In the Costa region, where underground water is used for irrigation and for domestic supply, the groundwater potential of the rocks in the coastal basins is reported to be problematical, but some waterbearing strata could be expected in the several thousand meters of rock (Saettone and Porter 1979: Annex 1, page 100).

It is speculated that among the variety of rock types found in the Andes, some acquifers must be present. Evidence of such aquifers comes from the springs in the Andes, on which large and small towns in the area depend for all or part of their water supplies. Little has been done in this region to develop groundwater by means of wells (Saettone and Porter 1979: Annex 1, page 101).

4.2.2.2 Groundwater utilization

ONERN has estimated that 99.96% of the 1,733.07 MCM of groundwater used annually is used in the Pacific watershed (Costa). Of this 80.4% is used for irrigation; 0.14% for cattle watering; 7.1% for industry; 11.2% for public supply; and 1.1% for unspecified purposes.

4.2.2.2.1 Irrigation

In the coastal region, wells tap groundwater for irrigation purposes. According to a 1976 report of the Organization of American States (OAS), nearly 10,000 wells in the coastal valleys withdraw more than 1,100 MCM per year, while more recent ONERN estimates place the quantity of groundwater used in the coastal region at 1,733.07 MCM, about 80% of which is used for irrigation. Thus, groundwater supplies about 9% of the irrigation water used in this area (Saettone and Porter 1979:Annex 1, 103-104).

4.2.2.2.3 Urban supply

Groundwater from wells is used in conjunction with surface water to meet urban water demands. Roughly 26% of the water supply of Lima is reported to come from wells in the Lima-Callao area, while other Costa cities such as Trujillo, Tacna, and Chiclayo rely solely on water pumped from wells. Of the some 120 wells used for public water supply, all but two are in the Pacific watershed area. In addition to public wells, the government has inventoried 2,818 domestic wells which pump some 234.7 MCM of water per year (Saettona and Porter 1979: Annex 1:109).

4.2.2.2.4 Industrial uses

The Direccion General de Aguas y Suelos of the Department of Agriculture has identified 478 wells used primarily for industry. In addition to water drawn from such wells, industries also sometimes use surface water, while some buy municipal water. There seems to be some uncertainty as to whether water from company-owned sources is included in statistical summaries of water use (Saettone and Porter 1979: Annex 1, 110).

4.2.2.3 Groundwater quality and problems with groundwater

Data on groundwater quality are sparse and most apply to the Costa region. High contents of both boron and fluorides have been reported in groundwater from volcanically active terrains such as those in the Departments of Arequipa, Moquegua, and Tacna. In some place, particularly where water has circulated through or near mineralized rocks, toxic elements such as arsenic, lead, and zinc are present (Saettone and Porter 1979: Annex 5: 25).

Major problems connected with groundwater are declining water levels and increasing water salinity. Water levels declines when the amount of withdrawal consistently exceeds the amount of replenishment received from rivers. No details appear to be available on the actual rate of decline.

Increasing mineral content of groundwater, particularly in coastal aquifers, results from 1) increased contact with minerals as the water comes closer to the sea, and 2) constant use and reuse, which in conjunction with evaporation and/or transpiration, reduces the amount of water in relation to the mineral content. This phenomenon has has been demonstrated for the Lambayeque Valley, where the dissolved solids in groundwater were found to increase from 261 to 1,240 meq in about 50 kilometers in the downstream direction. The extent to which groundwater salinity has been increased by these means in the coastal valleys is not known (Saettone and Porter 1979: Annex 1, 107).

Increased salinity also arises from the advance of sea water into fresh water aquifers where wells near the coast are too heavily pumped. Although it is thought that over-pumping may be responsible for increases in groundwater salininty in coastal areas such as Callao, such increases are not well documented (Saettone and Porter 1979: Annex 1, 107).

4.2.3 Water policy

Since 1969 the Peruvian government has been making an effort to create a national plan for water resources, and the methodological bases for a National Plan for the Organization of the Water Resources of Peru have been formulated. The Government's policy is to strengthen the program of water use, conservation, and protection at the national level, with chief emphasis on projects for the regulation of irrigation in order to increase production and productivity and extend the agricultural frontier. It is intended to provide drinking water for the entire population, and plans call for using hydroelectric energy instead of non-renewable resources to electrify the territory and foster industrial development (this may apply only to the eastern regions).

The government's plan, being drawn up by the Ministry of Agriculture, the National Planning Institute, and ONERN, involves the committment of up to 25 billion soles in various irrigation project by the year 1985. These projects are expected to contribute to the improvement of irrigation systems covering more than 539,000 hectares and extend agriculture to another 285,000 hectares ("National Water Use Plan..." 1975: 60).

4.2.4 Data collection

Peru has some between 300 and 400 gauging statues for the collection of hydrologic data in its rivers and streams. Because the government is primarily interested in the development of water for both irrigation and domestic and industrial purposes in the Costa region, it is has placed strong emphasis on the collection of data for the development and management of rivers on the Pacific slopes of the Andes. There has, however, been no strong incentive for collection of data in the remainder of the country, particulary because of technical difficulties involved in data collection in remote areas and, specifically with regard to the lowlands of the Selva, because water resources in that well-watered area far exceed both present and project water demands (Saettone and Porter 1979: Annex 5, 19-20). Data obtained from hydrologic metering stations have been used in estimating runoff from river basins on both sides of the Andes, principally with an eye toward evaluation of the country's hydropower resources.

Hydrometric Installations in Peru (CEPAL 1977)

Pluviometric Stations	Evaporimeters	Fluviometric Stations	Wells for groundwater observation
790	66	314	500

4.3 SOILS OF PERU

4.3.1 The resource*

Costa (from Saettone and Porter 1979)

In the low-lying valleys of the Costa region are found Entisols (new soil without complete profile development), while most of the remaining soils are classed as Aridisols (soils developing under dry conditions). These differ from the Inceptisols (soils with initial profile development), which also occur in this regions in the rate of saturated extract conductivity of the soil at the 18 cm to 50 cm layer.

The soils of the Costa are generally fertile, chiefly because low rainfall levels have prevented water from leaching bases from the profile, and they possess physical properties for good percolation and drainage. Those soils not flushed by water are, however, highly saline, with pH values near 8.0. Moreover, the soils are moderately to highly susceptible to erosion if water is excessive. Under proper irrigation and management, the low-lying soils are highly productive, particularly for food crops such as grains, potatoes, and sugarcane.

Sierra

A variety of soils occur in the Sierra regions, where slopes range from less than 5% to as high as 70%. The principal soils groups are Entisols, Inceptisols, and Mollisols. The Mollisols, generally darker soils with organic-rich surface horizons and high supplies of bases, vary considerably, some having thin, others deep, surfaces. Some Mollisols have clay horizons below the surface layer. Variations among these as well as other soils depend on the conditions under which the soils were formed: cold, cool, warm-humid, or seasonably dry.

Many of the soils in the Sierra occur on slopes at elevations suitable only for forests. The second most frequent group of soils are suitable only for pastures and forests; occurring at elevations of less than 3,200 meters these soils are erosive, and gully erosion is, in fact, a serious problem in this area. The fertility of the soils in the sierra ranges from high to low; leaching water may make the soils infertile and acidic.

Selva

In the high Selva Alfisols (with clay subsurfaces high in bases) and Ultisols (with clay subsurface low in bases) with well-developed soils profiles occur. Alfisols developed where a distinct dry season occurs. Ultisols are highly weathered and leached of their bases. Where soils are well-drained the profile becomes oxidized and takes on a red color from the iron and aluminum oxides. In depressions and valleys alluvial inceptisols occur, while Oxisols occur in relatively stable upland summit areas. The lateritic Oxisols have undergone a loss of silicon and have accumulations

*The following discussion is based on materials from Saettone and Porter 1979, which follow the soil classification and terminology of the National Cooperative Soil Survey, used in the United States since 1966. For the soil classification used by the FAO-UNESCO Soil Map of the World, see Appendix A.

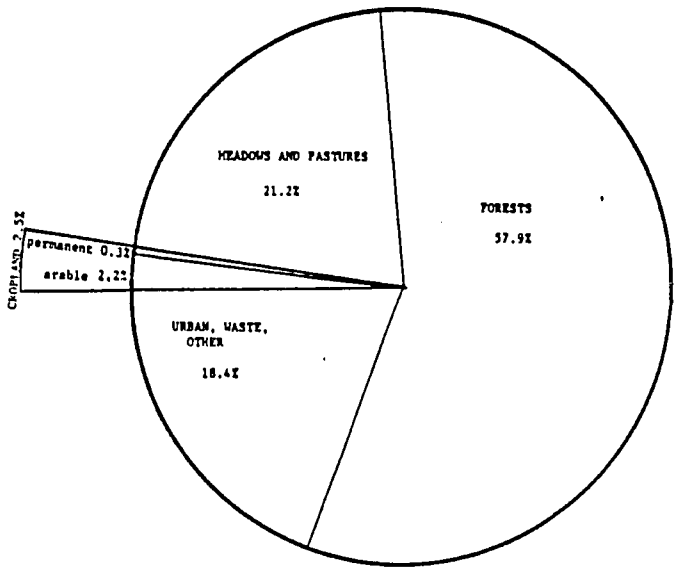
of iron and aluminum oxides within 2 meters of the surface; in these soils, infiltration is high and erodibility low because clays are aggregated and not readily dispersible in water.

In the low Selva, soils are dominated by Entisols formed as a result of recent alluvial deposits from river floodings. Because the clay fraction of these soils is kaolinitic or hydrous oxides (low in exchange capacity), these soils are often low in fertility. The bulk of the nutrients in these areas occurs in the living and dead organic materials.

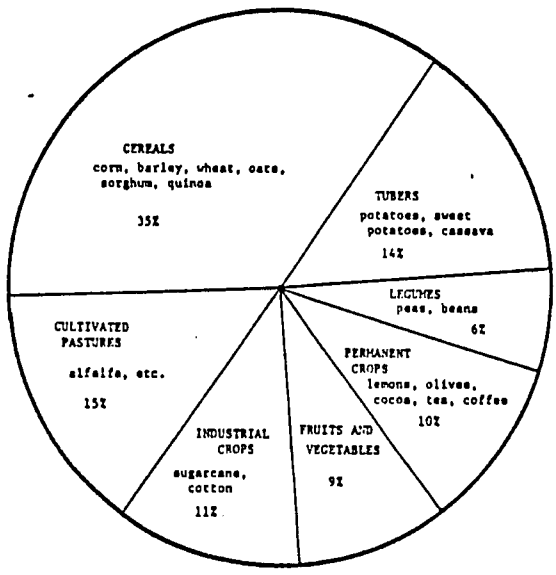
4.3.2 Soil and land utilization

Land use in Peru is indicated by the diagram below. Only about 2.5% of the land mass of Peru is currently under cultivation, and, as indicated above, large portions of the remaining area are, because of soil characteristics or water limitations, uncultivable. Many of the soils of Peru are suitable only for forests or grazing land.

LAND USE IN PERU



USE OF CULTIVATED LAND, INCLUDING PASTURES (Saettone and Porter 1979: Annex 8)



Total cultivated area: approximately 2,600,000 hectares.

Costa

The Costa region contains 27% of the total cultivated area of Peru. Because of low rainfall levels, virtually all agriculture must be irrigated, and, in fact, close to 2/3's of the irrigated land in Peru occurs in this region. In this region grow 75% of the rice produced in Peru, 58% of the corn (maize), 86% of the sweet potatoes, 99% of the cotton, and over 99% of the sugar.

Sierra

The soils of the mountainous Sierra support 50% of the agricultural activity of Peru. About 31% of the irrigated agriculture takes place in this area. Permanent crops are rare in this region, and a fallow system of crop rotation is usually followed. An estimated 500,000 hectares, approximately 20% of all cultivated land may lie fallow each year. Depending on the type of soil, land will typically lie fallow from one to two years. Cereals account for 40% and tuberous crops for 20% of the land cultivated in the Sierra: over 98% of all the barley, all the oats, 33% of the corn, all the quinoa (Chenopodium quinoa--a plant whose ground seeds are used as a cereal), 99% of the sorghum, 97% of the wheat, and 90% of all the potatoes.

The soils of the Sierra are in many places suitable only for grazing, which is another important activity in this region. Almost the entire population of alpacas, goats, horses, llamas, and pigs, and 80% of all Peruvian cattle are in the Sierra. Dung from these animals is utilized for heating, cooking and fertilizer (Saettone and Porter: Annex 8:28-29).

Selva

The Selva, which covers over 60% of the territory of Peru, contains about 23% of its cultivated area. Shifting cultivation predominates in this area, especially on the slopes of the high selva. This involves slashing and burning a hectare in the jungle, then planting corn or rice followed by yuca (Cassava), then bananas and mangoes or another fruit tree. Land is worked until it has been exhausted and then allowed to return to jungle. Because of the susceptibility of many of the soils to compacting and consequent erosion, farming with heavy modern machinery is not advisable throughout much of this region, and for this and other reasons, including the low fertility of soils once they have been cleared of their forest cover, the successful agricultural development of this region is dependent on environmentally sound approaches. Major crops in this region are plantains (78% of Peruvian production), cassava (yuca 78% of production), and rice (25% of production).

Grazing is not particularly well developed in the Selva, which contains less than 0.8% of the goats, 5.0% of the horses, 0.2% of the sheep, 11.5% of the pigs, 8.4% of the cattle, and 6.9% of the poultry of the country.

Because of the limitations on Selva soils, it has been estimated than only about six million hectares (60,000 square kilometers of the Selva are suitable for pasture and only about 20,000 square kilometers for cultivation). It has been said that as much as 25,000 square kilometers of the total 70,000 square kilometers should be in watershed protection forests.

4.3.3 Soil problems: erosion; salinization under irrigation, etc.

erosion

Erosion is a major problem in many areas of Peru. In the Costa, the extensive forest clearings in steep river valleys and subsequent overgrazing

by domestic animals have left the soil open to the erosive effects of the rivers during those times of the year when flows reach torrential proportions. (JPRS 63249[21 October 1974]:8). Such flooding has been exacerbated by removal of trees and other plant cover that had contributed not only to soil stability but had also helped to regulate the systems for storage of water for irrigation. Soil erosion has, furthermore, led to massive sedimentation of the dams, spillways and distribution channels of the irrigation systems (JPRS 63249 [October 21, 1974]:9).

Soil erosion and depletion have also been a problem in the Sierra region, where farming of steep slopes and excessive grazing have led to both erosion, soil depletion, and a decline in the productive capacity of natural pastures. (JPRS 63249 [October 21, 1974]:9).

On the hilly slopes of the High Selva, erosion is also a problem. About 91% of the soils of the high selva occur on slopes of more than 20%, slopes unsuitable for agriculture if erosion is to be avoided. As agriculture has spread from a few relatively fertile alluvial terraces in this region to land not suitable for continuous agricultural exploitation, soil erosion has resulted from the clearing of natural forest, leaving soils exposed to the erosive effects of the heavy rainfall experienced in this area (Maas 1969: 27; JPRS 63249 [October 21, 1974]:10). Modern mechanized agriculture may cause problems in this area; in contrast to hand clearing of land, mechanical clearing causes compacting of these soils as well as depletion of vegetable ash and toposoil. Erosion is a serious problem, especially on the sloping land of the High Selva.

salinization

Salinization of irrigated soils, a problem throughout the irrigated Costa region, results from a lack of control over the amount of water used for crops as well as from a failure of drainage channels to return surplus water to the rivers (JPRS 63249[OCtober 21, 1974]:8). It was estimated in 1971 that approximately 70% of the agricultural land of the costa was affected by salinity or drainage problems (Primer Seminario...1971:391). In the Lower Selva, where rivers frequently rise to flood the land, problems with drainage also occur.

desertification

Desertification due to deforestation and consequent soil loss is a problem in Peru. The sequence of deforestation followed by overgrazing and eventual desertification has been particularly prevalent in the semi-arid grazing areas of the Costa and Sierra. According to an official of the Division of Forestry of the Ministry of Agriculture Health, over the last fifty years "four or five million hectares of land have been lost to desertification in Peru. And this is increasing in exponential rates." (Lausche 1979).

4.3.4 Soil conservation

In ancient Peru, the Incas used extensive terracing to preserve the soil on the slopes of the Sierra. This practice fell into disuse, however, after the Spanish conquest. Today, soil conservation as practiced by most Peruvian farmers consists of fallowing and crop rotation (A.I.D. 1979:101).

4.3.5 Soil research and mapping

4.3.5.1 Soil map

A soil map of Peru was prepared at the scale of 1:1,000,000 by C.Zamora of ONERN (Oficina Nacional de Evaluacion de Recursos Naturales) in 1967; this map has been reduced and simplified and modified, particularly in the Amazon and Madre de Dios regions by an FAO representative for the FAO -UNESCO Soil Map of the World, which appears in Appendix A. Most of the information supplied by the FAO-UNESCO map is based on exploratory soil studies designed to give, in combination with basic information on the natural environment, a fair idea of the composition of the soil pattern. Portions of the map, however, rely on detailed soil surveys, while others, particularly in the Amazon region are based on occasional soil studies and therefore supply only a rough idea of the actual soil situation (FAO-UNESCO 1971:8-11).

More detailed studies of individual areas are found in publications such as that which resulted from the FAO/UNDP study of land and water use in the Hauaura River Basin of Lima Department in the costa region. Volume II of the final report of this study presents detailed information on soils, including a soil map [Reconocimiento sobre el Usa de Aguas y Tierras para el Desarrollo de la Cuenca del Rio Huaura. Informe Final. Volumen II: Estudio de los Suelos. FAO/SF:88/PER 23].

4.3.5.2 North Carolina State Soils Project

For the last seven years a team from North Carolina State University has, with A.I.D. funding, been taking an inventory of the soils of the Amazon Basin in Peru. The project has emphasized the farmer in the Amazon Basin, with the basic objective of showing if it is possible to change slash and burn methods of farming to permanent agriculture in the jungle areas. Working to encourage farmers to grow more cash crops, the project has also introduced rotation schemes and experimented with nutrient replenishment possibilities. Particularly successful as crops have been soy beans, corn, rice, and yuca (cassava).

The two principal findings thus far are:

- traditional slash and burn methodology should be used for land clearing rather than mechanized means that tend to caused soils compaction and erosion, often ruining the ability of the soil to produce as abundantly as it otherwise might;

- a single plot of land has been yielding three cash crops per year: The scheme for permanent agriculture is getting results equal to or better than earlier methods and because of their nutrient replenishment experiments either through natural crop rotation or some chemical supplement, the soils' physical properties are not being destroyed; instead the farming schemes are adding fertility to soils whose native fertility is negligible (Lausche 1979).

4.4 FORESTS

4.4.1 The resource (see map, page 64a)

Peru has an estimated 741,061 square kilometers of forests, about 57% of its total territory; 730,018 square kilometers of these forests (98.5% of the total) occur in the Selva. As reviewed by Tosi in 1961, forest areas of Peru (ranging from sparse tropical thorn forest in the Costa to dense moist tropical forest in the Selva, accounted for some 922,772 square kilometers or about 72% of the entire area of the country; however, much of this forest, particularly in the Costa and Sierra had been degraded or turned into grassland as the result of activities such as excessive lumbering and charcoal production.

Most forest growth is natural. Plantations, although becoming increasingly numerous, particularly in the Sierra region, where they account for 66% of forested land, still account for only 0.14% of total forest land. According to estimates of the Minister of Agriculture, however, another 103,939 square kilometers of land are suitable for forest plantations; if this land were to be planted and no loss of existing forests should occur, the amount of forested land in Peru would rise to 66% of the nation's territory.

NATURAL FOREST IN PERU AND LAND CAPABLE OF SUPPORTING FOREST PLANTATIONS (1976)

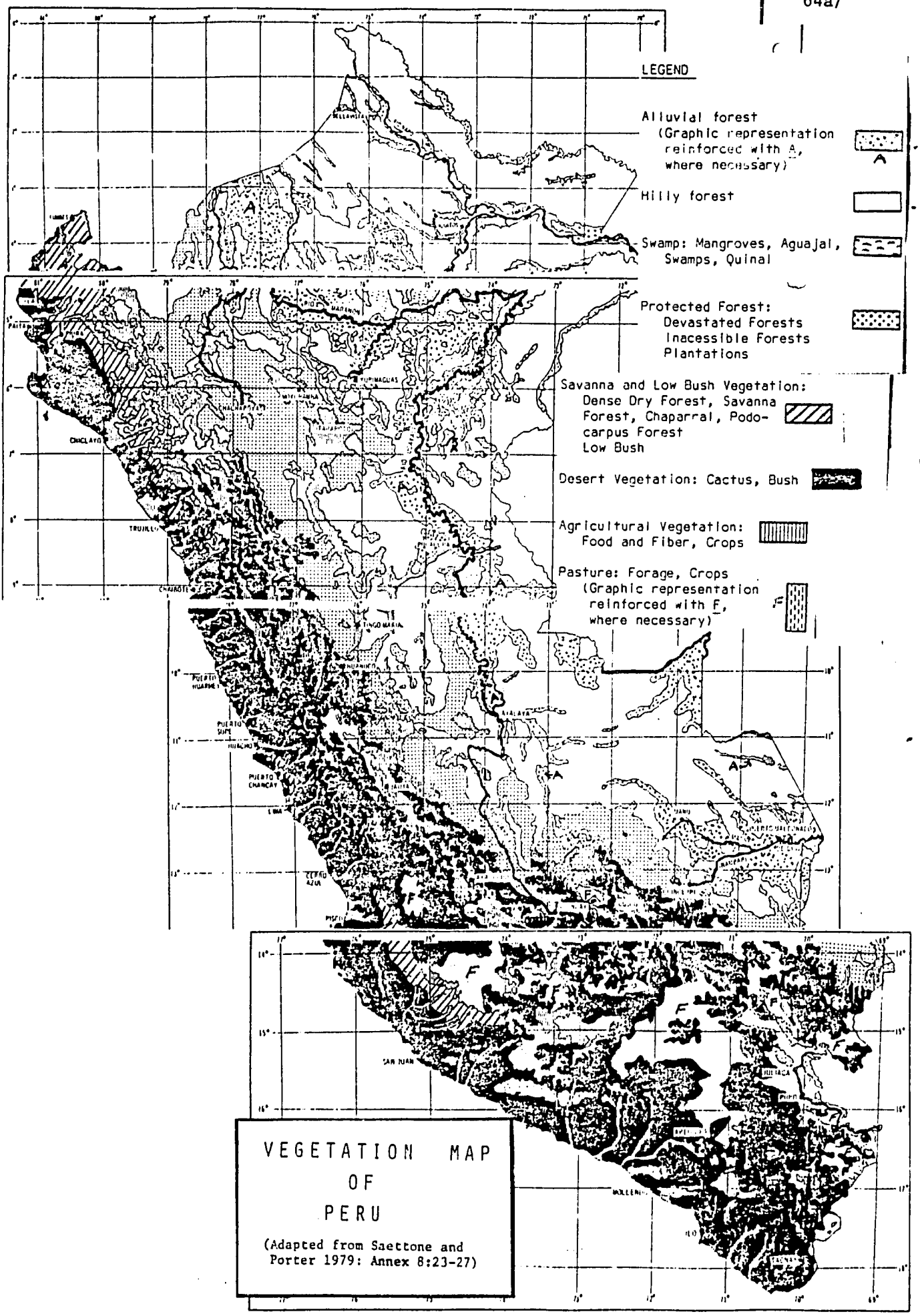
Region	Natural Forest	Plantations	TOTAL	Land Suitable for Planting	Potential Total
	square kilometers				
Costa	9,500	67	9,567	4,933	14,500
Sierra	500	977	1,497	74,023	75,500
Selva	730,000	18	730,018	24,982	755,000
TOTAL	740,000	1,061	741,082	103,938	844,000

Adapted from Saettone and Porter 1979: Annex 8, Table 14, based on data from the Ministry of Agriculture

Most Peruvian forest land is state-owned; only about 50,000 square kilometers are in private hands (Germany, Fed Rep of, Statistical Office 1978:8).

As indicated by the above table and as supported by the vegetation map (page 64a) most of the forest growth in Peru occurs in the vast eastern region of the Selva. These forests fall into two basic groups: the hilly or high forest of the eastern Andean slopes (the High Selva), and the low or alluvial forest of the lowlands of the Amazon. The first is characterized by strongly sloping relief, narrow valleys, and torrential rivers and the latter by gentle sloping and wide, meandering rivers (MAB UNESCO 1974a:75).

The alluvial forests, which account for about 12% of total Peruvian forest cover, contain species such as Cumala, Moena, Machimango, Shimbillo, Copal, Quinaquina, Zapote, Huimba, Oje, Palo Azufre, Requira, Cumalo, Lagarto, Caspi, and Cetico. Forest density in this area ranges from 65 to 120 trees per hectare. The hilly forests of the Selva account for about 72% of



VEGETATION MAP OF PERU

(Adapted from Saettone and Porter 1979: Annex 8:23-27)

forest land in Peru; the most abundant species in these forests include tornillo, moena, quinillo, cumala, mashonaste, copal, pashaco, chimieva, and cedro. Other forest types occurring in the Selva are the Podocarpus forest (about 0.32% of total forests), with species such as romerillo, ulcumano, moena, cumalo, puma, maqui, paltron, and roble; the palm forests of aguajae, huasai, and ungurahui (about 0.82%); the palms and aguaje of the swamp forests (2.72%); and about 8.667 hectares of forests which are inaccessible because of slope (6.74% of land). About 4.04% of the Selva consist of forest land which has been devastated by agriculture (Saettone and Porter 1979: Annex 8).

The Sierra is the least forested area of Peru. According to the vegetation map for Peru, the occurrence of natural forest in this area is very limited, with quena the dominant tree species. Much of this area has been deforested by centuries of human activity.

A large portion of the Costa is desert land, where vegetation is sparse or nonexistent. However, some types of forests, accounting for about 3,658,000 hectares (only about 2.8% of the total area of Peru), occur. Savanna forests, which cover approximately 1,121,000 hectares are dominated by algarrobo, zapote, huarango, hualtaco, palo santo, amd ceibo. The forests of the chapparel (about 899,000 hectares) are also dominated by algarrobo, and zapote along with sauce, and acacias. In the some 1,086,000 hectares of bush land, occur trees such as tara, pallilo, mito, sauce, and molle, while mangle, deli, avicenia, and conocarpus dominate the manglar areas along the coast. Finally there is the dry dense forest, which covers some 525,000 hectares and contains guayacan, palo de vaca, amarillo, sanchez, and zapote (Saettone and Porter 1979: Annex 8).

4.4.2 Forest Utilization

ROUNDWOOD EXTRACTED FOR PROCESSING / PRODUCTION OF FOREST PRODUCTS IN PERU 1968 and 1975

	1968			1975		
	cubic meters (m3)					
	extraction	%of total	production	extraction	% of total	production
Wood for Processing						
Sawn Timber for Boards	490,175		268,327	934,825		513,640
Parquet	20,086		5,624	20,189		5,653
Plywood	27,931		12,144	39,068		16,986
Veneer	27,441		11,931	73,545		31,976
Particle Board	11,881		8,149	10,594		10,594
Decorative Hardboard	1,539		810	2,081		1,095
Rail Ties	2,830		1,555	1,507		828
Total	581,883	19.7%	310,530	1,081,809	26.6%	578,327
Firewood	2,081,960	70.3%		2,580,185	63.3%	
Charcoal	27,951	0.9%		19,206	0.5%	
Pulpwood	n.a.			22,540	0.6%	
Rural Construction	268,743	9.1%		370,006	9.1%	
TOTAL EXTRACTED WOOD	2,960,537	100.0%		4,073,746	100.%	

Adapted from Saettone and Porter 1979: Annex 8, Tables 16 and 17, based on date from the Ministry of Agriculture

Wood use per individual Peruvian is estimated at 0.25 m3 per year (Saettone and Porter 1979: Annex 8, page 49).

4.4.2.1 Lumbering activities

Outside of Brazil, the Peruvian Amazon is said to represent the greatest potential for forest products in South America. Both the alluvial forests of the Low Selva and the humid forests of the High Selva on the slopes of the Andes support high volumes of wood. Despite the abundance of trees, only a relatively few species are used commercially and of these only trees with a top diameter of 40 centimers or more are included in inventories of timber trees. According to recent estimates not more than 2.7% of the forests are currently exploited, and harvesting is limited to only one cubic meter per hectare, a usage which represents less than one percent of the annual growth (Saettone and Porter 1979: Annex 8, 38,45). Of the numerous species found in the Peruvian Amazon only between 25 and 40 species are now exploited to any degree but because of antiquated methods, logging activities are limited to areas within the proximity of the rivers of the eastern lowland forests (Shane 1978:23); since logs are often transported

by river rafting, exploitation is frequently limited only to those species which float (Saettone and Porter 1979: Annex 8, 45). The normal procedure has been for lumberjacks to cut trees, wait for the water of the river to rise into the forest, and then float the logs into the rivers for conveyance to sawmills downriver (IDB[Inter-American Bank Development Bank]News, September 1979).

Ministry of Agriculture statistics indicate that 18 species accounted for some 90% of the 513,640 cubic meters of sawn wood produced in 1975. Of these four, native species accounted for about 50% of production, while eucalyptus, the principal plantation tree of the Sierra, accounted for another 17%. The species, in order of increasing volume, are: Roble corrienta, cedro (Cedrela spp.), Tornillo (Cedrelinga catenaeformis), Eucalyptus (E. globulus, E. camaldulensis, E. saligna, E. deglupta), Caoba (probably mahogany: Swietenia spp.), Moena (Ocotea spp.) Copaiga (perhaps copaia -Jacaranda), Cumalo (Virola spp.), Alfaro, Roble amarillo, Cafahua, Congoma, Ulcumano (Podocarpus utilior), Ishpingo, Diablo fuerto, Nogal, Lupuna, and Marupa (Saettone and Porter 1979: Annex 8, Table 15).

Peru's forest industry although still small has grown considerably since 1969, at which time it was limited to a few small-scale logging activities and sawmills to process species such as Spanish cedar (cedro[a member of the mahogany family]) and mahagony. By one recent count, there are today at least 467 mills processing Peru's forest products, including 341 sawmills, 34 parquet plants, 7 veneer mills, 1 particle board plant, 66 cajune fas, and 13 paper mills (only one of which uses wood, while the remainder use bagasse--residue from sugar cane and other plants) (Saettone and Porter 1979: Annex 8, Table 21). The bulk of these plants are in the Selva, with the greatest concentration in Pucallpa.

In one recently reported development, a small Perurvian company, with the help of the Inter-American Development Bank, has, since 1978, been using a floating lumber mill to produce plywood for use as doors, paneling, etc. This mill, possibly the first of many, allows immediate processing of wood and by eliminating the step of floating wood down river to stationary mills also avoids the loss of wood to waterlogging that often occurs before the logs actually arrive for processing (IDB News, September 1979).

Peru exports plywood and timber (18,120 cubic meters in 1974) to Colombia, Venezuela and North America), but imports large quantities of coniferous woods (60,448 cubic meters in 1974) , principally from Chile and the United States (Shane 1978:23). Wood exports represent only about 2% of wood extracted. Imported woods are used chiefly for the production of pulp.

4.4.2.2 firewood and charcoal

Firewood, used for both cooking and heating, accounts for anywhere from 60-85% of the wood used in Peru. Wood is generally collected by all members of a family, including children, who are instructed to bring home any small pieces of wood they may find while they are out playing. A UNDP study group has estimated that 20% of an adult's time is spent in wood collection (Saettone and Porter 1979: Annex 8,7). Eucalpytus is reported to be one of the species most used for firewood; it has been suggested that Eucalpytus be planted

specifically for firewood production (Saettone and Porter 1979: Annex 8, 7).

By subtracting the amount of wood products from the amount of wood extracted (see Forest Utilization table on page 66), it is possible to calculate the amount of wood lost during processing--some 503,482 cubic meters in 1975, nearly 47% of the wood processed during that year. These wastes, which have potential as biofuels, are often burned for disposal purposes (Saettone and Porter 1979: Annex 8,45).

Although charcoal production, the cause of past deforestation in the Sierra region, has been legally prohibited for many years, it still takes place in the Sierra and Selva regions. The cost of charcoal is too high to permit its extensive utilization; when available, it is used for cooking, particularly in restaurants (Saettone and Porter 1979: Annex 8, 7-8).

4.4.2.3 Other forest products

Apart from lumber Peru also produces forest products such as rosewood oil, achiote seed (for use as coloring for margerine and cheese), leche caspi for use in chewing gum, and marico, an astringent oil (Kurian 1978:1178). Forests also serve as a source of protein and other products from wild animals.

4.4.3 Deforestation

The rate of deforestation in Peru has been projected at 48,000 hectares per year between 1962 and 1985 (Parham 1978 from Sommer 1976); this is based on the clearing of 1.1 million hectares: 0.4 million for cropland and 0.7 million for pasture. According to a more recent estimate Peruvian forests are disappearing at the rate of 220,000 hectares per year; 200,000 of these hectares are thinned, while 20,000 are actually cleared (Parham 1978, based on an A.I.D. Lima February 1978 telegram).

4.4.3.1 Regional breakdown

In the Costa area where forest consists principally or *Prosopis juliflora* and *Acacia* spp., indiscriminate deforestation has led to eventual desertification. In the eastern forest area, where slopes are steep and rainfall is abundant, forests have been destroyed creating pasture land and often leaving soils open to rain-induced erosion and drastic decreases in fertility. The steep slopes of the high forest zone, above 3500 mm, where forests have also been converted to pasture suffer from overgrazing and severe erosion (MAB-UNESCO 1975a:67).

Deforestation would seem to be a less pressing problem in the Selva with its huge areas of forests, some of which are still untouched. However, indiscriminate and unmanaged lumbering of this area combined with forest clearing for shifting agriculture have led to degradation of the forest resource in this huge area as well.

Although intensive exploitation of timber in some areas is said to have resulted in the elimination of some valuable wood species as an economic resource over extensive areas of Peru's Selva region (UNESCO/MAB 1974a), a recent review of the Peruvian forest situation conducted principally

in conjunction with energy use in Peru, concludes that the annual rate of growth in the forests of the Selva is high enough to permit substantial use of wood for both timber and energy without reducing the current standing forest stock: "A well developed forest industry could generate substantial amounts of biofuels and lend support to managed forests over the currently exploited forests that are rapidly being degraded by timbering and shifting agriculture"(Saettone and Porter 1979: Annex 8, 49). The study advocates the expanding of forest resources particularly in the Selva, where planting with both pines and eucalpytus could increase the supply of acutely needed forest products and help to control erosion as well. Eucalyptus is recommended because it could serve as a source not only of fuelwood and charcoal but also of roundwood, sawnwood, pulpwood, and plywood (Saettone and Porter Annex 8,54). The study also points out that a strong forest industry could have the added benefit of producing energy savings by providing construction materials to replace materials such as concrete, whose production requires a large energy input (Saettone and Porter 1979: Annex 8,55-56).

4.4.3.2 Causes of deforestation and forest degradation in tropical forest areas (High and Low Selva): non-lumbering activities

4.4.3.2.1 Petroleum extraction

Petroleum extraction takes place in tropical forest areas near the cities of Iquitos and Pucallpa, but other tropical forest areas are being explored for further deposits (Shane 1978:675). River pollution in conjunction with oil exploitation has been identified as a cause of degradation of these forest regions (UNESCO 1974a:76).

4.4.3.2.2 Settlements and farming in tropical forests-

Small-scale slash and burn agriculture has been traditionally practiced by Indians in Peru's tropical forest. Yuca, bananas, corn, breadfruit, squash, oranges, and wheat are grown.

On the whole, however, despite Peru's need to increase farmed land in order to meet the food needs of its people, there has been little activity directed toward settling the tropical forests. Reasons for this lack of enthusiam are: shortage of government funds; awareness of the poor quality of the alkaline soils; and a reluctance on the part of highland Peruvians to move to the lowland tropical areas. Furthermore, agriculture has been generally unrewarding in Peruvian tropical forest areas. Crop yields around Iquitos and Pucallpa, the two principal towns in the Amazon basin area, have been poor.

Government sponsored colonization project exist, however; two are reviewed below.

Government sponsored colonies in tropical forest areas and government policy

Tarapoto in the department of San Martin is located on the eastern slopes of the Andes and may have the richest soils in Peru. Eighty families a month were moving in as of 1978, and this number will probably

increase when a 13-kilometer stretch of road from Moyobomba makes the area more accessible to settlers. In order to discourage spontaneous colonization, the government has required travellers along the still incompleted road to have a pass (Shane 1978: 65). To assist the rational development of the area, the Canadian development agency (CIDA) is planning to provide four million dollars for a school for instruction in agricultural and cattle ranching techniques (Shane 1978:49).

Tingo Maria in central Huallaga has been actively settled since 1936, and in 1964, with shared funding from the International Development Bank and the Peruvian government, the offical Tingo Marian Colonization Project was initiated. By 1974 5,300 families, considerably more than the projected 4500, were living there practicing subsistence farming of bananas, sugar cane, cacao, rubber, soy, rice, corn, tea and coffee. There are also about 37,000 head of cattle, but there is little understanding of pasturing techniques and only limited veterinary assistance is available (Shane 1978:49).

4.4.4 Reforestation

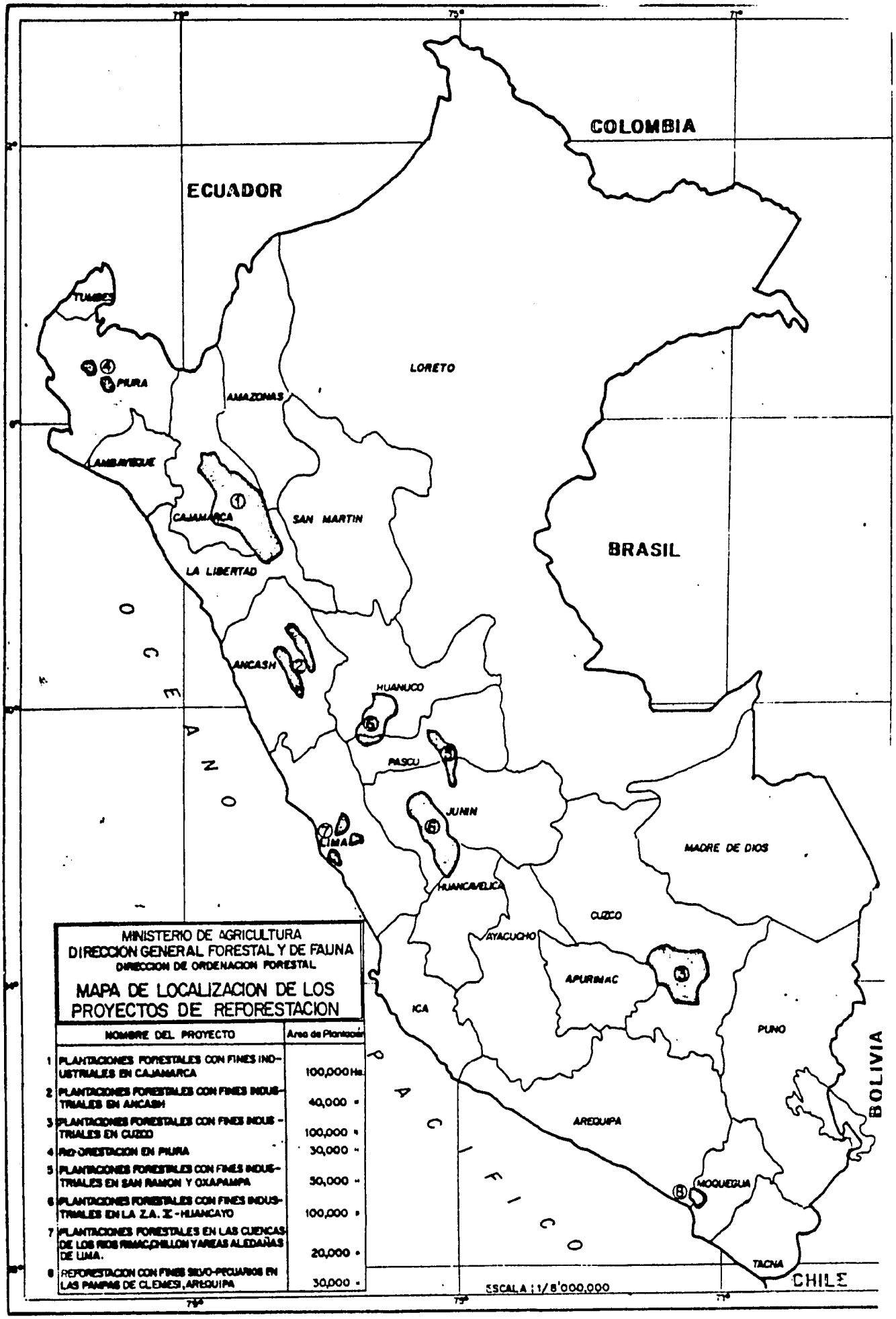
The greatest potential for reforestation is in the Selva and Sierra regions, the latter of which has been the focus of the bulk of reforestation projects and studies up to now (see table on page 64). Most reforestation has been with eucalyptus and Caribbean pine, species exotic to Peru. For the Selva it has been suggested that reforestation with eucalyptus could be begun on land abandoned after shifting cultivation (Saettone and Porter 1979: Annex 8, 60). Reforestation schemes following rapidly on land abandonment could help to reduce erosion by reducing the period during which soil is exposed to erosive forces.

Regulations under the forestry law of Peru require extractors to plant two trees for each cubic meter of wood extracted. This rule is only feebly enforced, however, and its effective implementation is further hampered by the circumstance that extractors seldom know where, when, or how to plant. In the vast (500,000 square kilometer) Selva Department of Loreto, moreover, the Forestry Department is reported to have only one nursery (Saettone and Porter 1979: Annex 8, 59). As of 1976, only 106,140 hectares had been reforested, 95% with eucalpytus (Parham 1978)

Because of only limited reforestation, timber shortages are reported to have occurred, forcing some sawmills and plywood factories to cut production by as much as 50% in 1977 (Shane 1978:23).

Reforestation projects

Reforestation projects outlined by the General Directorate of Forests and Wildlife of the Ministry of Agriculture in late 1977 include plantings aimed at timber development (390,000 hectares), production of firewood, charcoal, and other products (60,000 hectares), and watershed protection (20,000 hectares). Most of the projects call for planting of various varieties of eucalyptus, although varieties of pines (chiefly *Pinus radiata*), *Podocarpus* spp., and *Prosopis* spp., among other, are also involved. The improvement of the local economy and the creation of jobs are among the stated goals of these projects. The location of these projects



MINISTERIO DE AGRICULTURA
DIRECCION GENERAL FORESTAL Y DE FAUNA
DIRECCION DE ORDENACION FORESTAL

MAPA DE LOCALIZACION DE LOS PROYECTOS DE REFORESTACION

	NOMBRE DEL PROYECTO	Area de Plantación
1	PLANTACIONES FORESTALES CON FINES INDUSTRIALES EN CAJAMARCA	100,000 Has.
2	PLANTACIONES FORESTALES CON FINES INDUSTRIALES EN ANCASH	40,000 "
3	PLANTACIONES FORESTALES CON FINES INDUSTRIALES EN CUZCO	100,000 "
4	Re-FORESTACION EN PIURA	30,000 "
5	PLANTACIONES FORESTALES CON FINES INDUSTRIALES EN SAN RAMON Y OXAPAMPA	30,000 "
6	PLANTACIONES FORESTALES CON FINES INDUSTRIALES EN LA Z.A. X - HUANCAYO	100,000 "
7	PLANTACIONES FORESTALES EN LAS CUENCAS DE LOS RIOS RIMAC, CHILLON Y AREAS ALEDAÑAS DE LIMA.	20,000 "
8	REFORESTACION CON FINES SILVO-PECUARIOS EN LAS PAMPAS DE CLEMESI, AREQUIPA	30,000 "

is indicated on the map on page 70a. (Peru, Ministry of Agriculture 1977).

A proposed A.I.D. funded reforestation program would pay for conservation measures with food and provide employment in rural areas. Designed to cover eight departments and a total of some 31,000 hectares over a three-year period, the project will involve the planting of pine and eucaplytus, species exotic to Peru. The project plan brings together host government agencies (the forestry division, ONERN, nutrition and education organizations), local and international PVO's (church organizations such as the Catholic Relief Service, the Church World Service, and the Seventh Day Adventists), and A.I.D. About 1,000 metric tons of food will be distributed is exchange for work (Lausche 1979; Peru, Ministry of Agriculture 1978).

Under the plan as it now stands, the Forest Division will decide on the location of planting sites, and trees will be planted on both public and private land. The question as to the ownership of the mature trees has not yet been resolved (Lausche 1979).

One aspect of the project is the education by local private voluntary organizations and forest people in techniques for care and maintenance of the seedlings being planted. As part of the project, it is also intended to promote the planting of vegetable gardens and to provide addition education and training aimed toward encouraged people to develop their rural communities in an environmentally sound manner (Lausche 1979).

Reforestation is also an important component of the work of a professor (Sanchez) at one of the national universities, who for the past year 12 years has initiated small scale (five to six hectares) land management projects, which begin with terracing and reforestation and expand to include small fisheries development , irrigation, development of potable water throughout catch systems, etc. (Lausche 1979). Professor Sanchez has worked with the support of his university but without any financial support. The A.I.D. mission is currently considering projects which would replicate his work on a larger scale, again as part of a food for work program. (Lausche 1979).

4.4.4 National Forests

Under the Forests and Wildlife Law of 1975 and under previous legislation, sixteen national forests have been established, most of them in the Amazon Basin area. These forests, reserved chiefly for timber production, include the Siabo-Crodillera Azul National Forests (2,084,000 hectares) and the Apurimac National Forest (2,071,700 hectares) as well as the Alexander von Humboldt National Forest (United Nations, International Commission on Parks and Reserves 1971:383). The 1975 law also provides for protected forests to serve as watershed protection and soil conservation areas (see 3.2.1).

4.4.5 Forest Policy

In accordance with the provisions of the Forestry Law of 1975, the Peruvian government is aiming for modernization, reforestation, and

self-sufficiency in forest products by 1980. To this end, Peru, with international assistance, is upgrading its forestry technology, conducting forest inventories and research to increase the number

of usable species, and reforesting limited areas with eucalyptus and Caribbean pine (Shane 1978:23-24).

As outlined in a 1974 presentation to the MAB-UNESCO International Working Group on Project I (ecological effects of human activities on tropical and sub-tropical forest ecosystems), the Peruvian government, alarmed over the increasing uncontrolled exploitation of forest land, has been conducting studies designed to lead to more rational management of forests resources. This has included activites in the Alexander von Humboldt National Forest aimed at demonstrating a comprehensive management and utilization program for tropical forests (UNESCO 1974a:77).

With regard to colonization schemes, the Peruvian government, determined to learn from the mistakes of neighboring Amazonian countries, plans to encourage large-scale farming when funding permits but to utilize the soils of tropical forests only in accordance with their potential and to plan multiple-use programs integrating agriculture, animal husbandry, forestry, fisheries and wildlife management (Shane 1978:50).

4.4.6 Manpower

Most Peruvian forestry personnel has been educated in the Costa region and has had little experience with tropical forestry.

4.4.7 Research

Research recently conducted in Peru relevant to forest resources include an updating of the ecological map of the country (published by ONERN in 1976), studies of the technical properties of native Peruvian trees, studies designed to identify forest species by study of their botanical characteristics, and the use of remote-sensing techniques to evaluation natural resources (UNESCO 1974a: 77). LANDSAT technology, for example, has been used in the Amazon region to inventory the standards of aguaje palm, a tree which has potential as a source of palm oil, food products, livestock feed, industrial fiber, and cellulose for the pulp and paper industry ("Remote sensing...").

The National Agrarian University "La Molina" in conjunction with the Ministry of Agriculture published a forestry map of Peru (Mapa Forestal del Peru) in 1975 (see page 64a for a reduced version of this map).

4.5 WILDLIFE

4.5.1 The Resource

The wildlife resources of Peru display a variety that coincides with the geographical regions of the country: Costa, Sierra, and Selva.

Costa

Apart from birds and reptiles, most of the wildlife of the Costa region occurs in the oases or near mountain streams. In the rivers valleys of the Costa, wildlife once occurred in great abundance, with reptiles including caiman, boas and coral snakes, some mammals, and many species of birds. This wildlife has been greatly reduced but there are still three-toed sloths, tamandua anteaters, one species of howler monkey, one species of capuchin monkey, the white-tailed deer, (Odocoilcus virginianus), and small numbers of collared peccary, ocelot, and jaguar as well as many of the small mammals which are becoming increasingly typical in such areas: long-eared mice (Phyllotis spp.); the smoky bat (Amorphochilus schnablii); common bats (Myotis spp.), and several species of rats, including rice-rats (Oryzomys spp.) (Morrison 1974:48). Periodic rat plagues, especially of the rice rat (genus Oryzomys) are reported in some areas; these appear to coincide with the warmer, wetter weather occurring during those years when the cold Humboldt Current of the Peruvian Coast is supplanted by warmer sea currents (Morrison 1974:43).

The misty Loma regions of the western Andean slopes have served as a habitat for the now rare guanaco, which regularly migrated to these areas (Morrison 1974:53). In La Libertad province, 300 miles north of Lima, are found spectacled bears (Tremarctos ornatus) living in desert and semi-desert surroundings, where climate is warm and the sparse vegetation consists mainly of tall cacti and other xerophytes (Morrison 1974:53-54). The only frequently encountered desert mammal is the coastal fox (Dusicyon sechurae and Dusicyon griseus), which is known to prey on the coastal guano birds; it is related to the Andean fox, which is found in the lower foothills as well as in the higher altitudes. Also in the desert region of the Costa are hog-nosed skunks (genus Conepatus). However, the most common wildlife of the true desert regions of the coast are reptiles, including the 12-inch tropidurine lizard, a member of the iguana family.

Bird life along the coast is especially rich. In the Costa Department of Lima alone as many as 313 species of birds have been reported (Morrison 1974:49). Coastal birds include the guano cormorants (Phalacrocorax bougainvillii), pelicans (Pelecanus thagus), and boobies (Sula variegata) (see 4.6 for a discussion of the guano industry). In the Sechura desert of northern Peru are migrant water birds such as the frigate birds (Fregata magnificens) and the Galapagos albatross (Diomedea irrorata). Other birds on the desert coast are sanderlings, greater and lesser yellowlegs, turnstones, surf birds, and sandpipers. In the oases birds life is richer, including in some areas egrets, bitterns, and ducks, while the brackish ponds found in many spots along the coast serve as habitats for such north American visitors as Wilson's phalarope (Steganopus tricolor).

The coastal waters of Peru are the habitat not only of abundant fish life (see 4.7) but also of sea mammals such as the sea lion, which inhabits

most of the rocky islets and guano islands. The number of sea lions is said to have declined from some 400,000 in the 1930's to only about 30,000 today. Whales are also reported to be appearing in ever decreasing numbers in Peru's waters, while the sea otter and various sea turtles are also fast joining the endangered animal list. Because of their alleged damaging effects on fisheries operations, the Peruvian government in 1978 authorized the destruction of sea lions, a move strongly opposed by PRODENA, the local branch of the World Wildlife Fund (WER, April 24, 1978).

sierra

The most prominent wildlife of the Sierra region of the Andes is the group of cameloid mammals to which the domesticated alpaca and llama also belong. These are the vicuna and the guanaco, the latter of which bears the distinction of being the only member of this group to occur at lower altitudes as well. The North Andean humeul--also called taruca or guemal deer (Hippocamelus antisensis), found in altitudes above 4,300 meters in the Andes, occurs in populations which are becoming increasingly smaller because of overhunting. The puma (Felis concolor), also occuring in the heights, has played an important role in Andean folklore. In the central Andes are found also armadillos (Morrison 1974:111), usually the Euphractes of Chaetophractus. Among the smaller mammals are the highland desert mice (Eligmodontia spp.), the chinchilla mouse(Chinchillula), and Andean swamp rat (Neotomys), and other species adapted to life in arid regions. Felines are represented by the pampas or mountain cat (Felis colocolo), also found in the valleys and the lowlands, as well as by the Andean cat (Felis jacobita). The Chinchilla (Chinchilla brevicaudata brevicaudata), a soft-coated rodent peculiar to the Andes, is on the verge of extinction, but two related species may survive in isolated areas. A close relative of the chinchilla and one of the most common small mammals of the Andes, the mountain viscacha (Lagidium peruanum) lives in warrens beneath large stones (Morrison 1974: 151).

Most striking of the birds of the Sierra is the Andean condor (Vultur gryphus), the world's largest bird, which, like the puma, continues to play an important role in Andean folklore and art (Morrison 1974:120); it is also frequently found as a visitor in the coastal regions. Part of the unique fauna of Lake Titicaca is the flightless grebe (Centropelma micropterum).

selva

In the eastern slopes of the Andes and into the lowlands of the Amazon are found the greatest numbers and variety of wildlife in Peru.

Here are mammals such as jaguars, tapirs (Tapirus terrestris), capybaras, anteaters, armadillos, and several species of opposums, including the rare black-shouldered opposum (Caluromysiops), known only from the upper Madre de Dios Valley or the area of Iquitos. Widely distributed in this area are capuchin monkeys (Cebus), spider monkeys (Ateles), howlers (Alouetta), and the smokey woolly monkey (Lagothrix cana), which is found at altitudes of over 2,000 meters. Peccaries (genus Tayassu), the South

American wild pig, are found in the Amazon but also reach the high forest at over 1,200 meters, while many of the large rodents such as the agouti (Dasyprocta genus), the paca (Cuniculus genus), and the rarer pacarana (Dinomys branickii) also range from the lowlands into the high forest. Anteaters include the giant anteater (Myrmecophaga tridactyla), found of the Andean slopes. Relatives of the racoon, various species of coati are found in both lowland and upland areas, while other small mammals include the carnivorous tayra (Eira barbara), the Andean weasel (Mustela frenata), grisons (Galicitis spp.), foxes, and hog-nosed skunks. The felines are represented by the jaguar (Leo onca), the ocelot (Felis pardalis), the ubiquitous puma (Felis concolor). The spectacled bear, reportedly the number one sportsmen's trophy in South America, occurs in increasingly smaller numbers over a wide area (about 800 to 2,000 may still have been present in Peru in 1968)(Salvadori and Floria 1978:56), but undisturbed populations still are found on in part of Manu Park. Also in the Manu Park are the whitetailed deer (Odocoilcus virginianus). The marsh deer or guasu pucu (Blastocerus dichotomus) occurs in swamps and marshlands in southern Peru on the Bolivian border. In the waters of the Amazon is found the slow moving seal-like manatee (Trichechus inunguis).

Giant snakes include the anaconda (Eunectes murinus), the fer de lance (Bothrops atrox) and bushmaster(Lachesis spp.). River turtles (Podocnemis expansa) and Black caiman (Melanosuchus niger) are among the more interesting reptiles.

Bird life is extremely plentiful in the selva region and into the valleys of the Andean slopes. Among the more interesting examples of bird life are the cave-dwelling oil birds or guachoros (Steatornithidae) various ducks, including tree ducks, and hummingbirds.

4.5.2 Utilization of wildlife

The Forest and Wildlife Law of 1975, in calling for the rational management of wildlife resources, recognizes the importance of some species as sources of food and other products.

Wildlife have served as importance food sources for the Indians of the Amazon area, and various animals have also been hunted for their skins or, as in the case of the spectacled bear, as trophy animals. In the Huallaga Central Region, new settlers and the indigenous population are reported to to depend on wildlife for as much as 80% of their animal protein (A.I.D. 1979:104). Other uses include ingredients for traditional medicines (Morrison 1974: 114-115), or, as in the case of the Andean condor, as elements of traditional religious ceremonies (Morrison 1974: 126).

Among food mammals are peccaries (wild pigs) hunted extensively by both Indians and colonists (Morrison 1974:60), and the rare pacarana, (Dinomys branickii), a large rodent, also serves as food for the Indian tribes of the Amazon (Morrison 1974:61). Monkeys are pursued not only for food but also have formed the basis of a flourishing export trade (Morrison 1974:60).

A form of guinea pig, Cavia porcellus or cavie (a Caviidae) has been domesticated by the Sierran Indians; they are often used or food or as ingredients of a folk remedy (Morrison 1974:115).

Hunted nearly to the point of extinction for the value of their coats are the chinchilla and the vicuna, the latter of which has been granted special protection (see 4.5.5.1.3). The skins of the water opposum (Yapok-genus Chironectes) have been readily sold in fur markets (Morrison 1974:59), while the furs of ocelots, jaguars, and even of the smaller Andean cats have fetched high prices in the trading centers of both the lowlands and the sierra (Morrison 1974:67). An estimated 1,000 jaguar skins per year were leaving Iquitos in the late 1960's, and an estimated 138,000 ocelots had been despatched from from the same market during the 1950's and 1960's (Doughty and Myers 1971: 294).

Armadillo carapaces are used to form guitar-like instruments fashioned by craftsmen in the Vilcanota River valley near Machu Pichu (Morrison 1974:114).

4.5.3 Dangers to wildlife

Indiscriminate hunting and the expansion of agriculture have led to the decline of wildlife numbers, especially among high-altitude species such as the vicuna, the chinchilla, and mountain deer, all of which are in danger of becoming extinct, but the trade in skins and live specimens for export, in the judgement of some, has had the most devastating effect on the wildlife population of Peru (Morrison 1974:57).

The slaughter of animals for the skin-trade and for live specimens for export has taken a heavy toll among many of the animals of Peru, most notably the vicuna (see below), but other animals are also affected. The black caiman has completely disappeared from many Peruvian Rivers and giant otters are became increasingly rarer in the Amazon.

In the area of Manu National Park Indian tribes have traditionally hunted animals with arrows or by the use of simple tribes. The shift to guns among these Indians has had a noticeable effect on wildlife numbers, as the Indians have also begun participating in the commercial exploitation of animals and animal products (Morrison 1974:61).

The expansion of agriculture in the river valleys of the Costa has severely limited the habitat available for wildlife, and some species have disappeared completely as a result. Other species are threatened because they conflict with the economic interests of farmers or others. The puma, for example, is considered a danger to livestock and is generally killed wherever encountered in inhabited areas (Morrison 1974:40). Similarly, the condors which frequently swoop down from the high areas of the Andes to visit the coastal regions, are often killed by the guardians of guano bird colonies, who have free permission to kill them (Morrison 1974:131).

Slash and burn agriculture involving the clearing of forest land for the planting of maize and other crops, a practice most frequent in the high selva area of the Eastern Andes, has meant the destruction of thousands of hectares of wildlife habitat (Morrison 1974:57).

Development projects may also threaten wildlife habitats. The construction of the tunnel for bringing water through the Andes to supply irrigation water for the Olmos project in the north will threaten the survival of the Mountain Tapir by bringing roads nears its only habitat in Peru.

It has been estimated that South America has about 440 species of endemic birds (where endemic is defined as any species whose entire range comprises less than 50,000 km2). It is feared that if steps are not taken to preserve representative tracts of natural vegetation in appropriate areas, many of these endemics will be in danger of extinction. Danger comes especially from the conversion of forest land into farmland. A project partially funded by the World Wildlife Fund is attempting to compile for the Northern Andean region status reports of endemic bird species and their habitats. As of 1977 a list of 149 species had been compiled and attempts to map their habitats had been initiated. (Jackson 1977: 223).

Another species which faces extinction is the Humboldt penguin (Speniscus humboldti), in this case because of plans of the state fishing company, Pescaperu to extend guano-harvesting to the Mazorca and surrounding islands inhabited by these birds. These birds are also hunting for food by the fisherman living in the area (WER April 24, 1978:6).

4.5.4 Endangered species

Regulations under the wildlife law of 1975 prohibit absolutely the hunting of jaguar and tapir (Tapirus pinchaque), but permits the hunting in season of fifteen other species of mammals and birds of tropical forests, including capybara, white-lipped and white-collared peccaries, and brocket deer. The aboriginal tribes of the Amazon are not covered by this hunting law (Shane 1978:78). For provisions covering the vicuna, see 4.5.5.1.3.

Peruvian authorities have been cited as expressing confidence that wild animals and plants of the tropical forests of the Selva are not threatened because of the low level of human activity there(Shane 1978:78). However, Peru has recently published a comprehensive list of 144 protected jungle flora and fauna, which recognized four categories: flora and fauna threatened with extinction, flora and fauna considered vulnerable, rare wildlife, and jungle wildlife of undefined status. At the top of the list of species threatened with extinction is the yellow-tailed monkey, which until recently was thought to be already extinct; a single specimen has, however, been found, and it is hoped to use it as the basis of a breeding program, once a suitable mate is found. Among the jungle wildlife of undefined status are the ash colored deer (Mazama gouazoubira) and the short eared fox (Atelocynus microtis) (WER, Dec. 19, 1977:8).

The Peruvian wildlife list was not available for this report. The endangered species listed below, which include species from all habitats in Peru, are from the U.S. Fish and Wildlife Service's List of Endangered and Threatened Wildlife and Plants (1979).

ENDANGERED SPECIES OF PERU

Mammals

Andean cat Felis jacobita
North Andean huemul Hippocamelus bisulcus
Jaguar Panthera onca (listed for Central and South America)
Amazonian manatee Trichechus inunguis (South American: Amazon River Basin)
Margay Felis wiedii (listed for Central and South America)
Goeldi's Marmoset Callimico goeldii
Yellow-tailed monkey Lagothrix flavicauda
Ocelot Felis pardalis (listed for Central and South America)
Long-tailed otter Lutra longicaudis (listed as South America)
Giant otter Pteronura brasiliensis
Marine otter Lutra felina
Uakari Cacajao spp. (all species)
Vicuna Vicugna vicugna

Birds
Andean condor Vultur gryphus
Mitu Mitu mitu mitu
Brown pelican Pelecanus occidentalis (listed for entire Central and South America)
Darwin's rhea Pterocnemia pennata
Red siskin Spinus cucullatus (listed for South America)

Reptiles

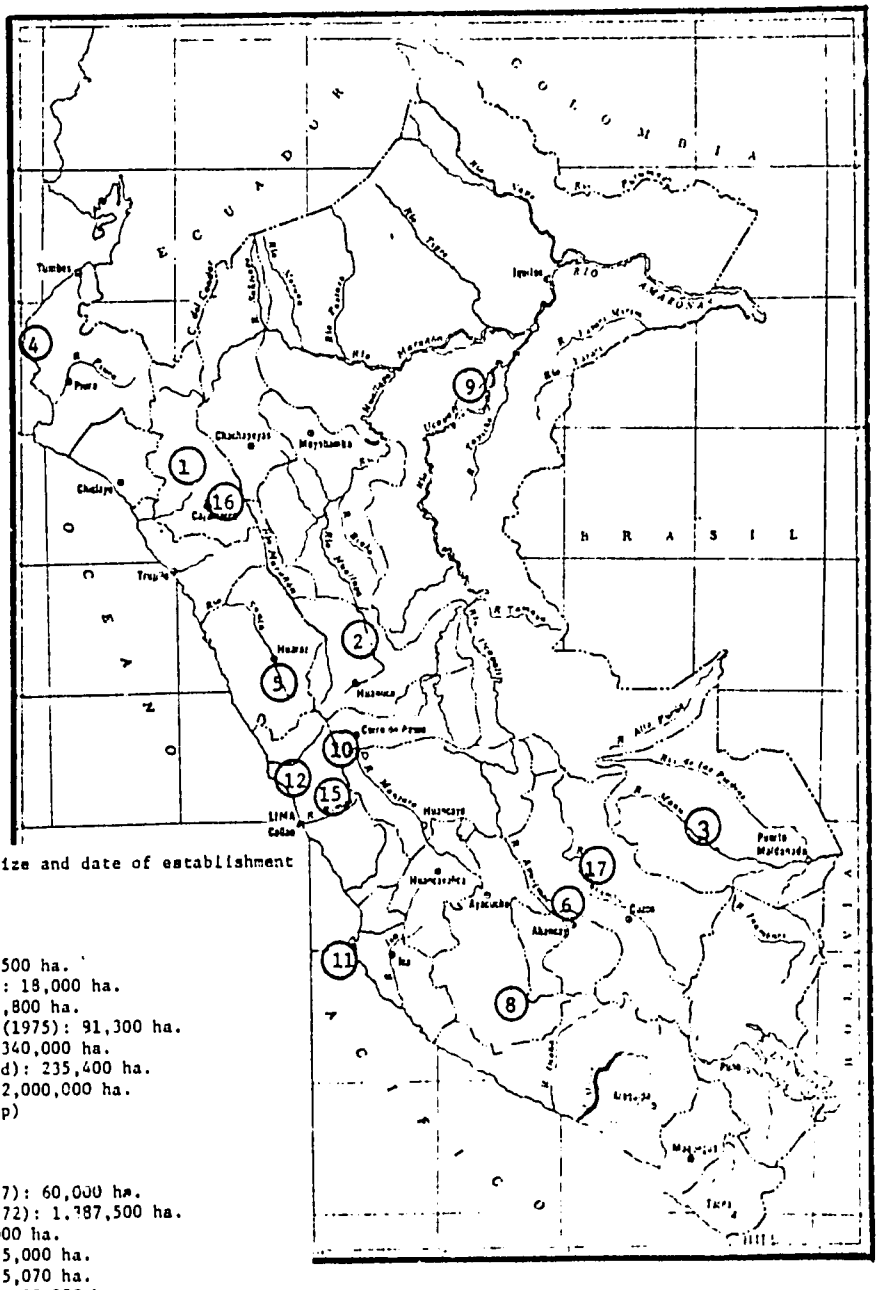
American crocodile Crocodylus acutus
South American turtle Podocnemis expansa (listed as Amazon River Basin)
Leather back sea turtle Dermochelys coriacea (tropical and temperate seas)
Hawksbill sea turtle Eretmochelys imbricata (tropical and temperate seas)
South American turtle Podecnemis unifilis (Amazon River Basin)
Yacara (Caiman) Caiman yacare

4.5.5 Protection of wildlife

4.5.5.1 National Parks and Reserves (see map, page 78a)

The national parks program in Peru began in 1968, although some areas had been set aside as early as 1961. As of 1978, Peru had five national parks, four national reserve areas, and two national sanctuaries. Two additional parks, two national reserves, and three national sanctuaries are being planned. Parks in tropical forest areas are: Tingo Maria National Park in Huanuco department; Manu National Park in the departments of Cuzco and Madre de Dios, and Samiria-Pacaya National Reserve in Loretto Department (Shane 1978:79). When all parks indicated on the map on page 78a have been established, 61,753.9 square kilometers, or 4.7 percent of the national territory will be protected (Dourojeanni 1976:8).

PERUVIAN NATIONAL PARKS AND RESERVES



CONSERVATION UNITS: size and date of establishment (area in hectares)

National Parks

1 Cutervo (1961): 2,500 ha.
2 Tingo Maria (1965): 18,000 ha.
3 Manu (1973): 1,536,800 ha.
4 Cerros de Amotape (1975): 91,300 ha.
5 Huascaran (1975): 340,000 ha.
6 Cutibireni (planned): 235,400 ha.
7 Loreto (planned): 2,000,000 ha.
(not shown on map)

National Reserves

8 Pampa Galeras (1967): 60,000 ha.
9 Samiria-Pacaya (1972): 1,?87,500 ha.
10 Junin (1974): 53,000 ha.
11 Paracas (1975): 335,000 ha.
12 Lachay (planned): 5,070 ha.
13 Titicaca (planned): 50,000 ha.
(not shown on map)

National Sanctuaries

14 Huayllay (1974): 6,815 ha.
15 Huaros (planned): 1,000 ha.

Historic Sanctuaries

16 Chacamarca (1974): 2,500 ha.
17 Machu Picchu (planned): 50,500

(Data from Dourojeanni 1976:8)

4.5.5.1.1 Manu National Park (no. 3 on map)

The park, the largest in Latin America, contains a large variety of ecosystems ranging from Parama grasslands to low land rain forests, with a diversity of plant and animal species. The site is particularly favorable because the Manu River basin has undergone minimal ecological alteration and to a large extent has been preserved in its original state. Birds: 468 bird species are found in an area of 200 hectares, including the Cashu laguna and its surroundings. Habitat is also provided for the giant otter, the otter, the black lizard and the jaguar. In the Andes sector are the most spectacular mammals, some of which are in imminent danger of extinction; these include the spectacled bear, the Peruvian guemal, the white-tailed deer, and the Andes cat.

There are plans to include the park in the tourist-archeological itinerary of Cuzco. International tourist programmes are under consideration. It is hoped that the park will generate a large amount of income.

Sufficient funding and the numbers of personnel now permit the management and control of an area of 1,532 hectares, particularly in those buffer zone areas where logging, hunting, and settlement are taking place. Pressure on the park falls particularly on the eastern boundary: from colonists, timber extractors, and oil exploiters (Information supplied by Carlos Ponce del Prado, Director of Conservation, Peru in WWF Yearbook 1976-1977:219-220).

4.5.5.1.2 Cerros de Amotapes National Park (no. 4 on map)

This park, proclaimed in 1975, covers dry tropical forest between 300 and 3,000 meters altitude along the coast of northern Peru; it is the first Peruvian conservation area in this its life zone. It not only is the most southern habitat of the endangered American crocodile, but its forest represents a type that is rapidly disappearing both in Peru and in adjacent Ecuador. Protection is particularly urgent for this area because of threats from ilegal hunting, shifting cultivation, and timber exploitation.

In 1975 91,300 hectares of this forest was proclaimed a National Park, but only limited funds were available at this stage because the national budget for that year had already been approved. The park administration has, however, used funds provided by the World Wildlife Fund (about $13,739) to purchase a vehicle and to construct a guard post in the far north-east area of the Park on its borders with the Bosque Nacional de Tumbes, in Rica Playa (Jackson 1977:221).

4.5.5.1.3 Pampa Galeras National Reserve and protection of the vicuna

Established in 1966, Pampas Galeras is situated in Department of Ayuacho. Intended principally as a vicuna reserve, Pampa Galeras has permitted the rise in the numbers of vicuna from 5,000 in 1966 to nearly 38,000 in late 1978.

Because of its particular importance as an Andean species and because of drastic reduction in its overall numbers, the vicuna has become the focus of special protection programs. This has involved, apart from the establish-

ment of the Pampa Galeras reserve and a similar reserve in Bolivia, the 1969 treaty among the vicuna countries (Ecuador, Bolivia, Argentina, and Peru) guaranteeing complete protection for this animal. Furthermore, even prior to the CITES (Convention on International Trade in Endangered Species), to which Peru is a signatory, Peru had placed a ban on trade in vicuna prducts (Biological Conservation: July 1972:306).

Because of the increase in vicuna numbers cited above and, furthermore, because Pampa Galeras is becoming overpopulated and is in danger of being overgrazed, Peru now wants to crop the vicuna, both by skinning them and killing them and by shearing them for wool. At the March 1979 CITES meeting in Costa Rica, Peruvian representatives accordingly requested that the vicuna at the Pampa Galeras reserve be removed from Appendix I of the CITES convention (commercial trade prohibited) to Appendix II (commercial trade allowed by permit). This request was fiercely opposed by Peruvian conservationists such as Felipe Benavides of PRODENA (see 2.3.3 above), who argued that to relieve the pressure on Pampa Galeras, the vicuna could be drugged and brought to a second reserve area available in southern Peru. The Peruvian government, on the other hand, argued that the numbers of the vicuna had risen to the point where a program for rational management and exploitation of the animal could begin. (In fact, the original agreement between the Peruvian government and the Community of Pampa Galeras, which owns the land on which the reserve is located, had stated that when the vicuna had made a sufficient comeback, their numbers were to be cropped for the benefit of the local people, whose cooperation was necessary to enable the vicuna's recovery.) In Costa Rica, the conservationist won the day, and the Peruvian request was rejected by the CITES meeting (Tinker 1979: 264-65).

4.5.5.1.3.1 Other measures involving the vicuna

Anti-poaching protection

With the help of funding from the World Wildlife Fund, protection is provided for the vicuna beyond the immediate protected area of Pampa Galeras National Reserves. Specially trained wardens presently provide vicuna protection over an area of 250,000 hectares. Guard posts, continuously manned by four wardens, have been established at strategically important sites, and these serve as the centers for daily horseback patrols. (Hofmann 1977:218-219).

The program is reported to be having considerable success at protecting the vicuna from poachers, with about 24,363 vicuna recorded within the program area in September 1976, only 4,543 of which were in areas of special protection (Hofmann 1977:217-218).

Other programs

The A.I.D. Mission in Peru is reported to be considering a program for the protection of vicuna by setting up reserves in some of the forest areas; such a project, if it is actually realized, would represent A.I.D.'s first involvement in wildlife management (Lausche 1979).

Educational programs

The WWF is funding a project to produce two films--one on the vicuna and the other on wildlife and habitat conservation in the Andes. These films are designed, among other things, to: inform the public on the status of the vicuna and other wildlife; to indicate the important role of the vicuna, including its economic importance as a source of fine wool; to educate not only students but also decision makers and the public in general, on the economic and cultural importance of the vicuna; and to obtain the understanding and cooperation of local people and authorities for conservation action programs (Jackson 1977:222).

4.5.5.1.4 Other reserves

The Guacharo Cave at Tingo Maria (no. 2 on map), the home of oilbirds, has been declared a reserve (Morrison 1974: 73). Paracas (no. 11 on map) is Peru's only coastal zone reserve. Samiria-Pacaya (no. 9 on map) is focussing on the conservation of inland fish resources. Still in the planning stage as of last report (1976) was the Machu Picchu Historic Sanctuary at the location of the famous ruins (no. 17 on map) (Dourojeanni 1976:8-10).

4.5.5.1.5 MAB Biosphere Reserves officially approved in Peru

Reserva Huascaran (no. 5 on map)
Reserva del Manu (no. 3 on map: see 4.5.5.1.1 above)
Reserva del Noroeste (not identified)

4 6 COASTS AND BEACHES

4.6.1 The resource and its utilization

Peru has a coastline of some 2,414 kilometers along the Pacific Ocean. This coastal area is an arid zone, with long stretches of coastal desert, broken by fertile coastal valleys which are the location of much of Peru's market agriculture.

There are 50 ports along the coast, only 13 of which are of any significance. Callao, the largest, handles about 75% of imports and 25% of exports. Fishmeal is handled at Chimbote, Supe, Huacho, Chancay, and Punta Pjuerrey, copper at Ilo, sugar at Salaverry, cotton at Paita, and iron ore at San Nicolas.

Peru has, since 1947, laid claim to all resources within 200 miles of its coast--the first nation in the world to do so.

The resources off Peru's coast, include rich fishing areas (see 4.7 below), oil deposits, some of which are presently being exploited (see 4.8 below), and the guano of the guano islands (see 4.6.2). Peru's beaches, such as Ancon, north of Lima, are a tourist attraction, offering the possibilities of surfing and, on the coastal dunes, of sand skiing.

4.6.2 The Humboldt Current and El Nino

Of vast significance for Peru's coastal resources is the Humboldt Current, which surfaces on the coast of South America, bathing the coastal areas of northern Chile and Peru with cold waters that are associated with rich supplies of plankton. These plankton support large quantities of fish life, particularly anchovies, which in turn provide food for the huge numbers of coastal birds which inhabit the offshore guano islands. For a series of complex reasons, these cold waters are periodically interrupted and warm waters approach the coast. These temperature rises may occur with varying degrees of severity, and there are indications that severe problems occur at roughly seven year intervals. The direct result of the warming, sometimes known as El Nino (the child) because of its occurence around Christmas time, is a drop in the number of fish in the coastal waters. This results in lower fish availability for humans as well as for birds, which either leave the area in search of food or die of starvation. Decreased deposits of guano, the bird excrement which has been of importance as a fertilizer, also result (Nelson 1979:597-98).

4.6.3 The Guano Islands, the guano birds, and guano

Lying for the most part within 16 to 19 kilometers of the coast are the guano islands, small bodies of land, almost all of which are completely barren, often jagged, excreta covered rocks that occur all along the Peruvian coastline. A few such as San Gallan, San Lorenzo, and La Isla Vieja are exceptional in attaining altitudes of more than 300 meters and in supporting pockets of luxuriant vegetation that is watered by cloud moisture.

The guano islands are the breeding places of sea birds, among which the Peruvian booby or piquero (Sula variegata), Peruvian cormorants (guanays) (Phalacrocorax bougainvillei), pelicans (Pelecanus occidentalis), red-footed cormorants, burrowing petrels, penguins, terns, gulls, and skuas. The excrement deposited by these birds, particularly the first three species mentioned above, gives the islands their name. The largest concentrations of birds are on the islands from Punta Negra, about 200 kilometers north of Chiclayo, in the north to Pisco, about 200 kilometers south of Lima.

It has been observed that the population of the guano birds fluctuates from year to year, and their numbers have been influenced by many factors, chief among them the abundance of fish in the coastal waters. When the numbers of these fish are reduced because of the El Nino phenomenon (see 4.6.2), drastic reductions of bird numbers occur, followed, however, by recovery. In 1959, for example, the number of guano birds was down to 6.8 million from the 20.3 million of 1956; by 1963, the number was back to about 18 million, but by 1966, following a particularly bad year in 1965, the number was down to only 4 million. Recovery from the 1965 low was less certain, however; this has been traced to the almost feverish rate of expansion of the Peruvian anchovy fisheries during that period, which for the first time offered serious competition to the guano birds. Reductions in bird numbers have more seriously among guanays, which feed almost exclusively on anchovies than among Peruvian boobies, which depend on other fish as well (Nelson 1978:605).

guano exploitation

Guano production has been favored by a combination of plentiful food for the Guano birds and the dry climate of the Peruvian coastline, which helped to preserve the Guano deposits over centuries. At the time of the beginning of the extensive exploitation of Peruvian guano in the nineteenth century deposits were as deep as one hundred fifty feet and supplies seemed inexhaustible. Although there is evidence that the Incas, who had collected guano for use as fertilizer in the coastal valleys, had also controlled the exploitation of this material, no such precautions were taken during the nineteenth century guano boom. In the 1880's, when exploitation was at its peak, as many as forty ships were gathered around the Chincha Islands alone, as guano traders cut out the guano for the European fertilizer market (Morrison 1974:37).

Guano from Peru's offshore islands in conjunction with the manure of domesticated animals had been until the late 1950's Peru's chief source of fertilizer for domestic agriculture, and until the 1930's it was also one of Peru's leading exports; by 1970 only minimal amounts were being exported (Weil 1972:276). Between 1970 and 1974, guano production declined from 51,000 metric tons to 19,306 metric tons (U.N. Yearbook of Fisheries Statistics).

protection of guano birds

During the last half of the nineteenth century, when guano was Peru's chief export, the guano islands were heavily exploited and many guano

birds were killed. In 1909, however, the Guano Administration was established and protection was afforded to the guano producing birds. The Guano administration has stationed guards at the main breeding stations to prevent human encroachments aimed at removal of eggs or birds as well as to control other predators such as foxes, gulls, condors, and turkey buzzards. Other restrictions, somewhat difficult to enforce and reportedly largely ignored, require boats to stay at least two miles away from breeding islands, prohibit fishing within a three-mile belt around all stations and five miles around some stations, and prohibit planes from flying any lower than 500 meters above the islands (Nelson 1978: 605).

The fishing industry, apart from competing with the guano birds for fish, poses other dangers to the guano birds. Fisherman kill many guano birds by accidentally catching them in nets, leading to their drowning or strangulation. Intentional killing has also been reported. In 1966 it was reported that "thousands of birds are being massacred daily by the fishermen, to prevent these hungry birds from spoiling their nets or interfering with their catch." The observer, a Peruvian conservationist, had himself witnessed more than 43,000 birds clubbed to death in 8 days (Nelson 1978: 605).

The Guano administration has also attempted to provide extra nesting areas on headlands of the Peruvian coast. This has involved not only the isolation of Peninsulas by 3-meter high concrete walls but also the enlargement and creation of nesting sites. The measures, begun in 1945, led to a marked expansion of the mainland population of guano birds, which had early been almost completely confined to the islands (Nelson 1978: 605).

4.6.4 Pollution of seas and beaches

Although the Ministry of Fisheries in 1975 reported that pollution along the Peruvian coastline, was practically non-existent ("Contaminacion marina..."1975:10), there are indications that Peru's marine waters are adversely affected by municipal, mining, and industrial wastes. ONERN reported in 1974, for example, that marine life on the Ite beach had declined as a result of the drainage of mine washings from Toquepala (JPRS 63249 [October 21, 1974]:9).

In April 1979 there were reports of fish deaths from the explosive growth of a microorganism that had contaminated the sea. The microorganism, whose rapid growth was attributed to changes in the water temperature, had affected anchovy, mackerel and other small fish, thousands of which had covered the beaches near Lima (JPRS 73475[1979]).

4.6.5 Government action relating to resources of coasts and beaches

ONERN, concerned with problems such as depletion of fish stock along the coast and the pollution of sea waters, has began research on an environmental profile of the Peruvian coast and is seeking assistance for this program (Amembassy Lima 1979). See also 2.1.2.1.

4.7 FISHERIES

4.7.1 The resource

4.7.1.1 Marine fish

Peru's offshore waters have been estimated to contain as many as 600 species of fish, crustacean, molluscs and marine mammals, while in the coastal rivers are shrimp, which are caught at the rate of 700,000 kilos per year ("Natural resources..." 1976:11).

In the cold and nutrient-rich waters of the Humboldt Current off the coast of Peru there normally occur vast numbers of cold water fish such as anchovy and sardines, which have formed the major focus of Peru's fishing industry. However, large quantities of other fish also occur, as can be ascertained from the list of Peru's fish catch for the period of the early to mid-1970's (see page 85a).

4.7.1.2 Freshwater fish

The waters of the South American interior are rich in fish life, an estimated 2,500 species occurring in the various lakes and river systems. Brazil, for example, has catalogued about 800 species of fish in its Amazon region, while about 230 have been catalogued for the lowland streams of Peru. The short rivers running from the Andes to the Pacific Ocean are, by contrast, much less productive; the total number of species in all the west-flowing rivers of Peru, Ecuador, and Colombia combined has been estimated at only 125 (Bates 1964:178; Romero 1973?:v.2,49). The most important Amazonian fish is the paiche--the giant redfish or pirarucu (Arapaima gigas), by some accounts the largest of all freshwater fish, it is the most important animal food of the Amazon region. Other fish important because of their value as food include the gamitana (Canntopomus sp.), the zungaro (Pimelina albicans), the carachama (Bunocephalus bifidos), the yaguarachi (Curimatus sp.), the corbina (Salminus afinis), and the eel (Gymnotus electricus) (Romero 1973?:50). Perhaps the best known fish of the lowland rivers is the carnivorous piranha, several species of which occur in Peruvian waters. Also abundant in the waters of the lowlands are small fish, which form the great bulk of the fish population; many of these are of the colorful and unusual types valued by tropical fish collectors.

In the waters of Lake Titicaca are lake catfish and a subfamily of freshwater cypridonts known as the Orestiinae, which attain a length of 10 inches and have served as a staple food for this areas for centuries. This species of fish has, however, been largely displaced by the lake trout introduced into Lake Titicaca in the late 1930's (Bates 1964:186).

Fish catch 1970-1977 (in metric tons): From FAO Yearbook of Fishery Statistics (1974-1977)

	1970	1971	1972	1973	1974	1977
TOTAL	12,534,900	10,528,600	4,724,100	2,377,700	4,149,888	2,529,995
FRESHWATER (all species)	2,000	2,500	3,000	4,700	5,450	6,500
MARINE FISHERIES						
Anchoveta	12,277,000	10,268,000	4,447,400	1,768,700	2,583,483	792,106
Eastern Pac. Bonito	57,400	73,000	64,200	34,800	7,132	5,743
Southeast Pac. Menhaden	19,700	22,800	38,600	44,600	16,577	5,062
Pacific Silver Hake	17,200	26,200	12,600	132,100	109,385	106,390
Smooth-hounds	12,200	9,300	8,500	19,200	14,429	9,787
Drums	7,900	5,800	6,000	16,000	11,838	10,227
South Pacific Breams	7,000	13,700	11,000	10,400	8,418	23,331
Yellowfin tuna	8,900	6,500	2,000	6,100	4,772	2,512
Chub mackerel	8,800	10,100	6,700	65,000	60,681	42,739
Skipjack tuna	7,200	5,700	2,400	4,800	2,289	3,232
Pacufic rock bass	5,000	4,200	3,800	4,000	4,441	1,751
Chilean Jack Mackerel	4,700	8,200	18,800	42,800	127,460	504,552
Silversides(Sand Smelts)	4,500	2,500	1,800	900	6,052	3,314
Skates and Rays	4,500	1,400	1,200	1,300	2,298	1,371
Peruvian drum	4,000	4,200	3,000	6,500	7,647	5,766
Peruvian weakfish	2,700	3,100	1,800	7,900	6,303	3,130
Swordfish	2,400	200	600	1,900	270	416
Tilefishes	1,700	600	800	800	227	460
Peruvian weakfish	1,700	400	400	500	552	251
Cusk-Eels	1,300	700	1,000	2,200	1,709	1,266
Mullets	1,000	2,100	4,600	6,900	7,129	5,854
Pacific grunt	900	1,200	2,200	4,100	1,520	1,383
Groupers	800	500	600	600	103	378
Flatfishes	700	500	500	700	612	1,001
Armoured ang.	500	100	300	300	398	325
Ch. Pilchard	500	6,100	6,300	60,500	73,591	870,889
Sierra King Mackerel	400	500	800	1,000	1,208	1,295
Pintandilla	300	200	300	400	159	111
Pompanos	300	200	200	200	195	210
Snappers	100	200	100	300	33	77
Various snarks	100	100	100	200	112	n/a
Whitemouth	--	0	0	100	8	119
Pelagic Perc.	00	00	00	100	55	70
Miscellaneous	6,500	700	6,600	59,000	47,645	59,697
Marine crabs	300	00	400	700	931	1,255
East Pac. Spiny Lobsters	00	00	00	00	2	9
Pacific White Shrimp	300	500	900	900	465	539
Gastropods	500	1,000	1,400	1,800	1,570	2,732
Cholga mussel	10,200	10,500	11,400	14,900	9,873	11,317
Scallops	400	400	400	3,100	982	1,067
Common squids	300	400	700	300	92	274
Squids(misc).	500	400	00	-	-	1
Octopuses	00	00	00	100	19	38
Marine molluscs	800	1,600	1,600	2,200	3,083	4,788

4.7.2 Peruvian marine fisheries, the Humboldt Current, and El Nino

Up until the late 1950's, fishing in Peru had been chiefly an artisinal activity; industrialization of the anchovy fisheries began in 1953, and by 1966 anchovy fisheries provided jobs for more than 40,000 persons and yielded profits of some 5,000.0 million soles per year. The fishery continued to grow, reaching its peak in 1970, by which time Peru had become the world's largest fishing nation. By the end of April 1970, the total yearly catch had already reached 9.5 million metric tons and continued for ten more days at the rate of 100,000 metric tons per day. Although a maxiumum sustainable yield limit of 9.5 million metric tons per year was recommended by an international team of biologists in 1970, little heed was taken of this cautionary advice in 1971, when the catch anchovy catch again topped 10.2 million metric tons. It was in late 1971 that the Humboldt Current, whose cold waters are so vital to Peruvian fisheries, was interrupted by the warmer waters of the El Nino current (see 4.6.2), driving the anchovies from the Peruvian coast. By mid-1972, after a period of heavy spring fishing, it became clear to the government that the anchovies had gone. Fishing was shut down for the remainder of the year, and despite cautious fishing and more efficient management in the wake of the El Nino disaster, the fishery has not yet recovered. In 1977 although the total catch of fish was 2.5 million metric tons, the anchovy catch was only 792,106 metric tons, down over 11.5 million metric tons from 1970.

Although some have ascribed the collapse of the Peruvian anchovy fisheries entirely to El Nino, there seems to be general agreement that the heavy fishing of 1970-71, to quote an FAO fisheries expert, depleted the stock to such a vulnerable condition that while successful replenishment by new spawning "...could be maintained under average or better environmental conditions, the unfavorable conditions of El Nino would cause a recruitment [replenishment by new spawning] failure that would not have occurred if the adult stock had been larger" (Eckholm 1976:158).

To limit overfishing fishing, moratoria on the anchovy of up to three months have been declared in recent years. Furthermore, anchovy fishing, when permitted, has been limited to the southern coast by measures aimed at protecting the species. There is still concern, however, that recovery will be limited (CEPAL 1978: 731).

4.7.2.1 Utilization of the fish catch

Most of the fish catch since the beginning of Peru's fishing boom has been used for the production of fish meal to be exported as animal feed. About 98% of the catch, mostly anchovies, are processed into fish meal and fish oil. In recent years, such as 1977, because of the low anchovy catch, fish such as jurel and sardines, traditionally used for direct human consumption, were also used for the production of fish meal and oil (CEPAL 1978:731). This has helped to maintain the level of fish oil, but because of the high fat content of the species used, production of fish meal could not be maintained (CEPAL 1978:731).

In 1977, 448,000 tons of fish were caught for human consumption, 34% more than in 1976. Some of this production is canned, some frozen, and some is consumed fresh. The food fishing industry is, however, faced with problems, such as the poor quality of the raw materials, said to result from fishing with inadequate vessels and gear, inefficient handling, and deficiencies in the freezing and discharge infrastructure (Germany, Fed Rep of 1978:8).

4.7.3 Freshwater fisheries

Freshwater fishing, although important in some areas of the country, has not played an important role in the Peruvian economy. In 1970, at the height of the Peruvian fishing boom, the freshwater fish catch was only 2,000 metric tons--less than 0.02% of the total catch; by 1974, this had, however, risen to 5,450 tons or about 0.13% of total catch.

The Indians of the Amazon are fisheaters, some depending almost exclusively on fish; the most important food fish for these people is the paiche. As described by Peter Mathiesson in The Cloud Forest, such fish are often captured by the use of poisons.

The waters of Lake Titicaca, which have provided food for Indians for centuries are said to be overfished (WER July 16, 1979: 5).

Another money-making activity relating to fish is the catching of ornamental fish of the Amazon for sale to tropical fish collectors in both Europe and the United States ("Fishing..." 1976:12).

4.7.4 Adverse effects of pollution on fishery resources (see 4.6.4)

Mining and industrial wastes are frequently held responsible for degradation of fishery resources. Wastes from mines have been held responsible for fish kills in the Majes, Camana, and Ocona Rivers, while industrial wastes from the city of Arequipe are said to have led to the extinction of shrimp in the Chili River (JPRS 63249, October 24 1974:8-9).

4.7.3 Government policy

In recent years the Peruvian government has advocated a fishing policy based on the rational management of fish resources; this policy, which covers lakes and rivers as well as the highly developed marine fisheries, puts greater emphasis than ever before on fishing for human consumption. The Empresa Publica de Servicios Pesqueros has been given the task of efficiently meeting the domestic demand for fish and promoting the large-scale consumption of fish among the population. As one facet of this program Peru has been stocking the lakes and rivers of Peru with fish which it is hoped will serve to feed its growing population ("Fishing... 1976: 10-12).

In order to promote the food-fishing industry, especially in the interior, the government has enacted measures such as construction of additional coolers, and expansion of fishing harbors (Germany, Fed Rep of:1973:8). One such operation is the Iquitos Fishing Complex in the Selva Department of Loreto; this is to provide facilities for unloading, handling, and canning for artisinal fishermen in support of the development of fishing for human consumption in the Selva region. Its fishing terminal, with a capacity for receiving 10,000 metric tons of fish per year, is to have freezing equipment ("Fishing..." 1976: 14).

In another move the Peruvian government under Decree 21558 of 1976 transfered the fishing fleet, which had been nationalized under PESCA-PERU in 1973, to small private enterprises, leaving in the hands of PESCA-PERU, matters relating to the processing of anchovies into fish meal and oil, production of any byproducts, and the explotation of guano and related activities ("Fishing..."1976:10-12).

4.7.4 Fisheries research and education

Technical education and training are also a part of the Peruvian government's push toward rational fisheries management. As of the end of 1976 nine Fishery Training centers were in the course of being established, in accordance with the General Education Law. They are attempting to raise the educational level of workers through the Higher Professional education schools (Escuelas Superiores de Educaccion Professional) and the Extraordinary Professional Qualification Centers (Centros de Calificacion Profesional Extraordinaria). ("Fishing..." 1976: 12-13).

Research in the field of fisheries includes the Experimental Cultivation of Microalgae Project, conducted by the Ministry of Fishing in collaboration with the German government; it has been developing scientific methods for cultivation of these organisms both in the Andean Lakes and in the seas ("Fishing"...1976: 12) (see also 2.1.2.1). At the Samiria-Pacaya National Reserve in Loretto Department research is being performed on the fish resources of the Amazon basin area.

4.8 MINERALS AND HYDROCARBONS

4.8.1 The Resource

Mining has always played an important role in the economy of Peru, today accounting for about 54% of total Peruvian exports. Proven and probable mineral reserves are reported to be as high as 15,524 million metric tons ("Natural Resources..." 1976: 11).

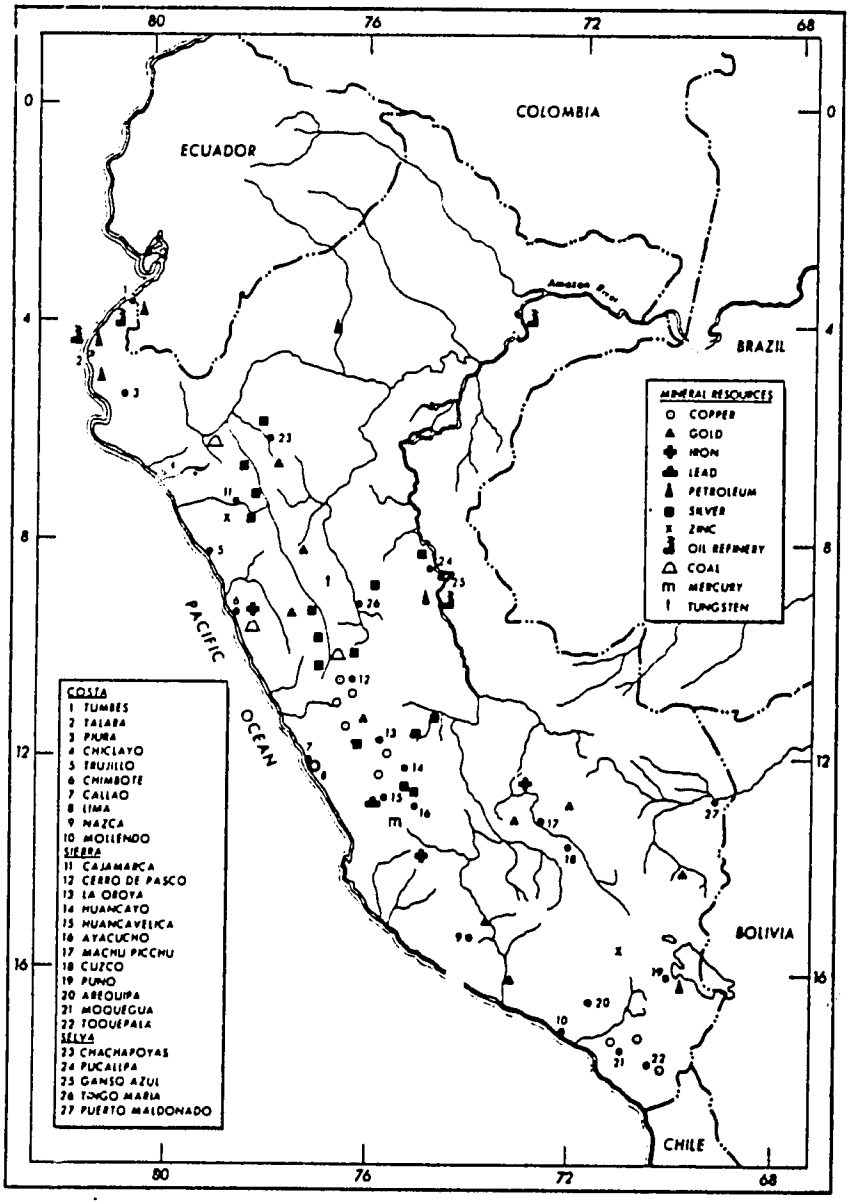
Metallic resources include copper, gold, iron, lead, silver, zinc, mercury, and tungsten; produced mainly as byproducts of the processing of these metals are antimony, arsenic, bismuth, cadmium, indium, manganese, molybdenum, selenium, tellurium, and tin.

Non-metallic minerals include phosphate deposits of 559 million metric tons, and brine (1,431,000,000 metric tons, containing 8 million metric tons of potassium chloride, 70 million metric tons of magnesium chloride and 170 million metric tons mt of sodium chloride). Salt is produced mainly from salt water evaporation, although numerous rock salt mines exist, mainly in the Huallaga River Valley. There are also deposits of gypsum, limestone, and marble (Natural Resources..." 1976:11).

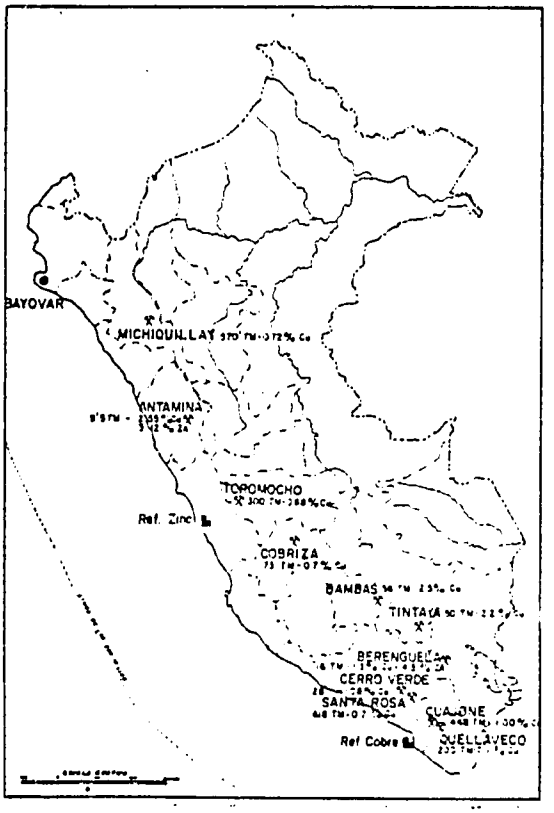
Recent government policy with regard to the mining sector has been to ensure state control of national resources and at the same time encouraging expansion of production and refining capacity. As processing capabilities are increased, it is hoped that Peru's mineral exports will shift from ore to refined metals production.

The major mining organizations in Peru are CentrominPeru, MineroPeru, and Southern Peru Copper. The first two were both created in 1974 and are government owned. Whereas CentrominPeru was formed as the result of the nationalization of the private Cerro de Pasco Corp., MineroPeru controls principally undeveloped mineral deposits. With the exception of already existing rights, MineroPeru now has exclusive authorization to refine and and market all mineral products. Another large enterprise is HierroPeru, the state iron mining company, which together with the other three companies accounts for some 654% of the output of the mining sector. About 60 medium sized private companies producing partially refined ores account for another 30% of the sector; the remmaining 5% is accounted for by approximately 1,000 small, labor intensive mines (Saettone and Porter 1979: Vol. 1, 2-6).

Exploration for uranium, which began as early as 1953, has been conducted by both Peruvian and foreign scientists. The chief Peruvian agency involved has been the Instituto Peruano de Energia Nuclear (IPEN), with strong assistance from geologists representing the United Nations Development Program (UNDP). Although uranium has been found in association with other metals, no economic deposits have been uncovered; however, uranium exploration continues. It is generally agreed that the most favorable areas for uranium search lie along the foothills of the eastern Cordillera and in the adjoining jungle extending toward the Brazilian Shield (Saettone and Porter 1979: Annex 1, 79-83).



LARGE MINING DEPOSITS
(RESERVES AND GRADES)



4.8.2 Metal resources

4.8.2.1 Copper

Copper is today Peru's major export and the principal product of Peru's mines. Reserves are estimated at 25.108 million metric tons. According to Peruvian sources, known reserves in the country could last a century and represent close to 10% of the world reserves of copper. As of 1977 Peru was the world's ninth largest copper producer, a slip from its earlier seventh place position. In general, the Peruvian copper industry has suffered from low world prices in recent years (CEPAL 1978:733).

Although copper and iron deposits have been found on the southern coast of Peru, the developed mineral deposits of Peru are concentrated chiefly in a north to south belt roughly 150 to 200 miles wide in the central Sierra. Most of the mines are at elevations ranging from 3,000 to 5,000 meters above sea level and are heavily dependent for workers upon the local Indian population that is accustomed to life at these altitudes.

The main sources of present copper production are the mines grouped around the La Oroya complex (controlled by Centromin); the Toquepala mine in the extreme south; the Cuajone mine, brought into operation in iate 1976 with an annual capacity of 180,000 tons; and the Cerro Verde mine in Arequipa, brought into production by MineroPeru in 1977, with a capacity of 33,000 tons per year. Undeveloped deposits currently being considered for exploitation are Cerro Verde II (Sante Rosa) with a projected initial stage production of 54,000 tons of copper concentrates per year; Tintaya, 247 kilometers south of Cuzco with a projected yearly production of 50,000 tons of copper concentrates; and Antamina, 250 kilometers north of Lima, with expected yearly production of 70,000 tons of copper and 59,000 tons of zinc. Financing for these developments appears to be uncertain, however, while financing for development of deposits in Michiquillay (in Cajamarca department), Quellaveco (between Cuajone and Toquepala), and Toromocho will not be available in the forseeable future (Economist Intelligence Unit 1978:10-11).

Copper production in 1977 was 332,800 metric tons, while production for 1978 has been estimated at 365,000 tons. Virtually all of Peruvian copper is smelted in country but only about 55% of it is refined there.

4.8.2.2 Lead

Peru is the world's fourth leading lead producer. Centromin produced 34% of Peru's lead in 1977; the biggest producer among the medium and small mines accounted for 8.7%. Lead production in 1977 totaled 176,200 metric tons, 79,300 (45%) of which were refined in country.

4.8.2.3 Zinc

In 1977 Peru was the world's fifth largest producer of zinc. Centromin produced 43% of the country's zinc in 1977; the biggest producer among the 30 or more medium and small mines accounted for only 7.7%. Zinc production in 1977 was 436,000 metric tons, only 66.8 (15%) of which which were refined in country. A zinc refinery, under construction since

1971 is scheduled to begin operations at Cajamarquilla near Lima in 1981.

4.8.2.4 Silver

Peru is the leading silver producer in South America and ranks fifth among world producers.

Most of the silver in Peru is produced as a byproduct of the mining of copper, zinc, and lead. Centromin accounts for 20% of production and the Cuajone copper mine for 11%; there are 36 independent producers. Silver reserves have been estimated at 28,371 metric tons.

Much silver is used for production of tourist goods.

4.8.2.5 Iron (reserves estimated at 324,603,000 mt)

Installed mining capacity is 10 million metric tons per year, but because of marketing problems, this level of production was not achieved in 1977, and production in recent years has generally failed to attain the 1974 high of 6,015,000 metric tons. The largest mine is the Marcona mine near Nazca, which was nationalized in 1975 and is now under the state company, HierroPeru. (CEPAL 1977:753; Economist Intelligence Unit 1978: 13).

Iron ore is processed into pellets, slurries, and sinter and concentrates at blast furnaces at Marcona, while the blast furnaces and steel production at Chimbote in the Costa have a capacity of about 520,000 metric tons of steel per year.

4.8.2.6 Gold

By 1969 Peru, once a major gold producer was only tenth in world production. Production from 1973 through 1976 remained steady at about 3,100 kilograms.

4.8.2.7 Mercury

The only mercury producing country in Latin America, Peru has consistently worked its mercury mines near Ayacucho since 1572; in late 1971, however, deposits seemed to be running out. Production for recent years were 123 tons in 1973, 112 tons in 1974, and 58 tons in 1975.

4.8.2.8 Other metals

Metals produced in conjunction with the mining of other metals are antimony (603 tons in 1976), tungsten (945 tons in 1976), and molybdenum (600

4.8.3 Non-metallic minerals

4.8.3.1 Production of salt in 1976 was 355,000 metric tons.

4.8.3.2 Limestone deposits supply the main raw materials for five government-owned cement plants at Atocongo near Lima, at Tarma in the central

Sierra, at Pacasmayo in northern Peru, and near Arequipe and Juliaca in the south. Current cement production is almost 2 million metric tons per year.

4.8.4 Petroleum

4.8.4.1 The resource

The history of hydrocarbon use in Peru goes back to the Incas, who utilized seepage oil and asphalt prior to the Spanish conquest. Drilling for oil began as early as the 1860's in the Talara basin in northwestern Peru, and the first commercial production in South America began in that oil field, which until recently has remained Peru's major source of petroleum, in 1874. Exploration in the Amazon Basin began in 1919, but the first discovery of oil did not occur until 1937. After a lapse of some years, exploration in the Amazon area was resumed in the early 1970's, resulting in the discovery of a dozen new oil fields. On the basis of these finds, a pipeline was constructed to transmit 200,000 barrels per day to the Pacific; additional finds were not forthcoming, however, and the pipeline, which opened in 1977, has been underutilized. Nevertheless, shipments via the pipeline to the crowded Costa region had by mid-1978 permitted Peru not only to achieve self sufficiency in petroleum but also to export small quantites.

Reserves of petroleum have recently been calculated by a team from the U.S. Geological Survey (Saettone and Porter 1979: Annex 2). Because oil exploration is no longer being conducted, these reserves represent the supplies on which Peru must relay for at least the next fifteen years.

Reserves in millions of barrels

Measured reserves:	Amazon region	385
	Talara offshore	60
	Talara onshore	120
Indicated reserves	(secondary recovery:Talara)	500
Inferred reserves		30
	TOTAL	1,095

The above table indicates reserves which are already known or the existence of which can be readily projected on the basis of known reserves. Undiscovered recoverable reserves, also estimated by the U.S. Geological Survey, come to about 2,060 billion barrels; these include both offshore and onshore potential in the Talara region as well as reserves in the Ucayali, Madre de Dios, and Maranon basins of the Selva (Amazon region).

4.8.4.2 Utilization

As of mid-1978, cumulative oil production in Peru for all fields was 978 million barrels; 96.7% of this oil was from Talara basin oil fields. The opening of the Amazon fields has brought about a shift in the relative importance of petroleum from the Talara fields. Oil fields currently exploited in Peru should produce a yearly total of 75.9 million barrels in 1979--an average of 208,000 barrels per day. Of this about 33% is

expected to come from the Talara oil fields, with 10.8 million barrels from offshore sites; the remainder is from the Amazon oil fields. The opening of the Amazon fields has permitted a jump in oil production from 6,400 barrels per day in 1976 to a projected 208,000 barrels per day for 1979. As of mid-1978, with average production running at 140,000 barrels per day, Peru was able to meet its domestic demand of 126,000 barrels per day (Saettone and Porter 1979: Annex 1: 26).

Peru nationalized oil holdings in the late 1960's, creating PetroPeru, the state oil company. In 1970 the government instituted a plan under which private companies were permitted to enter into partnership with PetroPeru for both exploration and development. In 1977, in an effort to further stimulate development of its oil resources, Peru began offering more favorable terms to private oil companies. Recently, extensive concessions formely reserved for PetroPeru were offered up for private bidding.

4.8.4.3 Petroleum refineries

There are presently six oil refineries in Peru, although one of these (Conchan) is not currently in operation. The largest refinery is at La Pampilla near LimaCallao; its total crude distillation capacity is 102,000 barrels per day (bspd). The others are at Talara (65,000 bspd), Conchan (8,500 bpsd), Pucallpa (2,500 bspd), Marsella (1,400 bspd), and Luis Diaz (1,200 bpsd).

4.8.5 Coal

Coal deposits, reported to occur in 18 of Peru's 24 departments, include coal ranging from lignite to anthracite. The most promising deposits are in central and northern Peru. Coal fields in Alto Chicama and Santa Valley in the north and Oyon-Gazuna and Jatunhausi in central Peru are said to have considerable potential as sources of fuel and metallurgical (coking) coal. Proven coal reserves in the Alto Chicama amount to 25.2 million tons, while probable and possible reserves come to 245.5 million tons. Other reserves are considerably smaller.

No coal reserves are presently being exploited, nor has coal been mined since 1973, when a small amount of anthracite was produced (Saettone and Porter 1979: Vol. 1, 2-15.).

4.8.6 Pollution related to mining and petroleum operations

As detailed in sections covering water and air pollution (see 4.2.1.1.3 and 4.9), pollution from mining operations is a major environmental problem in Peru. Wastes from mines are pumped directly into lakes and rivers, emissions from smelting and refining operations have damaged agricultural operations, and toxic wastes from mines are often simply deposited in ravines in the Andes. In the arid region of the southern part of the country, the Toguepala copper mines has transformed the Rio Lucumba into a lead colored stream, the pollution from which can be observed as far as two miles out to sea (Townshend and Townshend 1978: 119). It is also feared that water pollution may arise from the development of the oil deposits in the Selva region.

4.9 AIR AND THE ATMOSPHERE

4.9.1 Air pollution resulting from urbanization

Air pollution resulting from urban factors such as traffic is most pronounced in the greater Lima area, which in addition to having the greatest concentration of industrial activity in the country (about 78%), had in the early 1970's some 280,000 vehicles, about 64% of those registered in the entire country (Gastanaga Coll 1973: 33).

Contributing to air quality problems in Lima are the inversions which occur, particularly in the winter months, allowing pollutants to be trapped in the city (Gastanaga Coll 1973: 33).

Environmental pollution is Lima is caused by carbon monoxide, sulfur dioxide, sulfuruous anhydrides, and ammonia, all of which are reported to exceed all maximum tolerance levels. Specialists at the Fourth Peruvian Immunology and Allergy Congress, held in October 1978 in Lima, agreed that levels of pollution in Lima can be compared with those in Sao Paolo and Buenos Aires.

Whereas maximum tolerance levels for carbon monoxide are 30 parts per million (ppm), levels of carbon monoxide in Lima are general about 40 ppm and as high as 180 ppm in some downtown streets.

In winter the sulfur dioxide levels in Lima get as high as 0.071 parts per million. Levels of hydrogen sulfide are 0.071 ppm, as compared with the maximum tolerance levels of 0.022 ppm.

Doctors have pointed out these measured substances, in conjunction environmental dust containing fungi, fermentation bacteria and radioactive ions, have aggravated the health situation, leading to substantial increases within the past twenty years of rhinitis, bronchial asthma, conjunctivitis, allergic dermatis, and certain digestive problems (JPRS 72490[1978]:21-22).

Apart from air pollution problems attributable to the growth of cities, Peru suffers from pollution resulting from metallurgical smelting plants and fish meal plants.

4.9.2 Air pollution resulting from metallurgical operations

Typical of problems arising from metallurgical operations are those associated with metallurgical plants in the city of La Oroya in the Sierra region. As early as 1922 pollutants from the plant were seriously detrimental to agriculture within its vicinity; improvements in the plant's equipment have generally reduced levels of pollution, but La Oroya continues to be plagued by sulfur, lead, and arsenic emissions. Recent studies of agriculture communities within a radius of 50 kilometers of the plant have turned up disturbingly high concentrations of anhydrous sulfides, lead, arsenic and selenium in soils and pastures. At Ilo along the southern coast, where metallurgical plants have been in operation since 1960, sulfur anhydrides have had such a negative effect on agricultural production

that the plant has been required to pay indemnity to farmers, while in the Tambo Valley, 60 kilometers north of the smelting plant, air borne pollutants are reported to have damaged sugar cane production (Gastanaga Coll 1974: 31-32).

Also seriously affected by copper processing emission at Ilo have been olive trees, plants generally regarded as being resistant to environmental influences. The effects of the emissions have been found to extend to all olive groves in the Ilo valley, bringing about significant reductions in the production of both olives and olive oil. As of 1977, despite studies aimed at reducing the levels of noxious emissions from the plant, no action had been taken (JPRS 69228[1977]:32).

Sulfur anhydride emissions on a national level have been traced to smelting plants for copper, lead, and zinc (88.6%), petroleum refineries (10.9%), and other sources such including sufuric acid production, burning of anthracite coal, incineration of refuse (0.5%) (Gastanaga Coll 1974: 39). As mentioned above, concentrations of sulfur anhydrides are especially severe in La Oroya, averaging 0.100 ppm in the city but rising at times to as high as 1.33 parts per million. (Gastanaga Coll 1974: 41).

Other less serious pollution problems have arisen from portland cement plants in areas such as Leticia and Yura.

4.9.3 Pollution from fishmeal producing plants

Fishmeal producing plants have been another source of air pollution. Such plants are located on the coastal regions, important locations being Chimbote, Tambo de Mora, Pisco, Callao, Supe, Carquin, Chancay, Ilo, Atico and Vegueta. In Chimbote and Callao, the most important centers of fishmeal production, emissions of ammonia and hydrogen sulfide have befouled the air and caused respiratory diseases. Strong public protest over odors from fishmeal plants in the Lima-Callao area resulted in apparently successful government efforts to reduce their severity in the early 1960's (Gastanaga Coll 1974:33).

4.9.4 Monitoring and control of air pollution

The Institut de la Salud Ocupacional (ISO), the government agency charged with air pollution control, has three programs for atmospheric pollution: one in Lima, one in La Oroya, and one in the Valle de Tambo.

Air pollution control in Lima

In Lima the program has several facets: recording of air quality; a service for the registration of complaints and protests; special studies; training; and norms and regulations.

The Air Quality Registry, maintained by the Air Pollution Laboratory, of the Institute de la Salud Ocupacional keeps track of certain substances which serve as indices of air quality: sulfur anhydrides; nitrogen oxides;

hydrogen sulfide; ammonia; ozone and other oxidants; lead; and arsenic. The ISO maintains three monitoring stations for securing these readings; these monitoring stations are operated in conjunction with REDPANAIRE (the Panamerican Air Quality Monitoring Network). A fourth station is maintained by the National Engineering University (see 2.7)

The complaints service facet of the Lima program investigates complaints about air pollution, often resulting in the prescription of corrective measures.

Under special studies, are periodical determinations of levels of benzopirenes, carbon monoxide, and noise levels in the city. The Institut de La Salud Ocupacional has also conducted studies to plan the location of new industries and to determine air quality in future mining and industrial zones, including the location of a zinc refinery in Lima (1972), and, beyond the limits of the Lima program, the Bayovar Industrial Complex in Piura (1973).

Training in conjunction with the Air Pollution Program in Lima has included the training of technicians in the recognition of sources of air pollution: in 1973, for example, 64 such technicians were trained for the Environmental Health Service of the Health Zone of Lima.

In the category of norms and regulations the program has contributed to a draft of a new Air Pollution Prevention Law.

Air pollution control program in Oroya

In Oroya, the program has comprised periodical studies in the city and in areas around the copper smeltery with the goal of verifying changes in levels of contamination and using these findings as the basis for reducing pollution from these sources.

Air pollution control program in the Tambo Valley

The ISO also participated in work carried out in pursuance of Law No. 16583 forming the high commission charged with assessment of damages caused by emissions from the smeltery at Ilo in the Tambo Valley; these emissions had resulted in agricultural losses of roughly two million dollars per year. The Commission, which had a statutory lifespan of two years began work on January 1, 1973; it was a cooperative effort involving the ISO, which set up 18 stations for monitoring sulfur anhydrides and also made determinations regarding suspended matter, hydrogen sulfide, and ammonia; the Ministry of Agriculture, which was to establish the relationship between sugar cane production and smeltery emissions; the National Meteorological Service (SENAMHI), which was charged with studying the relationship between local climatic conditions and air pollution; and the Ministy of Energy and Mines, which coordinated the work of the Commission (Gastanaga Coll 1974: 37-39).

5.0 THE ECONOMY OF PERU

5.1 Basic economic indicators (National Intelligence 1979)

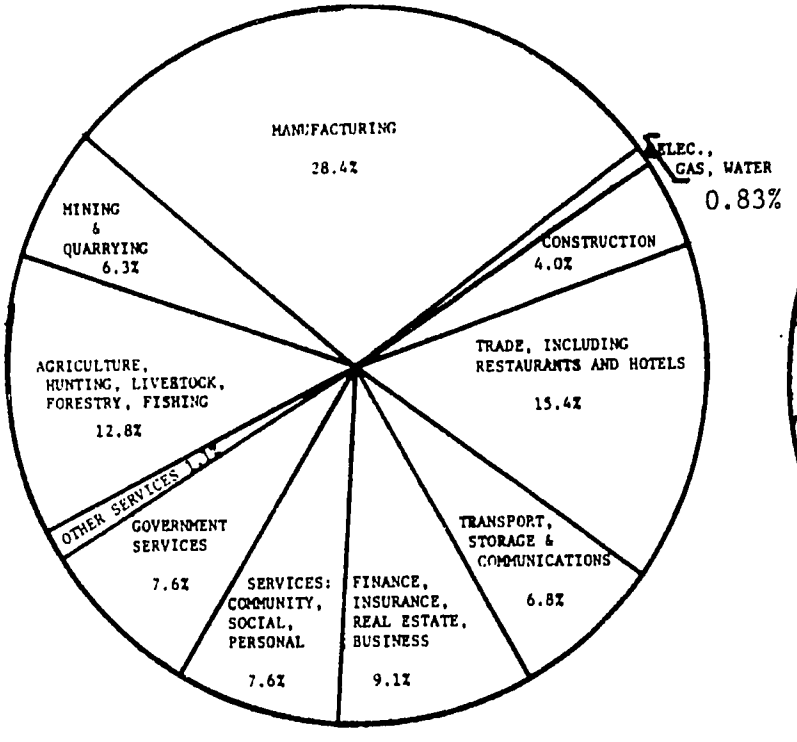
GNP: 1977 (in current prices): $12.1 billion
1978 (in current prices): $10.3 billion

Per capita share of GNP: $730 (1977)
$609 (1978)

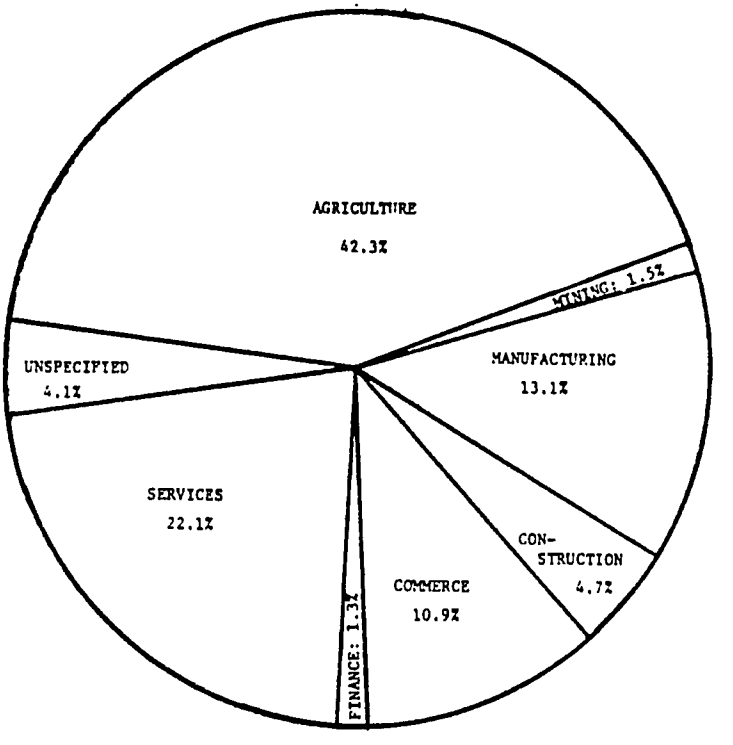
Real growth rate : -1.24% (1977)
-1.8 (1978)

Exchange rate: 174 soles = US$1 (12 October 1978): floats against the U.S. dollar
215 soles = US$1 (30 April 1979)

GROSS DOMESTIC PRODUCT BY SECTOR 1976
Source: U.N. Natl. Account Statistics 1977



EMPLOYMENT BY SECTOR: 1972
Source: Economist Intelligence Unit 1978



5.1.1 General economic situation

In the past decade Peru has undergone severe economic difficulties linked with political events at home and peculiarities of the world economy. Inflation rates have been high (higher than 70% in the last few years), there has been a persistent balance of payments deficit, and growth rates have been low or negative. The collapse of its anchovy

fisheries and the drop in world prices for copper and sugar, two of Peru's chief exports, have contributed to the generally gloomy economic picture. An effort to redress the situation and improve its international reserve position has led the Peruvian government in recent years to introduce austerity programs which have hampered its ability to implement the extensive economic and social reform programs which it announced when it came to power in 1968 (Evaluation Technologies 1978:30-32).

5.1.2 Poverty

A problem of enormous proportions for Peru is persistent rural and urban poverty, which affects not just a few isolated groups of people but at least eight million Sierra and urban slum inhabitants, about half of the population of the country. There are reported to be vast regions in which people exist on a per capita income of less than $150 per year (as compared with the general per capita share of GNP of $609) and entire cities in which more than half the population are slum dwellers (A.I.D./PERU 1978:159). The unfavorable economic picture of the last few years, which has brought with it higher prices and unemployment, has been particularly arduous for these poor.

5.1.3 Unemployment and underemployment

Unemployment and underemployment are major problems in Peru. The labor, force, estimated at 3,127,000 in 1960, was estimated at 4,473,000 in 1976. The growth of demand for employment has risen, therefore, at the general rate of 2.4% per year, a growth rate, which because of increasing urbanization, is significantly higher for the non-agricultural labor market.

The severely depressed economic situation presently prevailing in Peru is responsible for high unemployment levels because it has led to a shortage of central government funds for all but the most necessary projects and has meant that even those project having the highest priority have been curtailed and closely scrutizined to eliminate waste and extravagance. A squeeze on the private sector has led to a marked reduction of activities there as well. Unemployment, which stood at 4% in 1971 had risen to slightly above 5% by 1976 and would be even higher were it not for the Labor Stabilization Law, which legally prohibits the laying off or firing without extreme justification of any employee with over three years of service. The effect of the employment situation upon such workers is evident, however, from the underemployment rate, which increased from 30% in 1971 to 46.2% in 1976 for non-agricultural workers. Although more recent figures were not available, it is believed that both unemployment and underemployment have risen since 1976 (Saettone and Porter 1979: Annex 9:21).

In at least one case the Peruvian government has sought to relieve the unemployment problem through projects aimed at the conservation and development of natural resources. Reforestation as promoted by the Forestry Directorate of the Ministry of Agriculture and Nutrition has taken on importance as a means of increasing employment, while forest exploitation is also seen as a means of increasing employment in parts of the country (Lausche 1979; Peru, Ministry of Agriculture 1977).

5.2 Agriculture and agricultural production

Agriculture remains the basis of the Peruvian economy, contributing 12% to 15% to GDP and employing about 42% of the population. A total of about 30 million hectares of land are under agricultural use: only some 3 million (lower by some estimates) of these are under permanent or arable crops; the remaining 27 million are pasture land (see 4.3.2).

Crop agriculture is sharply divided between two productive systems: commercial agriculture oriented toward exports, and consumption agriculture, oriented toward local markets and subsistence production (Evaluation Technologies 1978:33). Since 1961-65 there has been a 34% increase in the arable area and a 78% increase in the area planted to permanent, mostly export, crops such as sugar, cotton, and coffee (Economist Intelligence Unit 1978:5).

The growth of the agricultural sector has tended either just barely to to keep pace with population growth or to fall behind it. Despite the Peruvian government's goals of improving agricultural production with the aim of achieving self sufficiency in food production, the index of per capita food production had actually dropped between 1961 and 1976 (to 81 using 1961-1965 as the base period). Although Peru exports agricultural products such as cotton and sugar, it is still forced to import significant quantities of food products such as wheat, dairy products, and soybean oil, as well as feed grains (Saettone and Porter 1979:Annex II:72).

The ratio of population to farming land is quite high (343 persons per square kilometer of arable land) and loss of land to erosion only aggravates this situation. Plans to increase the amount of land available for agriculture have two main facets: the colonization of the still sparsely settled Selva region and irrigation of arid lands in the Costa. The expansion of both population and agricultural activities into the vast Selva region may be limited, however, by unsuitable soils as well as by poor and uncomfortable climatic conditions. The expansion of agricultural land through irrigation in the Costa region or through land reclamation is expected to be bring about 812,000 hectares of new or improved land into production by 1985 (Saettone and Porter 1979: Annex 2:73; see also 4.2.1.1.2.2).

5.2.1 Land holdings

Land reform, undertaken by the "revolutionary" government after its coming to power in 1968, radically changed the nature of land holdings in Peru. Before the implementation of the Land Reform Law of 1969, there was a striking disparity between large and small landholders. In 1969, there were over 503,000 farms operated by smallholders; these accounted for 859,000 hectares or slightly more than 1.6 hectares per farm. On the other hand, there were 6,177 farms operated by largeholders; these accounted for 10,034,941 hectares, with the largest single landowner controlling 485,640 hectares and the 1,000 largest landholders controlling about 60% of arable land. Furthermore, there were 1.2 million landless peasants, over 70% of whom were in the Sierra (Turian 1978:1177).

The Land Reform Law (see 3.9.1) of 1969 set upper limits for land ownership, authorized expropriation of large holdings, and called for the redistribution of expropriated land to cooperatives.

The land reform program was considered complete as of 1977 (Turian 1978: 1177). By this date the reform had affected about one third of the some 30 million hectares under crops or pasture. 54% of all coastal land (about 1.5 million hectares) had been expropriated, and about 9.0 million hectares of pasture land had been expropriated (Saettone and Porter 1979: Annex 11:72). The large coastal sugar estates have been preserved as economic units with their mills, but have been turned into cooperatives. (Economist Intelligence Unit 1978:7).

The work of agrarian reform has been severely hampered by the poor economic situation, which has limited government spending in this, as in other areas of the economy (U.S.A.I.D/PERU 1978:158).

5.2.2 Major agricultural products of Peru (see tables on pages 100a and 100b)

Crop agriculture extends to only about 2.5% of the total land area of Peru. By far the most productive area of the country is the alluvial valleys of the Costa, where lack of rainfall makes irrigation necessary. All of Peru's export crops are grown in this area. In the Sierra and Selva subsistence agriculture predominates (see 4.3.2 for a more detailed account of agricultural activity and its distribution).

5.2.3 Fertilizers and modern machinery

Until quite recently the guano deposits of the Peruvian offshore islands and the manure of domesticated animals had been the only fertilizers used in Peru. During the 1950's, a rising demand for fertilizers and a decrease in guano production led to an increase in imports of chemical fertilizers, while domestic production of such fertilizers began in 1957. There are currently three major fertilizer producing operations: the Petroperu urea plant at Talara on the northern coast (commissioned in 1975), the state-owned Cachimayo ammonium nitrate plant near Cuzco, and the Fertisa ammonium nitrate and ammonium sulfate plants in Callao. There are plans for a major phosphatic fertilizer complex to be built at Bayovar in the northern Costa. Because domestic fertilizer production does not cover demand, significant imports are still necessary. (Saettone and Porter 1979: Annex 2:64-65).

Between 1973 and 1977, fertilizer use per year averaged 95,660 thousand metric tons for nitrogen-based fertilizers, 12,700 tons for phosphate-based fertilizers, and 10,560 metric tons for phosphatic fertilizers (Germany, Fed Rep of 1978:19).

Farm mechanization in Peru has been confined chiefly to large scale commercial production in the Costa region. As of 1968, there were approximately 10,000 tractors: 80% in the Costa; 17% in the Sierra; and 3% in the Selva (Weil 1972:276). The number of tractors in 1975 was estimated at 12,500 (Germany, Fed Rep of 1978:19). For the most part, however, agricultural techniques are those used since Inca times, al-

MAJOR CROPS OF PERU 1961-65 and 1975-through 1977
(statistics from FAO Production Yearbook: 1976 and 1977; F=FAO estimate; *=unofficial estimate)

CROP	region where grown	year	area: 1000's of ha.	yield: kg.per ha.	prod. 1000's metric tons	use
ROOTS AND TUBERS						
TOTAL		1961-65	337	6,390	2,154	
		1975	345	6,920	2,387	
		1976	351	6,849	2.404	
		1977	349	6,928	2,419	
POTATOES (several varieties)	Sierra & Costa; highest yields in Costa	1961-65	256	5,818	1,487	local consumption
		1975	251*	6,299	1,581	
		1976	256*	6,445	1,650	
		1977	250*	6,400	1,600	
CASSAVA	Sierra	1961-65	43	10,168	436	local consumption
		1975	38F	12,69	402*	
		1976	36F	11,167	402*	
		1977	38F	11,842	450*	
SWEET POTATOES	Sierra&Costa; about 55% of crop in Lima Dept.	1961-65	12	12,019	148	local consumption
		1975	14F	10,714	150*	
		1976	15F	10,333	155	
		1977	15*	10,667	166*	
CEREALS						
ALL CEREALS		1961-65	781	1,512	1,181	
		1975	813	1,827	1,486*	
		1976	852	1,912	1,630	
		1977	904	1,838	1,662	
MAIZE	Costa and Sierra	1961-65	337	1,453	490	local consumption; animal feed (Costa)
		1975	363	1,751	635	
		1976	385	1,883	726	
		1977	410*	1,707	700*	
BARLEY	Sierra	1961-65	180	1,031	185	local consumption; animal fed
		1975	163	913	149	
		1976	163	920	150	
		1977	188*	904	170*	
WHEAT	mostly on small plots in Sierra; principally in Junin and Huanuco	1961-65	153	982	150	local consumption;
		1975	134*	945	126	
		1976	134*	952	127	
		1977	140*	1,071	150*	
RICE	irrigated valleys of northern Costa; some in Selva	1961-65	80	4,067	324	local consumption;
		1975	122	4,383	537	
		1976	133	4,284	570	
		1977	125	4,640	580	
SORGHUM	Sierra	1961-65	1	1,946	2	
		1975	10	3,005	29	
		1976	15	3,132	46	
		1977	18*	2,778	50*	
RYE & OATS		1961-65	5	1,007	1	
		1975	2	835	2F	
		1976	2F	840	2F	
		1977	2F	954	2F	
QUINOA & CANIHUA	Indigenous grains of the Sierra; 85% in Puno (Weil 1972:281).	1970	25		18	local consumption

CROP	region where grown	year	area: 1000's of ha.	yield: kg.per ha.	prod.: 1000's metric tons	use
PULSES						
TOTAL	on marginal land in irrigated Costa valleys; less in Sierra&Selva	1961-65	108	1,036	112	local consumption
		1975	132	840	111	
		1976	128	837	107	
		1977	128F	842	108F	
BEANS (DRY)		1961-65	47	943	45	
		1977	75F	867	65F	
BROAD-BEANS(DRY)		1961-65	28	1,189	33	
		1977	20F	880	15F	
PEAS (DRY)		1961-65	22	1,129	25	
		1976	20F	762	15F	
OTHERS(Chick peas, lentils soybeans, peanuts)		1961-65	11		9F	peanuts use for production of peanut oil
		1977	15F		16F	
VEGETABLES AND FRUITS						
TOTAL VEG. +MELONS	truck produce vegetables in small areas in Costal and in Sierra valleys with access to urban markets	1961-65			519	vegetables are produced chiefly for sale in urban markets
		1975			742	
		1976			775	
		1977			797F	
CABBAGES		1961-65	3	12,468	31	
		1977	3F	15,853	54F	
ARTICHOKES		1961-65		12,963	2F	
		1977		8,889	2F	
TOMATOES		1961-65	3	12,428	34	
		1977	6F			
CAULIFLOWERS		1961-65	1	20,000	15	
		1977	1F	13,200	13F	
PUMPKINS, SQUASHES, GOURDS		1961-65	4	14,474	55	
		1977	6F	10,930	62F	
CUCUMBERS, GHERKINS		1961-65	1	10,330	3	
		1977	1F	9,400	5F	
CHILLIES& GREEN PEPPERS		1961-65	2	5,206	12	
		1977	4F	4,722	17F	
ONIONS, DRY		1961-65	3	19,248	89	
		1977	8F	18,675	155F	
GARLIC		1961-65	1	5,919	6	
		1977	2F	7,000	11F	
BEANS, GREEN		1961-65	4	1,487	6	
		1977	14F	1,906	27F	
PEAS, GREEN		1961-65	7	2,852	20	
		1977	15F	2,733	41F	
CARROTS		1961-65	2	20,588	35	
		977	2F	16,706	28F	
WATERMELONS		1961-65	2	16,363	35	
		1977	4F	10,486	37F	
MELONS, INCL. CANTELOPES		1961-65		12,500	5	
		1977	1F	12,099	10F	

CROP	region where grown	year	area: 1000's of ha.	yield: kg.per ha.	prod.: 1000's metric tons	use
TOTAL FRUIT	mostly on small garden plots throughout the country	1961-65		..	1,026	most consumed locally
		1975			1,674F	
		1976			1,629F	
		1977			1,650F	
APPLES		1961-65			71	
		1977			76F	
PEARS		1961-65			6	
		1977			7F	
PEACHES, NECTARINES		1961-65			28	
		1977			32F	
PLUMS		1961-65			1	
		1977			2F	
ORANGES		1961-65			134	
		1977			210F	
TANGERINES, etc.		1961-65			6	
		1977			20F	
LEMONS, LIMES		1961-65			52	
		1977			78F	
GRAPEFRUIT		1961-65				
		1977			6F	
AVOCADOES		1961-65			23	
		1977			95F	
MANGOES		1961-65			51	
		1977			90F	
PINEAPPLES		1961-65			15	
		1977			54F	
PLANTAINS		1961-65			437	
		1977			705F	
PAPAYAS		1961-65			30	
		1977			66F	
STRAWBERRIES		1961-65			1,000	
		1977			2,400F	
GRAPES		1961-65	8	6,612	54	
		1977	12F	5,528	68F	
wine		1961-65			10	
		1977			9F	
SESAME SEED		1961-65			637	
		1977			800	
COCONUTS		1961-65			3	
		1977			13F	
OLIVES		1961-65			8	
		1977				

CROP	region where grown	year	area: 1000's of ha.	yield: kg.per ha.	prod.: 1000's metric tons	use
COMMERCIAL CROPS				..	.	
SUGAR CANE	Costa; chiefly in north	1961-65	53	144,858	7,677	
		1975	57*	157,126	8,966	
		1976	55*	160,000	8,800	
		1977	57*	156,415	8,900*	
sugar(centrifugal-raw)		1961-65			791	local consumption: about 60%; export: about 40%
		1975			990	
		1976			956	
		1977			928	
sugar(non-centrifugal)		1961-65			22	
		1975			13*	
		1976			13*	
		1977			76F	
SEED COTTON	Costa, about 90% in Depts. of Ica, Lima & Piura	1961-65	248	1,546	383	export
		1975	97*	1,856	180	
		1976	115*	1,739	200*	
		1977	101*	1,996	202*	
COTTON SEED		1961-65			233	
		1975			120*	
		1976			124*	
		1977			125*	
COTTON LINT		1961-65			140	
		1975			63	
		1976			65	
		1977			60*	
COFFEE(GREEN)	valleys of Sierra and High Selva	1961-65	96	494	47	local consumption, export
		1975	128*	459	59	
		1976	128*	445*	57*	
		1977	128*	469	60*	
COCOA BEANS	small producers in High Selva, near Tingo Maria	1961-65	5	453	2	local consumption
		1977	6F	750	5*	
TEA	the High Selva; most in Cuzco Dept.	1961-65	2	567	1	local consumption;
		1977	3F	786	2*	
TOBACCO	additional crop on about 5,000 small farms; 90% from irrigated land in Tumbes Dept.	1961-65	3	992	3	locally processed
		1977	4*	1,111	4*	
PALM OIL		1961-65				
		1977		3,400*		
JUTE & SUBSTITUTES		1961-65	3	953	2	
		1977				
OTHER PRODUCTS						
NATURAL RUBBER		1961-65			3	
		1977			2F	
COCA	in poor soil on eastern slopes of Andes	no figures available; Peru is world's largest producer of coca (Weil 1972:282)				chewed widely as a stimulant

100b/

though the ox-drawn plow, introduced by the Spaniard in the sixteenth century, is in common use on bottom lands and other flat areas. On the hillsides the ancient Andean footplow, a kind of digging stick with a footrest to assist penetration, is still common (Weil 1972:275).

5.2.3 Livestock and grazing (see table on page 101a)

Grazing and livestock raising is practiced throughout Peru, but the greatest demand for animal products comes from the heavily population urban areas of the Costa, most particularly Lima-Callao. In the Sierra where an estimated 75% of the national herd is concentrated are sheep, alpaca, and lamas, with about half the population of sheep, llamas, and alpacas in the department of Puno. Cajamarca department is the leading cattle and horse-breeding area. Most of the goats are in Piura Department. Peculiar to the Andes are the llamas and the alpacas, the traditional livestock of the Andean Indians. Whereas the llama is used as a source of wool, animal labor, and fuel (from dung), the alpaca is raised solely for its wool (Turian 1978:1178).

5.2.3.1 Problems with grazing land

Peru has an estimated 27 million hectares of grazing land, much of which is of low quality. In the Costa region are grazing lands which include tree species such as *Prosopis juliflora* and varieites of acacia that serve as food for both cattle and goats; in many of these areas desertification has occurred. In the High Selva pasture land has been established as the result of deforestation; the effects of rain-induced erosion have seriously decreased the fertility of much of this grazing land. On the steeper slopes of the High Selva and in the Sierra deforestation has led to the establishment of pasture land which has been seriously effected by severe erosion and overgrazing (UNESCO. MAB 1975a:67).

LIVESTOCK NUMBERS AND PRODUCTS (from FAO Production Yearbook 1976 and 1977)
[*indicates unofficial figures; F indicates FAO estimate]

ANIMAL	NUMBERS (in thousands of heads) 1961-65	1976	1977	PRODUCTS (slaughted: thousands of heads; carcass weight and milk per cow in kilograms per animal; meat, wool, milk and skins production in thousands of metric tons	1961-65	1976	1977
sheep	14,311	15,000*	14,500*	mutton&lamb			
				sl.	2,073	2,010*	2,030*
				car.wt.	11	11	11
				meat pr.	23	22*	22*
				wool(greasy)	11,020	11,500F	12,000F
				(scoured)	5,450	6,000	6,200F
				skins(fresh)	7,255	7,7,035F	7,105F
goats	3,920	2,050*	2,060*	sl.	1,173	8820*	825*
				car.wt.	13	12	12
				meat pr.	15	10*	10*
				milk	70	19F	19F
				skins	2,933	2,050F	2,063F
cattle	3,358	4,168	4,,116	beef&veal			
				sl.	666	718F	672F
				car.wt.	121	120	120
				meat pr.	81	86	81
				fresh hides	13,327	14,360F	13,434F
milk cows	506	640F	650F	milk per c.	1,109	1,313	1,381
				fresh milk	515	827F	840F
				evap&con.	37,800	93,600F	94,800F
				cheese(all kinds)	19,041	42,860	42,870
				butter	3,305	6,000*	6,000*
pigs	1,813	2,143	1,994	sl.	1,027	1,231	1,168F
				car.wt.	55	58	59
				meat pr.	56	71*	69*
chickens	23,625	29,500F	30,000F	meat pr.	21	130*	120*
				eggs (thousands)	18,704	55,000	55,000F
horses	579	641*	643*				
mules	190	213*	214*				
asses	427	481*	483*				

NOTE: Figures for numbers of alpaca and llamas, important domestic animals in the high country of the Sierra, were not available. Production of alpaca wool averaged 2,500 metric tons from 1973 through 1976; production of alpaca meat averaged 6,900 metric tons for the same period(Germany,Fed Rep of 1978:20).

5.3 Industry

5.3.1 Major industrial activities

In recent years manufacturing has accounted for as much as 28.4% of the Gross Domestic Product and has employed about 13% of the labor force. In 1973 there were 7,612 manufacturing establishments, each employing over five workers. Most of these establishments are rather small; only 30 have over 500 employees and about 350 have between 100 and 500 employees.

Nearly 65% of Peruvian industry is concentrated in the Lima-Callao area, with lesser concentrations in Chimbote and Chiclayo--all in the Costa region. The government has attempted to attract industry to other areas by a program involving the construction of industrial parks in Trujillo, Arequipa, Tacna, Cuzco, Huancayo, and Bayovar (Turian 1979:1178-79).

Peruvian industry has traditionally been based on the processing of local minerals and fibers, but government policy since the 1968 revolution has been to change this situation through a massive program of industrialization. The chief goal is the reduction of dependency on foreign imports. This program includes measures promoting the expansion of large industries such as steel production, automobile construction, shipbuilding and the the chemical industry. Government plans include the industrial development of areas such as Trujillo, which is earmarked for the production of tractors, diesel engines, and machinery.

Among industrial operations, sugar processing and processing of fish products continue to be important, while other food related industries such as beverage production, milk processing, and meat and fish canning are of significance. The textile industry works with wool, cotton, jute, and synthetic materials. The chemical industry, with concentration on fertilizer production, synthetic fibers, pharmaceutical production, and paint production has been expanded in recent years. Among metal industries, the construction of vehicles, including ship construction and assembly plannts for trucks and aircraft are of most importance. The state iron and steel company (Empresa Siderurgica del Peru-Siderperu), founded in 1971, is presently expanding its facilities at Chimbote, with plans to expand its production to 1.5 million tons by the end of 1978.

Recent economic problems, by lowering the level of real wages, have decreased consumer demand considerably, affecting particularly those industries producing consumer goods. Between 1976 and 1977, for example, declines were recorded for industries manufacturing textiles (10%), clothing (about 15%), and footwear (35%), while a 4% decline was recorded for food, beverages, and tobacco, which account for about 50% of all consumer industries (CEPAL 1978:735).

5.3.2 Mining industry

The mining industry, which accounts for more than 6% of Gross Domestic Pro-

duct, is discussed in section 4.8.

5.3.3 Fishing industry

The fishing industry and its recent problems are considered in section 4.7.

5.3.2 Industrial pollution

Industrial pollution is associated above all with mining and associated smelting and refining operations. These are reviewed in the sections on water pollution (4.2.1.1.3) and air pollution (4.9).

5.4 Transport

Peru has about 52,400 kilometers of roads, about 5,400 of which are paved. The major highways are the Pan American Highway, which joins Peru with Ecuador to the north and Chile to the south; the Central Highway, which runs from Lima eastward through the Sierra to Pucallpa in the Selva; and the Longitudinal Sierra Road, which runs southward from La Oroya through Huancayo, Ayacucho and Cuzco to join the Pan American Highway at Puno (Turian 1978: 1180).

In the Selva region, waterways are important transportation routes. There are 8,688 kilometers of navigable waterways in the Amazon Basin. Ocean going vessels can come up the Amazon from the Atlantic as far as Iquitos. On Lake Titicaca are about 209 kilometers of navigable waterways.

5.5 Energy and energy outlook

A study of the Peruvian energy sector prepared under the direction of the Peruvian Vice Minister of Energy and a representative of the U.S. Department of Energy was recently issued in pre-publication form by the U.S. Department of energy. This report reviews in great detail Peruvian energy potential in terms of non-renewable fuels such as coal and petroleum as well as of renewable resources such as hydroelectric power, biomass, solar and wind, and geothermal (Saettone and Porter 1979).

REFERENCE LIST

A.I.D. 1979. Environmental and Natural Resources Management in Developing Countries: A Report to Congress. Volume I: Report. Washington, D.C.: Department of State, U.S. Agency for International development

A.I.D./Lima. 1979. Country Development Strategy Statement. FY 1981. Washington, D.C.: U.S. Department of State, Agency for International Development.

A.I.D./PERU. 1978. Annual Budget Submission. FY 1980. Washington, D.C.: U.S. Department of State, Agency for International Development.

Alba, Victor. 1977. Peru. Boulder, Colorado: Westview Press.

Amembassy Lima. 1979. "Proposed DS/ST Program for FY-81 on Coastal Zone Management." Department of State Telegram R 262153z Jun 79.

Bates, Marston. 1964. The Land and Wildlife of South America. Life Nature Library. New York: Time Incorporated.

Bucarey, Jose R.E. 1974. "Forestry in South America: Education and the Future." unasylva, vol. 27, no. 107. pages 14-19.

CEPAL[United Nations Economic Commission for Latin America]. 1977. The Water Resources of Latin American: Regional Report. ST/CEPAL/Conf. 57/L2/Rev. 2. Santiago de Chile: CEPAL.

CEPAL. 1978. Economic Survey of Latin America, 1977. 2 volumes. E/CEPAL/1050. 1 December 1978. New York: United Nations, Department of Economic Affairs.

Cole, John P., and P.M. Mather. 1978. Peru 1940-200: Performance and Prospects. 2 volumes. Nottingham, England: Nottingham University, Department of Geography.

"Contaminacion marina hace peigrar pesca en varios paises de America Latin." El Comercio (Quito), April 6, 1975, p. 10.

Doughty, Robin W., and Norman Myers. 1971. "Notes on the Amazon Wildlife Trade." Biological Conservation, vol. 3, no. 4 (July 1971), pp. 293-297.

Dourojeanni, Marc J. 1976. "Machu Picchu and Peru's National System of Conservation Units." Parks, vol. 1, no. 2 (July, August, September 1976), pages 8-11.

Eckholm, Erik P. 1976. Losing Ground: Environmental Stress and World Food Prospects. New York: W.W. Norton.

Economist Intelligence Unit. 1978. Quarterly Economic Review of Peru, Bolivia. Annual Supplement 1978. London: Economist Intelligence Unit Ltd.

Evaluation Technologies, Inc. 1978. Peru: A Country Profile. [Prepared for Office of U.S. Foreign Disaster Assistance, Bureau for Private and Development Cooperation, Agency for International Development, Department of State]. Washington, D.C.: A.I.D., Office of U.S. Foreign Disaster Assistance.

"Family Planning Organizations Tabu in Peru." March 1979. INTERCOM: The International Population News Magazine, vol. 7, no. 3, page 11.

FAO(Food and Agricultural Organization of the United Nations)-UNESCO. 1971. Soil Map of the World. Volume IV: South America. Paris: UNESCO.

"Fishing, Man and the Revolution." 1976. Peru Informa, September 1976, pages 10-14.

Gastanaga Coll, Anibal. 1974. "Administracion del Recurso Aire en el Peru." Salud Ocupacional, vol. 19, nos. 1-4 (1974), pages 29-43.

Germany, Federal Republic of. Federal Statistical Office. 1978. Laenderkuzbericht: Peru. Stuttgart: Kohlhammer GmbH.

IUCN [International Union for the Conservation of Nature]. International Commission on National Parks. 1971. United Nations List of National Parks and Equivalent Reserves. Brussels: Hayez.

Jackson, Peter, ed. 1977. World Wildlife Yearbook 1976-77. Geneva: World Wildlife Fund. 304 pages.

JPRS[U.S. Joint Publications Research Service]. Translations on Environmental Quality [Title recently changed to Worldwide Report: Environmental Quality]. Series published by the U.S. Joint Publications Research Service, Arlington, Virginia. Cited in report by JPRS no. and year.

Kurian, George Thomas. 1978. Encyclopedia of the Third World. Volume II (Laos to Zambia). New York: Facts on File.

Lausche, Barbara. 1979. "Visit to AID Mission/Peru, April 30--May 4, 1979." Draft Report.

Lavalle Vargas, Hernande de. 1973. A Statement of the Laws of Peru in Matters Affecting Business. 4th edition. Washington, D.C.: Organization of American States

Maass, Alfredo. 1969. Entwicklung und Perspektiven der wirtschaftlichen Erschliessung des tropischen Waldlandes von Peru, unter besonderer Berueck-sichtigung der verkehrsgeographischen Problematik. Tuebinger Geographischen Studien, no. 31. Tuebingen, Federal Republic of Germany: Geographical Institute of the University of Tuebingen.

Morrison, Tony. 1974. Land Above the Clouds: A Survival Special on South American Wildlife. London: Andre Deutsch.

"National Water Use Plan Being Drafted." Article from El Comercio(Lima), June 21, 1975, translated in Joint Publications Research Service, Translations on Environmental Quality, July 24, 1975, pages 60-61.

"Natural Resources and National Development." 1978. Peru Informa, Dec. 1976 pages 8-11.

Nelson, J. Bryan. 1978. The Sulidae: Gannets and Boobies. London/New York: Oxford University Press. [Chapter 7 deals with the Peruvian booby and the effects on this and other Peruvian coastal birds of both the guano industry and the anchovy fisheries.]

"Fishing, Man and the Revolution." 1976. Peru Informa, September 1976, pages 10-14.

Gastanaga Coll, Anibal. 1974. "Administracion del Recurso Aire en el Peru." Salud Ocupacional, vol. 19, nos. 1-4 (1974), pages 29-43.

Germany, Federal Republic of. Federal Statistical Office. 1978. Laenderkuzbericht: Peru. Stuttgart: Kohlhammer GmbH.

IUCN [International Union for the Conservation of Nature]. International Commission on National Parks. 1971. United Nations List of National Parks and Equivalent Reserves. Brussels: Hayez.

Jackson, Peter, ed. 1977. World Wildlife Yearbook 1976-77. Geneva: World Wildlife Fund. 304 pages.

JPRS[U.S. Joint Publications Research Service]. Translations on Environmental Quality [Title recently changed to Worldwide Report: Environmental Quality]. Series published by the U.S. Joint Publications Research Service, Arlington, Virginia. Cited in report by JPRS no. and year.

Kurian, George Thomas. 1978. Encyclopedia of the Third World. Volume II (Laos to Zambia). New York: Facts on File.

Lausche, Barbara. 1979. "Visit to AID Mission/Peru, April 30--May 4, 1979." Draft Report.

Lavalle Vargas, Hernande de. 1973. A Statement of the Laws of Peru in Matters Affecting Business. 4th edition. Washington, D.C.: Organization of American States

Maass, Alfredo. 1969. Entwicklung und Perspektiven der wirtschaftlichen Erschliessung des tropischen Waldlandes von Peru, unter besonderer Beruecksichtigung der verkehrsgeographischen Problematik. Tuebinger Geographischen Studien, no. 31. Tuebingen, Federal Republic of Germany: Geographical Institute of the University of Tuebingen.

Morrison, Tony. 1974. Land Above the Clouds: A Survival Special on South American Wildlife. London: Andre Deutsch.

"National Water Use Plan Being Drafted." Article from El Comercio(Lima), June 21, 1975, translated in Joint Publications Research Service, Translations on Environmental Quality, July 24, 1975, pages 60-61.

"Natural Resources and National Development." 1978. Peru Informa, Dec. 1976 pages 8-11.

Nelson, J. Bryan. 1978. The Sulidae: Gannets and Boobies. London/New York: Oxford University Press. [Chapter 7 deals with the Peruvian booby and the effects on this and other Peruvian coastal birds of both the guano industry and the anchovy fisheries.]

Nelson, Michael. 1973. The Development of Tropical Lands: Policy Issues in Latin America. Baltimore: Johns Hopkins University Press.

PAHO. 1976. Red Panamericana de Muestreo de la Contaminacion del Aire (REDPANAIRE). Informe 1967 - 1974. Division de Salud Ambiental, Serie Tecnica 18. Lima: Centro Panamericano de Ingenieria Sanitaria y Ciencias del Ambiente (CEPIS).

PAHO [Pan American Health Organization]. 1975. Proposed Program and Budget Estimates: Pan American Health Organization 1976. Official Document of the Pan American Health Organization No. 134. Washington, D.C.: Pan American Health Organization.

PAHO. 1978a. Report of the Director: Quadrennial 1974-1977/Annual 1977. Washington, D.C.: Pan American Health Organization.

PAHO. 1978b. Proposed Program and Budget Estimates: Pan American Health Organization 1979. Official Document of the Pan American Health Organization No. 154). Washington, D.C.: Pan American Health Organization.

Parham, Walter. 1978. LDC Deforestation Problem: A Preliminary Data Base. Washington, D.C.: Department of State, Agency for International Development, Office of Science and Technology.

Paylore, Patricia. 1977. Arid Lands Research Institutions: A World Directory 1977. Tucson: University of Arizona Press.

Penaherrera del Aguila, Carlos. 1969. Geografia General del Peru: Sintesis. Tomo I. Aspectos Fisicos. Lima.

"Perfil del Peru." 1978. Peru Economico, vol. 1, no. 6 (June 1978), pages 1-12.

Peru. 1971. Informe sobre el Deterioro del Medio Ambiente, Peru 1971. Lima. [Peruvian background report for the 1972 United Nations Conference opn the Human Environment.]

Peru. Ministry of Agriculture, General Directorate of Forestry and Wildlife. 1977. Guia Informativa sobre Proyectos de Reforestacion. Lima: Ministry of Agriculture.

Peru. Ministry of Agriculture. General Directorate of Forestry and Wildlife. and others. 1978. Proyecto de Reforestacion con Apoyo Alimentario en El Peru (Departamentos de Cajamarca, Ancash, Junin, Ayachucho, Huancavelica, Cuzco, Apurimac y Puno). Lima: Ministry of Agriculture.

Peru. ONEC [Oficina Nacional de Estadistica y Censos]. 1974. Indicores Demograficos, Sociales, Economicos, y Geograficos del Peru. Lima: Oficina Nacional de Estadistica y Censos.

Primer Seminario Latinoamericana FAO/PNUD sobre la Evaluacion Sistematica de los Recursos Tierras y Aguas. 1971. Mexico, D.F., 8-14 November 1971. Mexico City: Mexico, Secretaria de Recursos Hidraulicos.

"Remote Sensing: A Technology for Economic Development." Washington, D.C.: U.S.A.I.D. [Information pamphlet prepared for U.S.A.I.D. by the Technology Application Center, of the Institute for Applied Research Services of the University of New Mexico.

Romero, Emilio. 1973?. Peru: Una Nueva Geografia. 2 volumes. Lima: Libreria Studium.

Rossi, R. 1969. "Peru." In: International Association of Agricultural Economists. World Atlas of Agriculture, vol. III, Americas. Novara: Instituto Geographico de Agostini, pages 373-386.

Saettone, Ricardo, and William H. Porter. 1979. Joint Peru/United States Report on the Peru/United States Cooperative Energy Assessment. 7 volumes, 12 Annexes. Pre-Publication Copy. (With the exception of material from Volume I, all citations are to Annex No. and page).

Salvadori, Francesco Baschieri, and Pier Lorenzo Floria. 1978. Wildlife in Peril. London: Westbridge Books.

Scott, Geoffrey A.J. 1978. Grassland Development in the Gran Pajonal of Eastern Peru: A Study of Soil-Vegetation Nutrient Systems. (Hawaii Monography in Geography, no. 1.) Manoa: University of Hawaii.

Sagasti, Francisco R. 1979. Technology, Planning, and Self-Reliant Development: A Latin American View. New York: Praeger.

Shane, Douglas, R. 1978. A Latin American Dilemma: Current Efforts to Develop the Tropical Forest Areas of Thirteen Latin American Nations. [Information Presented During Lecture at U.S. Strategy Conference on Tropical Deforestation, June 12-14, 1978].

Sociedad Geografia del Peru. 1975. Anuario Geografico del Peru. Lima: Sociedad Geografia del Peru.

Sommer, Adrian. 1976. "Attempt at an Assessment of the World's Tropical Moist Forests." unasylva, vol. 28, no. 112-113, pages 5-25.

Tinker, Jon. 1979. "Wildlife in the Middle." New Scientist, vol. 82, no. 1152, April 26, 1979, 263-265.

Tosi, Joseph A. 1960. Zonas de Vida Natural en el Peru: Memoria Explicativa sobre el Mapa Ecologico del Peru. Boletin Tecnico No. 5. Instituto Interamericano de Ciencias Agricolas de la OEA.

Townshend, Jan, and John Townshend. 1978. Overview of Physical and Socio-Economic Environments Impact Situations in Latin America. Overview Paper #3. Worcester, Mass.: Clark University, Program for International Development.

Tryzna, Thaddeus C., and Eugene V. Coan. 1976. World Directory of Environmental Organizations. 2nd edition. Sierra Club Special Publications, International Series, no. 1. Claremont, Calif.: Sequoia Institute.

UNESCO. MAB[Programme on Man and the Biosphere]. 1974a. International Working Group on Project 1: Ecological Effects of Increasing Human Activities on Tropical and Sub-tropical Forest Ecosystems. Rio de Janeiro, 11-15 February 1974. MAB report series no. 16. Paris: UNESCO.

UNESCO. MAB. 1974b. Working Group on Project 6: Impact of Human Activities on Mountain and Tundra Ecosystems. Lillehammer, 20-23 November 1973. Final Report. MAB report series no. 23. Paris: UNESCO.

UNESCO. MAB. 1975a. International Working Group on Project 3: Impact of Human Activities and Land Use Practices on Grazing Lands: Savanna, Grassland (From Temperate to Arid Areas). Hurley 2-5 July 1974. Final Report. MAB report series no. 25. Paris: UNESCO: Paris.

UNESCO. MAB. 1975b. Regional Meeting on Integrated Ecological Research and Training Needs in the Andean Region. La Paz 10-15 June 1974. Final Report. MAB report series no. 23. Paris: UNESCO.

UNESCO. MAB. 1976. International Co-ordinating Council of the Programme on Man and the Biosphere (MAB). Paris, 18-26 November 1975. Fourth Session. Final Report. MAB report series no. 38. Paris: UNESCO.

UNESCO. MAB. 1977a. Regional Meeting on Integrated Ecological Research and Training Needs in Latin America, with Emphasis on Tropical and Sub-tropical Forest Ecosystems. Mexico City, 30 September--5 October 1974. Final Report. MAB report series no. 28. Paris: UNESCO.

UNESCO. MAB. 1977b. Regional Planning Meeting of the MAB National Committees of Andean Countries, with Particular Attention to Project 6. Lima, 2-5 December 1975. Final Report. MAB report series no. 39. Paris: UNESCO.

UNESCO. MAB. 1978. International Co-ordinating Council of the Programme on Man and the Biosphere (MAB). Fifth Session. Vienna, 24 October-1 November 1977. MAB report series no. 46. Paris: UNESCO.

United Nations. 1976. Progress in Land Reform. Sixth Report. New York: United Nations. [Prepared jointly by the United Nations, the Food and Agricultural Organization of the United Nations, and the International Labor Organization.]

"UN to Aid in Fight Against Pollution of Mantaro River." Article from El Commercio (Lima), May 14, 1979, translated in U.S. Joint Publications Research Service, Translations on Environmental Quality, no. 215, JPRS 73745, 22, June 1979, pages 25-26.

UNWC [United Nations Water Conference]. 1976. Report of the Regional Preparatory Meeting of the Countries of Latin America and the Caribbean for the United Nations Water Conference. Lima, Peru, 30 August - 3 September 1976. E/CONF.70/5. Mar Del Plata, Argentina: United Nations Water Conference.

U.S. Fish and Wildlife Service. 1979. "List of Endangered and Threatened Widlife and Plants. Republication." Federal Register, vol. 22, no. 12 (January 17, 1979).

Waters, R.F. 1971. Shifting Cultivation in Latin America. FAO Forestry Development Paper, no. 17. Rome: Food and Agricultural Organization of the United Nations.

WER[World Environment Report]. New York: Center for International Environmental Information. Monthly. Cited by date of publication and page number.

WHO-IRC [International Reference Centre for Community Water Supply]. 1976. Annual Report 1976. The Hague: WHO-IRC.

World Bank. 1979. World Development Report, 1979. Washington, D.C.: World Bank.

World Wildlife Fund. 1976. World Wildlife Fund Conservation Programme 1976-77. Geneva: World Wildlife Fund. 33 pages.

WER[World Environment Report]. Monthly newsletter. New York: Center for International Environmental Information. [Cited by date of publication].

WPDS. 1979. World Population Data Sheet of the Population Reference Bureau Inc. Washington, D.C.: Population Reference Bureau.

APPENDIX A

SOILS OF PERU (based on materials from FAO-UNESCO. 1971. Soil Map of the World [1:5,000,000]. Volume IV: South America. Paris UNESCO.

In the Amazon region of Peru soil associations are dominated by Xanthic Ferralsols (FX), which underly the tropical rain forest and Plinthic Acrisols in those imperfectly drained areas where chiefly savanna vegetation dominates.

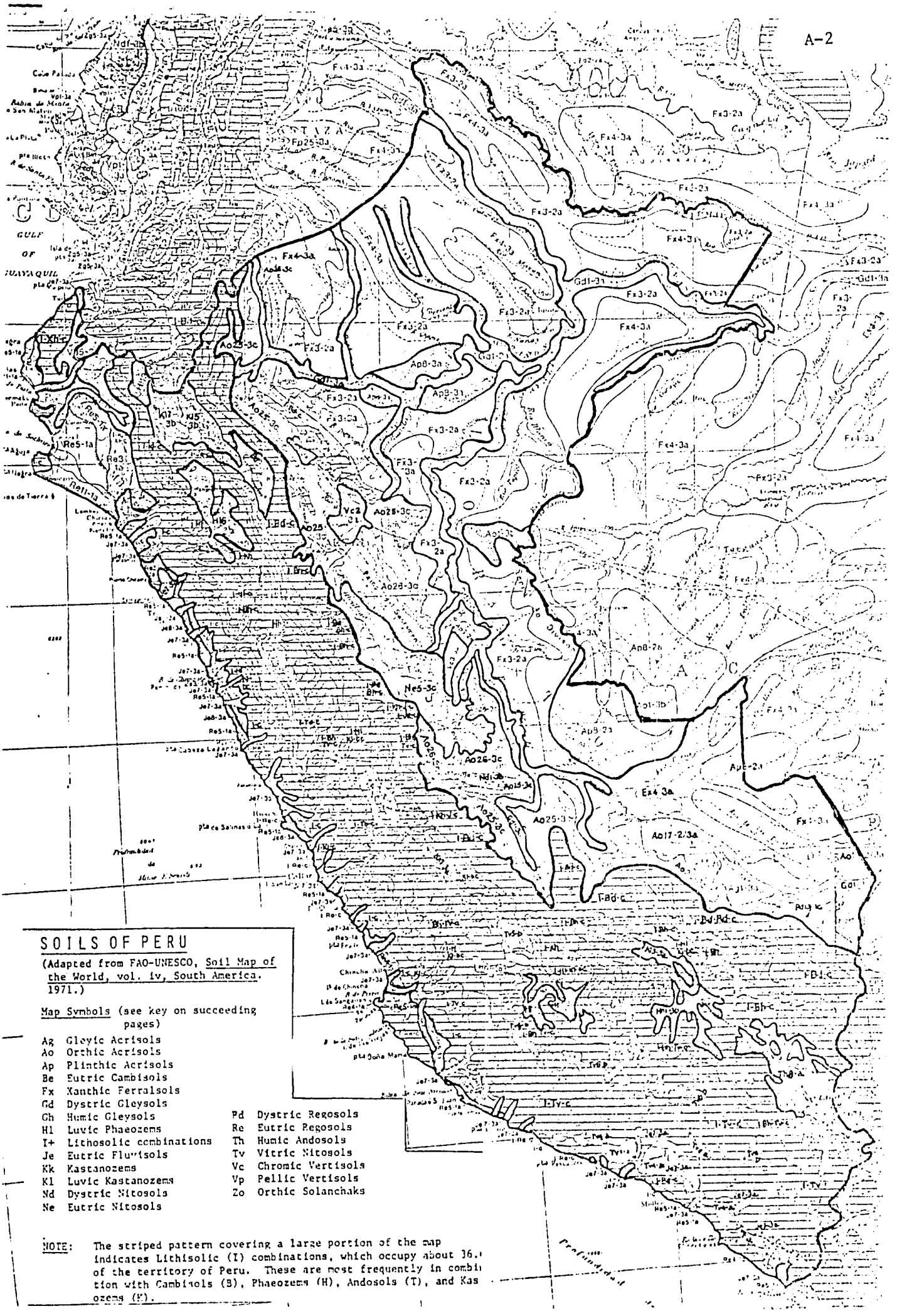
The Eastern Ranges of the Andes, a region of steep mountains, is underlain by by sedimentary and igneous rock of different ages. In the high altitudes soil associations are dominated by Lithosols in assocation with Dystric Cambisols (I-Bd on map); below 200 meters are mainly Orthic Acrisols (Ao on map) and Eutric Nitosols.

In the Northern Andean regions of Peru, Lithosols and shallow Dystric Cambisols dominate on steep slopes, while in the drier inter-Andean valleys, are stony Kastanozems, Phaeozems, and Lithosols; in the driest valleys are Chromic Luvisols, Vertisols and Solonetz soils.

The dry coastal lowland desert of Peru is an area of broad dry plains interrupted by alluvial valleys, coastal hills and elevated marine terraces. In southern Peru are Vitric Andosols (Tv) derived from volcanic ash, in the far north are are large areas of desertic sand dunes dominanted by Eutric Regosols, which also occur at areas along the coast. In the fertile valleys formed by the many rivers proceeding from the Andes are alluvial soils (Fluvisols-Je), which provide the base for most of the country's commercial agriculture.

Ranging from northern Peru to central chile are arid desertic mountain ranges, whose vegetation ranges from scattered cactus formations to denxer xerophytic scrubland at higher elevations. Soils is these areas of mostly Lithosols and Regosols, although Yermosols with limestone enriched subsoils (Calcic Yermosols Yk), are common. In southern Peru, Lithosols and Vitric Andosols derived from volcanic parent materials are common.

As indicated by the striped pattern on the map, Lithosolic (stony) soils combinations dominate throughout most of the Costa and Sierra regions of Western Peru.



SOILS OF PERU

(Adapted from FAO-UNESCO, Soil Map of the World, vol. iv, South America. 1971.)

Map Symbols (see key on succeeding pages)

Ag	Gleyic Acrisols		
Ao	Orthic Acrisols		
Ap	Plinthic Acrisols		
Be	Eutric Cambisols		
Fx	Xanthic Ferralsols		
Gd	Dystric Gleysols		
Gh	Humic Gleysols	Pd	Dystric Regosols
Hl	Luvic Phaeozems	Re	Eutric Regosols
I+	Lithosolic combinations	Th	Humic Andosols
Je	Eutric Fluvisols	Tv	Vitric Nitosols
Kk	Kastanozems	Vc	Chromic Vertisols
Kl	Luvic Kastanozems	Vp	Pellic Vertisols
Nd	Dystric Nitosols	Zo	Orthic Solanchaks
Ne	Eutric Nitosols		

NOTE: The striped pattern covering a large portion of the map indicates Lithisolic (I) combinations, which occupy about 36.[illegible] of the territory of Peru. These are most frequently in combination with Cambisols (B), Phaeozems (H), Andosols (T), and Kastanozems (K).

SOIL TYPE	Map symbol	associations/ inclusions	tex-ture	slope	area: 1,000 has	% of total area	climate	vegetation
ACRISOLS	A				19,489	15.4%		
Gleyic	Ag1-3a	Ap	fine	steep	454	0.36%	1.221	tropical evergreen forest and swamp ofrest, herbaceous swamp
Orthic	Ao				14,817	11.7%		
	Ao1-3b		fine	hilly	757		1.121, 1,471	tropical evergreen forest
	Ao17-2/3a	ApFo	med-fine	level	3,532		1.221, 1.471	tropical evergreen forest
	Ao25-3c	Bd I	fine	steep	6,812		1.12, 1.121, 1.31,1.34 1.72	tropical evergreen forest and subtropical evergreen forest
		Be I	fine	steep	3,716		1.12, 1.121, 1.13,1.72	Tropical and subtropical evergreen forest
Plinthic	Ap				4,248	3.4%		
	Ap6-2a	Vc	medium	level	83		1.13	savanna,herbaceous swamp
	Ap8-2a	Fx Gp/Gd	medium	level	2,842		1.21	swamp forest and wet savanna
	Ap8-3a	FxGp/Gd	fine	level	1,323		1.11	swamp forest and wet savanna
CAMBISOLS	B							
Eutric	Be3-3b	I Vc	fine	steep	374	0.3%	2.32	montane humid forest
FERRALSOLS	F				36,431	28.9%		
Xanthic	Fx							
	Fx3-2a	ApAoFp/GdGpQa	medium	level	17,532		1.11	tropical evergreen forest
	Fx3-3a	ApAoFp/GdGpQa	fine	level	1,456		1.11	tropical evergreen forest
	Fx4-3a	Ap/GdGp	fine	level	17,443		1.11 1.121	tropical evergreen forest
GLEYSOLS	G				6,635	5.3%		
Dystric	Gd1-3a	JGeGp	fine	level	6,610	5.2%	1.11, 1.121	varzea forest
Humic	Gh3-3a	AgAoPh	fine	level	75	0.1%	1.11	subtropical evergreen forest,swamp forest
PHAEOZEMS	H							
Luvic	H1				1,492	1.2%		
	H1 11-3b	K1 Tm I	fine	hilly	1,202		2.38	dry forest and xerophytic woodland of the intermontane valleys
	H1 12-3b	I Tm	fine	hilly	175		2.37	humid montane forest on the slopes, xerophytic woodland in the valleys
	H1 13-3b	J I	fine	hilly	115		2.61	subtropical and montane thorn woodland and montane forest

SOIL TYPE	Map symbol	associations/ inclusions	tex-ture	slope	area: 1,000 has	% of to-tal area	climate	vegetation
LITHOSOLS	I				46,261	36.6%		
	I-c			steep	2,899	2.3%	3.34,3.51	montane steppe and desert
+Cambi-sols	I-Bd-c			steep	6,639		3.52 1.72,1.73 2.32,2.37 2.38	montane rainforest,dry forest and xerophytic wood= land of the intermontane valleys
	I-Bd-Rd-c			steep	1,640		1.72,1,73 2.31,2.38	subtropical rainforest
	I-Be-c			steep	559		1.42,1.72 1.77	lower montane humid forest
	I-Be-Bh-c			steep	1,092	16.3%	1.72,2.32	montane forest and humid paramo
	I-Bh-c			steep	2,609		2.42,2.61 2.62	subalpine paramo, alpine tundra
	I-Bh-Tv-c			steep	8,017		2.61,2.62	upper montane cloud forest, Polylepis forest, paramo, alpine tundra
+Phaeo-zems	I-Hl-c			steep	785	5.3%	2.43	humid montane forests on the slopes, xerophytic woodland in the valleys, paramo on the plateaus
	I-Hl-Kl-bc			hilly-steep	5,926		2.3,2.37 2.38	dry to humid montane forest
+Fluvi-sols	I-Je-c			steep	509	0.4%	1.72,1.74	xerophytic woodland and cacti scrubland
+Kastano-zems	I-Kh-J-c			steep	2,149	3.6%	2.33,2.38	dry forest and xerophytic woodland of the inter-Andean valleys
	I-Kl-c			steep	2,129		2.3	montane xerophytic woodland and cacti shrubland
	I-Kl-Xl-c			steep	280		1.7,3.34	montane thorn woodland
+Regosols	I-Re-c			steep	1,683	1.3%	3.34,3.52	tropical coastal desert
+Andosols	I-To-c			steep	207	6.9%	2.61	humid upper montane forest with dry forest and xero-phytic woodland in the valleys
	I-Tv-c			steep	8,540		2.36,2.39 2.62,3.51 3.55	montane steppe, subalpine steppe, paramo, tundra
+Xerosols	I-Xh-c			steep	503	0.4%	1.34,3.14	tropical coastal desert
+Yermosols	I-Yh-b			hilly	95	0.08%	3.55	coastal and montane desert
FLUVISOLS	J							
Eutric	Je				2,370	1.9%		
	Je7-3a	Zg	fine	level	1,959		1.34,3.14 3.34,3.4 3.52	cultivated land
	Je8-3a	Yh I/Re	fine	level	259		3.34	tropical coastal desert
	Je17-3a	Yk/I	fine	level	152		3.34	tropical coastal desert
KASTANOZEMS	K				1,404	1.1%		
Calcic Luvic	Kk1-3a	HI J	fine	level	55	0.04%	2.61	lower montane dry forest & montane humid forest
	Kl				1,349	1.06%		
	Kl 3-3a	Gc Kk/Ge J	fine	level	328		2.38	montane humid forest
	Kl 5-3b	Vp I	fine	hilly	546		1.74	dry forests and xerophytic woodland and cacti scrubland
	Kl 7-3b	I	fine	hilly	475		2.32	humid montane forests on the slopes, xerophytic woodland and savanna in the valleys

SOIL TYPE	Map symbol	associations/ inclusions	tex-ture	slope	area: 1,000 has.	% of total area	climate	vegetation
NITOSOLS-	N				2,290	1.8%		
Dystric	Nd1-3b		fine	hilly	58	0.05%	1.72	subtropical humid evergreen forest
Eutric	Ne5-3c	Ao I	fine	steep	2,232	1.77%	1.12,1.75	tropical evergreen and montane evergreen foresss
REGOSOLS	R				3,905	3.1%		
Dystric	Rd13-1c		steep	fine	92	0.07%	1.71	tropical evergreen forest
Eutric	Re				3,8.3	3.0%		
	Re3-1a	Yk J	fine	level	544		3.14,3.34	montane steppe and scrubland
all are	Re4-1a	Yk Zo	fine	level	199		3.34	coastal tropical desert
petro-	Re5-1a	J Yh	fine	level	2,685		3.14,3.34	tropical coastal desert
calcic	Re11-1a	Zo	fine	level	385		3.34	tropical coastal desert
ANDOSOLS	T					3.2%		
Humic	Th8-a	GhBh/O		level	1,888	1.5%	2.51,2.61 2.62	Lake Titicaca:Altiplano steppe and river meadows; Headwaters Rio Mantaro: upper montane forests, paramo
Vitric	Tv				2,204	1.7%		
	Tv2-a			level	334		2.39,3.55 2.62	Altiplano steppe, river meadows
	Tv3-c	Kl J		steep	210		2.51,3.55	Altiplano steppe, river meadows
	Tv4-a	I Yk/J		level	990		3.34,3.52	Coastal desert
	Tv5-b	Kh I		hilly	256		2.38	Humid montane forest and dry forest, xerophytic woodland in the valleys
	Tv6-b	I/Kl Hl		hilly	414		3.35	subalpine desert paramo, tundra
VERTISOLS	V				1,463	1.2%		
Chromic	Vc							
	Vc2-3a	J	fine	level	385	0.57%	1.13	semidediduous and deciduous tropical forests
	Vc3-3a	Ne Ao/Ap	fine	level	339		1.12	tropical evergreen and semi-deciduous forests
Pellic	Vp5-3a	I XI	fine	level	739	0.58%	1.34	thorn woodland
SOLONCHAKS	Z							
	Zo1-2a	Yh	medium	level	21	0.02%	3.34	montane desert

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