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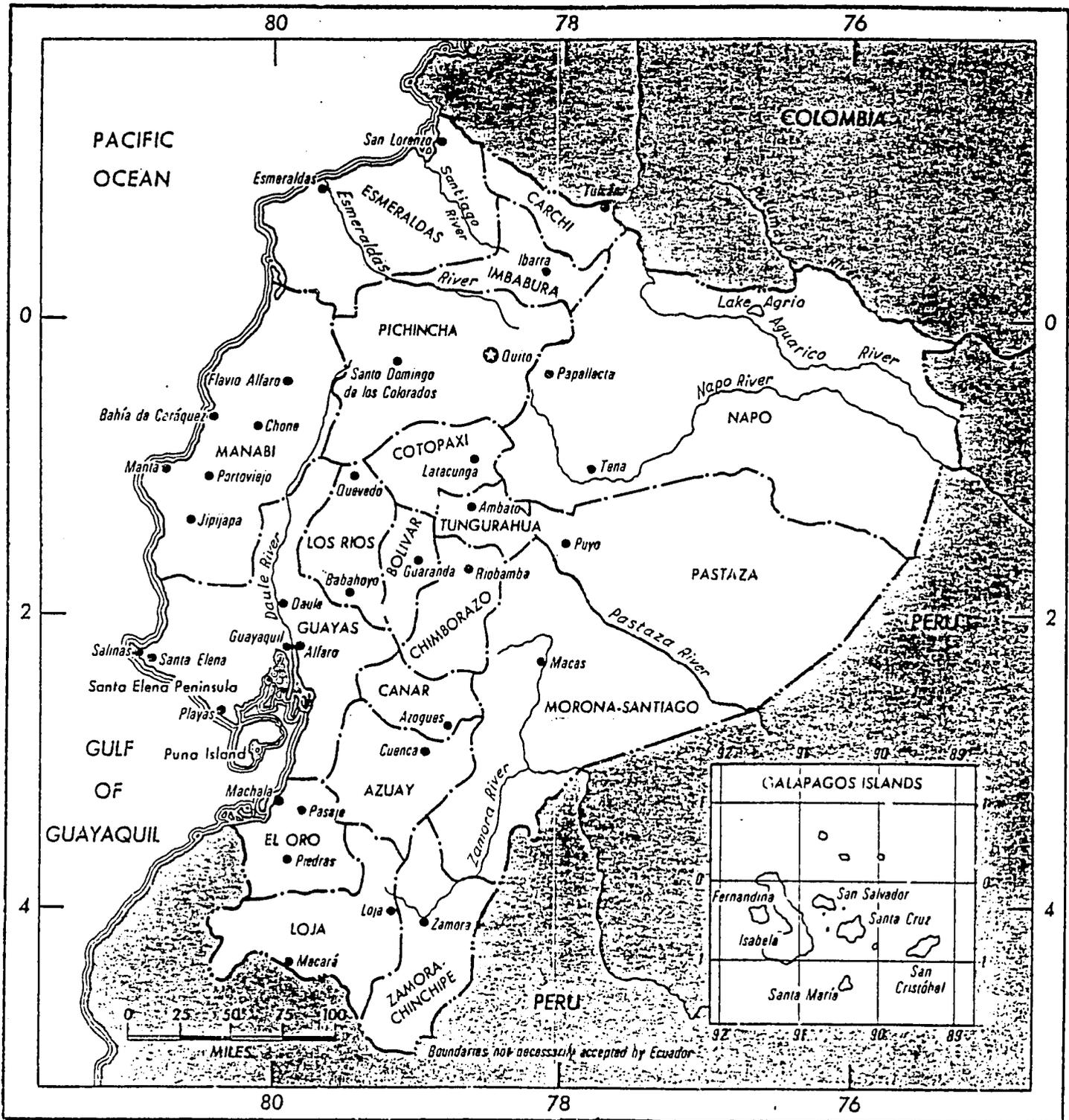
DRAFT ENVIRONMENTAL REPORT
ON
ECUADOR

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DRAFT ENVIRONMENTAL PROFILE OF ECUADOR



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ECUADOR: ENVIRONMENT AND NATURAL RESOURCES

0.0 INTRODUCTION AND SUMMARY

Located on the northwest coast of South America, Ecuador is a mountainous country bordered on the north by Colombia, on the south and east by Peru, and on the west by the Pacific Ocean. Ecuador can be divided into three major topographic regions: the Costa, consisting of the western coastal lowlands from the Pacific shore to the lower slopes of the Andes mountains; the Sierra, consisting of the two parallel spines of the Andes mountains and the Interandean Line of high mountain valleys; and the Oriente, consisting of gently rolling and flat lowlands covered with virgin tropical rain forest that leads to the Amazon River. A fourth region, the Galapagos Islands, are located 1,000 kilometers west of Ecuador in the Pacific. Ecuador's environment ranges from the tropical rain forests of the Oriente and the northern Costa region, to the almost desert-like conditions of the southern Costa along the Peruvian border, to the moderate climate of the Sierran valleys, to the perpetually snow-covered high peaks of the Andes. Climate in Ecuador is varied depending upon the region, the altitude, and the amount of rainfall. In the northern Costa, there is no real dry season, as there is no dry season in the Oriente. In the southern Costa, there is only 355 millimeters of rain a year. The climate of the Costa is greatly influenced by the meeting of the warm water of the Equatorial Current with the cold waters of the Humboldt Current which flows northward along the coast. In the Sierra rain and fine mist may fall every day of the year, but the rainy season generally lasts from October through May.

The main crops grown in Ecuador are for export and include bananas, coffee, cacao, and sugar cane. Domestic crop production is primarily focused on rice, corn, wheat, barley, beans, potatoes, and some fruits and vegetables. Agriculture accounts for 21% of the Gross National Product (GNP), while exploitation of petroleum accounts for 10.2%, manufacturing 16.3%, commerce 12.0%, transport, storage, and communications 12.0%, construction 5.4%, and 30.7% is accounted for by other small industries including handicrafts.

Ecuador has been producing oil for export since 1911, but a new find in 1967 near the Colombian border has increased the production up to 200,000 barrels a day. A member of OPEC, Ecuador exports oil to the United States (23% of total exports), to the Caribbean area (35% of total exports), and to the Andean pact countries of Chile, Peru, and Colombia (39% of total exports). Even so, Ecuador is a poor country. Revenues from petroleum are gradually being filtered down to those most in need, but the process is a difficult one.

Population in Ecuador is distributed fairly evenly between the Sierra and the Costa, but the government is promoting colonization projects in the Oriente which accounts for 57.4% of Ecuador's total land area. In the past few years, Ecuador has made significant progress in health and sanitation; the infant mortality rate has dropped from 100 per thousand live births in 1960 to 70 per thousand in 1975.

Fifty-two percent of Ecuador is still in forest, primarily in the Oriente. Deforestation, however, is extensive in the Sierra where moderate climate and fertile soil supported most of the population until the last few decades. Erosion is a problem in the Sierra as a result of population pressure, the steep slopes, and the young, loose soils.

Ecuador has legislation that deals with hunting and fishing, the control of air, soil, and water pollution, and the exploitation of forest resources and petroleum. However, enforcement is difficult due to a lack of trained personnel and to the relative inaccessibility of some areas in the Sierra and Oriente. The Ministries concerned with the environment and natural resources include Agriculture and Livestock, Natural Resources and Energy, and Industry, Commerce, and Integration.

MAJOR ENVIRONMENTAL PROBLEMS

The major environmental problems of Ecuador are erosion, deforestation, and desertification.

- 1) Erosion - There is severe soil erosion in the highland areas of the Sierra, due in part to overgrazing on steep slopes, cultivation of marginal lands, and deforestation. The Andes mountains which make up the Sierra are tectonically active, spewing volcanic ash and rocks periodically over the mountain slopes and valleys. In undisturbed areas soil is often made up of ash, pumice, and other loose materials which are easily eroded. All rivers in Ecuador rise in the Sierra and as they flow over steep slopes and loose soil, they cut deep gorges into the hills, carrying more soil and causing damage in the valleys below. Farming practices are another cause of erosion. Few farmers are aware of or use conservation methods such as terracing, and most till by hand. Cultivation tends to move soil down the slopes. As populations increase, farmers move higher up the slope, cutting down what few trees remain, exacerbating an already difficult problem. Experts agree that much of the erosion problem in Ecuador could be solved by the use of existing soil conservation methods, improving agricultural production on lower slopes, and providing better pasturage and forage crops for livestock.
- 2) Deforestation - Forests in the Sierra were cut long ago for fuel, timber, and to clear land for agriculture. Deforestation today is most evident in the Oriente, the virgin tropical rain forest that occupies over half of Ecuador's territory. The government has a policy of encouraging colonization in the Oriente by offering farmers 50 hectares of free land if they will agree to clear and farm the land within 5 years. Unfortunately the nutrients of the rain forest are in the plants and not the soil, so when land is cleared and farmed, the soil can only support limited production. As a result, farmers move on and clear another space to farm within a few years. Another impetus to clear land in the Oriente is the discovery of oil in the northeast near Colombia. Exploration is continuing throughout the Oriente and as roads are cut and pipelines built,

spontaneous migrations bring people who clear land along road cuts and deforestation begins. A third problem is the government's policy of granting concessions for logging, especially in the remaining forests of Esmeraldas, which is more accessible than the Oriente. Loggers often clear-cut areas and do not replant. Deforestation has another adverse effect as well: it reduces the available habitat for important jungle wildlife and plants, and puts pressure on the remaining tribal groups of the Oriente.

- 3) Desertification - It is estimated by the Ecuadorean Institute of Water Resources that the amount of arid land in Ecuador increased by 31.5% in the last 25 years. Out of 134,000km² of land in the Costa and the Sierra, 10,000 km² is now classified as arid land. Most of the arid area is along the southern coast and border with Peru, but the Santa Elena peninsula near Guayaquil is also considered arid. Deforestation and erosion both contribute to the production of arid lands. Deforestation removes ground cover, leaving soil open to dehydration and erosion by wind and water. Continuous cultivation also leads to desertification, especially when livestock are allowed to graze on crop residues, and no fallow period is possible.

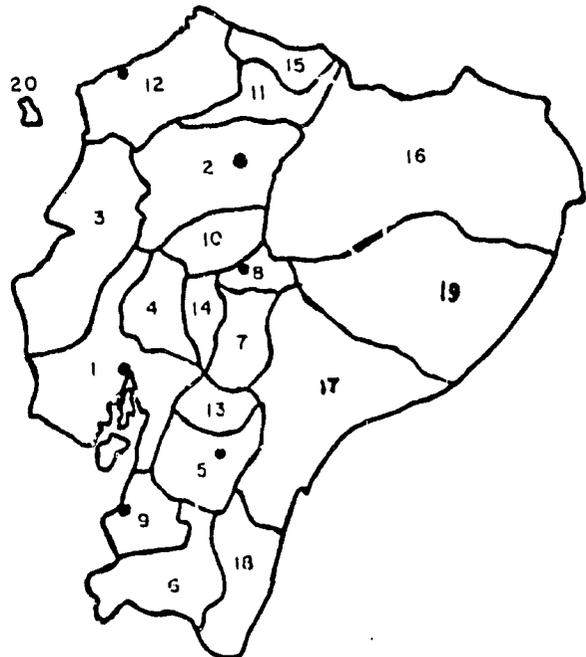
1.0 POPULATION CHARACTERISTICS

1.1 General Information

Ecuador is a mountainous country on the northwest coast of South America, bordered on the north by Colombia and on the south and east by Peru. It is slightly larger in area than the State of Colorado and has a population more than three times greater. Ecuador's population has risen from 7.3 million in 1977 to 8.0 million in 1979 (estimated mid-1979). Ecuador is divided politically into 20 provinces, including the archipiélago de Colón (Galapagos Islands), and 113 counties.

Figure 1. Provinces of Ecuador

1. Guayas
2. Pichincha
3. Manabí
4. Los Ríos
5. Azuay
6. Loja
7. Chimborazo
8. Tungurahua
9. El Oro
10. Cotopaxi
11. Imbabura
12. Esmeraldas
13. Cañar
14. Bolívar
15. Carchi
16. Napo
17. Morona-Santiago
18. Zamora-Chinchipec
19. Pastaza
20. Galapagos



Source: Wilkie, James W., ed. 1977. Statistical Abstract of Latin America Vol. 18. UCLA Latin American Center Publication, University of California, Los Angeles.

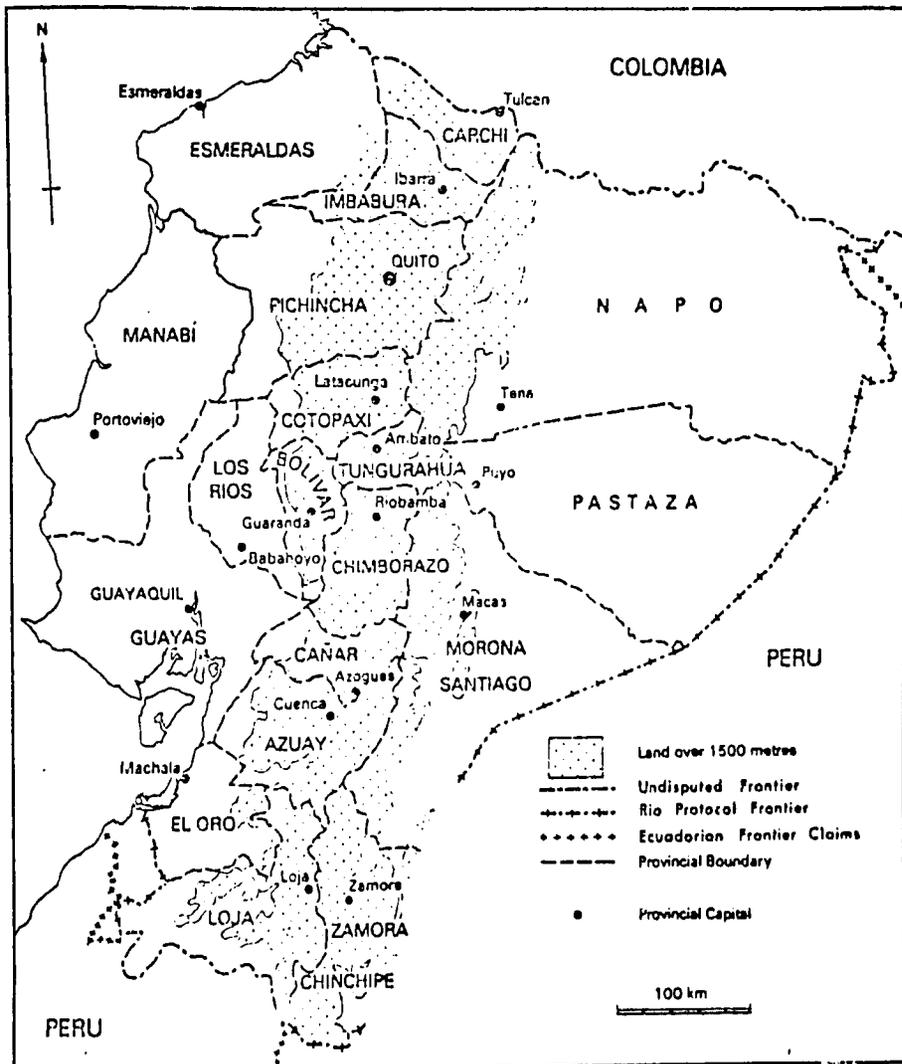
Table 1. Population by Province, 1974

<u>Province</u>	<u>Capital</u>	<u>Population</u>
Azuay	Cuenca	365,657
Bolívar	Guaranda	146,424
Canar	Azogues	147,463
Carchi	Tulcán	120,263
Cotopaxi	Latacunga	235,615
Chimborazo	Riobamba	306,138
El Oro	Machala	260,278
Esmeraldas	Esmeraldas	203,406

Table 1. (cont.)

Guayas	Guayaquil	1,512,838
Imbabura	Ibarra	217,813
Loja	Loja	343,153
Los Ríos	Babahoyo	384,113
Manabí	Portoviejo	808,615
Morona-Santiago	Macas	50,406
Napo	Tena	59,751
Pastaza	Puyo	23,058
Pichincha	Quito	981,053
Tungurahua	Ambato	276,114
Zamora-Chinchiipe	Zamora	34,645
Galapagos	Puerto Baquerizo	4,058

Figure 2. Provinces and Provincial Capitals



Source: Bromley, R.J. 1977. Development and Planning in Ecuador. Centre for Development Studies, University College of Swansea, University of Wales.

1.2 Population Statistics

Present population growth rate: 3.1 to 3.4 %

Number of years to double population: 22

Population under age of 15: 44%

Population over age of 64: 4%

Projected population for year 2000: 15.1 million

1.3 Population by ethnic membership

Ecuador's population is made up of two major groups, South American Indian and whites, primarily of Spanish descent. The American Indians, 40% of the population, are represented by both Quechua-speaking farmers in the highlands and small tribal groups in the Amazon lowlands. Once part of the Incan Empire, Ecuador was conquered by the Spanish, and today, whites represent 10% of the population. Through 500 years of shared history, Indians and whites have intermarried, producing the mestizo class. Today 40% of Ecuador's population are mestizos. The final 10% is made up of Negroes, whose ancestors were brought by the Spanish as slaves from Africa to work on coastal plantations. However, in Ecuador racial origins are not the most important distinction between groups, and censuses list people by language spoken rather than race. Also important is the economic level and the type of life style chosen by individuals. For example, in Ecuador an Indian is defined as an individual who retains his ties to Indian culture through dress, customs, and language. In this respect, a full-blooded Indian who is culturally a part of the Spanish-speaking society would not be considered Indian.

1.4 Regional distribution of ethnic groups

Ecuador can be divided geographically into three regions, the Costa, the Sierra, and the Oriente.

Costa - lowlands along the Pacific coast

Sierra - highlands including two Andean mountain regions and the Interandean valley area

Oriente - lowlands to east of Andes, tropical rain forest of Amazon basin

The almost 700 Indian groups represented in Ecuador are found in all three regions. In the Oriente live small tribal groups, such as the Yumbos, the Jivaros, the Aucas, and the Zaporos, many of whom speak only local dialects. Indians in the Sierra have had the most contact with Spanish culture and have assimilated many Hispanic cultural elements. Most Sierran Indians speak Quechua, a language introduced by the Incas, but many also speak Spanish. The Indian population of the Costa includes

small tribes as well as migrants from the Sierra.

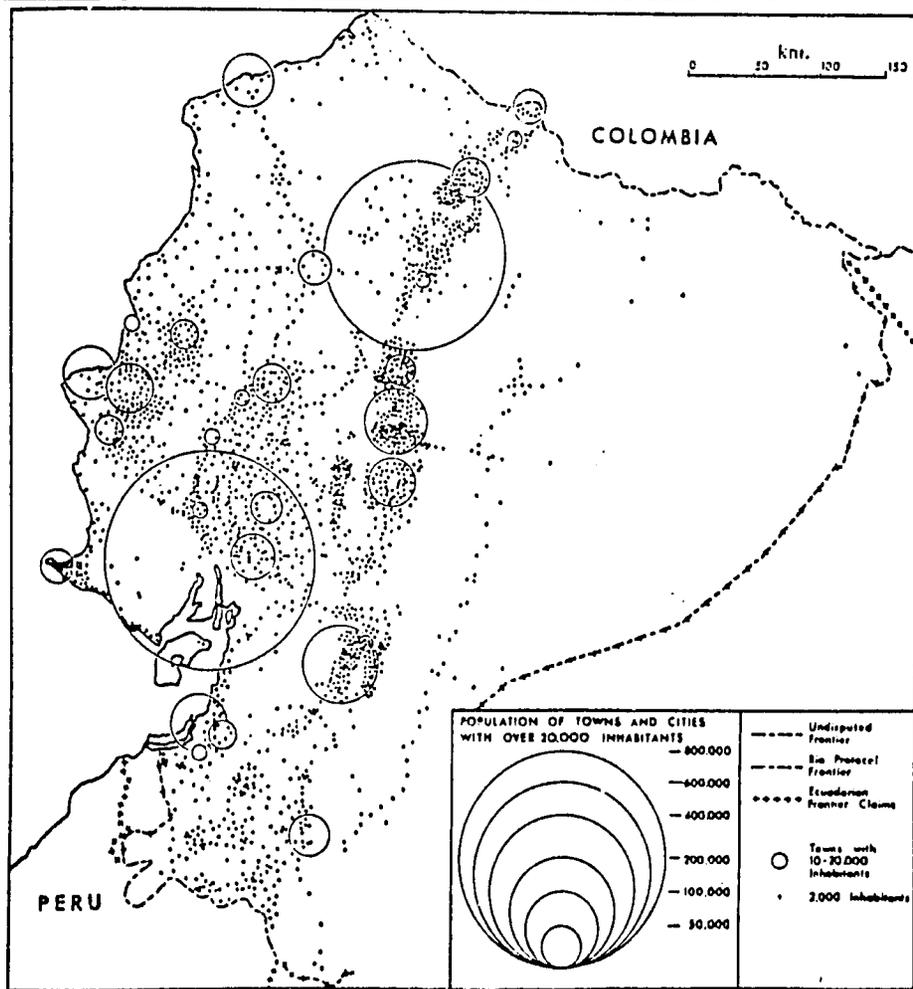
The Negro population is concentrated in the Costa, primarily in Esmeraldas Province. They speak Spanish and are culturally similar to other subsistence farmers of the region.

Whites, the elite of Ecuador's population, are concentrated in towns and cities, especially in Quito and Guayaquil. Merging with this group but below it are the mestizos, also concentrated in urban areas. Whites and mestizos are the dominant groups in Ecuador's economy and government, while Indians and Negroes represent the lower levels of society.

1.5 Rural-urban distribution of the population

In Ecuador 57.2% of the population is considered to be rural, and 42.8% urban, that is, living in provincial and county capitals (115 towns and cities). The Sierra and the Costa each contain 48.5% of the total population with the remaining 3% found in the Oriente.

Figure 3. Population Distribution in Ecuador, 1974



Source: Bromley, R.J. 1977. Development and Planning in Ecuador. Centre for Development Studies, University College of Swansea, University of Wales.

Two provinces of Ecuador, Guayas in the Costa and Pichincha in the Sierra, contain 39% of the total population and account for approximately 50% of the gross domestic product (GDP), 79% of the country's jobs, 79% of the total value of goods manufactured in Ecuador, and 76% of the credit available through the banking system. In general, underemployment affects 50 to 60% of Ecuador's labor force, and is particularly common in rural areas. There is migration from rural to urban areas because of this, but 47% of urban households do not earn enough to fulfill normal minimum needs. Even so, urban dwellers are much better off than rural people; median income in 1974 was \$221 for rural workers, and \$416 for urban workers. However, over 60% of Ecuador's population lives in conditions of poverty.

1.6 Educational characteristics of the population

Education in Ecuador is compulsory and all public schools are free. Primary school covers the ages from 6 to 12, and secondary school covers the ages 12 to 18. The number of children (ages 6-11) enrolled in primary school increased from 83% in 1960 to 96% in 1976, and 49% of the children ages 12 to 18 are enrolled in secondary school. Of every 1,000 students entering first grade in the public school system, only 379 finish the sixth grade. However, the adult literacy rate in Ecuador increased from 56% in 1950 to 75% in 1976. Ecuador has sixteen universities and technical schools. Some universities offer six year courses leading to degrees in teaching, among others.

Table 2. Population Literate Age 15 and Up, 1962 Census

<u>Population</u>	<u>% Urban</u>	<u>% Rural</u>	<u>% Total</u>
Male	91.9	61.5	68.4
Female	84.8	49.3	63.1

Source: Wilkie, James W. ed. 1977. Statistical Abstract of Latin America.

1.7 Health characteristics of the population

1.7.1 Vital statistics, 1979

Crude birth rate: 42 per thousand

Crude death rate: 10 per thousand

Infant mortality rate: 70 per thousand live births

Life expectancy at birth: 60 years

Ecuador has made significant progress in health matters since 1960, with infant and child mortality figures decreasing from 100 and 22 per thousand, respectively, to 70 and 15 per thousand in 1975.

Related services have also improved, such as electricity, roads, and water and sewerage systems. However, the nutritional intake of the population is deficient both in percent of protein and in total calories consumed. Housing is also inadequate, with an estimated deficit of 750,000 units in 1979.

The most common diseases are respiratory ailments, infectious and parasitic diseases, and diseases of the intestinal tract. Public health campaigns undertaken by the Ministry of Public Health with the World Health Organization and UNICEF eradicated yellow fever in the Costa region, and smallpox vaccination programs continue. Other public health programs concern tuberculosis, malaria, poliomyelitis, and leprosy.

Principal Causes of Death, 1978

<u>Cause</u>	<u>Number</u>	<u>Percent</u>
Enteritis and diarrheal diseases	7,676	11.9
Bronchitis, emphysema, asthma	4,886	7.5
Influenza and pneumonia	6,085	9.4
Heart disease	4,007	6.2
Accidents	4,312	6.7
Measles	3,286	5.1

Source: Evaluation Technologies, Inc. 1977. Ecuador: A Country Profile. Office of Foreign Disaster Assistance, U.S. Agency for International Development.

1.7.2 Medical facilities and health personnel

Medical personnel and facilities are concentrated in urban areas, although there is an increasing emphasis on rural hospital construction in the Rural Medical Program (begun in the late 1960's). In many rural areas traditional health attitudes and practices continue.

There are 248 hospitals in Ecuador, with a total of 14,300 beds. Of these, 54.9% are Ministry of Public Health facilities, 8.0% are Social Security program facilities, 21.9% are other public facilities, and 15.2% are private hospitals. In addition, Ecuador has 44 Maternal and Child Health Centers and 59 Public Health Laboratories. In general, there are more hospital facilities available than there are trained personnel. Medical personnel, including physicians, nurses, dentists, and auxiliaries, are trained at Ecuador's universities. Most of the medical personnel are in the large cities (60% were located in Quito and Guayaquil, where only 25% of the population lived, in 1970).

Medical personnel per 100,000 population (1970)

Pharmacists	46
Laboratory technicians	186
Nutritionists	12

Physiotherapists	18
Sanitary inspectors	161

Medical personnel per 10,000 population (1974)

Physicians	3,275
Dentists	579
Graduate nurses	766
Nursing auxiliaries	5,189

Health programs are directed by the Ministry of Public Health. The Ministry administers programs dealing with sanitation, social welfare, and other matters relating to health, including potable water supply, collection and disposal of garbage and human wastes, preventive medicine, food and drug registration and control, medical care and patient rehabilitation, health statistics, and health education. The Ministry, in coordination with such organizations as the World Health Organization, the Pan American Health Organization, and UNICEF, also conducts programs in the control and prevention of polio, smallpox, diphtheria, whooping cough, typhoid, typhus, and rabies. The Ministry has begun to establish minimal health posts in rural areas, staffed by paraprofessionals. By 1977, 200 of these posts had been established, with 1,000 more expected by 1984.

1.7.3 Health problems

In Ecuador the most critical health problems are related to the lack of potable water and nutritional deficiencies. It is estimated that only 13% of the rural population has access to either safe drinking water or to latrines or toilet facilities. In a 1977 study done by the National Institute of Nutrition, an estimated 40% of the population under the age of 5 years (550,000 children) were malnourished. In addition, 16% of the total population is considered to be malnourished. Respiratory diseases are common in the Sierra, and in cities heart disease and cancer are becoming more prevalent.

1.7.4 Sanitation and water supply

In Ecuador, water supply and sanitation traditionally have been the responsibility of the municipality, and cities such as Quito and Guayaquil maintain their own water and sewerage systems. In Quito there is a water purification system, but leaking pipes and low water pressure during the dry season sometimes has led to contamination of the city's water. In Guayaquil, water service is often unable to keep up with the population growth; in early 1972, for example, the municipal government was forced to distribute drinking water by tank truck to some parts of the city. Garbage and trash collection in the principal urban centers is generally satisfactory, with collection in Quito occurring six days a week, but in the urban slum areas sanitary services are virtually nonexistent. In rural areas, sanitation is left up to the local municipalities, which organize voluntary cleanup groups when

needed. Ecuador's Institute of Sanitary Works, part of the Ministry of Public Health, has a program of well-digging and latrine construction in rural areas, and is planning the construction of 800 well pumps and latrines in 120 localities with populations of 3 to 5,000. However, there are no plans for bringing similar sanitary services to rural areas of smaller populations. The government also conducts spraying and fumigation programs of Indian villages to rid them of disease-carrying rats and insects, and some adult education courses offered in rural areas concern environmental sanitation.

1.7.5 Family planning and birth control

Ecuador's Constitution proposes responsible parenthood and gives parents the right to have the number of children they can support and educate. Several agencies in Ecuador provide family planning services, including the Ministry of Public Health, the Ministry of Defense, the Social Security System, and private agencies, but there is no active promotion of such services. An estimated 84,000 persons participate in the public programs, while estimates of those participating in private services are unavailable.

Users of Birth Control Methods, 1975

<u>Method</u>	<u>Number of Users</u>	<u>Users, % Married Women Age 15-44</u>
IUD	26,900	3.3
Oral	19,000	2.3
Sterilization	1,100	0.1
Other methods	4,700	0.6
Total	51,700	6.3

2.0 ORGANIZATIONS WITH INTEREST IN ENVIRONMENT AND NATURAL RESOURCES

2.1 GOVERNMENT AGENCIES

Ecuador has been ruled since 1970 by a succession of civilian and military dictatorships, but in 1976 the three-man military junta in power announced that it intended to lead the country back to a truly representative democracy. The junta established committees to draft a new constitution, and in a referendum held in 1978 the people chose this new constitution over the revised 1945 Constitution that was suspended in 1970. Elections were held for the President and Vice President, and Ecuador returned to a constitutional democracy with the inauguration of President-elect Jaime Roldós Aguilera in August, 1979.

The new Constitution of Ecuador provides for three separate branches of government - executive, judicial, and legislative. The President heads the executive branch and may appoint and remove Ministers of State freely. Under the President is the General Secretariat of the Administration, which coordinates the functions of the Ministries, and the National Planning Board, which prepares the economic and social development plans of the country. Judicial functions are carried out by the Ministry of Government, which is responsible for internal political administration, including justice, police, public order, and religion. Legislative functions of past governments in Ecuador were carried out by decree from the Supreme Council of Government (the junta) and came into effect upon publication in the Registro Oficial. Under the new Constitution, laws and regulations will be developed by the new one-house Congress.

Ecuador is divided for administrative reasons into 20 provinces. Each province has a governor who represents the President in that province in administrative and executive functions. There are 12 Ministries and Ministry-level offices in the top levels of administration in Ecuador. Of these, 7 have functions relating to environment and natural resources.

2.1.1 National Planning Board (NPB)

Officially the Junta Nacional de Planificación y Coordinación Económica, the National Planning Board prepares economic and social development plans for the country and coordinates the development activities of all bilateral and multilateral donors in Ecuador. The NPB develops plans to integrate regional economies into the national economy, to increase employment and income, and to effectively use the national savings in development programs and projects. The NPB also recommends measures for adapting such programs to the President. The industrial promotion section of the NPB acts as an information center at the service of national and foreign entrepreneurs who wish to invest in the country, and prepares and analyzes investment projects. Agencies attached to the NPB include the National Population Council, the National Institute of Statistics and Census, the National Preinvestment Fund, and the National Register of Consulting Companies. The NPB also participates in the activities of the National Committee on Technical Cooperation and Economic Assistance.

The NPB Board of Directors includes a representative from the President; the Ministers of Agriculture and Livestock, Finance, Industry, Commerce, and Integration, Natural Resources and Energy, and Public Works; the General Managers of the Central Bank of Ecuador and the National Development Bank; and representatives from the agricultural, industrial, and commercial sectors.

2.1.2 Ministry of Agriculture and Livestock (MAG)

The Ministry of Agriculture and Livestock (Ministerio de Agricultura y Ganadería) is responsible for agriculture and livestock, agrarian reform, and unoccupied lands. The Ministry regulates the use, protection, and development of renewable natural resources consistent with the development plans of the country. Its functions include plant and animal health programs, classification of lands for better agricultural, livestock, and forestry use, and providing technical assistance in applying techniques to increase production of renewable resources. The Ministry has several Divisions or Directorates that are concerned with planning, rural development (cooperatives), agricultural development, forestry, and livestock. Each Division conducts applied research and extension programs, and is composed of several Departments. In addition, the Ministry is responsible for several semi-autonomous institutes for research, land reform and colonization, irrigation, marketing, and two formerly independent regional development organizations (CREA and CRM). Several of the Divisions and Institutes have functions relating to environment and natural resources.

Division of Forestry Development (Dirección de Desarrollo Forestal)

The Division of Forestry Development is composed of 5 Departments: Forestation, Logging and Forest Production, Administration of Wild Land Areas, Forestry Research, and Inventories of Native Forests. The Division maintains a Forestry Center at Conocoto (near Quito) and two small forestry stations. Within the Division is the Forestry Service (Servicio Forestal), which is primarily involved with the production of seedlings for distribution and sale to farmers and forestry cooperatives, research on growth, spacing, and planting techniques, and species testing, seedling production and test plantings. The Department of Administration of Wild Land Areas includes the National Park Service of Ecuador and other protected areas such as national forests, wildlife reserves, and natural recreation areas.

Division of Agricultural Development (Dirección de Desarrollo Agrícola)

The Division of Agricultural Development is composed of 5 Departments including the Departments of Plant Health, Agricultural Engineering, and Fertilization. Many of the functions of the Division are carried out in cooperation with the Institute of Agricultural Research (INIAP).

Division of Livestock Development (Dirección de Desarrollo Ganadero)

The Division of Livestock Development is concerned with all aspects of livestock breeding and improvement, including animal nutrition, genetic investigations, artificial insemination, and pasture development.

The Division has demonstration farms for livestock and pasture experimentation, and conducts research on dairy and beef cattle, horses, pigs, fowl, and range animals.

Ecuadorean Institute of Agricultural Research (INIAP)

The Instituto Nacional de Investigaciones Agropecuarias (INIAP) is a research institution that investigates all aspects of agricultural production in Ecuador, including weed control, control and prevention of crop diseases, development of resistant strains of crops, development of more resistant crops, and training in all of these fields. The Institute maintains 7 experimental stations, and is also involved with agricultural economics, engineering, nutrition, biometry, and planning. INIAP operates as the research arm of MAG.

Several other groups work with INIAP and MAG, including the International Center for the Improvement of Maize and Rice (CIMMYT) and the International Agricultural Development Service (IADS). CIMMYT analyzes the economic efficiency of various bean and maize combinations grown in association on farmers' fields, while IADS, an agricultural development support group, works with INIAP and MAG to plan, implement, and evaluate rural development projects.

Ecuadorean Institute of Agrarian Reform and Colonization (IERAC)

IERAC is the agency responsible for agrarian reform and land settlement, and all unoccupied lands within Ecuador belong to it for redistribution purposes. Unoccupied lands are those that have remained uncultivated for ten or more years, those whose owners are not in the country, and those that have reverted to the State for some reason. IERAC has a Bureau of Rural Development which implements training programs for officials in rural areas and other interested parties.

Ecuadorean Institute of Water Resources (INERHI)

The Instituto Ecuatoriano de Recursos Hidráulicos (INERHI) has the authority to implement the National Soil Irrigation and Drainage Plan, plan and construct irrigation and drainage works, establish standards for the execution of these works, maintain a register of grants of water rights, and collect fees from users of these irrigation works. INERHI plans the best use of hydraulic resources, evaluates and inventories these resources, and delineates zones of protection.

National Institute of Meteorology and Hydrology (INAMHI)

The Instituto Nacional de Meteorología e Hidrología is primarily concerned with the collection of data on hydrology, climatology, and with ecological investigations. The Department of Meteorology of INAMHI maintains river stations for data collection, and has ground stations to pick up information from COES satellites with an earth-synchronous orbit.

Other semi-autonomous agencies of the Ministry of Agriculture and Livestock include the Center for the Economic Reconstruction of Azuay, Cañar, and Morona-Santiago (CREA), the Rehabilitation Center of Manabí (CRM), the Program for the Development of Southern Ecuador (PREDESUR), and national organizations for semen (ENDES), for vital products (ENPROVIT), and for foodstuff and commercialization (ENAC).

Minister: Ing. Leonel Cedeño (Sept. 1979)

2.1.3 Ministry of Industry, Commerce, and Integration

The Ministry of Industry, Commerce, and Integration directs and carries out policy in fields of industrial, handicraft, and tourism development, foreign trade, and economic integration. The Ministry is in charge of semi-autonomous entities such as the Industrial Development Center (CENDES) and the Commercial Organization for Exportation of Handicrafts (OCEPA), as well as the National Center for Small Industry and Handicraft Development (CENAPIA) and the National Bureau of Tourism. The Minister of Industry, Commerce, and Integration presides over the Interministerial Committee of Industrial Development, which issues resolutions on the classification of industrial enterprises, establishes bases, registers, and specific conditions for automotive, petrochemical, electric, assembly, and other industries, determines periods for installation of industrial plants, and grants deductions and tax credits for industrial investments. Of particular importance are the National Bureau of Tourism and CENDES.

National Bureau of Tourism

The National Bureau of Tourism plans, executes, and promotes development of tourism in Ecuador, including the supervision and regulation of organizations. The Bureau includes the Tourism Governing Board which is concerned with establishing standards for tourist facilities.

Industrial Development Center (CENDES)

CENDES carries out industrial feasibility studies, supplies technical and administrative assistance to industry, promotes new industries, and supervises investment projects in Ecuador.

Minister: Dr. Martin Manosalbas Vaca (Sept. 1979)

2.1.4 Ministry of Labor and Social Welfare

The Ministry of Labor and Social Welfare is responsible for labor and social matters including the protection of minors, Social Security System, promotion of cooperatives and farmers, intervention in collective labor conflicts, and in improving the living conditions of workers.

Minister: Dr. Carlos Feraud Blum (Sept. 1979)

2.1.5 Ministry of National Defense

The Ministry of National Defense is responsible for all matters concerning the land, air, and sea branches of the armed forces, but also has jurisdiction over the delimitation of the shoreline of the sea and navigable rivers in Ecuador. The Ministry is charged with the prevention and control of the contamination of water in oceans and navigable rivers, and of air in the country's air spaces. Agencies of the Ministry include the Military Geographic Institute and its Remote Sensing Natural Resources Integrated Research Center (CLIRSEN). CLIRSEN is charged with evaluating and inventorying the natural resources of Ecuador through aerial remote sensing methods.

Minister: Gen. Rafael Rodriguez Palacios (Sept. 1979)

2.1.6 Ministry of Natural Resources and Energy

The Ministry of Natural Resources and Energy (Ministerio de Recursos Naturales y Energeticos) is responsible for the management of mining, petroleum exploitation, hydraulic resources, electric energy, maritime resources, and fishing policies. The Ministry has the authority to grant permits and licenses for the development and exploitation of mineral resources, petroleum, and fisheries resources, and is responsible for the prevention and control of soil contamination. The Ministry controls all petroleum exploration in Ecuador through the Corporacion Estatal Petrolera Ecuatoriana (CEPE), a State corporation that is semi-autonomous. CEPE, the Ministry of National Defense, and the Ministry of Natural Resources and Energy are together responsible for development of hydrocarbon policy in matters relating to national security. Several Divisions and Departments within the Ministry deal with environment, including the Division of Geology and Mines, the Division of Hydrocarbons, CEPE, and the Division of Fisheries.

Division of Geology and Mines

The Division of Geology and Mines administers the technical aspects of mining activities in Ecuador. The Division can, through the Minister of Natural Resources and Energy, hear, process, and decide upon claims, disputes, and petitions relating to mining. The Division grants permits contracts for prospecting, exploration, exploitation, processing, smelting and refining, and encourages the formation of cooperatives of small-scale miners.

Division of Hydrocarbons

The Division of Hydrocarbons is the technical administrative agency for the industrialization of hydrocarbon exploitation in Ecuador, and works with the Ministry of National Defense, Ministry of Natural Resources and Energy, and CEPE to develop hydrocarbon policy. Hydrocarbon policy concerns the optimum use of resources, conservation of reserves, and all economic matters related to the development of hydrocarbons.

Ecuadorean State Petroleum Corporation (CEPE)

The Ecuadorean State Petroleum Corporation is responsible for the direct exploration and exploitation of petroleum deposits in Ecuador. CEPE is charged with the transport, marketing, and installation and operation of industrializing plants for hydrocarbons, as well as petro-chemical and related industrial plants. CEPE is also responsible for exploring, marketing, and industrializing other products necessary for the petroleum or petro-chemical industry in order to achieve maximum use of hydrocarbon resources. CEPE has a board of directors, a general manager, and technical and administrative staff, and may carry out its functions itself or let contracts for these services.

Division of Fisheries

The Division of Fisheries regulates fishing activity at sea and in rivers and lakes, and in order to engage in fishing activities, fishing vessels must be registered and classified, and obtain permits from the Division. The Division may authorize the entry of foreign flag vessels and register them; however, Ecuador claims territorial waters up to 200 miles offshore and no vessels may fish in that area without prior authorization. The permission of the Ministry of Natural Resources and Energy is required to procure any bio-aquatic organisms through fishing activity in territorial waters, rivers, lakes, inland maritime waters, and natural or artificial canals.

National Fishing Institute

The Instituto Nacional de Pesca is the scientific and technical research institute for bio-aquatic organisms. The objectives of the Institute are to investigate aquatic resources and, based upon knowledge of the organisms and their environment, evaluate their potential, diversify production, promote development of fishing areas and the optimal and rational use of fishery resources. The Institute is also charged with providing technical assistance and aid to those interested in fisheries activities. Duties of the Institute include investigation of the nature, distribution, and volume of aquatic organisms in national waters and recommendations for preserving or preventing all possible contamination of the nation's waters and biological and aquatic organisms.

Ecuadorean Institute of Electrification and National Energy Institute

The Ecuadorean Institute of Electrification, a semi-autonomous agency, has the power to fix electric rates, grant permits to install private plants, and impose easements for the extension of electric lines. Another agency, the National Energy Institute, was recently established to draw up a national energy plan, and to research and explore solar and biomass sources of energy, and survey and study more rational uses of traditional energy resources.

Minister: Econ. Mauricio Dabalos (Sept. 1979)

2.1.7 Ministry of Public Health

The Ministry of Public Health is concerned with the development and promotion of health, environmental health, plant health, nutrition, sanitation, social welfare, and radioactive substances. The Ministry includes Divisions and Departments such as the Department of Plant Health, the National Health Bureau, the Ecuadorean Institute of Sanitary Works, the National Institute of Nutrition, and the Ecuadorean Atomic Energy Commission.

Department of Plant Health

The Department of Plant Health is responsible for studying, preventing, and controlling plagues, diseases, and pests which may affect agricultural crops. The Ministry of Agriculture and Livestock works with the Department to establish nurseries and fields for the propagation of seeds that may be imported into Ecuador to study their potential harmful effects prior to such importation.

Ecuadorean Institute of Sanitary Works (IEOS)

The Instituto Ecuatoriano de Obras Sanitarias is concerned with the planning and execution of sanitation programs, including elimination of human wastes, rainwater, and sewerage, collection and disposal of garbage, and provision of a potable water supply. Traditionally, most of these functions are carried out by municipalities; IEOS therefore is more concerned with planning on a national level. The IEOS also maintains a Sanitary Register that registers marketing and production of foodstuff, medicine, drugs, cosmetics, hygienic products, and insecticides.

Ecuadorean Atomic Energy Commission

The Ecuadorean Atomic Energy Commission, a part of the National Institute of Nutrition, carries out research on nuclear physics, radioisotopes, radiobiology, chemistry, and medicine. The Commission is also concerned with the production and sale of radioactive minerals.

Minister: Dr. Rodrigo Fierro Benitez (Sept. 1979)

2.1.8 Other Governmental or Semi-Governmental Agencies

2.1.8.1 Interinstitutional Committee for Environmental Protection

Created by law in 1976, the Interinstitutional Committee for Environmental Protection is charged with, on a national level, the rational planning of the use of air, water, and soil resources for the prevention and control of environmental contamination. The

Committee is responsible for determining criteria for the use of air, water, and soil resources and for the control of contamination in the country, deciding if development projects include the rational use of air, water, and soil resources without harming the environment, promoting the development of educational and informational programs on the national level on the problems of environmental pollution (oriented towards children and youth), and supervising urban development and work projects such as national parks, industrial areas, and zoning in general that cause impacts on ecology. The Committee is made up of representatives of the Ministries of Public Health, Natural Resources and Energy, Agriculture and Livestock, National Defense, Industry, Commerce, and Integration, and the National Planning Board, and is presided over by the Institute of Sanitary Works (IEOS), Ministry of Public Health.

2.1.8.2 Fund for the Development of Rural Marginal Groups (FODERUMA)

The Fund for the Development of Rural Marginal Groups was established in 1978 as a conduit for government funding, technical assistance and credit to the rural disadvantaged. FODERUMA's guiding principles are self-help and local participation.

2.1.8.3 National Development Fund (FONADE)

The National Development Fund was created to finance development investments by the public sector, and funds come from petroleum revenues and from foreign credits. Allocations from the Fund go to land reform, petroleum exploration, feeder roads, and education programs.

3.0 LEGISLATION DEALING WITH ENVIRONMENT AND NATURAL RESOURCES

Over its 150-year history, Ecuador has had 18 constitutions, but from 1970 until 1978, only portions of the 1945 Constitution remained in effect. During that nine-year period, acts, regulations, and amendments were prepared by the Supreme Council of Government and issued as Supreme Decrees. These Decrees were then published in the Registro Oficial, Ecuador's official gazette, for the notification of the public. In 1978 a new constitution was chosen by the people in a referendum, and upon the return to democracy, a new one-house Congress will perform the legislative functions as provided for in that constitution.

3.1 GENERAL ENVIRONMENTAL LEGISLATION

3.1.1 Prevention and Control of Environmental Contamination Law, 1976

Provisions: To give guidelines for the prevention and control of environmental contamination (pollution), protection of air, water, and soil resources, and the conservation, improvement, and restoration of the environment for the good of the public. This law creates the Interinstitutional Committee for Environmental Protection (see Section 2.1.8.1) and names the organizations that are responsible for regulation, control, and prohibition of the causes and the form of environmental contamination and the degradation of ecological systems. The organizations and their respective functions under the law are:

Ministry of Agriculture and Livestock - prevention and control of the contamination of the quality of fresh-water, rivers, and lakes, and of soil.

Ministry of Government - prevention and control of occasional contamination by operation of vehicles.

Ministry of Industry, Commerce, and Integration - control of all contamination that results from installation of new industries and other labor activities (with the Ministry of Labor and Social Welfare).

Ministry of National Defense - prevention and control of the contamination of ocean waters, navigable rivers, and of air space above national territory.

Ministry of Natural Resources and Energy - prevention and control of the contamination of soils (with the Ministry of Agriculture and Livestock).

Ministry of Public Education - planning and execution of educational programs on environmental pollution in schools and colleges.

Ministry of Public Health - prevention and control of contamination of water supplies used by humans, air, noise, and radiation.

Atomic Energy Commission - control and prevention of ionization and radioactive isotopes in industrial use or other use that have risks of contamination or exposure to radiation.

Universities and Technical Schools - investigations of environmental contamination and how to dispose of contaminants.

Prevention and Control of Air Pollution - Article 11 states that it remains prohibited to expel into the atmosphere contaminants that are harmful to life and human health, flora, fauna, and resources or benefits of the State. Potential contaminants of air are defined as:

Artificial substances - originating from man's actions or technological development such as substances from factories, plants, foundries, refineries, airlines, automobiles, burning of garbage or other residue, and exploitation of construction materials.

Natural substances - originating from natural phenomena such as volcanic eruptions, precipitation, landslides, and earthquakes.

Article 15 states that anyone who wishes to implement projects that might pollute the air must conduct studies on the environmental impacts of the projects and submit to the Ministry of Public Health plans that will be used to control such pollution for the approval of the Ministry.

Prevention and Control of Water Pollution - Article 16 states that it remains prohibited to discharge into rivers, lakes, or other natural or artificial waters, including sea water, anything which can infiltrate land or water that may contaminate human beings, flora, or fauna and their habitat. Other articles give the power to authorize projects that may pollute such waters to INERHI, and give the Ministry of Public Health the power to order the grade of treatment that will be given to liquids and to supervise the construction of treatment plants.

Prevention and Control of Soil Pollution - Article 20 states that it remains prohibited to discharge contaminants that may alter the quality of soil and affect human, floral, or faunal life, or other natural resources. Contaminants include radioactive substances and solids, liquids, and gases produced by industry, agriculture, municipal or domestic uses. The Ministry of Agriculture and Livestock is authorized to limit or regulate the use of substances such as herbicides, fertilizers, defoliant, detergents, radioactive substances, and others whose use could cause pollution.

The Ministry of Health is ordered to coordinate, plan, regulate, and supervise the collection, transport, and disposal of urban and rural garbage, radioactive substances, and nonbiodegradable substances such as plastic and aluminum. The law also describes fines and penalties for infringement of any of the prohibited actions defined in the law, ranging from imprisonment from 15 days up to three years if the action results in the death of a person, to a fine up to 5,000 sucres* for damage to the environment, depending upon the seriousness of the damage.

3.1.2 Health Law, 1971

Provisions: This law states that no person will be able to eliminate into the air, the soil, or the water any liquid, solid, or gaseous residues without previously treating them so as to render them inoffensive to human health. The law includes regulations to cover public nuisances such as noise, smoke, disagreeable odors, toxic gases, atmospheric dust, and other such emanations. Chapters deal with the protection of potable water supplies, elimination of excreta, toxic and dangerous substances, and the collection and disposal of garbage.

3.2 RENEWABLE RESOURCES

3.2.1 Water Resources

3.2.1.1 Water Law, 1972

Provisions: To regulate the use and benefit from the maritime, surface, underground, and atmospheric waters of the national territory in all their physical states and forms. The law states that all waters belong to the State, and individuals may enjoy only a right to use them. The right of use is enjoyed by former owners and by those who obtain the respective grant for that purpose. Each person must use waters in such a way that is not detrimental to others and they must conform to legal restrictions under the control of INERHI. The law states that other national properties for public use are the bed and subsoil of the inland and territorial seas (which extend up to 200 miles from the shoreline) and of rivers, lakes, ravines, marshes, and other permanent water courses or reservoirs.

Rights to water will be granted in the following order of preference:

- 1) for the supply of water to towns, for domestic needs and animal use;
- 2) for agriculture and livestock;
- 3) for energy, industrial, and mining uses; and
- 4) for other uses.

*U.S. \$1 = 25.00 sucres (1978)

Grants for water use are subject to these requirements:

- they must not interfere with other uses
- the waters to be used must be sufficient in both quality and quantity for the intended use
- the studies and structures necessary for the intended use must have been approved by INERHI.

No one may exploit underground waters without INERHI's permission. Grants for exploitation of underground water are subject to these conditions:

- flow diversion should not interfere with the conditions of the aquifer or the surface area included in the radius of influence of the well or gallery
- flow diversion should not interfere with other wells, galleries, or water sources.

INERHI is charged with studying the exploration and exploitation of mineral, thermal and medicinal waters and regulating, inventorying, classifying, and evaluating their usefulness for therapeutic, industrial, and tourism use in coordination with the Ministry of Public Health and the Tourism Bureau.

Prohibited Actions: All pollution of waters which may affect human health or the development of flora and fauna is prohibited. It is also prohibited to evacuate into waters any detritus, garbage, refuse, or excreta that may decompose and contaminate the water. The use of organic fertilizers and chemicals such as pesticides must be authorized by INERHI and is prohibited within certain distances of water sources. Also prohibited is the use of poisons such as algicides to clean irrigation canals or other artificial water courses.

3.2.1.2 Prevention and Control of Environmental Contamination Law, 1976

Provisions: See Section 3.1.1

3.2.2 Forest Resources

Although there are several laws that deal with forest resources, many of their provisions deal with the exploitation of forests rather than forest protection, and give procedures for obtaining concessions from the State. Some of the more important provisions are scattered throughout seven laws as follows.

3.2.2.1 Forestry Law, 1958

Provisions: To conserve, protect, improve and develop the forests of Ecuador, this law established the Division of Forests within the Ministry of Production (now Ministry of Agriculture and Livestock). The law gives the Division the

power to authorize the exploitation of natural and artificial forests (plantations) that are State property.

3.2.2.2 Forest Wildlife and Fishery Resources Protection Law, 1970

Provisions: Primarily a hunting and fishing law, this law also states that it is prohibited to cause forest fires for the purpose of hunting.

3.2.2.3 Agricultural Livestock and Forestry Development Law, 1971

Provisions: The Ministry of Agriculture and Livestock is charged with studying and classifying the national lands according to their best use as agricultural, pasture, or forests, and with determining the methods to adopt and formalizing the ways to utilize, defend, and develop natural resources.

3.2.2.4 Other Forest Laws

Other laws that deal with forest resources are:

Law on Protective Forests, 1964
Law on Forestry Repopulation, 1964
Law on Forestry Concessions, 1966
Law on Preservation of Reserve Zones and National Parks, 1971

Provisions of these laws include: The Ministry of Agriculture and Livestock must determine which lands are naturally suitable for forests (forest industry). Existing forests in national territory are classified as protective or productive; protective forests have the primary function of conservation of the soil, water, forest life, and other natural resources or works of public interest. Productive forests may be exploited by obtaining concessions from the Department of Forestation, with the understanding that such forests are to be conserved through proper use. Concessions are granted for exploitation of State forests only after the Division of Forestry has issued a favorable report for such uses, including utilization of timber or other forest products, settlements, or construction of roads. If private forests are declared protective, owners of such forests are obliged to carry out forestation or reforestation on them, and special assistance including loans is available to them. Owners of forests may only exploit them through a license granted from the Department of Forestation.

Prohibited Actions: It is prohibited to pasture cattle or use fire in protective forests. Other prohibitions include:

- the destruction of forestry products in State forests or their use without having complied with the law
- causing forest fires

- perpetrating any act which injures or damages the value of State or privately owned forests
- lack of compliance with the obligations indicated in the law or its regulations.

Owners of lands suitable for forestry are obligated to work them through one of three systems according to the Ministry of Agriculture and Livestock in the following order of priority:

- through the social system of forestation
- for their own use, within periods and conditions established by the Ministry
- for the account of the Ministry.

Lands with industrial forests which were planted or replanted with trees are exempt from all taxes for an indefinite period. All plants, seeds, and machinery needed for forestation are also exempt from import taxes.

3.2.3 Wildlife Resources

3.2.3.1 Forest Wildlife and Fishery Resources Protection Law, 1970

Provisions: This law details the means and manner in which it is permitted to hunt and fish in Ecuador, and gives a list of prohibited actions in this connection. The law states that people can only hunt and fish using the arms and implements allowed by the laws and regulations of the Ministry of Production (now Ministry of Agriculture and Livestock). It is prohibited to use military arms for hunting or fishing, to hunt with arms not strong enough to kill, or to use traps, lassos, slingshots, or artificial lights at night, or to use any device that will cause unnecessary pain or prolong the agony of a hunted animal. It is further prohibited to hunt or kill animals, birds, or fish that by their actions are beneficial to agriculture or human health, such as for example national wildlife that are rare species in the world or that are in danger of extinction. It is also prohibited to use insecticides, herbicides, and fungicides that may cause the death of such rare species.

Prohibited Actions: According to this law, it is prohibited to:

- cause fires in forests, pastures, and fields at the end of hunting
- kill birds in their nests or animals in their homes, or when they are lactating or are very young
- kill female animals that are pregnant
- utilize for hunting or fishing any kind of chemical, poison, acids, explosives, or electricity, or anything that deoxygenates the water such as cocoa, cicuta, cloruro de cal, cal vivia, or any other form which may cause harm to fish, crustaceans, molluscs, sponges, turtles, or their young

-import species that may harm agriculture, animal husbandry, or fisheries development and the development of forest wildlife.

Regulations: Regulations were added to the law in 1977 to control the commercial exportation of specimens and elements (products) of wildlife. The regulations allow the disposal or export of 16,000 specimens of birds and 10,000 specimens of the mammal genus Tayassu during 1977. Animals not allowed to be exported include:

Aratinga weddelli
Forpus coelestis
Pionis seniloides
Pteroglussus pluriunctus
Pteroglussus inscriptus
Electron platyrhynchum
Momotus momota
Cyanocorax moptacalis
Tangara velia
Tangara icterocephala

The quantities of animals stated in the regulations may be exported by obtaining a license. Those who wish to receive licenses must justify their reasons before the authorities and show that they have the necessary experience to catch and maintain animals before licenses will be issued. No wildlife can be exported that is on the list of animals not to be exported.

3.2.3.1 Other Wildlife Laws

Ecuador agreed in 1976 to the Convention for the Conservation of Vicuña that was agreed upon by the Governments of Bolivia and Peru in 1969. The Convention permits the conservation of species in danger of extinction and their reintroduction into Ecuadorean territory, especially species as potentially valuable as the vicuña. The Convention is under the auspices of the Ministry of Foreign Affairs.

3.2.4 Fishery Resources

3.2.4.1 Forest Wildlife and Fishery Resources Protection Law, 1970

Provisions: See Section 3.2.3.1

3.2.4.2 Law on Fishing and Fishing Development, 1974

Provisions: This law regulates fishing activities both at sea and in rivers and lakes. The law states that the bioaquatic organisms and resources of the territorial sea and the inland maritime waters, rivers, lakes, and natural or

artificial canals are national property whose rational use will be regulated and controlled by the State in accordance with its interests. The State reserves fishing activity for national or mixed enterprises but foreign flag vessels may be registered and granted a permit for fishing by the Ministry of Natural Resources and Energy. In order to engage in any fishing activity express authorization of the Ministry is required. Those who fish in Ecuadorean waters are obligated to:

- catch only the species that may be fished
- submit themselves to the regulations concerning size, prohibited periods, etc.
- facilitate control by the competent authority
- utilize equipment and systems which are technically advisable and prevent environmental pollution
- maintain the corresponding accounting records
- perform such other obligations as are required in the regulations.

All ships of foreign flags must carry a fishing registration card valid for one calendar year and a fishing permit valid for the duration of the trip in addition to the documents required by the Maritime Police.

Prohibited Actions: Under this law it is prohibited to:

- fish by illegal means such as poisons or explosives
- produce pollution from sewerage without proper treatment
- abandon objects which may cause danger in the water or on the shores
- carry tackle, rigging or other systems different from those permitted
- use vessels for unauthorized purposes
- sell or transport the catch which must be sold ashore

Also prohibited is the entrance of foreign flag shrimping or lobster vessels unless they require docking for repairs or in case of emergency.

The law further states that fishing firms must supply national industries with the products which they need for processing.

3.2.4.3 Civil Code of Ecuador

Provisions: Article 628 of the Civil Code of Ecuador states that the adjacent sea up to a distance of 200 nautical miles, measured from the farthest islands of the Archipiélago

de Colón, and from the points of lowest tide, according to the baseline that shall be established by executive decree, is the territorial sea and is of national ownership. Also of public domain is the bed, subsoil, and air space under and over the territorial sea as defined.

Article 647 states that fishermen may make use of the seashores for necessary repairs, mooring, and construction, and of contiguous lands up to a distance of eight meters in from the shore, but they may not touch existing buildings or structures, nor may they enter into lands containing standing timber, plantings, or sown fields.

3.2.5 Air and the Atmosphere

3.2.5.1 Prevention and Control of Environmental Contamination Law, 1970

Provisions: See Section 3.1.1

3.2.5.2 Health Law, 1971

Provisions: See Section 3.1.2

3.3 NONRENEWABLE RESOURCES

3.3.1 Mineral Resources

3.3.1.1 Mining Development Law, 1974

Provisions: This law states that the State has direct ownership of all minerals or substances which are found in deposits or concentrations in veins, strata, or pools whose nature is different from that of the soil. Companies and individuals may only exercise ownership over the surface of the land below which the mines or pools may be located. The State may carry out mining activities either directly or through contracts. Companies or individual persons who exploit, process, smelt or refine minerals must sell the final products in the national market in amounts sufficient to satisfy the internal needs of the country. Only when production exceeds the national requirements of smelting and refining may the State authorize any export of the surplus. Mines are considered to be deposits of mineral, metallic, or nonmetallic substances, except stones, sand, and clay, which are found in quarries. The President of the Republic establishes mining policy, and policy is carried out by the Minister of Natural Resources and Energy through the Division of Geology and Mines. The mining industry is considered to be a public utility and therefore the expropriation of lands, buildings, and installations are in conformity with the law.

Quarries:

Quarries containing stone, sand, clay, and other construction materials may be exploited by permit. The exploitation of quarries permit lasts for 5 years and is renewable for equal periods. Exploitation of quarries along public roads is subject to the regulations of the Highway Law.

Companies or individuals who contract for any of these mineral resources must adopt the necessary measures for the protection of flora, fauna, and other natural resources, and avoid pollution of waters, the atmosphere, and the land.

3.3.2 Petroleum Resources

3.3.2.1 Hydrocarbon Law, 1974

Provisions:

This law states that the deposits of hydrocarbons and accompanying substances located in the national territory in whatever state found are the property of the State. The State is responsible for the direct exploration and exploitation of the hydrocarbon deposits, and it is the State's right to transport hydrocarbons by pipelines or gas lines and to refine them. The hydrocarbons industry is a public utility and the expropriation of properties and the establishment of necessary easements for the industry's development are in conformity with the law. The state will exploit, transport, market, operate, and install industrializing plants for hydrocarbons through the Ecuadorean State Petroleum Corporation, CEPE. CEPE may itself carry out activities of exploration, exploitation, refining, industrialization, transportation, and marketing of hydrocarbons, or it may enter into contracts with foreign or national firms for one or more of such activities, or establish joint public-private companies.

Contracts:

Contracts for exploration and exploitation of hydrocarbons may cover an area not larger than 200,000 surface hectares. For all types of contracts, exploration periods may last up to five years, while the exploitation period may last up to 20 years, and be extended for an additional 10 years. Foreign firms which wish to enter into contracts must first become domiciled in Ecuador, remain subject to national courts, and must expressly waive any recourse to diplomatic means. Contracts authorize the exploitation of crude petroleum only. Natural gas obtained in the the exploitation of petroleum deposits belongs to the State, as do surface deposits of asphalt, and deposits of lands impregnated with hydrocarbons. Substances found in association with hydrocarbons may only be recovered and exploited by CEPE.

- Prospecting: Contractors may obtain grants for the right to carry out surface studies and surveys in an area of up to 50,000 hectares in a single unit, over a period of 3 years.
- Explorations: Contractors who have found evidence of mineral deposits through prospecting that is verified by the Division of Geology and Mines may enter into an exploration contract for an area up to 30,000 hectares that is part of the area prospected previously. Contracts may extend over three years.
- Exploitation: Contractors who have found deposits through exploration may within 120 days enter into an exploitation contract. If the time elapses without such a contract, the State may take over the area. Preparation of the mine and construction of the ore processing plant must begin within 6 months of the contract registration date. Such contracts may be up to 20 years, with another 10 years allowed if the reserves are available.
- Processing: If the individual production from mines is small, a regional processing plant may be built to process the ore from several mines. The installation of such plants may be made by the Division of Geology and Mines or by companies or individuals. Mining exploiters who do not have their own plants must sell their minerals to regional plants at a price fixed by the Division.
- Smelting and Refining: The State or interested parties may establish smelting or refining plants to receive materials from the processing plants. Installation of plants may be done by contract with the State for 30 years, with 10 year extension periods allowed.
- Small-scale Mining: Small-scale mining, the working of mines that only produce up to 1500 tons of mineral per month, is encouraged by the State as is the formation of cooperatives of small-scale miners. The Division, to encourage such miners, is charged with:
- collaborating in the exploration and evaluation studies of areas granted
 - cooperating in the preparation of reports and in the management of the operations
 - providing guidance in the selection of adequate systems for exploitation and processing of the minerals
 - advising in the technical and economic studies necessary for making full use of commercially available resources.
- Alluvial placers and Washings: Alluvial placers, mineral substances embedded in detritus deposits in the channels, banks, and beds of present or former rivers, in lake basins, or in the shores of the sea, may be exploited by permit from the Division of Geology and Mines. The area to be used as a washing place for prospecting, exploration and exploitation may not exceed 30,000 hectares, 20,000 hectares, and 10,000 hectares, respectively.

Contractors have the right to only the crude petroleum assigned to them by their contracts. The Ministry of Natural Resources and Energy may require a percentage of the petroleum belonging to the contractor to supply the refining needs of plants established in the country. Contractors are obligated to:

- employ a minimum of 95% Ecuadorean labor, 90% Ecuadorean administrative staff, and 75% Ecuadorean technical personnel, unless national technicians are not available
- submit plans for exploration and development for Ministry approval
- furnish reports on topographical, geological, geophysical, drilling, and production conditions, and estimates of reserves
- furnish economic data on all aspects of petroleum exploitation
- employ modern and efficient machinery and observe at all times the policy of conservation of reserves established by the State
- comply with standards on quality and specifications of products
- open to public use the roads, airports, sea and river ports they construct
- submit an aerial photogrammetric plan of the land area contracted for exploration, using the scale and specification established by the Military Geographic Institute
- adopt measures necessary for the protection of flora and fauna and of other natural resources
- avoid polluting waters, air, and land.

Prices: The State is responsible for fixing prices for crude oil products, and derivatives. The law distinguishes between prices for the foreign market, for industries established in Ecuador, and for the consumer.

Expropriations: The Ministry of Natural Resources and Energy may expropriate or establish easements on lands or other real property needed for the development of the petroleum industry. Expropriations are carried out in the name of CEPE which then transfers the use of the land or property to the interested firm.

3.3.2.2 Law of Administration of Petroleum Terminals, 1977

Provisions: Ecuador has ratified the International Convention on Civil Responsibility for Damage Caused by the Contamination of the Sea by Hydrocarbons. In this context, navies that have contaminated a maritime area in Ecuador have to pay all the costs that are incurred to decontaminate and make restitution for all damage caused by the contamination.

3.3.3 Soil Resources

3.3.3.1 Prevention and Control of Environmental Contamination Law, 1976

Provisions: See Section 3.1.1

3.3.3.2 Health Law, 1971

Provisions: See Section 3.1.2

3.3.3.3 Agricultural Livestock and Forestry Development Law, 1971

Provisions: See Section 3.2.2.3

3.3.3.4 Civil Code of Ecuador

Provisions: See Section 3.2.4.3

3.3.3.5 Mining Development Law, 1974

Provisions: See Section 3.3.1.1

3.3.4 Land Use and Agriculture

3.3.4.1 Agricultural Livestock and Forestry Development Law, 1971

Provisions: This law provides for the protection and development of agricultural, livestock, and forestry activities and of the resources for hunting and river fishing. The Law charges the Ministry of Agriculture and Livestock with regulating the use, protection, and development of natural resources with the development plans of the country. The Ministry is further charged with:

- offering protection, incentives, and assistance in applying techniques and increasing agricultural, livestock, and forestry production and productivity
- classifying lands for better agricultural, livestock, and forestry use
- controlling and inspecting agricultural, livestock, and forestry production
- carrying out campaigns for plant and animal health
- establishing programs for the conservation, selection, and reproduction of animals for industry, and promoting and regulating training centers for artificial insemination and the freezing of semen
- preventing the introduction into the country of animals of low quality for use in reproduction
- establishing genealogical records for control of pure breeds and hybrid cattle
- issuing advance decisions on imports of animals and plants and products for agricultural, livestock, veterinarian and forestry use.

This law also establishes the National Agricultural Livestock Committee which has as its functions the promotion and sponsorship of agricultural livestock and forestry activities necessary to the country in accordance with development plans. To promote such development, the law grants 100 percent exemption from taxes for the following items:

- apparatus for artificial insemination
- mechanical milking machines and milking cans
- fire extinguishers
- equipment and pumps for disinfecting and spraying plants and animals
- irrigation equipment
- seeds, shoots, sprouts, buds, bulbs, rhizomes, and live plants
- machinery, implements and tools for agricultural or livestock use
- animals for breeding purposes.

3.3.4.2 Uncultivated Lands and Land Settlement Law, 1964

Provisions: This law established the standards concerning uncultivated lands, the transfer of title for ownership of these lands, and procedures for acquiring State lands. It also gives the definition of unoccupied lands that form the patrimony of the Institute of Agrarian Reform and Colonization (IERAC).

3.3.4.3 Supreme Decree No. 390, 1963

Provisions: This Decree declared the perpetually snow-covered peaks and the areas situated at more than 4,500 meters in altitude to be national property of public use. All titles of private ownership of these areas are declared null. Legal easements and transit is allowed across these lands for easiest access.

3.3.4.4 Agrarian Reform Law, 1972

Provisions: This law details the process of gradual and orderly change in the economic, social, and political aspects of agriculture in Ecuador. The State guarantees the right of ownership of rural lands which fulfill their social functions; if the lands do not fulfill these functions, they will be appropriated totally or partially. Social functions are not fulfilled when:

- lands are deficiently exploited
- natural renewable resources are not conserved
- the responsibility of the owner of the exploitation is not maintained
- monopolization of land holdings occurs
- the laws governing agricultural labor are not complied with.

3.3.5 Plant Protection

3.3.5.1 Plant Health Law, 1974

Provisions: To prevent the introduction of pests that do not exist in the country and which may endanger the principal economic crops. For the control of important plants, it is prohibited to import plants or parts of plants originating in countries affected with the following sicknesses or plagues: roya (disease of cereals and coffee), swollen shoot disease in cacao, banana disease, and sigatoka negra, a bacterial disease. If it is necessary to import plants or parts of plants for experimental purposes for INIAP or other institutions previous authorization from the Ministry of Agriculture and Livestock is required. Such plants must come through the airports of Quito or Guayaquil, or through the sea port of Guayaquil, and be treated by the Department of Plant Health before being released. In no case may seeds of plants be imported in sacks or packing bags that might harbor microorganisms which could be harmful to the national agriculture. Agronomy Engineers are to be Plant Health Inspectors and can order the treatment of boats, planes, and vehicles entering Ecuador and their products to prevent the introduction of harmful organisms or products.

4.0 RESOURCES

4.1 Climate

Ecuador is a mountainous country on the northwest coast of South America, bordered on the south and east by Peru, on the north by Colombia, and on the west by the Pacific Ocean. Named for the Equator which passes a few miles north of the capital city of Quito, Ecuador has an area of 284,000 square kilometers (km). Ecuador's climate varies from the tropical rain forest in the interior Amazon River basin to the perpetually snow-covered peaks of the Andes mountains. The equatorial climate is moderated by the cold waters of the Humboldt Current which flows along the coast.

4.1.1 Topography and altitude

Ecuador can be divided into three topographic regions - the Costa, the Sierra, and the Oriente - with a fourth, the Galapagos Islands, located some 1,000 km to the west.

Costa - The Costa, also called the Litoral, is composed of the western lowlands of Ecuador from the foothills of the Andes to the Pacific Ocean. The Costa has a very diverse climate, ranging from tropical rain forest in the north to almost desert along the Peruvian border in the south. The Costa contains many water courses, including the Guayas River System, which flow from the Andes and form alluvial fans where they enter the Pacific. The country's richest agricultural zone is found here, and permanent plantations grow bananas, cacao, coffee, and sugar cane. The Costa contains 5 provinces and 16.5% of the total land area of Ecuador.

Sierra - The Sierra is composed of two parallel spines of the Andes mountains, the Cordillera Occidental and the Cordillera Central, with a series of high mountain valleys or basins in between, called the Interandean Line. The Cordillera Occidental is a compact high mountain range which stretches the length of Ecuador from north to south, while the Cordillera Central is less a range of mountains than a series of lofty peaks. East of the Cordillera Central is a range of lower mountains, the Cordillera Oriental, which descend to the Orient. The Sierra area is volcanic in origin, and the soil is porous and loose. The Sierra contains 22 peaks which are higher than 4,200 meters (m), including Chimborazo at 6,310 m and Cotopaxe, the highest active volcano in the world at 5,943 m. The Sierra contains 24.3% of the national land area and 10 provinces.

Oriente - The Oriente is composed of gently sloping land and flat valleys that stretch from the eastern edge of the Andes to the headwaters of the Amazon River. Most of the soil is relatively infertile, with poor drainage. The Oriente contains three major rivers which all drain to the Amazon. The Oriente is mostly jungle, and represents 57.4% of the total land area of Ecuador in only 4 provinces.

Galapagos Islands - The Galapagos, a chain of islands that stretches 400 km west to east and located 1,000 km west of Ecuador's coast, are famous for the diversity and uniqueness of their fish and wildlife. Although the Equator passes just to the north, the climate is moderated by the Humboldt Current which brings cold water from the south. Parts of some islands are almost desert-like, while along the shores live penguins and other wildlife which depend upon cold water. The Galapagos have been studied extensively since their exposure via Charles Darwin's Origin of the Species. The Galapagos Islands, or the Archipiélago de Colón, contain 1.8% of the total land area of Ecuador and constitute one province.

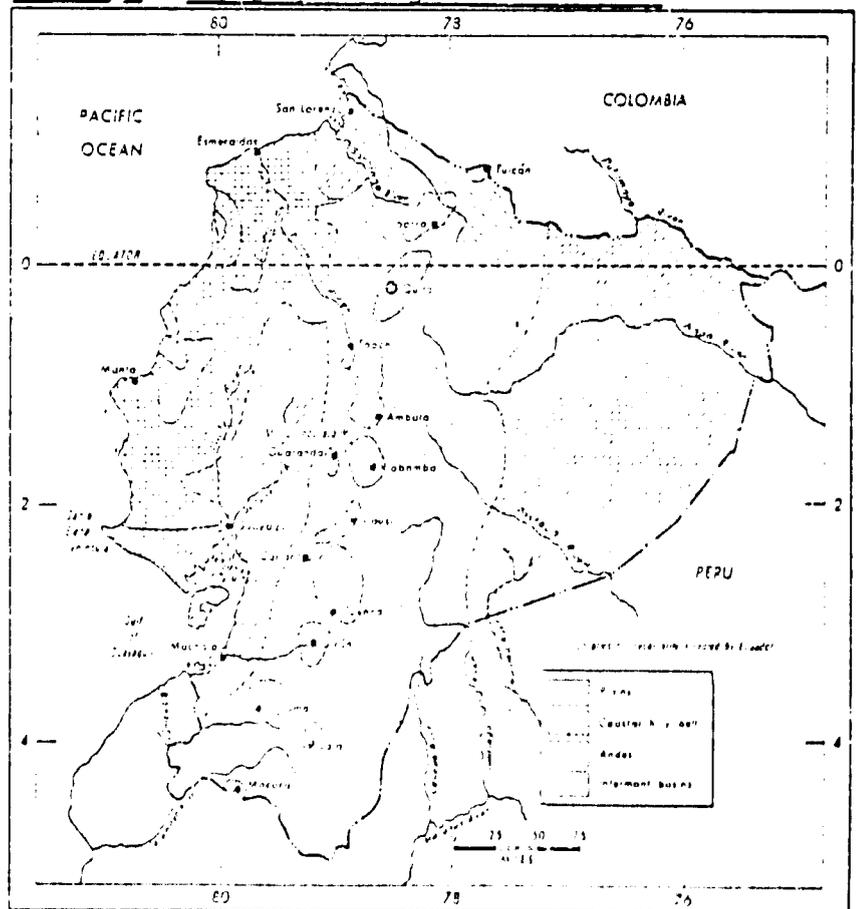
4.1.2 Rainfall patterns

The amount of rainfall in Ecuador varies considerably with the region, altitude, and season. However, there has been a drought all over the country for the last two years, and water is becoming a problem. Many rivers have dried up, and prospects are not good if the coming rainy season also fails.

Costa - Along the lower Andean slopes of the Costa rainfall normally reaches 2,540 millimeters (mm) annually and there is no real dry season. The northern rain forest receives 1,270 to 2,032 mm during the rainy season which lasts from December through May. On the Santa Elena peninsula, however, there is only 355 mm of rain a year. Rainfall in the Costa is influenced by the meeting of warm water of the Equatorial Current with the cold water of the northward-flowing Humboldt Current. The moisture-laden winds of the Equatorial Current prevail in the rainy season.

Sierra - Rainfall in the Sierra varies with local conditions. The high plateaus receive very fine rain and mists throughout the year, but many basins

Figure 4. Topographic Regions of Ecuador



Source: Weil, Thomas E. 1973. Area Handbook for Ecuador.

are arid. The rainy season in the Sierra lasts from October through May. Rain is distributed evenly, and there is seldom a month in which no rain falls. Quito receives up to 1,470 mm of rain annually, while some exposed mountain slopes receive 2,540 mm. Snow occurs only on the highest mountain peaks.

Oriente - Rainfall in the Oriente is generally heavy, ranging from 2,160 mm to an average of 5,000 mm annually at the only weather station in the region. There is no dry season in the Oriente. Rain in both the Sierra and the Oriente is produced by winds blowing across the flat Amazon basin.

4.1.3 Temperature and humidity

Temperatures in Ecuador are generally high in the lowlands and moderate in the highlands, with little seasonal change. Temperatures are different depending upon the region and the altitude. In the Costa the mean monthly temperature varies between 24.4 and 26.6°C with little seasonal difference. Temperatures in the Oriente are also fairly uniform but lower than in the Costa. Ecuador's average temperature at sea level is 79°F; the temperature decreases at a rate of 1°F for every 360 foot increase in elevation. In the Sierra the annual mean temperature is 60°F at 7,000 feet and 50°F at 10,000 feet. Because of Ecuador's equatorial position there is little seasonal change, but the diurnal changes can be extreme. Temperatures can vary as much as 40 degrees (°F) in one day in Quito.

Table 3. Temperature, Relative Humidity, and Rainfall, 1976

<u>Place</u>	<u>Median Temperature, °C</u>	<u>Relative Humidity, %</u>	<u>Total Annual Rainfall, mm</u>
Guayaquil	25.6	75	960.9
Portoviejo	24.8	79	532.5
Rocafuerte	25.6	83	212.9
Conocoto	15.2	83	1,425.2
Quito	13.0	75	1,248.0
Otovalo	14.2	83	839.2
Cuenca	14.3	75	810.0
Riobamba	13.2	77	399.9
Fuyo	20.2	88	4,319.3
Cotopaxi (3,560 m)	7.9	87	1,061.1
Pisayambo (3,615 m)	6.6	85	1,116.7
San Cristobal, Galapagos	23.8	79	398.2

Source: Landívar, Carlos Blandín. 1976. El clima y sus características en el Ecuador.

4.2 Water Resources

All rivers in Ecuador rise in the Sierra and either flow westward to the Pacific Ocean or eastward to the Amazon River. Ecuador has 13 major rivers, of which 6 form the Guayas River System in the Costa. Most of these rivers are deep and navigable for a good distance. The rivers that form the Guayas River System are:

Guayas River - 34.8 miles navigable, depth 11.8 to 25.8 feet

Daule River - 92 miles navigable

Babahoyo River - 83 miles navigable, depth 17.7 feet

Vinces River - 93 miles navigable

Guayas - Salado Canal - 4.3 miles navigable, 13.1 feet deep

Salado Estero - 46 miles navigable, 29.5 feet to 42.6 feet deep

There are 959 miles of transportation routes along Ecuador's waterways. During the rainy season, rivers are the only means of transport in the coastal region.

There are three other rivers in the Costa of importance - the Chone, the Esmeraldas, and the Santiago. In the eastern lowlands of the Oriente there are four major rivers, including the Putumayo, the Napo, the Macuma, and the Namamgoza. During the last two years Ecuador has been experiencing a drought. Water levels are down by as much as 60%, and in some cases rivers have completely dried up.

Ecuador has a hydroelectric potential of 1 million kilowatts (kw), although as yet hydroelectric power is little developed. In 1976 out of a total power capacity of 590,000 kw produced in 1200 generating plants, 21% or 124,000 kw was produced by hydroelectric plants.

There is little information on groundwater resources in Ecuador. People use tube wells for drinking water, and in the urban areas water is piped from reservoirs. Water supply does not appear to be a problem except where reduced flows result in contamination. However, only 13% of the rural population has access to safe drinking water.

4.3 Forest Resources

Approximately 52% of Ecuador is still in forest, primarily in the Oriente. The rain forest of the Oriente and the northern part of the Costa contain valuable trees and other forest products, including balsa wood, tagua palm nuts (for vegetable ivory), kapok, cinchona bark (for quinine) and other tropical woods. Mangrove swamps line the Gulf of Guayaquil and the northern coastline. Along the eastern slopes of the Andes and the western slopes near the Colombian frontier there is a montane broadleaf evergreen forest, while in the central part of the Costa there is a semi-deciduous forest. The southern part of the Costa has dry scrub forest and grassy savanna areas, with desert scrub forest found on the Santa Elena peninsula and in the southern Sierra near the Peruvian border.

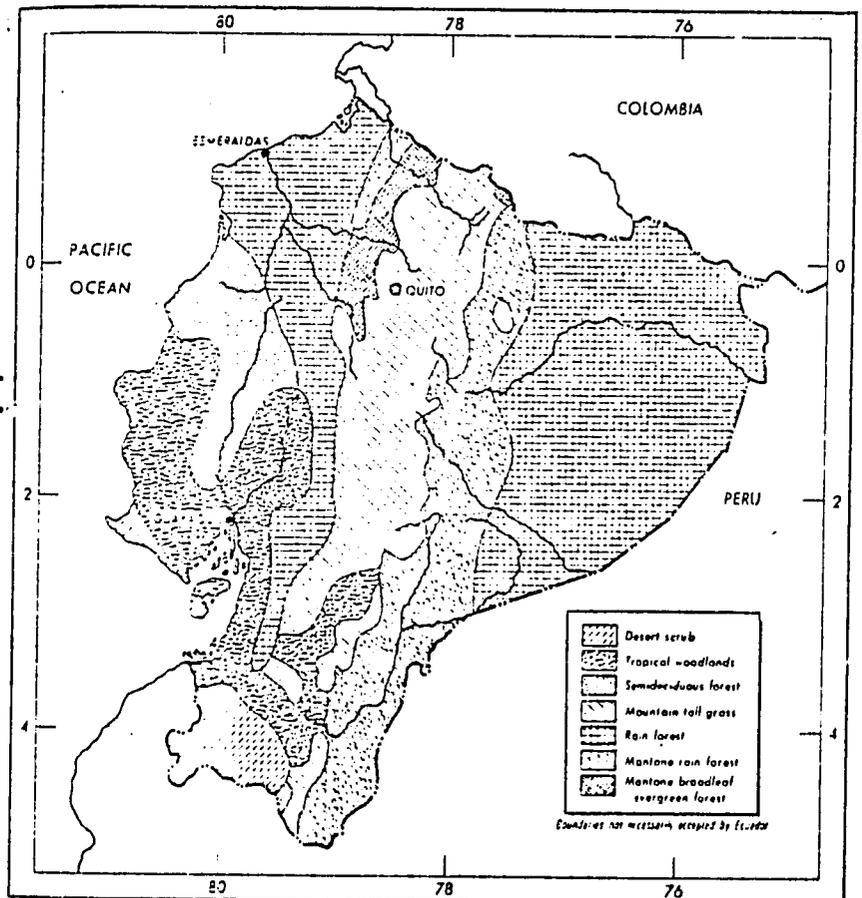
The loose, porous volcanic soils of the Sierra have resulted in poor forest cover except on the outer slopes of both Andean Cordilleras. Stands of eucalyptus which was introduced in the 19th century from Australia provide most of the firewood and lumber used in the Sierra. Along the lower levels of Sierran basins the prevailing ground cover is a scrub-like brush vegetation called maquis. Also found there are desert plants such as cacti, mimosa, chaparral, and algarroba. In the higher areas of the Sierra are tufted grasses such as bunchgrass and other forbs and grasses, and above 4,500 m there is little vegetation.

In the Galapagos there is little rainfall; occasionally a tree will exist above 300 meters, but most vegetation is desert-like. Because of the unique location of these islands, and the climatic conditions, several varieties of plant life have evolved that exist nowhere else but here. In fact, 47% of the plants found in the Galapagos are unique to that island chain, and some are unique to individual islands in the chain.

4.3.1 Deforestation and other problems

Deforestation is becoming a problem in Ecuador, especially in the watershed areas of the Sierra. The native forests at altitudes of 1,000 to 2,000 m have been completely cleared for farming, timber, and firewood, while the demand for these products is growing. Eucalyptus stands provide some relief, but population pressures on the land, logging, and the government policy of encouraging colonization of tropical areas which cannot support agriculture contribute to the problem. Forestry laws are good, but are not often enforced. The lack of cover on critical watershed areas results in a loss of fertility on agricultural lands, sedimentation in irrigation systems and in sources of potable water, and reduces the life of hydroelectric

Figure 5. Predominant Types of Vegetation



Source: Weil, Thomas E. 1973. Area Handbook for Ecuador.

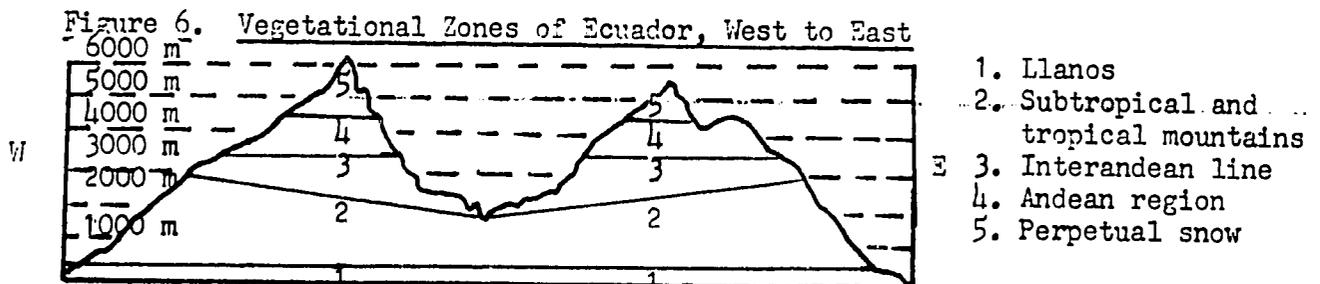
reservoirs, all of which have high economic costs as well as environmental ones.

In the past 25 years, the amount of arid land in Ecuador increased by 31.5% (INERHI data); out of the 134,000 km² of land in the coastal and mountain regions, 10,000 km² is now classified as arid land. In the Costa, only Esmeraldas Province has significant forest cover, but even this is being denuded by clearcut logging. Six rivers and several lakes have dried up in Esmeraldas as a result. In the Oriente vast areas of tropical forests have been converted to grazing land but a lack of soil fertility results in abandonment after a few seasons. This is partly due to the government policy of granting 50 hectare plots of land in the Oriente to farmers, with the stipulation that the land must be cleared and farmed within 5 years; most of the nutrients of tropical rain forests are in plants rather than soil, so when these lands are cleared, most nutrients go as well. The National Development Bank has instituted a program for the 1979-1980 year to grant loans for the establishment, cultivation, and maintenance of forests in areas of no less than 5 hectares; loans may extend for periods up to 20 years.

4.3.2 Vegetation patterns in the Sierra

The Sierra can be divided into several zones depending upon the altitude and the type of vegetation. The area from 1,000 m to 2,000 m is known as the tierra templada, while the area from 2,000 m to 3,000 m is the tierra fria. From 3,000 m up is the paramo or mist zone of the Andes. The areas from 1,000 to 3,000 m are highly susceptible to erosion due to steep slopes, heavy precipitation, and easily eroded parent rock. This naturally intensive erosion is exacerbated by the activities of man such as cutting and burning of forests. With erosion, soil fertility drops, and downstream agricultural areas are ruined by flooding and sedimentation. Below 3,000 m the original broadleaf evergreen forests are now all gone, except in deep, inaccessible valleys.

The paramo is considered to be the area where traditional agriculture is limited by low temperatures (2800 m to 3400 m) to the limit of native plant growth (4500 m). Above 3,000 m there is temperate mountain forest of broadleaf evergreens; and some dense stands on steep protected slopes and rocky areas. From 3,500 to 4,000 m there are sub-alpine conditions and from 4,000 to 4,500 m is the alpine zone with tundra-like conditions. The peaks above 5,000 m are covered with snow year-round. The dominant vegetation of the entire paramo region is bunchgrass, with forbs and other low grasses forming an almost continuous mat or sod between bunchgrass tussocks. This land is used for extensive grazing of livestock.



Source: Wolf, Teodoro. 1975. Geografía y Geología del Ecuador. Casa de la Cultura Ecuatoriana, Quito, Ecuador.

4.3.3 Forest utilization

Forests in Ecuador are utilized for firewood, charcoal production, poles for building construction, and timber. There is little softwood in Ecuador, and paper products must be imported, although eucalyptus is cited as a possible future source of pulpwood. Most forested land belongs to the government, which grants concessions for its exploitation. There are several Ecuadorean logging companies that have permission to log, especially in Esmeraldas. Although extensive virgin forests remain in the Oriente, commercial logging is hampered by lack of roads and transportation facilities.

The Costa provides most of the country's wood, primarily hardwoods. Forest products with commercial value are balsa wood, of which Ecuador is the world's main producer; rubber; toquilla palm fiber for weaving Panama hats; cinchona bark, from which quinine is derived; tagua palm nuts known as vegetable ivory; and kapok, which comes from the ceiba tree. Other less known products are annatto seeds from the bixa tree, used to extract a yellow-red dye; divi-divi pods which yield tannin; matico, a common shrub used as a styptic; condurango, the dried bark of a vine which yields a poisonous glucoside; and the ambrette seed, which has a musk scent and is used in perfumes and coffee.

<u>Roundwood Removals</u> (All nonconiferous)	<u>1971</u>	<u>1972</u>	<u>1973</u>
	(Figures in 1,000 cubic meters)		
Sawlogs, veneer logs, and logs for railroad ties	1,553	1,708	1,800
Fuelwood	1,454	1,583	1,598
Other industrial wood	60	66	68
Total	3,067	3,359	3,466
<u>Sawnwood Production</u> (All nonconiferous)	<u>1973</u>	<u>1974</u>	<u>1975</u>
	(Figures in 1,000 cubic meters)		
Sawnwood	833	833	745
Railroad ties	5	2	2
Total	838	835	747

4.3.4 Forests as wildlife habitat

The tropical rainforests of the northern Costa and the Oriente are rich in wildlife and plant species, many of which are not yet properly classified. Wildlife includes species such as the tapir, the peccary, the giant otter, raccoons, alligators, iguanas, boa constrictors, and the pudu, a small South American deer. There are few wild animals left in the Sierra, although the puma and the llama are found in the highlands. The colonization of the Oriente is putting more pressure on wildlife and may push several species deeper into the forest. The major danger to wildlife in Ecuador is destruction of habitat by clearing land for agriculture or grazing of livestock, and logging.

4.4 Soil Resources

Ecuador's soils are influenced by frequent tectonic activity in the Sierra, by previous glaciation, and by weathering of sedimentary, metamorphic, and igneous parent rock. A soil survey underway in the Sierra, using the Comprehensive Classification System developed by the U.S. Soil Conservation Service, is mapping soils according to profile depth, natural fertility, and drainage. In general, uncultivated soils are rich in organic matter; in 5 to 8% of uncultivated soils the organic matter reaches a depth of one meter or greater. This organic matter serves as a reservoir of plant nutrients, but at high elevations and low temperatures these nutrients are only available slowly. The government has a policy of encouraging the use of fertilizer, but at present there is little fertilization. INIAP maintains a soil laboratory and offers free analyses and recommendations to farmers who bring soil samples.

Soils vary in each of the three regions, but there is little information available on the soils of the Galapagos Islands. The following information is taken from the FAO/UNESCO Soil Map of South America. (See bibliography for complete reference.)

Costa - On the coast there are lithosols, fluvisols, and ancient dystric nitosols. In the southern uplands are found chromic luvisols, while vertisols are found in the lowlands. Fluvisols, gleysols, and solonchaks occur on the coastal plain, and orthic acrisols and podzols are found on the coastal terraces. There is a narrow strip at the foot of the Andes at 400 to 600 m composed of soils with a high base status and a high proportion of volcanic ash. Some of the soils of the Costa may be ochric andosols.

Sierra - Soils in the Sierra vary from west to east and from north to south. The northern portion of the Sierra is geologically younger than the south and is composed of thick, usually stratified, layers of volcanic ash and pumice on the uplands and glacial outwash and alluvium composed of volcanic rocks in the valleys. In the south rocks are older and there is more exposure of igneous, sedimentary, and metamorphic rocks. In the west soils are more acidic containing volcanic ash, while in the east soils are composed of basic pyroclastics and pumice. The valley floors of the Sierra contain deep, dark-colored soils derived from alluvium, volcanic ash, and glacial outwash. The soils of the slopes are derived from various volcanic materials, and include low base status ochric andosols. The Interandean valleys contain kastanozems, phaeozems, and lithosols, while the driest valleys contain chromic luvisols, vertisols, and solonetz soils. In the southeast, sandstones, claystones, and lithosols dominate.

Oriente - Much of the soil in the Oriente contains recent volcanic ash on top of sedimentary and igneous rock. In the higher altitudes there are lithosols in association with andosols, but below 200m there are orthic acrisols, eutric nitosols, and humic ferralsols.

4.4.1 Soil Erosion

Soil erosion is a major problem in the highland areas of Ecuador where steep slopes and loose soils are combined with improper tillage practices. In large areas of the lower slopes of the Sierra, topsoil has been removed completely; as a result, people have moved higher into areas of potentially lower agricultural productivity and greater tendency to erode when tilled. Land is usually cultivated from the valley floors to the top of the hills, and mostly by hand. Each cultivation operation thus moves soil down the slope. The removal of topsoil causes excessive runoff and results in flooding and damage from siltation in the narrow floodplains of the Interandean valleys below.

Wind erosion is also a problem in the areas with fine and sandy soils. Some trees are being planted in the tall grass areas in order to serve as windbreaks.

It appears that presently known soil conservation methods could make a significant difference in the erosion problem in Ecuador. However, even the fields of the INIAP are not properly laid out or contoured (see E.L. Smith, 1975). Part of the problem lies in the social structure of the small Indian farmers in the highlands who are reluctant to change traditional ways, and in the lack of extension personnel willing to work in isolated rural areas.

4.5 Wildlife Resources

Ecuador has a wide variety of wild animals and birds, especially in the tropical rain forests of the Oriente and the northern coastal area. The Galapagos Islands are known for their unique and varied species of birds as well as giant tortoises, marine iguanas, and seals. However, with a population increase, pressure is put on existing natural wildlife areas. In 1970 a government decree (Forest Wildlife and Fishery Resources Law, see Section 3.2.3.1) established one of the world's most extensive regulatory systems for the protection of wildlife species. The decree restricts the taking of certain forest birds and animals and freshwater fish, and bans the taking of species considered to be endangered. Unrestricted killing is allowed only for dangerous or nuisance animals, and limits are placed on the taking of beneficial animals.

4.5.1 Wild Animals

Wildlife species in Ecuador are most numerous in the Oriente and scarce in the long-inhabited Sierra. Some species exist in very limited areas, such as the llama which only can be found in the Andes close to the Peruvian border. The major carnivores in Ecuador are the puma, jaguar, coati-mundi, fox, kinkajou, otter, peccary, raccoon, skunk, and weasel. There are many species of monkeys, and a small South American deer, the pudu. Also found are rodents and bats, including the vampire bat, turtles, alligators, lizards, snakes, and other reptiles and amphibians. Many of the wildlife species are not yet properly classified, and there are probably a few that have not yet been discovered.

Several species are considered to be endangered or threatened with extinction, among which are the following*:

<u>Hippocamelus antisianus</u>	North Andean huemul
<u>Callimico goeldii</u>	Goeldi's marmoset
<u>Alouatta villosa</u>	Howler monkey
<u>Tapirus pinchaque</u>	Mountain tapir
<u>Tapirus bairdii</u>	Central American tapir
<u>Cacajao</u> sp.	Uakari
<u>Vultur gryphus</u>	Andean condor
<u>Buteo galapagoensis</u>	Galapagos hawk
<u>Spheniscus mendiculus</u>	Galapagos penguin
<u>Conolophus pallidus</u>	Barrington land iguana
<u>Geochelone elephantopus</u>	Galapagos tortoise
<u>Panthera onca</u>	Jaguar
<u>Pelecanus mendiculus</u>	Galapagos pelican
<u>Pharomachrus mocinno mocinno</u>	Resplendent quetzal
<u>Priodontes giganteus</u>	Giant armadillo
<u>Tremarctos ornatus</u>	Spectacled bear
<u>Pteronura brasiliensis</u>	Giant otter
<u>Felis pardalis</u>	Ocelot

4.5.2 Birds

Over 1,500 classified species of birds are found in Ecuador, many of which are migratory species such as the scarlet tanager, the barn swallow, and many types of waterfowl. Domestic birds include the hummingbird, parrots, and the giant condor of the Andes, an endangered species. The Galapagos Islands are well-known primarily for the great variety in bird species found there, which includes 13 species of finches, 9 species of albatross, 6 boobys, 16 gulls, 5 hawks, 4 owls, 4 pelicans, 2 penguins, 4 petrels, 3 vultures, and 3 species of terns. Of special interest to the scientific community of the world is the variety of beak shapes and sizes among the finches of these islands, a fact that led Charles Darwin to conclusions about evolution found in his book, Origin of the Species.



Vegetarian Finch. Life-size



Medium Tree Finch. Life-size

Figure 7. Varieties of Galapagos Finches



Woodpecker Finch. Life-size



Small Tree Finch. Life-size

*U.S. Fish and Wildlife Service List of Endangered and Threatened Wildlife and Plants, and International Union for the Conservation of Nature and Natural Areas (IUCN) Red Data Book.

4.5.3 Fish

Ecuador has many varieties of both freshwater and marine fish. There are at present 276 identified freshwater species, including catfish, carp, trout, chame (Dormitator latifrons), corvina de rio...(Cynoscion albus), and the arapaima in the Oriente which reaches enormous size. Fish are an essential item in the diet of tribal Oriente groups. The government promotes the cultivation of rainbow trout in cold water areas, and is conducting experiments in the culture of the tilapia, Tilapia mossambica. There are some plans to introduce the eel (Anguilla sp.) into streams in the Oriente as well.

Ecuador has a rich marine fishery resource along its coast and in the territorial waters up to 200 miles off the coast. The most important commercial species is skipjack tuna which appears off the coast from January through April each year. Fishermen also catch herring, pompano, flounder, mackerel, snapper, haddock, sea bass, and moonfish. Other fish and shellfish caught include tarpon, sailfish, albacore, shrimp, crabs, spiny lobster, and mollusks.

4.5.4 Wildlife Protection

There are several laws that deal with protection of wild animals and birds, including the Forest Wildlife and Fishery Resources Protection Law of 1970 (See Section 3.2.3.1) and Ecuador has set up a national park and several reserve zones which are the precursors to national parks.

4.5.4.1 Galapagos Islands National Park

In an agreement between the Government of Ecuador and the Charles Darwin Foundation for the Galapagos reached in 1964, 10,000 hectares of land on the western part of Santa Cruz island were set aside to form the Galapagos Islands National Park. The Park guarantees strict protection of all species found within its boundaries, but most experts agree that this is not enough of an area to protect the unique species found in the archipelago. Each island has different climatic and topographic conditions which have fostered the development of different types of organisms, and it is argued that some or all of each island should be protected. Tourism is becoming a problem in some areas, and unregulated tourists are ruining habitat and displacing species. In addition, feral domestic animals such as cats, pigs, and goats are preying upon the endemic species and reducing both their numbers and their food supply. Several species are already in danger of extinction, including these:

Galapagos penguin	1,000 to 2,000 birds
Flightless cormorant	1,600 birds
Galapagos hawk	250 birds
Flamingo	500 to 1,000 birds
Lava gull	less than 800 birds

4.6 Mineral Resources

Although the western flank of the Andes is generally rich in minerals, little mineral wealth exists in Ecuador. Gold was once taken from the southern part of the country, which prompted the Spanish to name the area El Oro, the name of that province today. The known deposits of gold and other precious metals in Ecuador are of limited extent and located in areas where elevation and terrain make mining uneconomical. In the northern Costa rivers, however, there is still some small-scale panning for gold.

An Ecuadorean geological study in 1968 showed the most promising and varied mineral resources in the provinces of Canar and Azuay. Iron and other ferrous metals were found in abundance, and the provinces also showed the country's most extensive coal deposits. Azuay also has deposits of copper. The Guayas River basin has deposits of kaolin and other clays, and natural asphalt is mined in Napo Province. There are also some small deposits of sulfur, zinc, cadmium, lead, and tin. At present only two small firms are producing any appreciable amounts of mineral resources, although several companies are exploring possibilities.

Table 4. Quantity of Minerals Produced in Ecuador, 1978

<u>Commodity</u>	<u>Unit of Measure</u>	<u>Quantity</u>
Cadmium	pounds	920
Clays, kaolin	metric tons	1,185.6
Copper	wet metric tons	5,700
Gold	grams	99,933
Lead	pounds	484,661
Silver	wet metric tons	5,700
Zinc	wet metric tons	5,700
Coal	metric tons	1,800
Gypsum	metric tons	45,000
Sulfur	metric tons	4,500

Source: Bureau of Mines, U.S. Department of the Interior.

4.7 Petroleum Resources

Petroleum has been exploited since 1911 in the Santa Elena peninsula of Guayas Province, but in 1955 production started to decline. By 1971 production was down to about 5,000 barrels a day while domestic demand was over 20,000 barrels a day. Since 1937 several companies have been exploring for oil in the Oriente, but it was not until 1967 that a Texaco-Gulf consortium found several rich fields in the extreme northeast corner of the country near the Colombian border. In 1972 the total of proved, probable, and possible reserves in that area was estimated at 5.6 billion barrels. Experts predict that Ecuador will become the second leading oil producer in South America after Venezuela when the full output of these new fields is realized.

In 1977 the Ecuadorean State Petroleum Corporation (CEPE) acquired Guifi's remaining 37.5% share of the Texaco-Gulf consortium. CEPE also operates a field at Chapara which has a production of 5,000 barrels a day. A 300-mile-long pipeline with a carrying capacity of 250,000 barrels a day was completed in 1972 from the Texaco-CEPE fields to the port of Esmeraldas. In addition, large quantities of natural gas have been discovered. According to law, natural gas deposits belong to the government and can be exploited only by CEPE (see Section 3.3.2.1 for laws on hydrocarbon exploitation).

Table 5. Crude Petroleum Production in Ecuador

<u>Origin</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977 (estimated)</u>
	(In thousands of barrels)			
Eastern fields	63,971	57,921	67,594	65,452
Coastal fields	937	832	768	690
<u>Total</u>	<u>64,908</u>	<u>58,753</u>	<u>68,362</u>	<u>66,142</u>

Source: Ministry of Natural Resources and Energy, Ecuador.

5.0 ECONOMY

5.1 General Economic Picture

GNP: US\$6.4 billion (1979 estimate)

Per capita GNP: US\$795 (1978 estimate)

Real growth rate: 10.38% (average for 1973-1978)

Monetary conversion ratio: Ecuadorean sucres S25.00 = US\$1 (May 1978)

Average annual inflation rate: 15.2% (1970-1977)

Although Ecuador has made efforts to promote small industries and construction in the last few years, agriculture is still the mainstay of the economy, providing 21% of the GDP (gross domestic product) and employing 46.2% of the labor force. During 1976-1977 the output of petroleum increased as did the market for traditional export crops (bananas, coffee, and cacao), and the country's economy reached a high growth level. Changes in Ecuador's economy generally reflect fluctuations in petroleum prices and output.

<u>Origin of GDP (1977 estimate)</u>	<u>% GDP</u>
Agriculture, forestry, fishing	20.8
Petroleum	10.2
Manufacturing	16.3
Commerce	12.0
Transport, storage, communications	12.0
Construction	5.4
Other (including handicrafts)	30.7

5.2 Agriculture

Ecuador produces bananas, sugar, coffee, and cacao for the export market, and is the world's leading producer of bananas. Crops grown for domestic consumption include fruits, vegetables (mainly onions, garlic, carrots, and cabbage), potatoes, yucca, corn, rice, wheat, barley, and beans. All suitable and most unsuitable land in the Sierra between 2,000 and 3,000 m in elevation is cultivated for wheat, barley, potatoes, oats, corn, and other crops. Irrigation is common for dry season farming, but is relatively poorly designed, with water directed through sodded terrace-like ditches with permanent cuts for drainage. Most fields are heavily grazed after harvest. Major weaknesses in the agricultural sector are the lack of storage facilities, appropriate equipment, and extension services. Most agriculture depends upon hand tilling, although some large farms have become mechanized.

The Guayas River basin is the most important agricultural area, and produces 3/4 of the total oilseed crop, 1/2 the total corn crop, and 3/4 the total rice crop. It is also the major producing area for bananas, cotton, cacao, coffee, and soybeans. The rate of growth of agricultural

production has decreased from 7.7% in 1975 to less than 3% in 1977, primarily due to drought in the Sierra and a massive insect infestation of the barley crop. Banana and coffee production increased in 1976 and 1977, but cacao and sugar production fell in 1976 and stabilized in 1977.

Table 6. Production, Acreage, and Yield of Main Agricultural Crops, 1976

<u>Crop</u>	<u>Production</u> (thousand metric tons)	<u>Acreage</u> (thousand hectares)	<u>Yield</u> (metric tons/ha)
<u>Export crops</u>			
Bananas	2,571	107	24.0
Coffee	87	256	0.3
Cacao	65	230	0.3
Sugar	5,761	-	-
<u>Domestic use</u>			
Plantain	895	73	12.3
Fruit	681	125	5.4
Potatoes	533	48	11.1
Yucca	348	33	10.5
Corn	294	277	1.1
Rice	199	130	1.5
Vegetables	186	15	12.4
African palm	112	14	8.0
Wheat	65	76	0.9
Barley	63	72	0.9
Beans	57	103	0.6

Source: International Monetary Fund data, 1978.

5.2.1 Pesticides and Fertilizer Use

Soils in Ecuador are medium in available nitrogen, low in available phosphorus, and high in available potassium. The government encourages the use of fertilizer by paying a bonus for certain crops which can only be used to purchase fertilizer and improved seed. Ecuador produces some fertilizer but most of the fertilizer needs are met through importation.

<u>Fertilizer Production and Consumption</u>	<u>1973/4</u>	<u>1974/5</u>
	(in metric tons)	
Commercial nitrogenous fertilizer production	1.5	2.0
Commercial phosphate (P ₂ O ₅) production	5.2	2.0
Commercial nitrogenous fertilizer consumption	20.0	28.7
Commercial phosphate consumption	13.0	15.0
Commercial potash (K ₂ O) consumption	9.4	8.7

Two crops receive most of the insecticide used in Ecuador - bananas and cotton. Bananas are sprayed by aircraft with a mixture of toxaphene and oil to control defoliating caterpillars (*Ceratitis viridis*) and sigatoka disease. Cotton receives 10 to 12 chemical applications of

insecticide (35% of the cost of production) per season to control worm-weevil complex. Small farmers apply insecticides with hand sprayers or dusters. Most farmers obtain and use insecticides on the recommendation of the insecticide suppliers; there is little government support through extension services of pest control practices.

Typical losses to insects in Ecuador are a 30 to 40% reduction in production of Cavendish bananas due to attacks of the banana borer, a 70% reduction in pod set in cacao due to feeding by mirids, a 60% infestation of potato tubers by weevils, and an 85% loss of green and dry corn to caterpillars. In general, pesticide use in Ecuador is increasing with little regulation by the government.

5.3 Animal Husbandry

Lands not suitable for cultivation in Ecuador are used for grazing livestock, primarily dairy cattle, sheep, goats, burros, and hogs. Common cattle breeds are Holstein, Brown Swiss, and the native breed of Criollo cattle. Livestock are kept as a sideline to the main occupation of farming, and produce milk, cheese, wool, and animal power.

Overgrazing is generally severe because few attempts are made to provide pasture or forage crops for animals. Livestock production as a result is low due to inadequate nutrition, disease, and lack of genetic improvement. Farmers burn grasslands in the high altitude areas to remove dead material and promote new growth which is more nutritious and palatable to the animals. The INIAP is conducting research on all areas of livestock production, especially in the production of milk and cheese by animals grazed on improved pastures. Experiments in the Sierra show an increase of 2 to 6 times in the carrying capacity of fertilized grass-legume pastures over native vegetation.

Table 7. Livestock Numbers in Ecuador

	<u>1975</u>	<u>1976</u>
Cattle	2,711,380	2,792,640
Sheep	2,104,700	2,146,800
Hogs	2,542,910	2,733,630

The fish and seafood industry is growing rapidly in Ecuador. Since 1972, the value of fish and seafood exports has risen at an average annual rate of over 30%.

5.4 Manufacturing

Over 70% of the industrial development in Ecuador is attributed to small industries that produce food and beverages, textiles, chemicals, petroleum derivatives, and nonmetallic minerals. There are plans for major industrial projects including petrochemical plants, ammonia-urea plants, steel plants, shipyards, and automobile assembly plants. However, in 1976 to 1977, medium to large scale industries grew at a rate of only 12% while small industry and handicrafts grew at rates of 18 and 10%, respectively. Ecuador is promoting the development of small industries to diversify its economy.

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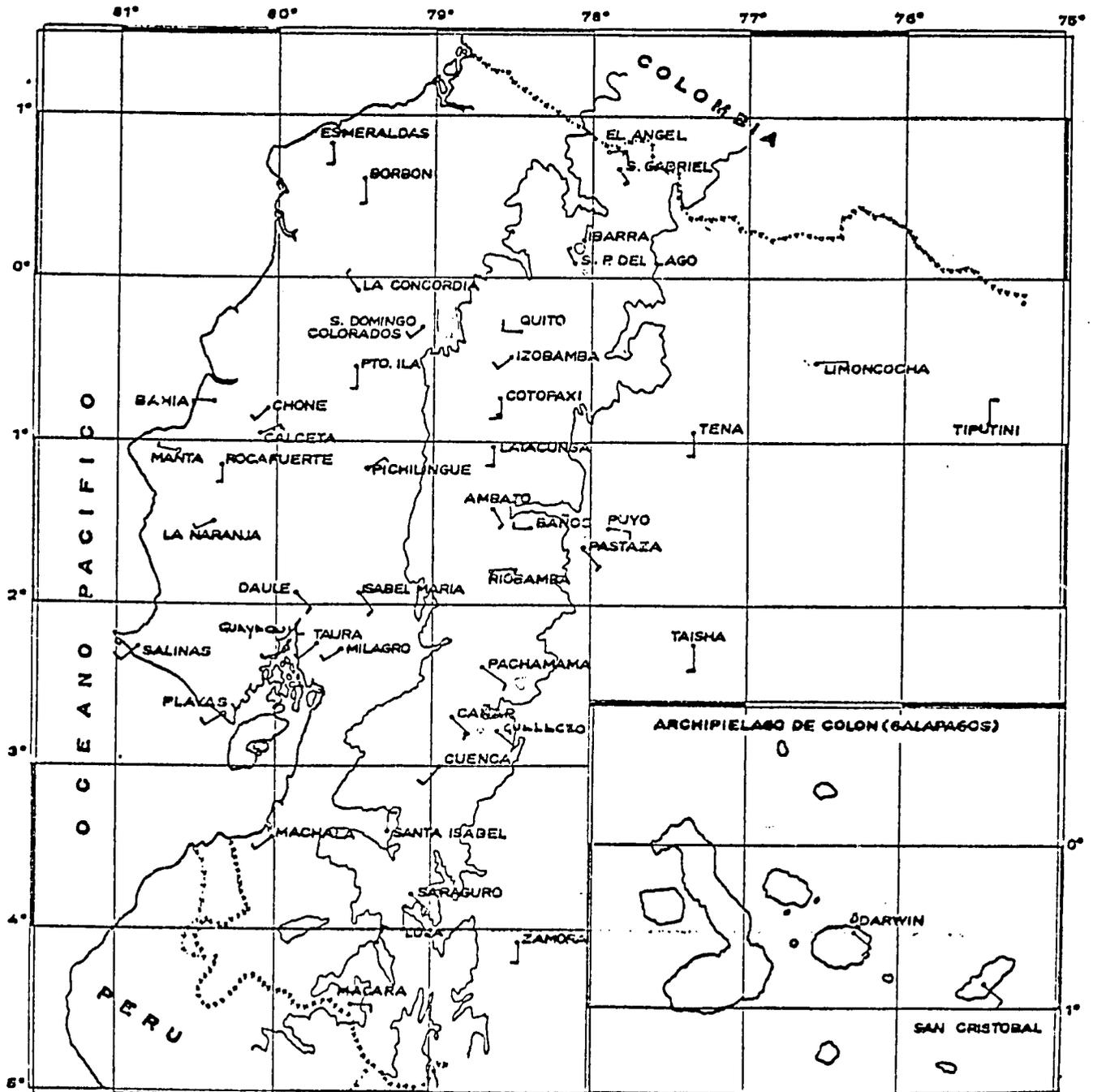
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Also extremely useful to the legislation section were all available copies of Registro Oficial, Organo del Gobierno del Ecuador, the official gazette of Ecuador, from 1976 through 1978.

Appendix A.

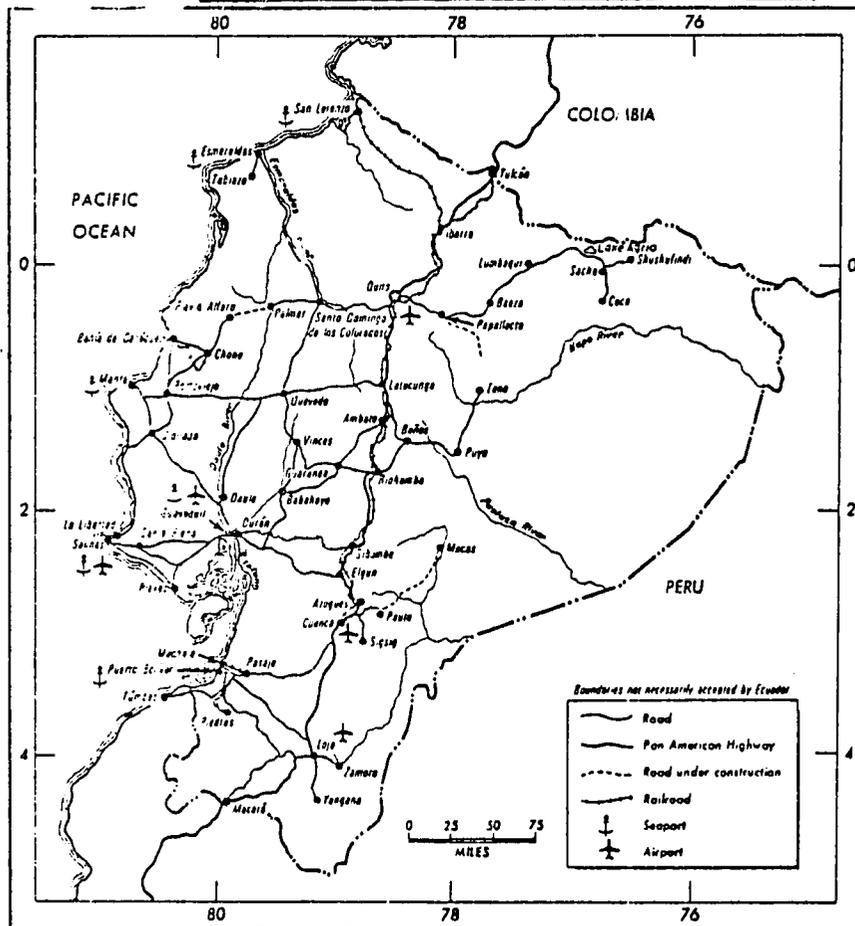
Prevailing Winds in Ecuador



Source: Landívar, Carlos Blandín. 1976. El clima y sus características en el Ecuador. XI Asamblea General del Instituto Panamericano de Geografía e Historia, Biblioteca Ecuador, Quito, Ecuador.

Appendix B.

Transportation Facilities in Ecuador, 1972



Source: Weil, Thomas E. et.al. 1973. Area Handbook for Ecuador.

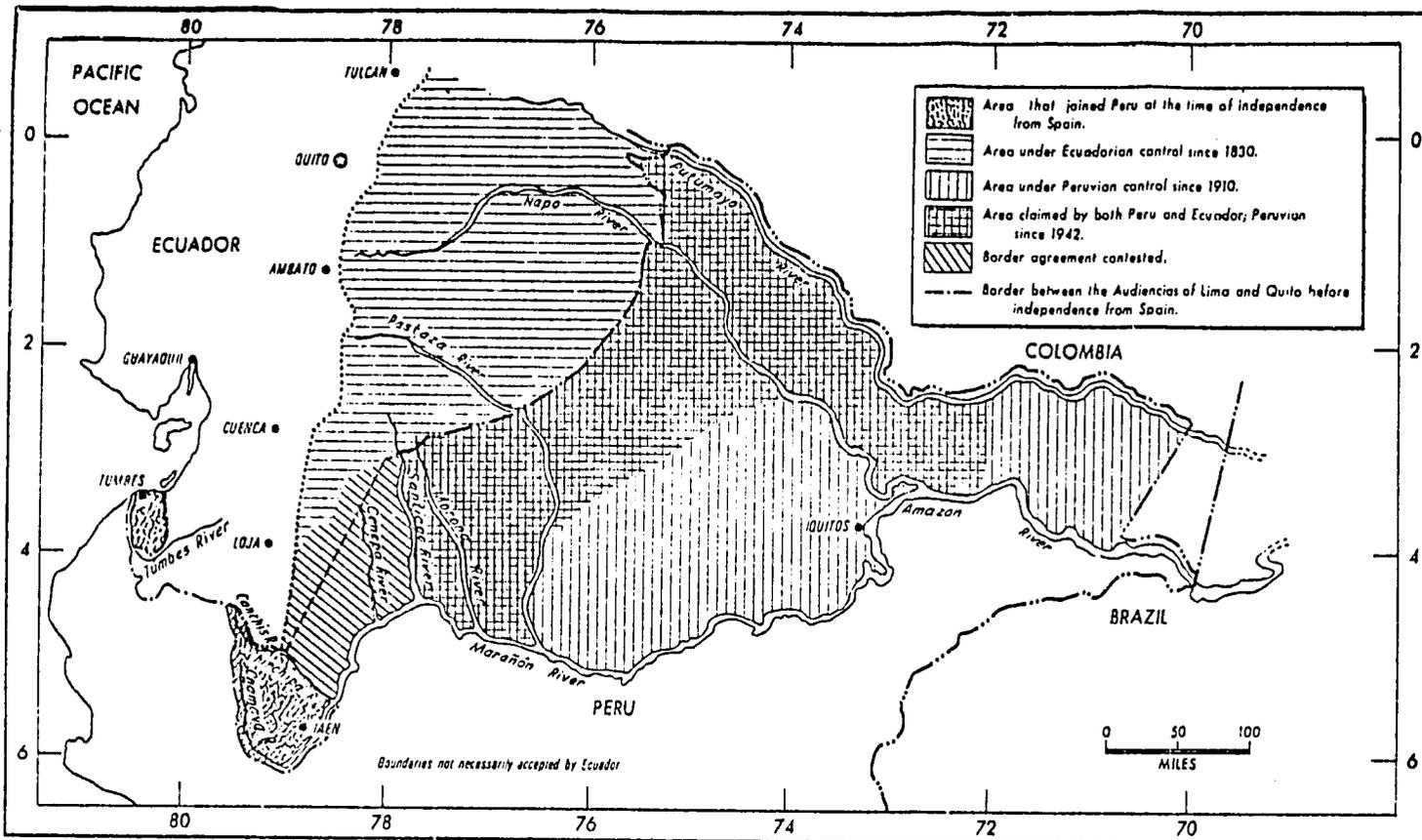
Appendix C.

Roads and Principal Towns and Cities, 1975



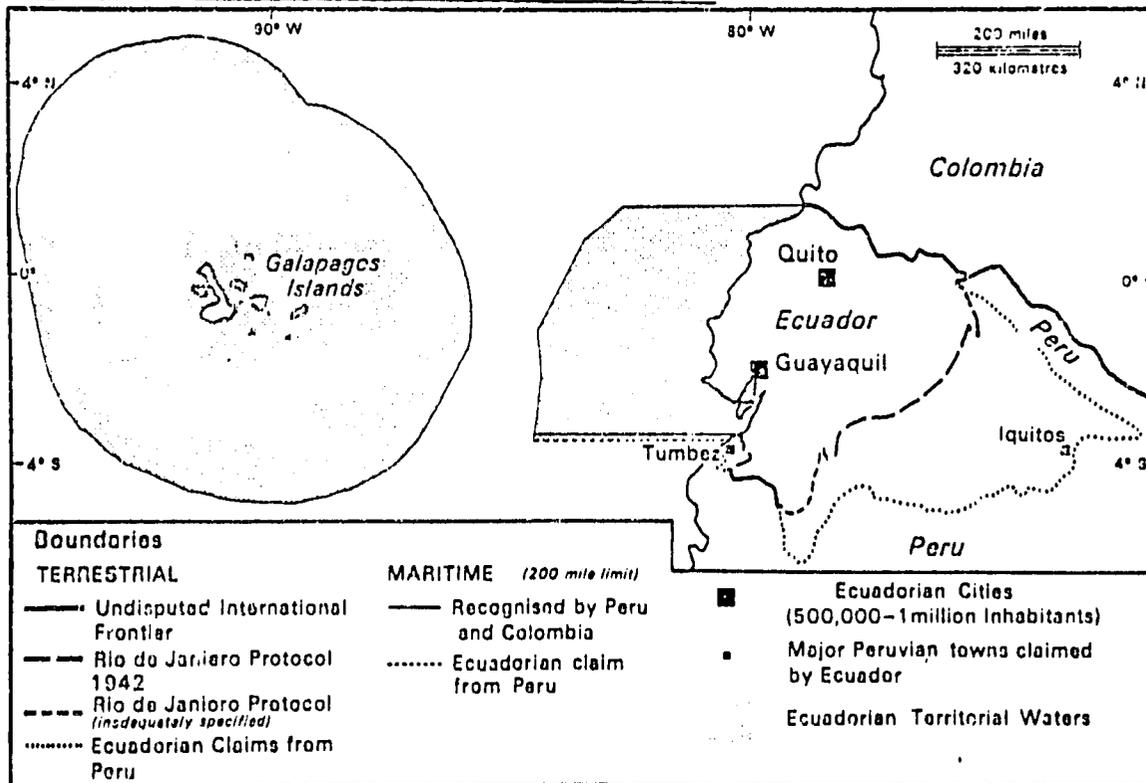
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Appendix D. Territory in Dispute between Ecuador and Peru



Source: Weil, Thomas E. et. al. 1973. Area Handbook for Ecuador. Foreign Area Studies, The American University, Washington, D.C.

Appendix E. Territorial Boundaries of Ecuador



Source: Bromley, R.J. 1977. Development and Planning in Ecuador. Centre for Development Studies, University College of Swansea, University of Wales.