

GT
330.97281
L697

PN- AAG- 981

DRAFT ENVIRONMENTAL REPORT
ON GUATEMALA

PREPARED BY THE SCIENCE AND TECHNOLOGY
DIVISION, LIBRARY OF CONGRESS
WASHINGTON, D.C.

AID/DS/ST CONTRACT NO. SA/TOA 1-77
WITH U.S. MAN AND THE BIOSPHERE SECRETARIAT
DEPARTMENT OF STATE
WASHINGTON, D.C.

MAY 1979

DRAFT ENVIRONMENTAL REPORT ON GUATEMALA

Table of Contents

<u>Section</u>	<u>page</u>
0.0 Introduction and summary	
1.0 Population characteristics	
1.1 General population statistics	1
1.2 Ethnic composition of population	3
1.3 Educational characteristics of population	4
1.4 Health characteristics of population	5
1.5 Population control	6
1.6 Water supply and sanitation	7
2.0 Organizations with interest in environment and natural resources	
2.1 Government agencies	9
2.2 Non-governmental organizations	17
2.3 International organizations	19
2.4 International cooperation	20
2.5 Educational, research and training capabilities	20
2.6 Monitoring capabilities	21
2.7 Statistical capabilities	22
3.0 Legislation dealing with environment and natural resources	
3.1 Renewable resources	
3.1.1 Water resources	24
3.1.2 Forests	26
3.1.3 Wildlife and hunting	27
3.1.4 Fisheries	29
3.1.5 Air and the atmosphere	30
3.1.6 Proposed pollution control legislation	30
3.2 Non-renewable resources	
3.2.1 Mineral resources	31
3.2.2 Soil	33
3.2.3 Coasts and beaches	33
3.3 Land use and agriculture	
3.2.1 Land use	33
3.2.1 Land ownership and reform	33
3.4 Pesticides control	34

4.0	Resources	
4.1	Water resources	
4.1.1	Rainfall and climate	35
4.1.2	Rivers	37
4.1.3	Lakes	39
4.1.4	Groundwater	41
4.2	Forests	42
4.3	Soil	51
4.4	Wildlife	54
4.5	Coasts, Beaches and Fisheries	
4.5.1	Coasts and Beaches	59
4.5.2	Fisheries	60
4.6	Minerals	62
5.0	The Economy of Guatemala	
5.1	General economic picture	66
5.2	Agriculture	66
5.2.1	Land use and farm size	67
5.2.2	Major crops	68
5.2.3	Recent trends in agricultural production	68
5.2.4	Use of pesticides and environmental and health effects	71
5.2.5	Animal husbandry	74
5.3	Industrial production	
5.3.1	Industrial activity	76
5.3.2	Industrial and urban pollution	77
	Reference List	79
	Appendix A Wildlife protected under the 1970 Hunting Law	83
	Appendix B FAO/UNESCO Soil Classification 1975	

INTRODUCTION AND SUMMARY

These problems, listed in a recent A.I.D. Telegram from the Mission in Guatemala are to be discussed in a somewhat expanded introduction and summary section. Other problems also dealt with in the paper will be considered as well.

principal problems of Guatemala:

deforestation : more than 50% of the nation's forests have been destroyed since 1890

- reasons: lack of forest resource management and increasing population pressures in the highlands regions;
- population density in some highlands region nearly equal to that of Haiti
- deforestation leads to soil erosion as sloped land is increasingly put into use without proper soil conservation measures being taken;

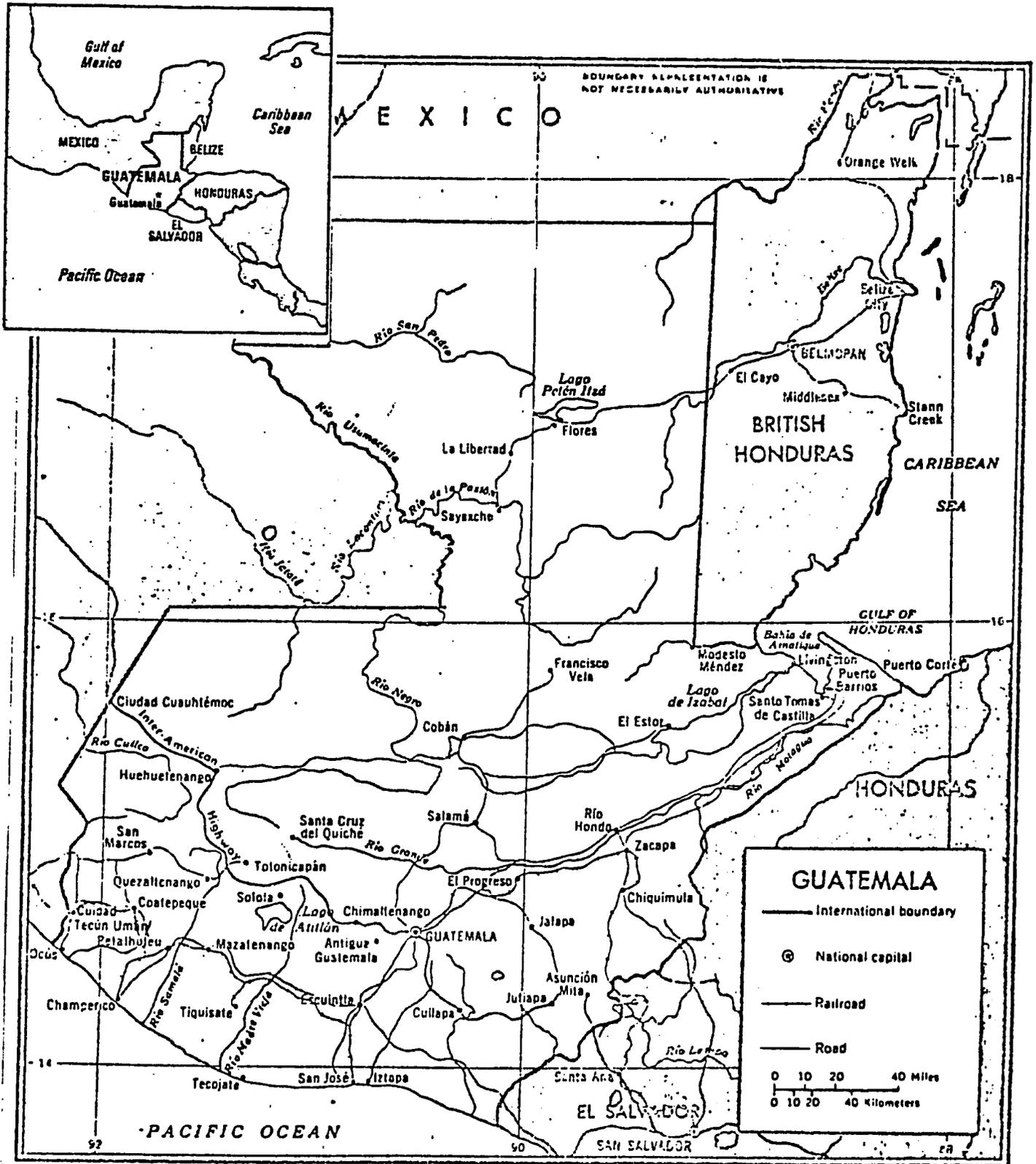
soil erosion: in the wake of deforestation (see above);

water pollution: concentration of population without adequate waste disposal and increased surface runoff because of barren surfaces

pesticide abuse: limited to cotton growing areas on the south coast; traces of insecticides in beef and dairy products growing; contamination of water supplies also results;

population growth is very high 3.1 (not as high as, however, El Salvador and Honduras

-environmental fund places it at 2.9



414207 8-73

REPUBLIC OF GUATEMALA

land area: 107,890 square kilometers
 water area: 1,000 square kilometers

1.0 POPULATION CHARACTERISTICS

1.1 General population figures:

Situated in Central America, the Republic of Guatemala, with a territory of 108,880 square kilometers (42.5 thousand square miles), is the size of Ohio. In common with other Central American countries, Guatemala has a high annual growth rate; population has doubled every 37 years between 1778 and 1950. Estimated 1977 population includes 1.3 million women of childbearing age.

Present population (1978 estimate)

6.6 million*
1973 census: 5,160,221

Present population growth rate: 3.3

Years to double population:
22*

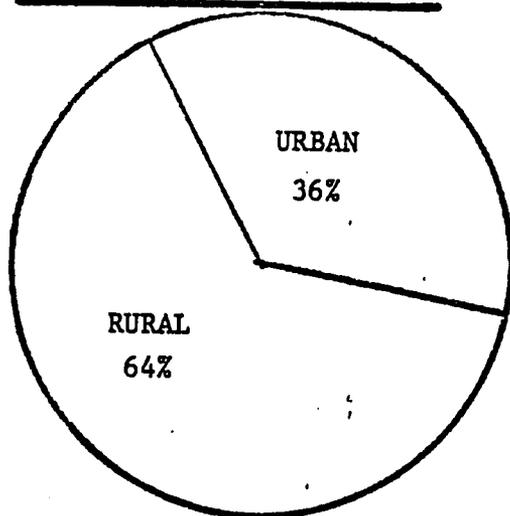
Population project to year 2000: 12.2 million*

Percentage of population under 15: 45%

Percentage of population under 64: 3%

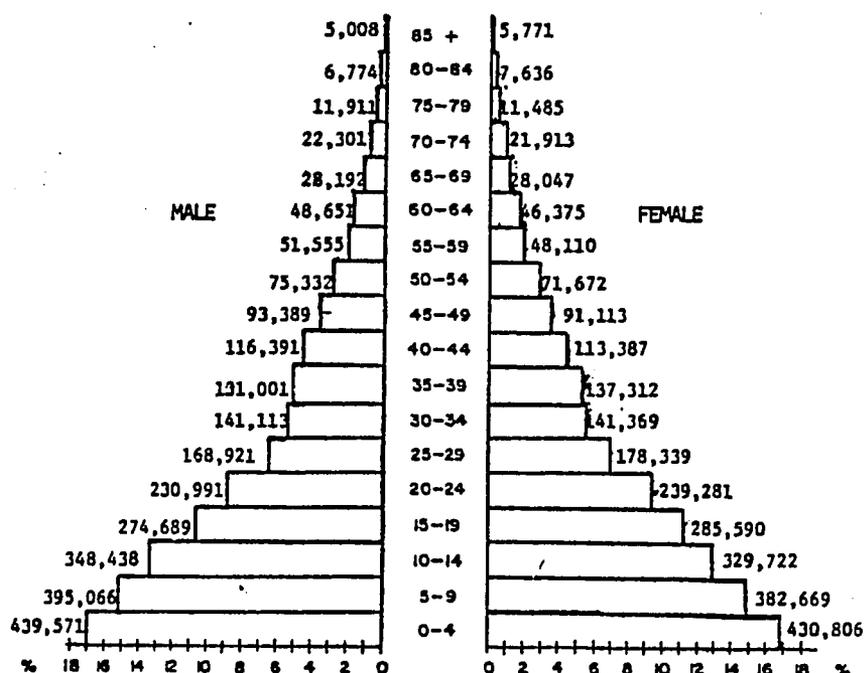
Urban population: 36%*

RURAL - URBAN POPULATIONS



POPULATION PYRAMID 1973

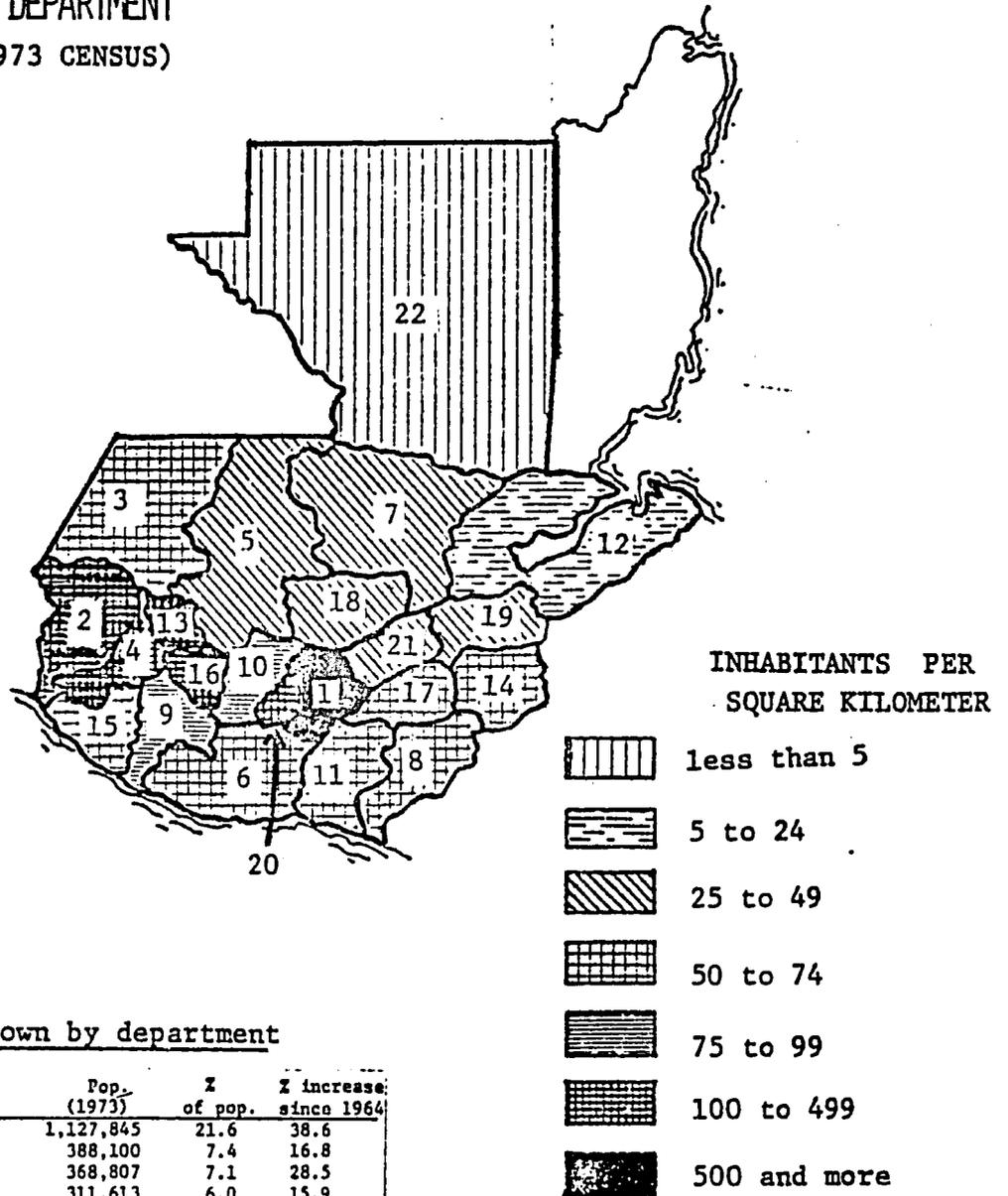
(based on the 1973 census)
AGES



In common with other Central American nations Guatemala has experienced an increase in urban population over the past decades. Whereas in 1966 there were only 644,000 urban dwellers, their numbers had increased to 1,067,000 by 1973; according to recent projections, this number will rise to 1.4 million by 1980, 2.1 million by 1990, and 3.0 million by the year 2000. Most of this urban population is in Guatemala City, which is presently some 20 times larger than Quetzaltenango, the nation's second largest city, and is expected to be 30 times larger by the year 2000 (IDBa 1977: 1-3).

*Figures from the World Population Data Sheet 1978 of the Population Reference Bureau, Washington, D.C.

POPULATION DENSITY
BY DEPARTMENT
(1973 CENSUS)



Population breakdown by department

Department	Area (sq. km)	Pop. (1973)	% of pop.	% increase since 1964
1. Guatemala	2,126	1,127,845	21.6	38.6
2. San Marcos	3,791	388,100	7.4	16.8
3. Huehuetenango	7,400	368,807	7.1	28.5
4. Quezaltenango	1,951	311,613	6.0	15.9
5. Quiché	8,378	300,641	5.8	21.3
6. Escuintla	4,384	300,140	5.7	11.2
7. Alta Verapaz	8,686	276,370	5.3	6.3
8. Jutiapa	3,219	231,005	4.4	16.1
9. Suchitepequez	2,510	212,017	4.1	13.8
10. Chimaltenango	1,979	193,557	3.7	18.2
11. Santa Rosa	2,955	176,198	3.3	13.3
12. Izabal	9,038	170,864	3.3	49.4
13. Totonicapan	1,061	166,622	3.2	19.3
14. Chiquimula	2,376	158,146	3.0	4.6
15. Retalhuleu	1,856	133,993	2.5	9.1
16. Solola	1,061	126,884	2.4	16.6
17. Jalapa	2,063	118,103	2.3	20.5
18. Baja Verapaz	3,124	106,909	2.0	11.8
19. Zacapa	2,690	106,726	2.0	11.2
20. Sacatepequez	465	99,710	1.9	23.9
21. El Progreso	1,922	73,176	1.4	9.7
22. Paten	35,854	64,503	1.2	141.4
GUATEMALA	108,889	5,211,929	100.0	21.6

Population density for the country as a whole was 59.7 persons per sq. kilometer by 1976 estimates; density for arable land was higher: 142.9 per square kilometer.

1.2 Population by ethnic membership:

There are two basic ethnic groups forming the population of Guatemala: Indian and Ladino; these are distinguished perhaps more by cultural behavior rather than by physical qualities.

Indian (41.4% of the population)

Indians, speaking some twelve to twenty indigenous languages predominantly of the Mayan language family (most men and some women have Spanish as a second language), are the dominant ethnic group in the western and central highlands of Guatemala. With social customs based on the extended family and a community oriented outlook, the Indians of Guatemala are principally poor subsistence farmers who must supplement their meager incomes through handicrafts or day labor. Their religion combines Roman Catholic and Mayan elements.

Ladino (58.6% of total population)

In contrast, the Ladinos, comprised of westernized Indians and persons of mixed blood, are Spanish-speaking, Hispanic in their cultural orientation, Roman Catholic, and generally urban. They predominate in the capital area and the area to the east as well as on the Caribbean and Pacific Coastal Plains. The Ladinos, who have traditionally controlled economic, social, and religious affairs in Guatemala dominate the commercial, service, semi-professional, and professional occupations. Their power, however, has suffered some decline with the coming of township elections.

1.3 EDUCATIONAL COMPOSITION OF POPULATION

Literacy: about 50%

Indian population: about 18% literacy

Rural population: 31% literacy (male 39.96%
female: 22.33%)

Urban population: 70% literacy (male 79.75%
female: 64.29%)

The gap between male and female literacy is especially marked among Indians.

Educational institutions and enrollment*:

School enrollment as percentage of eligible age group:

	<u>1970</u>	<u>%increase over 1960</u>
Primary enrollment[ages 7-13]:	49.9%	70.3%
Secondary enrollment[ages 14-19]:	10.9%	172.9%
Higher education [20-24]:	3.7%	219.2%

Rural vs. urban primary school enrollment 1968:

	<u>male</u>	<u>female</u>
urban: 273,299	147,53	124,766
rural: 219,942	130,102	89,840
total	493,241	

Universities:

Guatemala has five universities: the largest, San Carlos (with an enrollment of some 30,000 students and a faculty of 1,200 in 1976), is public; the other four (with a total 1976 enrollment of 5,600 students and a total of 464 faculty members) are private. All are located in Guatemala City, but the University of San Carlos also has branches in Quezaltenango and Chiquimla.

University enrollment by specialization: 1971

[Based on a total student enrollment of 13,957 (San Carlos)]

Humanities and education: 1,430

Law: 2,651

Economics, commerce and finance: 3,247

Other social sciences: 80

Natural sciences: only group are those included under pharmacy(below)

Architecture: 676

Engineering (civil and others): 2,108

Agriculture: agronomy: 567 veterinary medicine: 342

Medical sciences: medicine: 1,830

dentistry: 554

pharmacy: 361 (includes students in chemistry)

Others: 111

*Figures from tables 1003, 1110 and 1021 of Statistical Abstract of Latin America, vol. 18 (1977) [UCLA Latin American Center Publications].

1.4 HEALTH CHARACTERISTICS OF POPULATION

average annual birth rate: 43 per 1,000 population*

infant mortality rate: 75 per 1,000 live births *
 mortality rate for 2 year olds:
 33.5 per 1,000 in 1976;

crude death rate: 12 per 1,000 population*

life expectancy at birth: 53*[the lowest in Central America]
 Life expectancy for Indians is about
 49.9.

1.4.1 Health problems

There is a high mortality rate for respiratory diseases and gastroenteritis especially among children ages 1-5. Malnutrition in rural areas leads to a higher incidence of disease mortality. Leading causes of illness in 1974 were: enteritis and other diarrheal diseases, acute respiratory infections, avitaminoses and other nutritional deficiencies, skin infections, and anemia. Also prevalent were malaria, as well as parasitic infections such as intestinal helminths (ascaris, hookworms, and trichocephalus), and onchocerciasis. Lack of a safe potable water supply and absence of sanitary facilities are often behind the high rate of illness. Toxic poisoning by pesticides is a problem in some areas, especially in the cotton growing country in the Pacific Coastal plains. Heavy use of pesticides has also resulted in the development of immunities among disease vectors such as mosquitoes (see 5.2.4).

Major causes of death [1971]: all ages:
 total deaths: 75,223

	no.	rate	%
enteritis and other diarrheal diseases:	14,216	265.8	18.9%
influenza and pneumonia	12,618	235.9	16.8
measles	5,861	109.6	7.8
causes of perinatal mortality	3,022	56.5	4.0
whooping cough	2,975	55.6	4.0
accidents	2,013	37.6	2.7

*Figures from the World Population Data Sheet 1978 of the Population Reference Bureau, Washington, D.C.

** Table 708B in Statistical Abstract of Latin America, vol. 18 (1977).

1.4.2 Health Facilities

An estimated 60-70% of Guatemala's population is without modern medical services. The Ministry of Health operates modern in-patient in the capital area, which receives about 51% of the Ministry's expenditures. Because the Ministry of Health has almost no programs designed to reach the rural poor, private and volunteer organizations attempt to fill this gap, but their services are concentrated in only a few rural areas. There is relatively little cooperation between the Ministry of Health and private organizations.

In 1977 there were 131 hospitals, 37 of which were run by the Ministry of Health, offering 9,407 beds or 1.6 beds per 10,000 population.

The Institute of Social Security runs another 35 hospitals with 1,767 beds, as well as 20 ambulatory care units. Half of these are in Guatemala City.

Finally, there are 59 private hospitals with 1,200 beds; two-thirds of these are in the capital.

1.4.3 Medical Personnel

Estimates of the total numbers of physicians vary widely; there may be as many as 2,000. In 1977 there were approximately 928 Ministry of Health doctors, 410 of whom were in the capital. Thus Guatemala City, with 15% of the nation's population has 40% of its medical doctors; it also can boast of 43% of the dentists and 45% of the nurses and lab technicians.

In rural, predominantly Indian areas, there are Rural Health Health Technicians who acts as mid-level health workers and community organizers.

1.5 Population Control

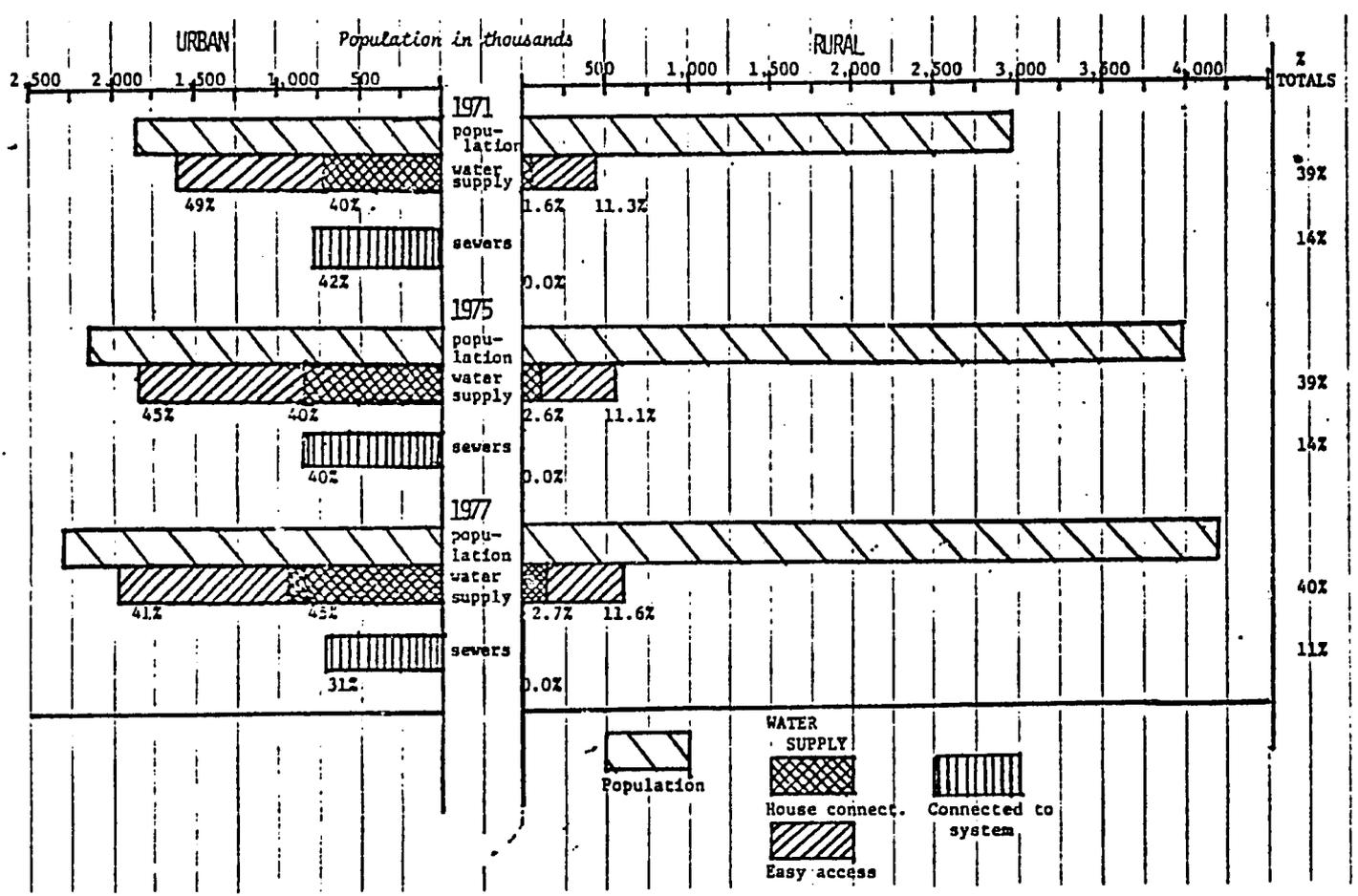
Guatemala has no official population control program, although some education programs are operated by the Division of Maternal, Child, and Family Health of the Ministry of Health.*

Active family control programs are operated by APROFAM (the Guatemalan Association for Family Welfare), a privately sponsored affiliate of the International Planned Parenthood Federation, which has a central clinic in Guatemala City. APROFAM, operating since 1964, with heavy emphasis on IUD's (Prior 1977), also offers gynecological services. 1974 figures indicated that about 50,000 women, or about 4.4% of married women between the ages of 15 and 44 were using some kind of birth control.

*The exact role of the Division is not clear; according to one source the Division is responsible for family planning in rural areas, while APROFAM has the responsibility in Guatemala City. (See Trzyna 1976).

1.6 Water supply and sanitation

URBAN AND RURAL POPULATIONS SERVED BY WATER SUPPLY AND SEWERAGE SYSTEMS:
1971, 1975, 1977



1.6.1 Drinking water supply is not satisfactory; as the above table indicates, only about 40% of the population has either piped water or easy access to other safe water sources.

EMPAGUA, the organization responsible for water supply, meets about 80% of the demand in the capital area; working with government subsidies, EMPAGUA is said to be highly uneconomical. The water supply system is generally said to suffer from a high leakage rate in the distribution system and a large number of illegal taps and faulty connections. Water treatment plants for Guatemala City, for example, which draw most of their supplies from underground sources, often suffer from a lack of water and can work only about 12 hours per day; this discontinuous functioning is said to adversely affect water quality.

Drinking water quality in general is said to be poor and to serve as the source of much of the disease which afflicts Guatemalans, especially in rural areas. As part of its effort to correct this situation Guatemala in 1975 received approval for a loan of 7,000,000 dollars for rural water supply improvements; the Guatemalan government provided \$2,600,000 in matching funds.

As the above graph indicates, however, although the absolute number of persons served by water supply and sewerage systems has increased in recent years, the percentages of population covered have either remained the same, increased slightly, or, as in the case of total urban population with access to safe water supply, decreased.

In those areas heavily hit by the 1976 earthquake, extensive damage to water supply systems occurred; 75 urban water systems were partially or totally destroyed and about 240 rural localities were also affected. The waterworks in Guatemala City suffered extensive damage, and fecal contamination of water supplies became a threat because of possible cross connection of water and sewerage lines. The situation in smaller urban areas was often much worse. In rural communities, where water is often drawn from private wells and municipal springs and where lack of both sewerage and waterworks precluded the danger of cross contamination, the situation was less severe.*

1.6.2 Sanitation and Waste Disposal

1.6.2.1 Wastewater and sanitation

As indicated by the above graph, only between 11% and 14% of the total population of Guatemala has been served by sewers throughout most of the 1970's. Wastewater treatment is non-existent, even in Guatemala City, whose domestic wastes entering rivers are the major source of water pollution for both the Atlantic and Pacific watershed areas of the country.

1.6.2.2 Solid Waste

Solid waste disposal is a municipal responsibility, although residential areas in Guatemala City, for example, are served by private companies.

The central dump for Guatemala City is located in the downtown area, where it gives off a foul penetrating odor. This dump, which serves for all types of wastes: garbage, industrial wastes, hospital wastes, and toxic wastes, has no basic sealing and no drainage water control

*See Pan American Health Organization. Report of the Director. Quadrennial 1974-1977. Annual 1977, as well as various articles in the PAHO Bulletin.

2.0 ORGANIZATIONS WITH INTEREST IN ENVIRONMENT AND NATURAL RESOURCES

2.1 GOVERNMENT AGENCIES

A recent UNEP report identified a widespread lack of institutional authority, capacity, and financial resources as a major constraint on more effective environmental control programs in Central America as a whole, an assessment which seems to apply to Guatemala in particular. All indications are that rational planning and implementation of natural resources development programs are severely hampered by the large number of government agencies with a diversity of responsibilities impacting on this area. To remedy this situation the National Economic Planning Council has recommended the creation of a decentralized and autonomous institution to integrate the responsibilities of planning and execution of a natural resources program. There are also expectations that the 1979-1982 Development Plan, still forthcoming as of January 1979, will place high priority on environmental concerns. (A.I.D. Guatemala. 1979). Other serious constraints are the low numbers of trained technicians required for work such as the operation of remote sensing equipment, and the lack of the data so necessary for effective programs. Even the most complete study, the National Economic Planning Council's Preliminary Inventory of Renewable Natural Resources of Guatemala is reported to suffer from a lack of data gathered in a coordinated, integrated, and continuous manner.

2.1.1 Ministerial Commission Charged with the Conservation and Improvement of the Human Environment

Established by a Resolution of May 3, 1973.

The Commission is comprised of representatives of the following ministries:

- Ministry of the Government
- Ministry of Communications and Public Works
- Ministry of Agriculture
- Ministry of External Affairs
- Ministry of National Defense
- Ministry of Education
- Ministry of Economics
- Ministry of Finance
- Ministry of Public Health and Social Assistance
- Ministry of Labor and Social Planning.

The Commission is authorized to set up technical groups concerned with planning and implementation of activities dealing with conservation and improvement of the human environment; the decisions of such groups are subject to the Commission's approval. The Commission is also authorized to dictate (dictar) the measures it deems necessary to resolve the problems of environmental contamination.

All government agencies are required to cooperate with the Commission in the performance of its functions.

2.1.2 Ministry of Agriculture

2.1.2.1 DIGESA: Direccion General de Servicios Agricolas (General Directorate of Agricultural Services) Guatemala City

Through its various services DIGESA provided assistance to over 21,000 farmers representing nearly 93,000 hectares of subsistence farmland between July 1977 and June 1978.

DIRENARE: Department of Renewable Natural Resources

Division of Water Resources

By a resolution of August 11, 1972 the Division of Water Resources is granted control of all state waters. It is charged with: conducting studies relating to all aspects of water quality and use; regulating all national waters, both groundwater and surface waters; organizing irrigation projects; and assuming responsible for water conservation.

The subdivisions of the division are the Department of Studies, with responsible for conducting investigations, relating, among other things, to flood control and irrigation, soils, and geological factors; the Department of Supervision and Construction, charged with the construction of irrigation works; and the Department of Operations, Maintenance, and Administration.

The Division is authorized to appoint representatives in areas where is maintains operations.

The Division presently operates 23 irrigation works in five districts, providing water for a total of 14,774 hectares. (Guatemala, Office of the President 1978:76).

Fauna Division: general responsibilities in the areas of wildlife and fishing.

This division bears the chief responsibility for enforcement of the 1970 Hunting Law, including the issuing of hunting permits.

Department of Commercial Fishing (Departamento Pesca Artesinal)

Responsible for the issuing of fishing licenses.

Directorate of Livestock (Direccion de Ganaderia)

The Directorate's activities include artificial insemination programs.

DECA Direccion de Ensenanza y Capacitacion Agricolas
(Directorate of Agricultural Education and Training)

The directorate is responsible for agricultural education and training programs at the basic, middle and higher levels. In the period between July 1977 and June 1978, for example, it reached over 40,000 persons with basic level programs designed, among other things, to provide technical assistance to agricultural cooperatives. As the agency responsible for rural education the Directorate also is responsible for 3 rural normal schools and 248 rural primary schools.

On the middle level DECA operates the Institute Tecnico de Agricultura (ITA-the Agricultural Technical Institute); graduates of the ITA are considered Agronomy Specialists (Perito Agronome).

At the higher level, the ITA in 1977-78 granted 83 scholarships to the Faculty of Agronomy and 15 to the Veterinary Faculty. (Guatemala, Office of the President 1978: 75-76).

2.1.2.2 ICTA: Instituto de Ciencia y Tecnologia Agricolas, Guatemala City
Institute of Agricultural Science and Technology
Guatemala City

The institute is responsible for promoting the use of agricultural technology with the general aim of increasing agricultural production. Its activities include the identification of new varieties of plants and experimentation with their use in Guatemala.

2.1.3 INAFOR: Instituto Nacional Forestal (NATIONAL FORESTRY INSTITUTE)

Established by decree in June 1974, INAFOR, incorporates agencies formerly under the Ministry of Agriculture and the Instituto Nacional de Transformacion Agraria (INTA).

INAFOR is headed by a policy-making Board of Directors (Junta Directiva) comprised of the Ministers of Agriculture (the presiding

officer), Economy, Finance, and National Defense, and the Secretary General of the National Planning Council.

The day-to-day business of the Institute is handled by a General Manager.

The functions of INAFOR, as outlined in Article 14 of the decree, are:

- to implement the Forestry Law and other pertinent statutes;
- to plan and execute a national forestry plan;
- to conduct a forest inventory;
- to carry out ecological zoning of the country;
- to establish a National Forestry Register;
- to carry out programs of afforestation and reforestation to restore the natural resources of the country and increase forest production;
- to cooperate with INDE (National Electrification Institute) and other institutions in the conservation and improvement of hydrological basins;
- to plan and execute forest management programs, including marketing of forest products and industries based on them;
- to deal with export of wood and wood products;
- to supply educational funds for the formation of human resources in the forestry area;
- to administer national parks in conjunction with the Guatemalan Tourist Institute and the Institute of Anthropology;
- to study and collaborate in programs designed to avoid environmental contamination and to promote ecological balance.

INAFOR is to be funded, at least in part, by fines and fees arising from forest activities.

INAFOR's competence does not, however, extend to El Peten department (the location of most of Guatemala's tropical forests), where FYDEP (the National Company for the Development of El Peten) has jurisdiction.

Activities (July 1977-June 1978):

As outlined in the 1978 report of the President to the Congress, INAFOR's activities during the reporting period included:

- distribution of seed and seedling for both coniferous and broad leaved trees;
- reforestation of 4,988 hectares with 10,603,000 plants sown;
- a forestry inventory covering 12,000 square kilometers in the high plateau of the northwest and east central parts of the country;
- ecological studies including a land use map covering

- 35,774 square kilometers, a potential land-use map covering 16,138 square kilometers, and a map of reforestation priorities covering 24,287 square kilometers;
- issuance of 4,722 licenses for forest utilization covering 98,640 cubic meters of forest products;
 - measures to combat pine weevils over 2,451 hectares;
 - prosecution of 1,342 offences under the forest law resulting in the imposition of 121 sentences;
 - development and promotion of forest cooperatives (two are now in the organizational stage, one is about to begin operations, and two are already functioning).

Departamento de Parques Nacionales

In cooperation with the Institute of Tourism and the Institute of Anthropology, the department operates Guatemala's national parks.

2.1.4 INTA: Instituto Nacional de Transformacion Agraria (NATIONAL INSTITUTE FOR AGRARIAN TRANSFORMATION)

Established in 1962, INTA, the state land reform agency, oversees programs designed to provide the landless not only with government land or with other unused agricultural land but also with housing, technical assistance, and credit necessary to undertake agricultural operations. Since 1972, INTA has been working on the distribution of smaller areas of land to agricultural cooperatives.

2.1.5 INDECA: Instituto Nacional de Comercializacion Agricola

Created by the government in 1970 with headquarters in Guatemala City, INDECA is an autonomous, decentralized state agency charged with marketing, price stabilization, and supply of agriculture produce; it replaces and combines the functions of the early Instituto Nacional de Fomento de la produccion (INFOP) and the Direccion General de Mercadeo Agropecuario.

2.1.6 FYDEP: Empresa Nacional de Fomento y Desarrollo Economico del Peten

Responsible for El Peten, the northeastern department which occupies two-third of Guatemala and contains most of its tropical forests, FYDEP was established in 1959 with the goal of developing roads, agriculture, and industry in El Peten. It also is in charge of plans to colonize and develop large tracts of forest land.

As part of its forestry-related activities, FYDEP operates a small-scale cedar and mahogany reforestry experiment and is also engaged in planting efforts involving white pine, cedar, citronella, and chicle. It also levies a 20% tax on forestry products extracted in the area.

According to a recent report (Shane 1978), FYDEP shares with INAFOR the problem of an inadequate budget for enforcing forestry laws.

2.1.6 MINISTRY OF PUBLIC WORKS AND COMMUNICATIONS Guatemala City

INDE Instituto Nacional de Electrificación

As the agency concerned with the development of the hydroelectric potential of the country, INDE takes great interest in Guatemala's rivers. It operates a network of stations monitoring river water

level, and has commissioned at least two environmental impact studies in conjunction with hydroelectric projects (see Goodland and Tillman 1975 and Goodland and Pollard 1974).

Department of Aqueducts and Sewerage

Instituto Geographico Nacional

-Division de Geologia

Avenida las Americas 5-76, Zona 13
Guatemala City
Director: Oscar Daniel Salazar

The division has worked on the preparation of a geological map.

-Division Geografica

The Division has taken a great interest in the environment as evidenced by studies relating to the location of possible national reserves; a study, carried out in association with the University of Oregon, on environmental protection legislation; the preparation of a plan for the restoration of Lake Amatitlan, including a study of the problems of the Lake and its basin; and a study on the adaptability of species in the region of Lake Amatitlan.

-Division de Investigacion de Recursos de Agua (Water Resources Investigations Division)

-Departamento de Agua Superficial (Department of Surface Water)

Instituto de Sismologia, Vulcanologia, Meteorologia, y Hidrologia
 (Institute of Seismology, Volcanology, Meteorology and Hydrology)
 7 Avenida 14-47, Zona 13
 Guatemala City
 Director: Claudio Urrutia

-created by decree of 3/26/76.

2.1.7 MINISTER OF PUBLIC HEALTH AND SOCIAL ASSISTANCE

Direccion General de Servicios de Salud (Directorate General of Health Services)

The service is responsible for hospitals, mostly in Guatemala City and other urban locations.

Subdirectorato for Technical and Normative Affairs

Comprises several divisions, including the Division of Maternal, Child, and Family Health, the Division of Epidemiology; the Division of Medical Care, and the Division of Environmental Health (Division de Saneamiento Ambiental)

Division de Saneamiento Ambiental (Div. of Environmental Health)

The division's responsibilities include:

- regulation of drinking water quality;
- regulation of waste water discharges into surface and sub-surface water;
- setting noise standards to protect worker health;
- responsibility for operating the air pollution monitoring station in Guatemala City under the Pan American Air Air Pollution Monitoring Network (REDPANAIRE) (the station monitors dust fall, total suspended particulates, and sulfur dioxide);
- authority to regulate air pollution from industrial sources.

Division of Maternal, Child, and Family Health

Although the government of Guatemala has no official family control program, this division of the Ministry of Health has a program of family orientation which includes some education in family planning (see 1.5).

2.1.8 MINISTRY OF ECONOMY

-Department of Mining, Hydrocarbons and Nuclear Energy

Established by a decree of October 6, 1969, the Department is responsible for mineral development in Guatemala.

-Direccion General de Estadistica (General Directorate of Statistics)

The chief statistical office of the Guatemalan office, the Directorate was responsible for the 1973 census of the population and also collects and periodically publishes statistics relating to weather, agriculture, health, industry, the economy.

2.1.9 Consejo Nacional de Planificacion Economica (NATIONAL ECONOMIC PLANNING COUNCIL)

As the chief planning office of the Guatemalan, the Council has of necessity taken an interest in natural resources and their development as well as in the promotion of agricultural development. As part of its general charge to formulate a national policy for the conservation and management of renewable natural resources, the Council has been responsible for a preliminary inventory of renewable natural resources in Guatemala (1972). The Council has been expected to give high priority to natural resources conservation and development in the 1979-1982 development plan.

2.1.10 LOCAL GOVERNMENT AND ITS RESPONSIBILITIES

Guatemala is organized into 22 departments (Departamentos), each of which is headed by a governor (Gobernador). Divided among the departments are 325 municipal governments (municipios), with elected governing bodies each headed by a mayor (alcade).

Municipalities have health related responsibilities under the laws establishing their governments and under the Health Code. For Guatemala City, for example, these include:

- regulation of bus emissions (smoke)
[the municipality has issued regulations but seems to have no active enforcement program];
- regulation of vehicular noise within city limits;
- responsibility for regulating solid wastes under the Health Code;
- transportation and collection of household wastes
[in residential areas, however, waste collection is carried out by private companies];
- planning and regulating land use;
[the municipality has issued regulations governing the location of new industry].

Despite its responsibilities in this area, however, Guatemala City has issued no active program for the control of domestic wastewater charges, which are the single largest source of water pollution in both the Atlantic and Pacific watershed areas.

2.2 NON-GOVERNMENTAL ORGANIZATIONS AND ORGANIZATIONS RECEIVING SOME GOVERNMENT SUPPORT

A number of non-governmental organizations speak for the interests of conservation and rational exploitation of natural resources in Guatemala. Representatives of these organizations attended the first meeting of Central American Non-governmental Conservation Societies held in Guatemala City in early December of 1978, for which one of the organizations, the Guatemalan Natural History Association,* served as co-host. No details were available either on this organization or on other non-government organizations whose representatives were scheduled to attend the meeting, including:

Asociacion Amigos del Bosque

-the Association of Friends of the Forests;

Amigos de la Naturaleza

-Friends of Nature;

Asociacion Guatemalteca Pro-defense del Medio Ambiente

-Guatemalan Association for the Defense of the Environment;

Asociacion Amigos del Pais

-Association of the Friends of the Nation.

The principal resolution to emerge from this meeting urged organizations to take action to ensure environmental impact studies of all public projects as well as of those financed by national banks. Irrational use of natural resources was identified as the number one problem affecting the area, and action to influence governments to pursue rational development of such resources was urged. Another important resolution committed organizations to send to President Carter a telegram strongly encouraging him to put an end to U.S. exports of chemical substances presently outlawed in the U.S. itself.

Institute of Anthropology and History

The institute is concerned with the preservation of ancient Mayan sites; it assisted Goodland and Tilman (1974) in evaluating matters dealing with the environmental impact of hydroelectric projects on such sites.

*Information on this and other organizations which participated in the meeting should be available when proceedings of the meeting are published.

Museo Nacional de Historia Natural
Guatemala City

Initiated in 1948 by Jorge Ibarra, the National Museum of Natural History was officially inaugurated in 1950 with the effective support of the Ministry of Education, from which it still gets some of its funding. The Museum has sections dealing with mineralogy, paleontology, and zoology as well as a herbarium.

One of its aims, according to its director, is to "create a public consciousness of the need to know the plants and animals that take part in biologic equilibrium. Such a function is put to practice through exhibits, popular lectures, conferences, publications and promotion of conservation activities" (Ibarra 1975: 8).

Since 1964 the museum has published Historia Natural y Pro Natura, a journal which generally features articles about conservation not only in Guatemala but throughout the world. The journal also publishes laws and regulations relevant to the environment and conservation. Historia Natural y Pro Natura and its editor, Jorge Ibarra, have led the fight to establish reserves for the quetzal, the endangered national bird of Guatemala.

Ibarra, who appears to be one of the most prominent figures in conservation efforts in Guatemala, also cooperated with environmental impact reconnaissances performed by the Cary Arboretum regarding hydroelectric development, providing information concerning endangered mammals and conservation (Goodland and Tillman 1975).

Comite Operacion Quetzal

Established on 12 December 1972 and later officially sanctioned by a decree of November 17, 1962, the Committee has as its principal concern the prevention of the extinction of the quetzal, the national bird of Guatemala.

Its purposes include:

- educating the public of Guatemala as well as of Mexico and other Central American countries regarding the gradual extinction of the quetzal;
- advising on the establishment of national parks and refuges at sites which are presently quetzal habitats;
- promoting reforestation of those species of trees which serve as food for the quetzal.

In its efforts to achieve its goals, the Committee is authorized, among other things, to conduct campaigns to increase awareness of the scientific and historical importance of the quetzal; such

activities may include publicity in both Guatemalan and international publications, contests, the designing of postage stamps, and cooperation with international organizations interested in the preservation of avifauna.

Supported chiefly by the dues of its members, the committee is also authorized to accept contributions from other sources. It has received support from la Direccion de Desarrollo Socio Educativo Rural, through the Seccion de Castellanzacion y el Departamento de Educacion Familiar.

Epigonist Society of Guatemala (Guillermo Perezcanto, president)

This organization has been noted for its interest in conservation by Historia Natural y Pro Natura, the journal of the Museum of Natural History.

Circulo Guatecalteco de Periodismo Cientifico (Scientific Journalism Club)

As noted in Historia Natural y Pro Natura, this organization has promoted conservationist efforts.

2.3 INTERNATIONAL ORGANIZATIONS

ICAITI (Central American Research Institute for Industry)

ICAITI was founded in 1955 as an independent institution by the governments of the five Central American Republics with the assistance of the United Nations Technical Assistance Administration in response to the need for an applied research institution in Central America. With headquarters in Guatemala City, ICAITI has conducted many technical-economic studies and performed applied research on a wide variety of subjects relating to industrial development.

ICAITI has taken a strong interest in the environmental effects of development and has become perhaps the key organization in efforts to develop programs geared to a regional approach to environmental and natural resource problems. It has, for example, in cooperation with the United Nations Environment Program (UNEP), carried out research on the environmental and economic effects of pesticide use in Central America (ICAITI 1976). Furthermore, a recent fact-finding mission to Latin America has suggested that ICAITI serve as the environmental advisory institution for Central America; its technical staff and laboratories are seen to offer an excellent resource for carrying out the environmental baseline studies so urgently needed in the region.

2.4 INTERNATIONAL COOPERATION

Meetings on environmental problems have been held between Guatemala and other countries of the region. One such meeting took place in late 1974 between representatives of the Guatemalan Ministerial Commission for the Improvement of the Human Environment and the Mexican Sub-secretariat of Environmental Improvement. In June 1978, Guatemala hosted a Regional Seminar in the Use and Management of Pesticides in Guatemala City. Guatemala also participates in Pan American Health Organization programs, operating under the Division of Environmental Health of the Ministry of Health and Social Assistance a station in the Pan American Air Pollution Monitoring Network (REDPANAIARE).

2.5 EDUCATION, RESEARCH, AND TRAINING CAPABILITIES (see also 1.3)

2.5.1 University of San Carlos

College of Physical Sciences and Pharmacy

The College had been operating a PAHO type (as employed by the Pan American Air Pollution Monitoring Network-REDPANAIARE) air pollution monitoring station up until the time of the earthquake in February 1976; the college now has plans to ask for equipment from PAHO for five stations to be operational by June of 1979; the school is presently operating two sound survey meters and is planning on adding three more of these and perhaps recorders to make for five stations to be used for both air and noise monitoring.

These facilities, designed primarily as a training function with the collection of reliable environmental data as a secondary consideration, could be important in providing technicians trained in the use of air and noise monitoring equipment. (ROCAP 1978: 4)

Faculty of Engineering

Regional School of Sanitary Engineering (ERIS)

Activities: The School offers postgraduate courses in and performs applied research relating to sanitary engineering and the quality of the environment.

Analytical work involved in the cooperative water quality investigations carried out by the University of North Carolina and the Instituto Geografico Nacional in 1969-70 was carried out by ERIS (Weiss 1971a,b,c).

Papers published by the Faculty of Engineering include studies of the coliform level of Lake Amatlan.

-Department of Botany

The department was instrumental in the establishment of a sanctuary for quetzal at Purulha Preserve in Baja Verapaz.

2.6 MONITORING CAPABILITIES (see also 2.2.1)

2.6.1 AIR POLLUTION

Institute of Seismology, Meteorology and Hydrology

Operating with a 1.56 million dollar budget with \$395,000 devoted to meteorology, the Institute can provide data for wind direction and velocity, inversions, temperature, humidity, and barometric pressure.

Although the Institute has no responsibilities pertaining to air quality, its data could be useful in the operation of an air pollution control program.

The Institute has one full time meteorologist on the staff and four full time technicians, who, according to a recent evaluation, would require only a limited amount of training to operate air-monitoring equipment. (ROCAP 1978:3).

Division of Environmental Sanitation (Division de Saneamiento Ambiental), Ministry of Public Health (see 2.1.7)

The Division has been operating a single station as part of the REDPANAIRE monitoring system since 1974 and has plans to reactivate another destroyed by the 1976 earthquake.

According to a recent evaluation of its monitoring capabilities "... the health agency is equipped to handle the collection and analysis of samples from a simple type of ambient air sampling network but does not have the technicians to handle a continuous monitoring network at this time." (ROCAP, 1978: page 7).

2.6.2 RAINFALL AND WATER QUALITY MONITORING

There are a total 55 hydrometeorological stations located throughout the country, twelve of which have the capability of monitoring rainfall; temperature, wind velocity and direction, relative humidity, solar intensity, temperature, humidity, and barometric pressure; an additional forty stations monitor rainfall, temperature, wind direction, and maximum and minimum temperatures. Many of these stations were established by the Proyecto Hidrometeorological Centroamericana (PHC) as a basic network; others were set up by the National Meteorological Observatory.

85 hydrological stations providing data on water level and flow are located along the rivers of Guatemala; 73 of these are the responsibility of INDE (the National Institute de Electficacion); and 13

are run by the National Observatory.

13 hydrological stations monitor water level on the lakes of Guatemala; 7 of these are run by INDE and 6 by IGN (the National Geographical Institute).

The above organizations participated in the work of the water quality investigations carried out in cooperation with the University of North Carolina in 1969-79; other bodies mentioned as having taken part in this research were:

Direccion General de Obras Publicas
Municipalidad de Guatemala

Laboratorio Quimico Bacteriologico de la
Municipalidad de Guatemala

Laboratoria Quimico de Obras Publicas.

2.7 STATISTICAL CAPABILITY

Statistical operations are generally under the aegis of the Ministry of Economy, whose Directorate General of Statistics and the Comision Nacional de y Censo was responsible for the 1973 census of the population. The last agricultural census, the second of its kind, was conducted in 1964; by a General Regulation of the Ministry of Economy, issued on December 7, 1978, the Third Agricultural Census (III Censo Agropecuario), is to be conducted between the 15 and 30th of April 1979, under the general oversight of the Director General of Statistics.

Ministry of Economy, Director General of Statistics

Statistical publications: Boletin Estadistico
1975-1976. Statistics dealing with
Geography
Demography (birth and death)
Industrial production and consumption
Foreign commerce
Transport
Hospital statistics.
Bulletin covering 1975-76 was published
in June 1978.

Quarterly Survey of Industrial Production
-compiled by Industrial Section of
the Department of of Industrial, Commercial
and Services Statistics.

-statistics for the second and third quarter of 1976 were published as a single volume in December 1977.

Annuario Estadístico

-statistics covering geography, demography, economics, health, and education.
-the 1974 edition was published in August 1976.

Although data on the levels of rivers and lakes is apparently obtained regularly (see 2.6.2), there seems to be no publication in which this is made available. The last extensive data available on water quality in Guatemala's lakes and rivers appears in the publications resulting from water quality investigations conducted in 1969-70 by the University of North Carolina (Weiss, 1971a,b,c); this data covers the following characteristics: pH; turbidity; total solids; dissolved solids; hardness; total alkalinity; contents of chlorides, calcium, potassium, sodium, and magnesium; temperature; dissolved oxygen; nitrate-nitrogen; total nitrogen; phosphate; and total phosphorus.

Generally a lack of data on the status of the natural resources of the nation is said to be a factor hindering the establishment of effective programs. The last review of natural resources was that published by the National Council for Economic Planning in 1972; this "Preliminary Inventory of Renewable Natural Resources of Guatemala" has been judged to be insufficient, however, because the data it presents was not obtained on a coordinated, integrated, and continuous basis.

3.0 LEGISLATION DEALING WITH ENVIRONMENT AND NATURAL RESOURCES

NOTE: A large number of laws and decrees have implications for the environment and natural resources development. Little information is available on the actual enforcement of this legislation, although figures for prosecutions under the Forest Law appear in a recent report of the Guatemalan executive to the national congress (see 3.1.2.1). As for pollution control legislation, it has been noted that in general implementation and enforcement of such provisions are severely hampered by: the absence of standards and emission/effluent limitations; the lack of trained enforcement staff and monitoring equipment; and a lack of commitment on the part of agencies with jurisdiction.

3.1 Renewable Resources

3.1.1 Water Resources (see also 3.2.1.1)

Although provisions dealing with water resources are included under various decrees and laws, there is no single Guatemalan law dealing comprehensively with this important resource.

A plurality of legislative provisions dealing with water resources has been stated as one of the important constraints on the execution of water development plans (Report of the Regional Preparatory Meeting...1976).

3.1.1.1 Health Code

Provisions:

- Articles 97 and 99 give to the Division of Environmental Health (DSA--Division de Saneamiento Ambiental) of the Ministry of Public Health and Social Assistance, the authority to regulate drinking water quality.
- Article 101 grants the DSA the authority to regulate wastewater discharges into surface and sub-surface waters.
- Article 106: grants municipalities the authority to regulate wastewater discharges within city limits.

Enforcement and implementation:

Indicative of the effectiveness of these provisions is the fact that Guatemala City, the municipality whose domestic wastewater discharges are the single largest source of water pollution in the country, has no active control program.

3.1.1.2 Decree no. 1551 of October 17, 1962, the Agrarian Transformation Law

Provisions: Chapter 23 (Articles 247 to 259) deals with the regulation of water and irrigated land. Provisions deal with utilization, ownership, and the policy on water use.

-water and irrigation systems:

- waters in the public domain as well as those privately owned waters in excess of the amount necessary for the rational utilization of the land are subject to expropriation
- the use, enjoyment and benefit of the waters and the areas benefited by them are subject to the limitations and regulations of this law and its regulations;
- rights-of-way for aqueducts through land of any kind, whether owned by the state, a municipality, or private persons, are exempt from taxes or fees of any kind; such aqueducts are to be built under the supervision of the Institute;
- the following may not be expropriated: water used in irrigation irrigation works or public dams; water intended for use in industrial activities; water that is being rationally utilized in cultivated land, including that sufficient for the normal use of the reserve lands; water used by public services; waters needed for small and medium-sized farms, experimental stations, and model farms; and water that fulfills a necessary function in the service of the community;
- priorities in the use of river waters:
 - flood control
 - agricultural development and land distribution
 - irrigation
 - generation of power
 - human or industrial use
 - navigation and other uses.

3.1.1.3 Resolution of 2/25/67 issues the regulation for the operation of rural systems of potable water.
E.G. March 13, 1967

3.1.1.4 Decree No. 1004 of August 30, 1953 concerning the prohibition against discharging wastes into waters

Provisions: -Recognizing the dangers caused to all waters and consequently to fish and livestock and to human health from contamination by agricultural and human wastes, this decree prohibits categorically the discharge into the water of rivers, streams, springs, or lakes of vegetable or

chemical substances, agricultural or industrial wastes or residues, or those species of plants (such as citronella and agave) harmful to fish, livestock, or human health.

- prohibits the use on the banks of water bodies of latrines which do not adequately purify wastes;
- requires municipalities to conduct studies on the treatment of municipal wastes;
- penalties are those which under articles 235 to 237 of the Penal Code apply to person whose acts have harmful or dangerous consequences.

Implementation: The Ministries of Agriculture and of Public Health and Social Assistance.

3.1.1.5 Municipal regulations

Various municipal regulations govern potable water systems, e.g. Reglamento para el servicio de agua potable de San Pedro Jacapilas de Departamento de El Quiche, which was published in the official gazette for November 21, 1978.

3.1.2 FOREST LEGISLATION

3.1.2.1 Decree no. 58-74 of June 12, 1974 promulgating the Forestry Law*

This comprehensive basic forestry law replaces most earlier legislation covering forest resources, including the earlier comprehensive law promulgated by Decree no. 170 of October 6, 1945.

Consists of 73 articles divided into 13 chapters dealing with: general provisions; classification of forests; forest production; statistics and trade; forest exploitation; transport of wood; reforestation; forest incentives; taxation; forest offences, sanctions, and penalties; forestry awards; forestry terminology and transitional provisions.

Enforcement: INAFOR, the basic enforcing agency under the forest law reported for the year running from July 1977 through June 1978 the prosecution of 1,342 offenses under the Forest Law, resulting in the imposition of 121 sentences. Details on the severity of the

*The present status of this legislation is somewhat uncertain. In a recent interview, an INAFOR official, speaking as if the 1974 legislation did not exist, indicated that no recent comprehensive forestry legislation was on the books and that the 1945 law was no longer enforceable; the official spoke of draft legislation for a new law (ICAITI 1978). Another report, dating from October 1978, states that the President of the Supreme court had just ruled the National Forest Law unconstitutional; no further details are supplied ("Tree Troubles."1978:302).

sentences were not available. (Guatemala. Office of the President 1978.)

- 3.1.2.2 Decree no. 51-74 of June 6, 1974 establishing the National Forest Institute (Instituto Nacional Forestal-- INAFOR)
- 3.1.2.3 Resolution of October 3, 1975 (of the Ministry of Agriculture) on Income Tax Deductions for Reforestation Expenses
- 3.1.2.4 Decree of February 12, 1976 prohibiting the exportation of lumber (madera aserrada).
Official Gazette, no. 5 of February 13, 1976.
- 3.1.2.5 Decree no. 66-78 of 31 October 1978 declares the marimba the national instrument of Guatemala and declares it in the national interest to protect and plant it;
- names as a protected species the Hormigo tree (Platumiscium dimorphandrum) as well as other species used in the manufacture of the mirimba.
 - Minister of Agriculture charged with protection measures.
- 3.1.2.6 Emergency Reforestation Law (1978) (See also 4.2.2.6)
- Provides that all reforestation efforts be directed by INAFOR;
 - provisions:
 - all municipal governments are to reforest areas within their jurisdiction;
 - the educational system is ordered to commence study programs promoting conservation, tree cultivation, environmental improvement, and the actual planting of trees (an average of twenty trees per student);
 - the military and convicts are to aid in tree planting;
 - tax breaks: -farmers are granted income tax breaks for tree planting;
 - a ten-year territorial tax exemption is granted for growing new forests.

3.1.3 Wildlife and Hunting

3.1.3.1 Decree no. 8-70 of February 10, 1970 promulgating the General Hunting Law (Ley General de Caza)

- Provisions: -declares wild animals the exclusive property of the nation;
- conservation, reproduction and increase in all forms of wildlife is declared a matter of national emergency;
 - the introduction of species tending to alter the natural balance is categorically prohibited;

- provides for the establishment of national parks, refuges and reserve zones; hunting areas are to be set aside by the Ministry of Agriculture;
- four categories of hunting are established:
 - domestic consumption; scientific investigation; sport; and commercial
 - hunting for food is justified under circumstances where necessary to support a family's needs;
 - licenses are required for the capture of animals for scientific purposes;
 - commercial capture of animals is permitted only in the case of songbirds and ornamental birds and is to be subject to a fee;
 - sport hunting requires a license and is permitted only for animals considered as game animals—such matters are to be specified by regulations; licenses are to be issued by the Division of Flora and Fauna (Vida Silvestre y Fauna) of the Directorate General of Renewable Natural Resources of the Ministry of Agriculture;
 - hunting season: from November to March for mammals;
from September to February for birds;
 - hunters are defined as all persons who capture wild animals whether for food, study, sport, or scientific purposes; all such persons are subject to legal regulations; foreigners defined as hunters require licenses; most hunting activities are open to Guatemalans without such licenses;
 - hunting methods:
 - license required for hunting weapons;
 - certain practices such as hunting with lanterns or explosives are prohibited.
 - protected species (see Appendix A).
 - penalties: penalties including fines and prison sentences are specified for infractions of the law.

Implementation: The law is generally to be carried out by the Directorate General of the Ministry of Agriculture through its Division of Flora and Fauna.

3.1.4 FISHERIES LEGISLATION

3.1.4.1 Decree no. 1235 of January 13, 1932 on Fish and Fishing

[DETAILS TO BE SUPPLIED]

3.1.4.2 Decree no. 1470 of June 23, 1961 concerning the rational regulation of national fishery resources and of the fees to be collected for the granting of licenses for fishing in territorial waters.

[DETAILS TO BE SUPPLIED]

3.1.4.3 Resolution of August 16, 1962 approving the regulation on the exploitation of the fishery resources of the country

3.1.4.4 Resolution of February 12, 1968 concerning the prohibition of corte de tul in Lake Atitlan

3.1.4.5 Resolution of 10/27/71 prohibits for five years the capture, circulation, and trade of green turtles (Chelonia, Mydas)
E.G. Nov. 2, 1971

3.1.4.6 Resolution of November 15, 1978 authorizing fishing throughout the year in Lake Atitlan in the Department of Solola
D.C.A. November 22, 1978

3.1.5 AIR AND THE ATMOSPHERE

Health Code: Article 115, which grants to the Ministry of Health the authority for regulating air pollution from industrial sources, does so in very general terms: prevention of nuisances

Municipal Code: Articles 24,25, and 28 grant to the municipalities the authority to regulate bus exhaust emissions. The municipality of Guatemala City has issued regulations as the Reglamento de Transportes Urbanos para Autobuses-1971.

There is no statutory authority for any agency to regulate other vehicle emissions.

Other pollution control provisions, pertaining to air pollution on the work site, are contained in the Labor Code.

3.1.6 PROPOSED POLLUTION CONTROL LEGISLATION

Draft Law on the Conservation and Improvement of the Environment
-prepared in 1976 by the Inter-Ministerial Commission (see 2.1.1)

-Provisions: would create a centralized environmental agency (Secretaria) directly responsible to the president with the authority to issue regulations and set national standards and limitations for air, water, and noise pollution, for natural resource exploitation (as it effects environmental quality), for regulation of solid waste, and for control of billboards. The law, which would also regulate wildlife and endangered species and provide for the conservation of other natural resources, including the establishment of parks and ecological reserves, would give the general public authority to enforce its provisions.

The Draft Law's prospects are uncertain: it was sent back by the President, whose approval it requires, for restudy in 1977.

3.2 Non renewable resources

3.2.1 Mineral resources

3.2.1.1 Mining Code, Decree Law 342 of April 22 1965

- to be interpreted in light of paragraph 5 of Article 129 of the Constitution, which provides that the subsoil, deposits of hydrocarbons and minerals, and any other organic or inorganic substance in the subsoil belong to the nation;
- all minerals and quarries belong to the state;
- the Bureau may grant to private persons the right to survey, explore and exploit minerals; state may carry out these operations itself;
- state may declare specific areas closed temporarily or permanently to mining activities when the public interest so requires or when these are included in programs of urbanization or forestry, archeological or zoological resources to be developed there; but existing operations at the moment of such declaration remain valid;
- licenses granted for reconnaissance, exploration, exploitation
- derived mineral rights:
 - in connection with a concession, the following rights are granted:
 - construction and use of water supply and drainage systems through any farms located between the source of water and discharge thereof and the mines, smelting plants and other installations on the concessions, such easements including the right of passage for the maintenance of such works;
 - upon authorization of forestry authorities or other corresponding authorities of the municipalities or of the decentralized agencies, concessionaire has the right to use the ordinary timber found on national lands within the boundaries of the concession for everything connected with the works and operations;
 - he may make use of the waters flowing through natural or artificial channels outside the area of the concession for such purpose as he considers advisable, in accordance with civil legislation on this type of easement;
 - concessionaire may also use for the works and operations of the concession or related purposes public or private waters as well as those which flow out of or appear from mining operations, provided that: the residents of cities, towns or settlements whose supply themselves from these waters are not adversely affected; the amounts used are not greater than those needed for the concession; use of water from navigable rivers does not impede flow or navigability; the waters used do not make useless nor contaminate the flowing waters or lakes or lagoons into which they discharge; and the waters containing sediments, colloidal substances or sands in suspension are permitted to settle in a closed space or area prior to permitting their runoff;
 - under stated conditions a second concessionaire may utilize the water used by another concessionaire
 - plans for operations must be up-to-date and available;

Implementation: the executive branch, through the Ministry of Economy's Department of Mining, Hydrocarbons and Nuclear Energy, hears, processes, and resolves all questions concerning mines, provided there is nothing of a contentious nature which would fall under the jurisdiction of the regular courts.

3.2.1.2 Petroleum Law of 1975

In contrast to the previous law (the Petroleum Code of July 7, 1955), this law does not authorize the granting of concessions but rather provides for contracts which strictly delineate the responsibilities of companies operating in Guatemala. The Guatemalan government is to receive a certain percentage of the returns from petroleum extracted by such companies. Refining and transportation of petroleum are made the responsibility of the state.

-enforcement: Secretary of Minerals, Hydrocarbons and Nuclear Energy.

[Petroleum Code: Decree 345 of July 7, 1955
(abrogated by above law)]

- all natural deposits or occurrences of petroleum located within the land or maritime boundaries of the republic or within the outer limit of the continental shelf belong to the nation, and their ownership is inalienable and inprescriptible;
- assignment of petroleum rights is regulated;
- holders of rights must take precautions to avoid wastes and dangerous acts
- state may deny the granting of petroleum rights in lands corresponding to agricultural, grazing or industrial regions, if it deems that petroleum operations in such areas may be contrary to the petroleum policy of the country (Article 2).]

3.2.2 SOIL

There is no comprehensive legislation dealing with soil conservation.

Resolution of January 21, 1966 creates the permanent National Coordinating Committee for Programs of Soil, Fertility and Vegetable Nutrition as a dependency of the Ministry of Agriculture.

No information on this committee or its activities could be found and the law was not available for examination.

3.2.3 COASTS AND BEACHES

Decree 2-76 of 6/18/76 declares Guatemala's territorial sea to be 12 miles and established an exclusive economic zone of 200 nautical miles

D.C.A. July 1, 1976

3.3 LAND USE AND AGRICULTURE

3.3.1 Land Use

Municipalities have the responsibility for planning and regulating land use. The Municipality of Guatemala City has issued zoning regulations for new industry (Reglamento de Localizacion e Instalacion Industrial, August 2, 1971).

3.3.2 Land Ownership and Reform

Decree no. 1551 of October 17, 1962: Agrarian Transformation Law

- The major agricultural legislation, this law establishes the National Institute of Agrarian Transformation (INTA), with responsibility for planning, developing and executing the cultivation of uncultivated or poorly cultivated land, and also for changing the social milieu;
- establishes the definition of idle land (land which is not cultivated or which yields less profit than that established by regulations; generally speaking, land that is abandoned or inadequately exploited, or land whose yield is too low); but forests on arable land are not idle if up to 50% of trees are of commercial value; forest reserves; mining areas);
- idle land may be expropriated by the INTA
- establishes agricultural development zones: those areas requiring government intervention for proper development;
 - areas can be declared as ADZs; subsidization available for development of these lands;
- family-owned farms (patrimonio familiar)

- single person is the owner; the land must fulfill certain requirements , including economic sufficiency of the production of the land; production is market-oriented
- technical and financial aid
- may be established by the government
- public lands
 - such lands not being used by the INTA ;
 - may be rented to private persons
 - privately-owned rural land may be found to be in excess--it then reverts to the nation as a whole.

3.4 PESTICIDES

Decree 43-74 of 5/30/74 enacts the law regulating the importation, manufacture, storage, transportation, sale and use of pesticides.

See also: Resolution of 4/19/74 (D.C.A. May ;9, 1974)

-issued by the Ministry of T. y Prevision Social

Resolution of 7-11-68 issues the regulation on Agricultural Pesticides. E.G. July 27, 1968; temporarily suspended by Resolution

Acuerdase cancelar el registro del Pesticida denominado "Phosbel", en todas sus formulaciones y de todes aquellos productos cuyo ingrediente principal activo es el "Leptophos," prohibiendo su importacion, elaboracion, almacenamiento, transporte, venta y uso en el ramo agricola

26 October 1977. D.C.A. vol. 108, January 26, 1978, no. 6.

Order No. SP-A-35-71 of 28 April 1971 of the Minister of Public Health and Social Welfare establishes standards for "biological residues" and incorporates these in the Regulations for the inspection of meat and edible meat products

Limits are laid down for residues of pesticides, among other things, in meat products. "Biological residue" refers to any substance remaining in the animal at time of slaughter or following slaughter, as a result of treatment with or exposure to a pesticide, an organic compounds, etc.

4.0 RESOURCES

4.1 WATER RESOURCES

A recent survey of the water resources situation in Guatemala stated that only about 3% of Guatemala's abundant resource were currently being used (Report of the Regional Preparatory Meeting...1976). Problems, however, arise from the geographical distribution of these resources in relation to water-demanding activities; in the Guatemala Valley, for example, the limit of the water supplies is said to have almost been reached. Furthermore, it has been estimated that by the beginning of the 21st century total demand will be equal to the average runoff of the country and that a considerable part of the hydroelectric resources will be used.

4.1.1 RAINFALL, TOPOGRAPHY, AND CLIMATE

4.1.1.1 The resource

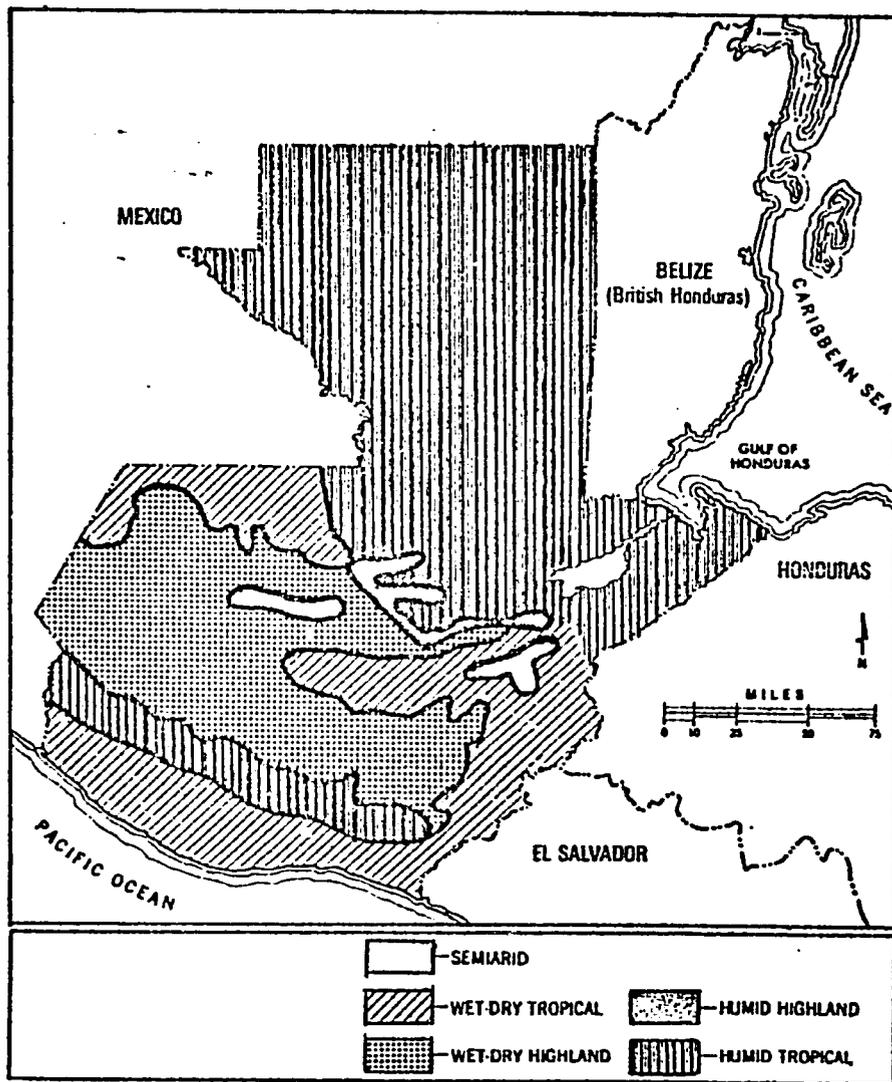
Guatemala lies entirely within the tropical zone, but its climate is influenced both by the Temperate Zone to the north and by its predominantly mountainous topography. The country is traversed by the Sierra Madre Range, which runs from Mexico southeastward to El Salvador and Honduras, dividing the country into four landforms:

- the Peten Lowlands of the north, covering about a third of the country;
- the Pacific Lowlands, reaching inland from the ocean to a distance of 10 to 35 miles;
- the Caribbean Lowlands, lying between the lowlands of Belize to the north and those of Honduras to the south, extending inland from the coastal plain along three stream valleys;
- the Central Highlands, varying between 95 and 145 miles in width; these comprise the largest landform and have several spurs from the main Sierra Madre range, including the Sierra de los Cuchumatanes, Sierra de Chuacus, and Sierra de las Minas.

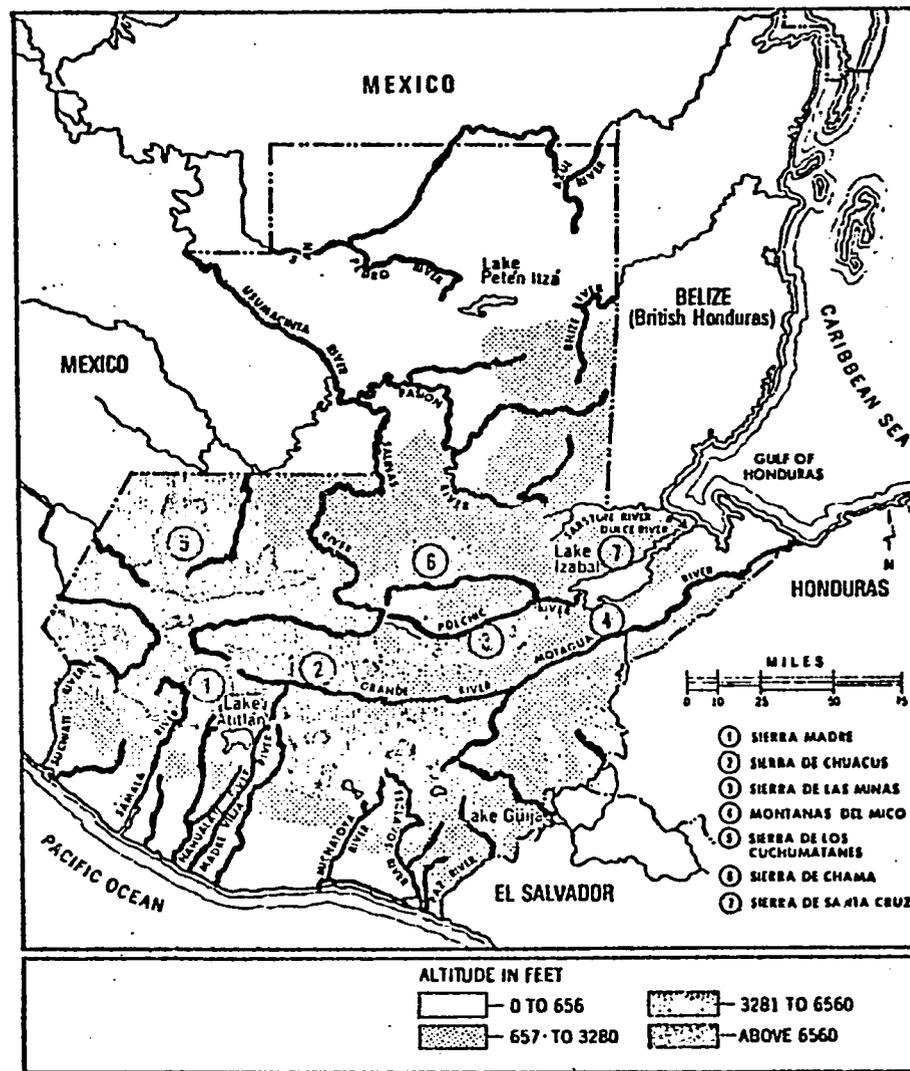
Twenty-one volcanoes--some still active--occur in the Central Highlands. Earthquakes are frequent in the southern part of the country, the major fault zone running some 240 kilometers from Guatemala city to Puerto Barrios in the Montagua valley; the last major earthquake, which occurred in February 1976, was the worst in the northern hemisphere since the San Francisco quake of 1906. Related to both volcanic and seismic activity are the tsunamis, long-period sea waves, which may occur along the Pacific Coast.

Temperature varies with altitude, three temperature zones generally being recognized: the tierra caliente (hot land)--with altitudes of up to 1,000 feet--of the coastal lowlands and the northern department of Peten, where mean daily temperature maximums are in the high

RAINFALL PATTERNS IN GUATEMALA
(from Dombrowski 1970)

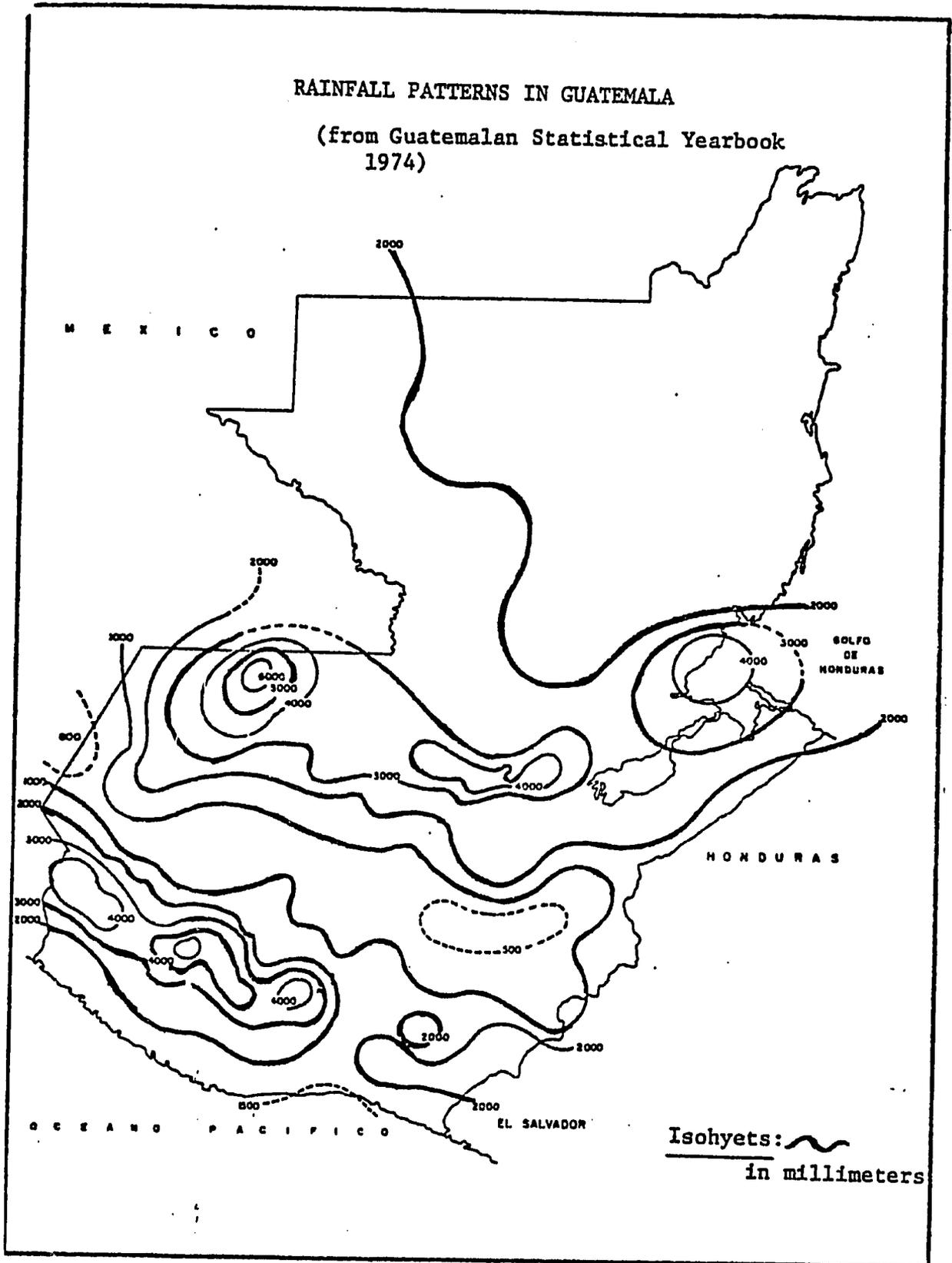


RIVERS AND MOUNTAINS OF GUATEMALA
(from Dombrowski 1970)



RAINFALL PATTERNS IN GUATEMALA

(from Guatemalan Statistical Yearbook
1974)



80's and low 90's; the tierra templada (temperate land) at altitudes between 1,000 to 1,900 meters, with mean annual temperatures as low as 63 degrees fahrenheit in the upper levels; and the tierra fria (cold land) of the upper altitudes, where mean annual temperatures range from 63 degrees F to 41 degrees F. The tierra fria is subject to greater seasonal and daily variations than are the coastal areas; at the highest levels (Mont Tajumulco in the Department of San Marcos—13,824 feet/4,220 meters) freezing temperatures may occur even during the generally warmer dry season.

Rainfall (see maps, pages 35a and 35b) also varies considerably throughout the country. Most areas of the country experience both dry and wet seasons that vary in both length and intensity. Most dry seasons, however, last about six months, with the driest period running from December through March. Rainy season begins around April in the lowlands and usually some time in May in the Central Highlands.

Rainfall levels increase between the Pacific Ocean and the mountains ranging from about 55 inches at San Jose on the coast to as high as 200 along the southern mountain slopes. The highest yearly levels of precipitation are reported at stations in El Quiche Suchitepequez, and San Marcos, all of which are on the southern slopes of the Central Highlands. Rainfall tends to be somewhat lower on the northern and eastern sides of the mountain divide and generally decreases as one moves from higher to lower elevations. In some areas, wet season rainfall is torrential and may be as high as 20 inches per month (Quetzaltango, Quiche, Solola, San Marcos, Suchitepequez).

Evapotranspiration potential varies throughout the country. Maps prepared by the National Geographic Institute based on data provided by DIRENARE in 1971 cover the November through April dry season. These indicate that evaporation during these periods is strongest along the strip of land along the Pacific Coast (over 1000 millimeters) and weakest in areas of the Western Highlands (less than 750 millimeters), including parts of Quetzaltenango and Totonicapan. Throughout the vast El Peten area of northern Guatemala, as well as in the Caribbean coastal plain, the level of potential evapotranspiration ranges between 900 and 950 millimeters (Guatemala. Instituto Geographico Nacional. 1976 map 3.3).

4.1.1.2 Utilization of rainwater

Most Guatemalan agriculture takes place under rainfall conditions. However, rainfall patterns tend to limit agricultural development in some respects. Because of the wide seasonal variation in rainfall on the South Coast, for example, it is difficult to maintain stable feed levels for dairy and beef cattle; the long dry season in the highlands also means a reduced carrying capacity for upland pastures and makes for difficulties in starting fruit trees as well.

Heavy rainfall following the long dry seasons is said to aggravate soil erosion in some areas.

4.1.1.3 Droughts

Droughts in recent years have been responsible for decreased agricultural production in various parts of the country. A long-lasting drought in 1977-78, for example, cut coffee production, while drought in the eastern area of Guatemala led to decreases in the production of beans in 1977.

4.1.2 Rivers (see map showing major rivers, page 35a)

4.1.2.1 The resource

A large number of rivers, most arising in the central Highlands of the country, drain Guatemala. There are 17 major river basins flowing toward the Pacific; these drain 26,344 km², about 24% of the land area of Guatemala. Four river basins, two of which (the Rio Dulce and the Rio Motagua) consist of two or more sub-basins, flow toward the Caribbean; these drain about 30,743 km², about 28.5% of the land area of Guatemala. Two major river basins, the Grijala, consisting of 3 sub-basins, and the Usumacinta, consisting of 7 sub-basins, flow toward the Gulf of Mexico, draining 50,803 km² or about 47.1% of the country. River flow is said to have been adversely affected by silting ultimately traceable to deforestation along watersheds; the Motagua, for example, is reported to have lost more than than half of its volume in the last twenty years ("Forestry law..."1979: 108).

4.1.2.2 Utilization of rivers

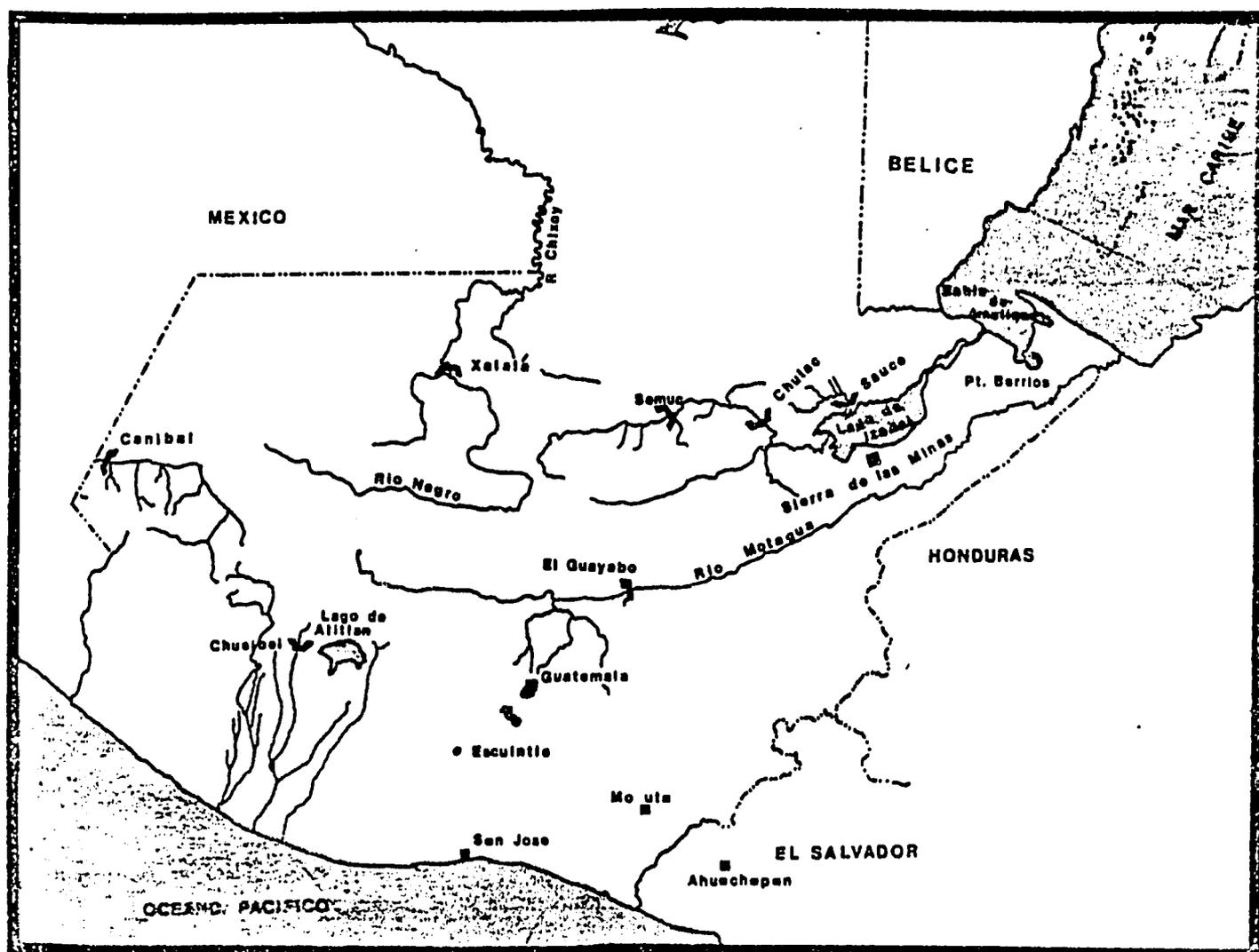
4.1.2.2.1 Navigation:

Although Guatemala has many thousands of miles of rivers (the river complex formed by the Chixoy O Negro, the Salinas and the Usumacinto along is 728.85 kilometers long and the Rio Motagua flows 486 kilometers from its source in El Quiche department to the Caribbean), there are only about 260 kilometers of rivers that are navigable year-round, while a total of 730 kilometers are navigable during high-water season. The Motagua is navigable along about 192 kilometers of its length, but the only major inland route is formed by the Lake Izabal-Dulce River system, which empties into the Bay of Amatique on the Gulf of Honduras. Other lakes and rivers serve as local transportation routes.

4.1.3.2.2 Hydroelectric power

The hydroelectric potential of Guatemala is estimated to be about 4,000 megawatts. The rivers flowing from the mountains to the Pacific are said to have particularly high hydroelectric potential;

HYDROELECTRIC POWER LOCATIONS UNDER INDE'S ENERGY MASTER PLAN
(from Goodland and Tillman 1975:9-10)



PROJECT NAME	DEPARTMENT	RIVER	Reservoir				
			POWER (MW)	LENGTH (km)	AREA (km ²)	VOLUME (106m ³)	DAM HT(m)
El Guayabo	El Progreso	Motagua	80	43.8	43.8	2250	120
Chulac	Alta Verapaz	Cahabon	221	44	37.3	1738	180
Semuc	Alta Verapaz	Cahabon	95	-	1.0		10
Xalala	Alta Verapaz	Chixoy	125	38	41.6	1000	75
El Sauce	Sauce	Izabal	70	44	16.0	736	110
Canibal	Canibal	Huehuetenango	50	7.0	6.0	284	100
Lake Atitlan and Chusibel	Solola	Samala and Nahualate	31				10

they presently serve to supply the major portion of electric power available in Guatemala. The Samala River serves the plant at Santa in Quezaltenango, and the Michatoya River serves the hydroelectric plant at Palin, Escuintla.

Total hydroelectric output in 1974 was 659,370 kWh, about 16.5% of the country's hydroelectric potential.

INDE, the agency charged with development of hydroelectric power, has developed a Master Plan for Electrification involving increased electrical production from both thermal and hydroelectric sources. (see Goodland and Tillman 1975). The seven hydroelectric projects as reviewed by Goodland and Tillman in 1975 are indicated by the map and table on page 37a.

4.1.3.2.3 Irrigation

Rivers serve as a source of water for irrigation, but Guatemala's irrigation potential has been underutilized.

<u>Total irrigation: in 1,000 has.</u>			
<u>1961-65</u>	<u>1966</u>	<u>1971</u>	<u>1976</u>
38	45**	60**	62**

Irrigated land accounts for only about 4.29% of total farmed land dedicated to both harvest and permanent crops. In 1964 only 3.5 per cent of the total cultivable area was irrigated. Existing irrigation has tended to be controlled by large farms. According to the 1964 agricultural production census, for example, of 14,391 farms using irrigation (representing 52,355.7 hectares of irrigated land), about 82 percentage of these hectares were on farms of greater than 45 hectares and 39.5% on farms of more than 900 hectares.

Government irrigation efforts, conducted under the Division of Water Resources of the Ministry of Agriculture (see 2.1.2.1), have been concentrated mainly in the Motague River Valley. The country is presently planning to develop its irrigation potential in conjunction with hydroelectric projects (see Goodland and Tillman 1975).

4.1.3.2.4 River Fisheries

Fish vary in quantity in the rivers of Guatemala. Goodland and Pollard (1973:24), for example, found that most of the Chixoy River in the area designated for joint hydroelectric and irrigation development was unusually deficient in fish, there being no persons deriving their incomes solely from fishing. A suggested cause for the low numbers of fish was the heavy silt load carried by the river. Other rivers such as the Polochic serve as sources of fish, but fishing in general, especially in the inland waters of Guatemala, is not of

great importance. (See also 4.5.2.)

4.1.3.3 Pollution of Rivers and Water Quality

Guatemala City has a main collecting sewerage system for both stormwater and domestic wastewater but no sewage treatment system; the rivers which ultimately collect this wastewater are therefore heavily contaminated. Because these rivers are used by rural populations for washing and cleaning, among other things, such river pollution represents a significant health hazard (GTZ 1978:4).

4.1.3 Lakes

4.1.3.1 The Resource

Guatemala has about twenty lakes of various sizes, the largest being Lake Atitlan in Solola Department (130.10 km²) and Lake Izabal in Izabal Department (589.6 km²).

Lake Atitlan situated about 65 miles southwest of Guatemala City is of special interest. Situated amid spectacular volcanic peaks and renowned for its clear waters, the Lake is the home of abundant wildlife, the most famous of which is the Atitlan Grebe (Podilymbus gigas), a rare waterbird occurring nowhere else in the world. Fed by small mountain streams, the Lake has no outlets, inflow being approximately balanced by evaporation and seepage.

Lake Amititlan is a somewhat smaller lake about 20 kilometers south of Guatemala City. While Lake Atitlan is still relatively pristine, Lake Amititlan has suffered significant degradation because of its proximity to the capital city.

4.1.3.2 Utilization of lakes

4.1.3.2.1 Tourism

Lake Atitlan is the location of considerable tourist activity. Hotels and tourists resorts presently tend to be concentrated at Panajachel on the northern shore, but tourist development plans call for the construction of six large scale apartment towers of as many as 23 stories at Panajachel as well four similar four similar structures on the opposite shore of the lake. These buildings will have the adverse effect of bringing to this still relatively unspoiled lake thousands of people and

their sewage (Goodland and Tillman 1975, page 85). Lake Atitlan, because of its proximity to Guatemala City, has been the location of many vacation homes, which, because of frequently inadequate sanitary facilities, have played a role in the degradation of the waters of the lake.

4.1.3.2.2 Fisheries and the case of the large-mouthed bass in Lake Atitlan

Only Lake Atitlan has been an important focus of fishing activities, principally because of the fresh water crabs which have been an important component of the diet of local inhabitants.

The native fish stock of the Lake and the habitat of the rare Atitlan Grebe were both seriously threatened by large-mouthed bass (*Micropterus salmoides*) introduced into the lake in September 1958 and again in June 1960. Fingerlings of the bass grew at a rapid rate and competed so successfully with native species of both birds and fish for food that the crab industry slumped and populations of native fish and other aquatic life dropped drastically. There have been attempts to rectify this situation through the introduction of other fish species and the reintroduction of nearly exterminated species such as the Pescadito (*Poeciliopsis gracilis* and *Poecilia sphenops*). Rescue operations for the Grebe are reported to have resulted in the gradual restoration of its numbers.

4.1.3.2.3 Hydroelectric power development

4.1.3.2 Pollution of lakes [SOME DETAILS TO BE SUPPLIED]

4.1.4 GROUNDWATER

4.1.4.1 The Resource

Little data on groundwater could be found. There do not seem to have been groundwater surveys conducted in Guatemala.

4.1.4.2 Utilization of groundwater

It has recently been estimated that about 60-70% of the 160 million liters of drinking water consumed daily in Guatemala City comes from groundwater sources. In fact, the actual amount of groundwater consumed is said to be higher because this estimate fails to account for a large but unknown number of unregistered wells. This heavy demand plus water loss related to deforestation in the area, is reported to be leading to a permanent decrease in the groundwater supply. Losses also arise from leaking in the water distribution system. (GTZ 1978: 3)

4.2 FOREST RESOURCE

Estimates of the extent of the forest resource of Guatemala vary widely. The most recently issued FAO statistics place it at 64,000 square kilometers or some 59% of the total land area of the country, an estimate similar to the 57% stated by the Central Intelligence Agency in the most recent edition (January 1979) of its National Basic Intelligence Factbook. Other estimates are far lower. The Guatemalan Association for the Defense of the Environment recently estimated that only 36,100 square kilometers or about 33% of Guatemala is still forested, while Walter Mittak, an FAO consultant who has been instrumental in forming forest policy in Honduras estimated it at 36.3% in 1975 ("Tree Troubles"...1978:301). FAO figures cited by Wadsworth for the late 1960's are curiously in conflict with the more recent ones mentioned above in placing total forest area at only 41,000 square kilometers or about 38% of the total land area of the country. It could not be ascertained to what extent any of these figures reflect the findings of a still only partially reported FAO-Guatemalan government study of Guatemala mentioned by Shane (1978) and other sources.

Whatever the actual percentage of forest land, however, it is clear from most sources that increasing and uncontrolled loss of forests is a problem of major concern in Guatemala.

The management of the forest resource is in the hands of two organizations: INAFOR—established by law in 1974 (see section 2.1.3), the government agency responsible for forests throughout most of Guatemala; and FYDEP (Fomento y Desarrollo del Peten) (see 2.1.6), which counts forest management as one of its many concerns as the agency responsible for the development of the one-third of the country comprising Peten Department, the most forest region in Guatemala. In addition to levying a twenty-percent charge for the extraction of forest products, FYDEP runs several logging and sawmill operations in El Peten.

4.2.1 The resource

Forest growth is rich and varied throughout Guatemala, which, as a result of various climatic, physiographic, and soil conditions has the most diversified plant growth of any country in Central America (Steyermark 1950); there are estimates that the country's forests contain some sixteen species of coniferous and some 450 species of broad-leaved trees. Several forest zones can be identified.

In the Pacific Coastal area, wet lagoons filled with mangroves lie inland from the shore. The coastal plain beyond the shore is predominantly savanna, interspersed with semideciduous forests. Further inland, there is tropical semideciduous forest covering the foothills and lower slopes of the highlands, while at heights of from 2,000 to 5,000 feet, there are still remnants of the once tropical broadleaf forest growing among the coffee plantations which now dominate this area.

In the highlands, there are still traces of the once extensive pine and oak forests that covered the hills before much of the land was cleared for subsistence agriculture. The major trees in the area of the Chixoy Development Project in the western highlands as listed by Goodland and Pollard (1974) include three types of pine (Pinus oocarpa, P. montezumae, and P. pseudostrobus), three types of oak (Quercus peduncularis, Q. acatenangensis, and Q. brachystachys), one Malpighiaceae (Byrsonima crassifolia), and one Dilleniaceae (Curatella americana). The Guatemalan fir (Abies guatemalensis), endangered because of its use in religious ceremonies, grows only in the high-mountain wet forests of the highlands between 2700-3500 meters and is most plentiful near Totonicapan.

On the Caribbean Coast, with the exception of plantation areas such as the as the Motagua River Valley, are tropical rainforests of broadleaf evergreens.

The most densely forested area of Guatemala is El Peten, the northern department comprising about one third of Guatemala. Here grow an estimated 80 per cent of the hardwoods of the country. Whereas some tropical rainforest occurs in the southern parts of the department, most of the area is dominated by tropical evergreen seasonal forest. In the northern areas, in the vicinity of the famous Tikal ruins, for example, there is upland forest of mahogany (Swietenia macrophylla), Spanish cedar (Cedrela odorata), ceiba (Bombax ellipiticum)--the Guatemalan national tree, zapote (Manilkara achras), ramon (Brosimum alicastrum), and various palms. There is also a small area of pine forests--a rarity for this part of the country--near the northeast corner of Tikal National Park. In poorly drained areas (bajo) throughout El Peten, there are dense almost impenetrable forests of logwood (Haematoxylum campechianum) and other low spiny leguminous species; between these areas and the upland forests are found spiny escoba palm (Cryosophilia argentea) and the botan palm (Sabal morrissiana). Where upland forest has been cleared it tends to be replaced by fast-growing Cecropia. In the southern parts of the province, there are small savanna areas with pine forests (Pinus caribea), among which grow oaks, palms, and sedges (Tikal...1976?:8-10).

4.2.2 Utilization of forests

Figures presented by Wadsworth (1971?) indicate that about 2,650,000 hectares, or about 65% of the forest land of Guatemala was accessible and under exploitation for timber or fuelwood. Wadsworth also cites figures indicating that, if soil capabilities, climatic and topographic factors are taken into account, about 6,330,000 hectares or about 59% of Guatemala is unsuitable for crop or forage agriculture; by this account 3,180,000 hectares or about 50.2% of this area would be suitable for timber production, while the remaining 3,150,000 hectares would be reserved as protective forest cover, serving for soil and water conservation as well as for wildlife habitat.

4.2.2.1 Wood and forest products

Most of the broadleaved (non-coniferous) hardwoods suitable for exploitation are in the vast El Peten region of northern Guatemala, while conifers are found chiefly in the southwestern mountains. By one estimate there are about 300 species of tropical, subtropical, and temperate varieties of wood capable of being exploited. Recent exploitation of wood for commercial purposes has concentrated on El Peten and the area known as the Transversal del Norte. Government plans to open up the El Peten department, including the construction of roads and ports to serve this area, should considerably increase logging and wood production in that area. There are also plans to establish sawmills and a veneer cutting plant.

Forest utilization is indicated in the following tables:

UTILIZATION OF FORESTS (from the FAO Yearbook of Forest Products 1975)*

ROUNDWOOD REMOVALS (thousands of cubic meters excluding bark)

	Coniferous			Broadleaved			Total		
	1964	1974	1975	1964	1974	1975	1964	1974	1975
Sawlogs, veneer logs and logs for railway ties	286	236	449	58	168	87	344	404	536
Other industrial wood	8	27	10	--	--	--	8	27	10
Fuelwood	3,294	4,220	4,220	600	900	900	3,894	5,120	5,120
TOTALS	3,588	4,483	4,679	658	1068	987	4,246	5,120	5,666

ROUNDWOOD EXPORTS (thousands of cubic meters)

	1964	1973	1974	1975
Broadleaved and Coniferous	1	8	8	7

SAWNWOOD PRODUCTION (thousands of cubic meters)

	1964	1973	1974	1975
Coniferous sawnwood	110	183	144	225
Broadleaved sawnwood	25	28	59	44
TOTAL	135	211	203	269

SAWNWOOD EXPORTS (thousands of cubic meters)

	1964	1973	1974	1975
Coniferous sawnwood;	7	60	50	28
Broadleaved sawnwood	7	11	16	10

*1975 Figures are FAO estimates

As indicated by the preceding table, fuelwood accounts for about 90% of the wood used in Guatemala. Some of the hardwoods cut have been exported, but most of the softwoods are used domestically. Limits on the exportation of timber have been periodically imposed by government decree.

Wood products produced in Guatemala include construction materials such as veneer sheets and plywood (about 23,000 cubic meters in 1974), printing and writing paper (about 12,000 metric tons in 1974), and other paper products such as construction paper and wrapping and packaging paper (about 16,000 metric tons in 1974). Outputs of all of these products have increased by as much as a factor of as much as two or three since the mid-1960's. Paper production is, however, based on imported rather than on locally produced wood pulp.

One important forest product, the object of the most important forest activity in El Peten department chicle, the base for chewing gum, derived from the zapote tree. Chicle is not grown on plantations; rather, wild zapote trees are tapped by chicle gatherers, usually beginning in June of one year and continuing through March of the following year. Chicle is processed into large balls of gum before being exported to the United States.

Other important forest products are vanilla, sarsparilla, medicinal barks and herbs, camphor, cinnamon, oil-bearing palms, tannin, and bamboo. Another product of Guatemala's tropical forests is "chipe," derived from the Cyathea fern, now listed as an endangered species; the trunk of the fern is used for construction and its root is exported as fertilizer (Shane 1978).

4.2.2.2 Firewood and deforestation

Over 90% of the wood cut in Guatemala is used for firewood, which remains Guatemala's chief energy source; cutting of wood for this purpose is cited as the major cause of deforestation in Guatemala. A recent survey of the situation lists domestic cooking, brick (ladrillo tayuyo) production, lime production, coffee driers, and bakeries as the chief consumers of firewood within the country (ICAITI 1978).

4.2.2.2.1 Domestic use of firewood

It is estimated that about 600,000 rural families use firewood for cooking, accounting thereby for about 1,800,000 felled trees per year.

4.2.2.2.2 Lime production

The production of lime also consumes large quantities of firewood. The limekilns in the town of Cabrican in Quetzaltenango Department are estimated to consume 60 to 75 tons of firewood per week--about 13,000 trees per year.

4.2.2.2.3 Brick (ladrillo tayuyo) works

In the town of El Tejar alone there are 82 brick furnaces, which consume 9,500 to 10,000 trees per year in the form of firewood.

4.2.2.2.4 Coffee driers

An estimated 300 coffee estates employ firewood in their driers, accounting in all for about 40,000 felled trees per year.

4.2.2.2.5 Bakeries

Bakeries consume an estimated 1,800 to 2,000 trees per year in the form of firewood.

4.2.2.3 Other causes of deforestation

4.2.2.3.1 Pine weevil plagues

Considerably forest is said to have been lost to the ravages of pine weevils (Dendroctonus). It was recently observed in Quetzaltenango Department, for example, that hundreds of trees had been totally dried out by these insects. Although the pine weevil has been present in Guatemala for many years, indications are that it may be increasing as a problem. Whereas forest areas infected by pine weevil had been estimated at about 100,000 hectares earlier in 1978, by December 1978 that estimate had been revised up to 200,000 hectares, leading the government to introduce plans for a massive campaign of eradication and control. The problem is particularly severe in San Marcos, Huehuetenango, Quiche, Chimaltenango, and Chiquimla ("Forests in Danger" 1978:393-394).

4.2.2.3.2 Clearing of land for agriculture

The clearing of land for agricultural endeavors is a cause of continuing deforestation in those areas such as the Western Highlands where the already dense and continuously growing population requires land for the production of subsistence crops. Frequently traditional slash and burn agricultural practices are involved in the clearing and working of this land.

Government programs encouraging the colonization of El Peten and other areas of low population density often involve the clearing of forest land which is not actually suitable for agricultural purposes.

4.2.2.3.3 Forest fires

Forests fires, especially in the dry areas, are a continuing threat to the forest resource.

4.2.2.4 Rate of deforestation

Although deforestation is generally acknowledged to be perhaps the leading environmental problem of Guatemala, estimates of the rate at which it is proceeding vary. According to a recent A.I.D. publication, for example, an estimated 30-50% of forest resources have been destroyed since 1950 (A.I.D. 1979:61); an F.A.O. estimate places the rate at 60,000 hectares per year with complete denudation by 2,000 if no action is taken ("Forestry Law..."1978:108); an ICAITI paper from late 1978 states losses at 33% of forest wealth within a ten year period (ICAITI 1978:2); the Guatemalan Association for the Defense of the Environment has stated that only 36,100 of the former 96,368 square kilometers of forest still remain; W.L. Mittak of the F.A.O. says that whereas 64.7% of Guatemala was forested in 1950 only 36.3% was forested in 1975; and Dr. Luis Alberto Ferrate, until recently the head of INAFOR (the National Forest Institute), has cited figures indicating that 65% of Guatemala's forests have been destroyed since the beginning of the century (the last three figures are from "Tree Troubles"1978:301). On a local level, an official in Cabrican in the Department of Quetzaltenango (Western Highlands) has estimated that about 2/3's of forests in his area had been lost (ICAITI 1978:2).

Deforestation in the crowded Western Highlands has been a problem for some time. Concern now focuses chiefly on the Franja Transversal del Norte (Huehuentenango, Quiche, Alta Verapaz, and Izabal) and El Peten, which as the main forested areas of the country are also most seriously affected by deforestation from lumber operations and agricultural settlements.

4.2.2.5 Effects of deforestation

Deforestation, especially of slopes in the highland areas of the country, leads to soil erosion, particularly because cleared land is so frequently put into use without proper soil conservation measures being taken. Such erosion in turn leads to silting of rivers and reduction of their flow. By one report the Motagua River has experienced a considerable loss of total flow in the last twenty years; increased aridity following this reduced flow is said to have contributed to the desert conditions now prevailing in the once sub-tropical Zacapa region of eastern Guatemala ("Forestry Law..."1979:108).

It is also feared that forest clearing and other activities associated with development projects (road building, construction of houses, etc.) may lead to increased erosion, especially in steeply sloped areas where extensive dry

seasons are followed by heavy rainfall (Goodland and Pollard 1974).

Deforestation also threatens wildlife habitat; the habitat of the quetzal, the national bird of Guatemala, has been progressively reduced as land in the highlands has been cleared for agricultural exploitation.

4.2.2.6 Efforts at reforestation

INAFOR, the national forest institute, is reported to recognize the need for reforestation to meet future needs for firewood and charcoal; it has established nurseries within the individual departments of Guatemala and distributes trees for planting free of cost. FYDEP, which administers forestry programs in El Peten Department is reported to have planted 48,000,000 pines and cypresses in El Peten in 1978; the thin soils of this region make prospects of successful reforestation uncertain (ICAITI 1978). On the local level the Mayor of Cabrican in

Quetzaltenango Department reported that 38,000 pines and cypresses had been planted in the area of this municipality in 1978. Furthermore, in order to fell trees in this municipality a special permit is required which will be granted only under the condition that at least ten seedlings be planted. A recent review of the problems of deforestation in Guatemala has observed, however, that INAFOR's reforestation attempts have had only limited success; efforts to educate the public in the need for reforestation and conservations have not prevented reforested pine trees from being cut often only shortly after they are planted. Furthermore, INAFOR's reforestation efforts do not include hardwoods because they take too long to reach maturity (Shane 1978, 13).

The new Guatemalan administration is reported to be placing special emphasis on reforestation, making every effort to increase public awareness of the problem of deforestation. President Lucas, declaring 1979 as "The Year of the Tree," has initiated a major tree planting campaign ("Tree Troubles..."1978). A new emergency reforestation law calls for each student to plant 20 trees, while the requirement for convicts is 50 trees each. Furthermore, farmers are to be allowed income tax breaks for reforestation efforts ("Forestry Law..."1979:108).

However, several problems plague the successful implementation of this campaign. One is the lack of manpower to carry out such a program. INAFOR, the agency charged with implementing the campaign, is still small and inadequately financed. There is only one

academic level forestry engineer on its staff at present, and it will probably take years to train a corps of forestry experts at all levels to police and implement reforestation legislation adequately. In the meantime, however, the burgeoning population is consuming the forests faster than they can grow. Even prior to the passage of the new law, it had been remarked that enforcement agencies, deficient with regard to budgets for both enforcement and personnel, were unable to crack down on logging companies and other who were ignoring reforestation laws (Shane 1978:14). These deficiencies seem likely to continue so long as the government is unwilling to back up its talk of reforestation with money. Despite the publicity involved in the present reforestation campaign, for example, no public funds are being budgeted; labor is to be volunteered by municipalities, and the private sector is to be asked to donate seeds ("Forests in Danger."1978:394).

The response of INAFOR to the problems posed by pine weevil infestations (see 4.2.2.3.1) has not been particularly promising. INAFOR's campaign, scheduled to begin in January 1978, calls for the use of expensive insecticides, a search for resistant varieties of coniferous trees, and reforestation of affected areas, but because of lack of funds for pesticides, the campaign promises to consist of little more than a massive felling of diseased trees. Critics of the campaign claim that attempts to eradicate the disease are not only overly costly but also could have dire environmental consequences. They fear that healthy trees will be felled along with diseased ones and express skepticism about INAFOR's ability to follow through in its reforestation plans. Critics, including the College of Guatemalan Agronomy Engineers, who have sent a message to the president urging him to cancel the campaign, argue that the plague does not automatically mean an end to pine trees, that the diseased trees must rot for the plague to disappear, and that resistant varieties of the trees was spread as the susceptible ones are lost ("Forests in Danger..."1978:394).

Doctor Mario Dary, a biologist, commenting on the campaign and Guatemalan reforestation efforts in general, has stated that until now such reforestation as has been practiced in the country has involved simply planting trees without the supervision necessary to ensure that the trees will grow; he points out that the money necessary for a technically sound program (about \$3,500 per hectare) is not available ("Forests in Danger..."1978:394).

Furthermore, INAFOR's reforestation efforts have always involved conifers, which grow faster than but lack the waterholding capacity of the hardwoods they are often meant to replace.

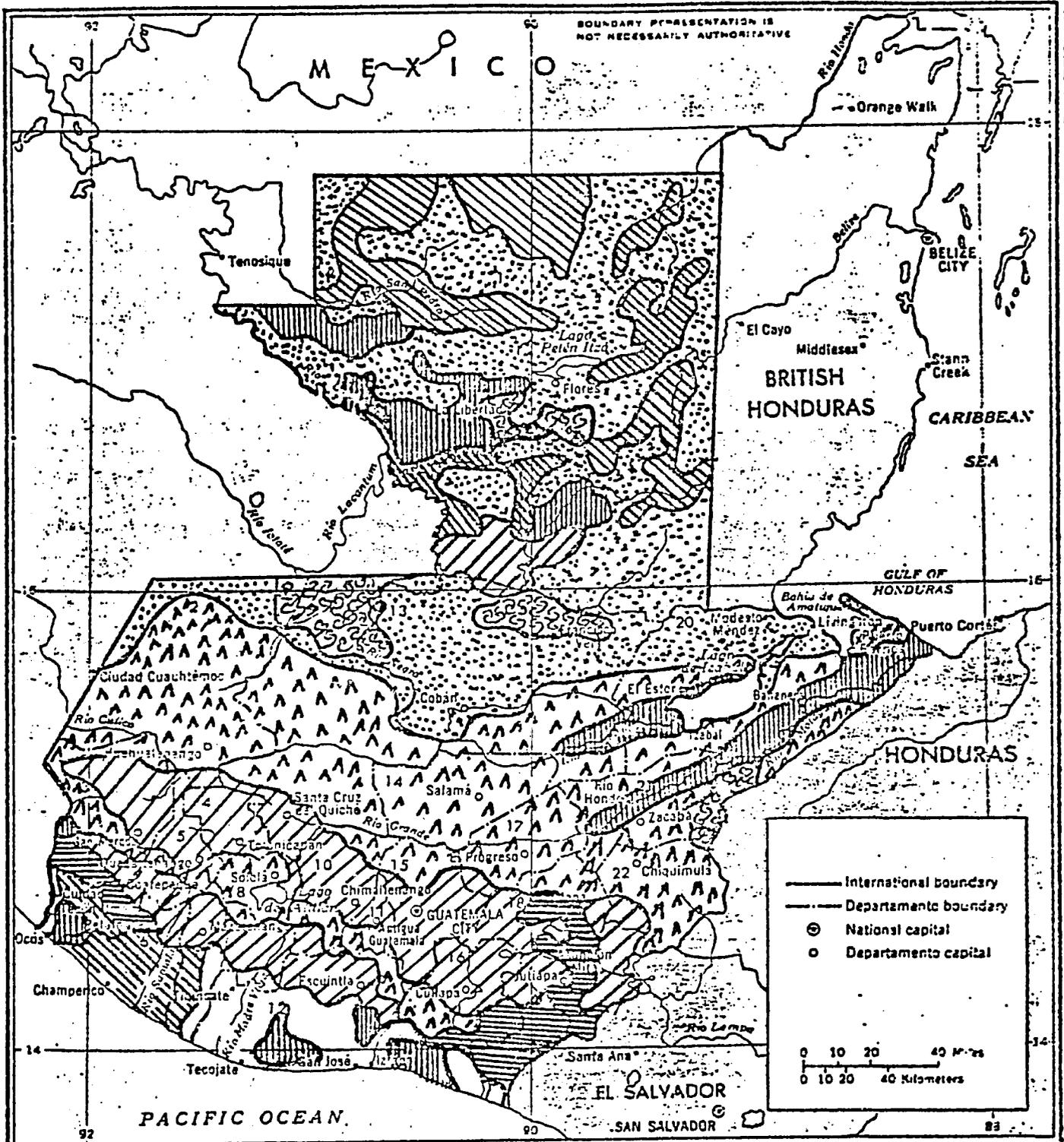
Such questionable programs are also hampered by the possible conflict between reforestation and development efforts. Although felling rights in El Peten, for example, had been cancelled because of growing deforestation, FYDEP, late in 1978 signed con--

contracts granting three companies the right to carry out extract lumber in El Peten. All of the companies are legally obligated to reforest felled areas, but environmentalists have taken little comfort in the announcement of one such company that it was "carrying out experiments to find way to comply with the obligation to reforest" ("Forests in Danger"1978:394).

Goals of development and the preservation of forest resources frequently come into conflict, especially since forested areas such as El Peten and the Franja Transversal del Norte are also the focus of programs for resettlements of peasants from the overcrowded Western Highlands. The development plan for the Franja Transversal del Norte, for example, calls for clearing of forests for crops and pasture even in areas not considered suitable for agriculture ("Tree Troubles"1978:394).

SOILS OF GUATEMALA

(adapted from Wylie 1970)



- | | | | | | |
|---|--------------------------------|---|--|---|---------------|
|  | Alluvial soils |  | Reddish-Brown Lateritic soils |  | Peat and sand |
|  | Humic Gley soils |  | Red-Yellow Podzolic soils | | |
|  | Grumusols (dark, plastic) |  | Terra Rossas (red) and Rendzinas (black) | | |
|  | Ando soils (from volcanic ash) |  | Lithosolic soils (shallow) | | |

4.3 SOILS

4.3.1 The Resource

Guatemala has many different types of soils, which vary considerably in fertility among regions; according to some estimates almost two-thirds of the country has soils with little farming potential. Wadsworth (1971?) cites studies indicating that if soil capabilities, climatic, and topographic factors are taken into account, about 63,000 square kilometers or about 59% of Guatemala is unsuited for crop or forage agriculture. A 1970 study of El Peten, the undeveloped northern area of Guatemala that has been the focus of governmental agricultural development and colonization schemes, states that about 85% of the Department is covered with shallow clayish, poorly drained soils which are highly susceptible to erosion when the now dominant forest cover is removed (Tikal National Park 1976:25).

Major soil types (from Wylie 1970—see map)

Alluvial soils

Occurring along the Pacific slopes and plains, these soils are fertile and well drained, with a loam of silt loam surface and a fine sandy loam subsoil.

Humic Gley soils

Also occurring on the Pacific plains, these soils are poorly drained and usually too wet for cultivation; proper drainage would be necessary to bring them into production.

Grumusols

Occurring along the Pacific coast and in some parts of Peten, these soils, which are difficult to manage since they are sticky when wet and very hard when dry, could be productive if good management techniques are employed.

Ando soils

Found mostly in the mountainous areas of the central highlands, these soils are moderately fertile with loamy surfaces and subsoils containing slightly more clay than the surface soil. Subject to erosion on the steep slopes, they are intensely cultivated on the more gentle slopes.

Reddish-Brown Lateric soils

Deep, well-drained, and friable (easily crumbled), these soils, although the most productive in the country, are not particularly widespread.

Red-Yellow Podzolic soils

Less productive than the Reddish-Brown Lateric soils, Red-Yellow Podzolics occur in a few areas in Central Guatemala; they respond well to fertilization.

Terra Rossas (red clays) and Rendzinas (black or dark brown clays):

These soils occur on the plains and hills in northern Guatemala; both are shallow but their surfaces are high in organic matter.

Lithosolic soils

These stony soils, which dominate the mountains and steep slopes of central Guatemala, are largely forested and have little farming potential.

Peat and sand

In the area northeast of Puerto Barrios along the Gulf of Honduras, occurs acid fibrous peat, interspersed with low ridges of beach sand; it has little agricultural potential.

4.3.2 Soil erosion

Over thirty-five percent of Guatemala's land area has a twelve percent or greater slope and fifty-seven percent has been characterized as subject to from moderate to severe erosion. (A.I.D. 1979:61). Dr. Luis Alberto, former head of INAFOR--the National Forest Institute--has recently cited figures indicating that since the beginning of the century 40% of the productive capacity of the land had been lost through erosion. ("Tree Troubles" 1978:301).

Soil erosion, aggravated by forest clearing and lack of proper soil conservation techniques, is especially severe in the densely populated and heavily cultivated Western Highlands, where soils are especially subject to erosion and where population pressure has led to greater cultivation of steep slopes. Soil losses in this region have been estimated at from 5 to 35 metric tons per hectare annually without soil conservation measures. In the Xaya-Pixcaya watershed alone, for example, an estimated 267 hectares of soil (one foot in depth) are being lost annually; if soil loss continues at this rate, the topsoil in the watershed will be depleted in 15 years. (A.I.D. 1979:61).

Soil erosion in the basin of Lake Amatitlan to the southwest of Guatemala City has been blamed for the increased accumulation of pesticide and fertilizers residues in that lake. Increased settlement of El Peten has led to intensified destruction of

ground cover and consequent soil erosion in that area. Furthermore, soil erosion has been blamed for the silting of important rivers, for example, the Motagua River, which has reportedly seen a reduction in flow over the last twenty years as as result of silt deposits.

4.4 WILDLIFE

4.4.1 The resource

4.4.1.1 Mammals

Guatemala has a wide variety of mammal species, its territory representing the southern limit for some species that are typically North American and the northern limit for others that are typically South America. Some smaller species such as Anthony's Spiny Pocket Mouse (Liomys anthonyi), the Big Deer Mouse (Peromyscus grandis), and the Guatemala vole (Microtus guatemalensis) are endemic to Guatemala and occur nowhere else in the world. Among the larger mammals, many of which are among those listed as rare and endemic by the International Union for the Conservation of Nature (IUCN) are the Central American tapir, the jaguar, the ocelot, the margay, the white-tailed deer, the brocket deer, the river otter, the howler monkey, and the spider monkey. There are over twenty species of bats, six species of squirrels, opossums, shrew, anteaters, gophers, a large variety of mice and rats, foxes, racoons, weasels, skunks, mountain lions, peccaries (wild pigs), and manatees (marine mammals). (Goodland and Tillman 1975, pages 68-70, provide an exhaustive list of Guatemalan mammals with Spanish, English and zoological names).

4.4.1.2 Birds

Colorful and exotic birdlife abounds in Guatemala. Of particular interest is the resplendent Quetzal, the national bird of Guatemala, which is found principally in the montane forests of Quetzaltenango, Huehuetenango, El Quiche, Alta Verapaz, and Baja Verapaz. The quetzal, whose habitat has been increasingly exploited and destroyed in recent years, has been given its own reserve of about 500 hectares in the virgin cloud forest on Volcan Atitlan on Lake Atitlan.

On Lake Atitlan occurs a rare species, the Atitlan Grebe, a flightless waterbird, the total world population of which has been estimated to range from between 90 to 200 individuals. The habitat of this bird has been disturbed, among other things, by tourists in motorboats and by predation by the largemouth bass introduced into Lake Atitlan, and it is feared that fluctuations in water level caused by a proposed hydroelectric project may disturb the vegetation on which the grebe depends for successful nesting. A campaign to save the grebe, in conjunction with protection afforded the bird under the 1970 Hunting Law, has been reported to have been successful in restoring and preserving its nesting habitat (Goodland and Tillman 1975:74).

Other birds of particular interest are the Horned Guan, which inhabits the forest heights of northwestern and central Guatemala, and the Brown Pelican, which is found on both the Atlantic and Pacific Coasts but which has disappeared from Lake Atitlan.

Possible danger to these and other birds could arise from road construction and deforestation. As reported by Goodland and Tilman in 1975, road construction in conjunction with hydroelectric projects could threaten the montane habitats especially of the Quetzal. Another danger to the quetzal appears to be arise from a trade in stuffed quetzals; as recently as 1975 there were reports of crudely stuffed quetzals being sold in shops in Quiche Department ("Quetzal Shelter..." 1975: 32).

Slash-and-burn shifting agriculture (ladang), reportedly still widespread in Guatemala, is also cited as a threat to wildlife habitat.

4.4.1.3 Reptiles

Reptilian life is plentiful; 107 species of reptiles, including amphibians, turtles, crocodiles, lizards, and snakes, are listed as occurring in El Peten alone (Tikal National Park 1976?:40). Among endangered reptiles are morelet's crocodile (Crocodylus moreleti), which is protected by a law concerning the hunting of reptiles, and species of turtles.

4.4.2 Utilization

Provisions of the 1970 Hunting Law covering the hunting of wildlife for food make it clear that wildlife serve as a source of protein for Guatemalans; further details on this utilization of wildlife were, however, not available. It is evident from the 1970 Hunting Law that a certain amount of trade in exotic birds has been conducted; no further details were available, however.

4.4.3 National Parks and Reserves

Reserved areas were first authorized by law in 1949, and further provisions for such areas were later included in the Hunting Law of 1970. The Department of National Parks, a subunit of INAFOR, is generally responsible for such parks.

Beginning as early as 1955, several parks were established throughout the country. The status of these parks and their conformity to international standards for such institutions is uncertain. Whereas the 1971 edition of the IUCN listing of national parks and equivalent reserves listed four parks, the 1974 list mentions only two parks (one of which is only tentatively included), and the 1975 edition lists only one, Tikal National Park, which covers about 57,000 hectares in the Peten Department.* Goodland and Tillman, reviewing the situation in 1975, mention four existing national parks (Tikal, Atitlan, Guatemala, and Rio Dulce), but list 17 national parks proposed by INAFOR.

*Failure to be included on the United Nation-IUCN list indicates that the parks do not meet the criteria established by the IUCN, which include: legal protection (establishment by statute at the highest level); effective protection (sufficient budget and staff to supervise the area); size (a minimum of 1,000 hectares of area in which nature protection is the prime consideration); exploitation (economic activities, with the exception of sport fishing must be prohibited); and management (requirement for the location of tourist facilities, roads, and administrative offices).

Parks on which information was available are listed below. The present status of these parks is not known, and there was no indication of the progress being made by INAFOR in the establishment of the proposed parks listed by Goodland and Tillman (1975:63-64).

Rio Dulce National Park (IUCN 1971 list; tentatively on 1974 list; not on later lists)

established: 1955 area: about 20,000 ha.

Decree of 26 May

status: general protection, no hunting, wood-cutting or quarrying

staff: 2 supervisors and 2 forest guards (1971)

area description: a flat region, hot damp climate, consisting of lake Izabel, the Rio Dulce and its mouth, plains covered with such trees as mahogany and Spanish cedar

animals: whitetail deer Odocoileus virginianus
puma Felis concolor
Central American tapir Tapirus bairdii
CA spider monkey Ateles geoffroyi
North American racoon: Procyon lotor
Tropical avifauna: toucans, egrets, etc.

no research facilities

Santa Rosalia National Park (IUCN 1971 list; not on later lists)

established: 1956 area: 4,061 ha.

status: general protection; periphery is under cultivation;

staff: supervisors and forest guards stationed in neighboring villages (1971)

area description: quaternary hills covered with conifers, especially Pinus occarpa

animals: whitetail deer, racoon, opossum Didelphis marsupialis

no research facilities

Atitlan National Park (IUCN 1971 list; not on later lists)

established: 1955

status: general protection; barely qualified for IUCN's 1971 list because of the number of inhabitants of the area and the touristic exploitation of the lake;

area: unknown--undemarcated

area description: mountainous region; active volcanoes around Lake Atitlan, volcano slopes are covered by forest (pine, cypress, oak), meadows, moss and lichen

animals: whitetail deer, the eastern cottontail Sylvilagus floridanus, squirrel Sciurus deppei; endemic Atitlan or giant pied-billed grebe Podilymbus gigas ***

Naciones Unidas National Park (IUCN 1971 list; not on later lists)established: 1955area: uncertain 450 ha. or
according to 1966 report,
9,125 ha.status: general protection, kept for experimental work in
reforestation (eucalypts, etc.) under the management of
the School of Forestry; included because of effectiveness
of supervisionno special research facilitiesarea description: mountainous region with comparatively cool climate;
afforestation area with cypresses, eucalyptus,
casuarina;animals: eastern cottontail, eastern pocket gopher Geomys sp.;
raccoon, grey fox Urocyon cinereoargenteus.Tikal National Park: 1955 (only park included on 1975 IUCN list)established: 1957area: 57,600 ha.location: El Petenarea description: logwood forest covers about 20-25% of the park
area and palms about 15-20%; the remaining
area is upland forest dominated by ramon, zapote,
or mahogany;wildlife: about 280 species of birds, about 200 of which are per-
manent residents, including tinamous, curassows, guans,
parrots, hummingbirds, trogons, honeycreepers and tanagers;mammals: howler monkeys, spider monkeys, coatimundis,
agoutis, grey foxes, Tamandua anteaters, white-tailed
deer, brockets, peccaries, weasels, armadillos, tayras,
oppossums; present but seldom seen are: jaguars, ocelots,
jaguarundis, pumas, ringtailed cats, pacas, kinkajous,
grisons, and tapirs;reptiles and amphibians: 64 species have been found,
including 13 amphibians, 3 turtles, 1 crocodile, 20
lizards, and 27 snakes.archaeological sites: The Tikal Mayan ruins, dating from 550-900 A.D.Notes: Plan to enlarge visitor facilities and to make the park generally
more accessible to tourism are reviewed in Tikal National Park
(1976?).Volcano Atitlan Quetzal Cloud-Forest Reserve (not on IUCN lists: see La Bastille,
1973)Established: 1972-73area: about 45 ha. on private landLocation: southern slopes of the Atitlan Volcano on Lake Atitlan.area description: most of the area is composed of virgin lower-montane
wet forest at an altitude of between 1,707 to
2,438 meters;wildlife: quetzaladministration: three official game wardens (picked from farm workers)
and six honorary game wardens.

Areas listed by IUCN in 1971 as not meeting its requirements to be considered parks or reserves.

1. Cerro del Baul National Park: 1955 (area not indicated)
2. Cerron Miramundo National Park: 1956; 900 ha.
3. El Pino National Park of estate: 1955; 518 ha.; use for grazing and forestry exploitation;
4. El Reformador National Park; 1955; situated in a built-up area
5. La Laguna El Pino National Park; 1955;
6. Los Aposentos National Park; 1955; 45 ha.

Other parks mentioned in various sources but for which not further information was available are the Alta Vera Paz Quetzal Reserve, a 2,250 hectares reserve established in 1975; and Pacaya Volcano Park, set aside by INAFOR in 1974.

4.5 COASTS, BEACHES AND FISHERIES

4.5.1. Coasts and Beaches

4.5.1.1 The Resource

Guatemala has over 400 kilometers of coastline. The some 320 kilometers along the Pacific coast present black sandy beaches backed by wet lagoons where mangroves grow; offshore waters are relatively shallow and there are no natural harbors. Ports are located at San Jose, the second largest maritime port in the country, handling about 50 percent of imports and some coffee exports. Less active is the port at Champerico, while the minor port at Ocos has been largely abandoned since 1967.

The 112 kilometers along the Gulf of Honduras, an arm of the Caribbean, is flat and open to storms from the Caribbean. The Bay of Amatique (10 miles wide and 25 miles long), provides a sheltered area in which the country's major port, Puerto Barrios, and the Ports of Matias de Galvez and Livingston are also located. Most of Guatemala's foreign trade goes through Puerto Barrios. Matias de Galvez, a nationalized port, handles most mineral exports. Livingston, the major Guatemalan port before the growth of Puerto Barrios, and still the point of export for Verapaz coffee from the Coban, now handles mostly river and coastal shipping

4.5.1.2 Utilization

Tourism

The long beaches of black volcanic sands along the Pacific Coast are a tourist attraction, and there are frequent hotels and facilities appealing to the tourist trade. At Likin, east of San Jose, is a planned resort community, which, with its hotel, yacht club, private airstrip, and condominiums, is the only one of its kind in Guatemala. Tourist trade along the shorter Caribbean coast is less active.

4.5.2 Fisheries

4.5.2.1 The Resource

Guatemalan coastal waters are reported to be rich in fish; this is especially true of the waters of the Pacific Coast, where abundant quantities above all of shrimp but also of tuna, snappers, and mackerel are to be found. Inland waters, while varying somewhat in this regard, appear to be significantly less productive, some areas, such as the development area for the Chixoy River Hydroelectric Development project have been judged to be actually deficient in fish life, and most of the large Guatemalan lakes offer little in the way of either sport or commercial fishing (Goodland and Polard 1974).

Lake Atitlan, for example, may have as little as three indigenous species of fish, and recently introduced species such as serica, pescadita, and gulumina are not utilized extensively. More popular is the common freshwater crab (cangrejo). Large-mouthed bass (Micropterus salmoides) introduced into Lake Atitlan in 1958 and again in 1960 have multiplied rapidly, severely limiting the habitats and numbers of native species of fish, including the nutritionally important freshwater crab, and threatening the food supply and the young of the rare Atitlan Grebe (Goodland and Tillman 1975: 86).

Goodland and Tillman (1975) list about 22 "important" indigenous freshwater fish species and seven introduced species of fish.

4.5.2.2 Fisheries exploitation

Fisheries resources tend to be underutilized, a circumstance traced largely to a lack of interest on the part of Guatemalans in either fish or fishing; local markets throughout large areas of the country do not have large offerings of fish products (Goodland and Tillman 1975: 43). Food and Agriculture Organization (FAO) findings indicate, furthermore, that Guatemala has the lowest per capita consumption of seafood in the world (Dombrowski 1970: 287). It is estimated, however, that more than 50,000 Guatemalan families depend on fishing for their livelihood ("Fish in the Area" 1978:28).

Although small or locally-important fisheries operations such as the freshwater crab industry on Lake Atitlan exist, active commercial fishing operations are limited to coastal areas, particularly along the Pacific Ocean, where commercial quantities of large pink and white shrimp occur. These shrimp are the focus of the only well-organized commercial fishing enterprises, the largest number of which produce shrimp for the export market. The annual maximum potential of the shrimping industry has been estimated at 4 million pounds if overfishing is to be avoided (Dombrowski 1970: 287); the development of this potential has been limited, however, by the lack of facilities for processing and freezing the shrimp which are caught.

Figures for fish catches for the years 1970-1973 indicate a constant catch of 5,000 metric tons total: 3,600 tons of salt water and 1,400 tons of freshwater fish (Germany, Federal Republic of 1976:17). Exports of fish, crustaceans, and molluscs as reports for 1971 amounted to 2,787,200 pounds valued at 2,479,000 Quetzals.

Shrimp production in recent years has been adversely affected by migratory changes in the shrimp banks of the Pacific Coast which have led to large numbers of the shrimping fleet either being laid up or forced to operate in other locations (CYB:510).

4.5.2.3 Government control of fishing activities

The Guatemalan government, through the Department of Agriculture, exercises control over fishing, requiring licenses for commercial fishing in both inland and marine waters. Licenses for commercial deep sea fishing have been limited to those enterprises owned wholly or in part by Guatemalans which use refrigerator-equipped vessels of 30 tons or more and can provide both on-shore facilities for provisioning boats and plants for processing the catch. In order to avoid over-fishing of shrimping grounds, the Government in 1962 took steps to limit the number of shrimping vessels along the Pacific Coast; in 1968 this limit was 50 boats (Dombrowski 1970: 287).

4.5.2.3 Fisheries development

The Guatemalan Government, aware of the importance of fish as a source of protein, has established fishery management stations at Zacapa, San Jeronimo and Lake Atitlan, but these are reported to lack both the personnel and equipment necessary to mount more than basic programs (Goodland and Tillman 1975: 44).

Recent studies of the nation's hydroelectric plans have recommended the promotion of fisheries development in the reservoirs created by such projects, including the careful introduction of exotic species such as tilapia (Tilapia), carp (Cyprinus), and bass (Micropterus). The unconsidered introduction of potentially harmful species, as illustrated by the case of the large-mouthed bass in Lake Atitlan, may lead to drastic consequences for native species (Goodland and Tillman 1975: 86).

In another development, a fishing cooperative in the Santa Rosa Department has announced plans to set up several fish farms to protect certain species from extinction and develop others. The cooperative has stated that intense fishing practices have endangered several species of fish ("Fish in the Area..."1978:28).

There are also indications that Guatemala may soon become involved in the exploitation of its tuna resources ("Fish in the Area..." 1978:28).

4.6 MINERAL RESOURCES

4.6.1 The Resource

Guatemalan mineral wealth is diverse. Gold, lead, chromite, silver iron, zinc, manganese, ochre, talc, antimony, platinum, sulfur, tin, copper, nickel, and mercury have all been mined at one time or another. Nevertheless, despite promising developments in that direction, mining in 1977 accounted for only 0.1% of the GNP and supplied jobs to only 0.7% of the labor force.

It is the policy of the Guatemalan government to encourage mining operations, especially as a means of providing employment; considerable fiscal concession are accordingly granted to mining companies which agree to mine ore locally. Up til now, however, metals extracted in Guatemala have been only crudely refined in Guatemala or exported.

4.6.1.1 Nickel mining

Guatemala's hopes for increased wealth through mining operations rest principally on expanded nickel mining operations at the Niquegua mine near the town of El Estor on Lake Izabal (see map, page 49a). Expectations are that nickel mining will make Guatemala a leading nickel exporter. A major nickel mine and smelter have been constructed by EXIMBAL (Exploraciones y Explotaciones Minerales Izabal), a subsidiary of the International Nickel Company of Canada. The plan is for electric furnaces to beneficiate the 1-2% nickel ore to 75% nickel. This complex, which also includes a port facility, a 60 MW thermal generator, and large slurry settling ponds, began experimental operations in the last quarter of 1977; it was scheduled to reach full operation capacity--25 million pounds of dull nickel per year--during the second half of 1978.

4.6.1.2 Petroleum extraction and refining

Petroleum exploration by companies such as Texaco and Getty has been conducted both inland and offshore, and although offshore exploration has not yet yielded any finds, oil is already being extracted in the interior of Guatemala. Present expectations are that the country should be able to produce a fourth of the oil it consumes within a few years and might even have the potential of becoming an exporter of crude oil in the future. In mid-1978 the director of Mines and Hydrocarbons reported to the Guatemalan press that about 100,000 barrels (at 42 gallons each) of petroleum had been produced in 1977 and the first four months of 1978. ("Oil Tax..."1978:212), but the country is not expected to begin pumping oil in commercial quantities until the Rubelsanto pipeline is completed some time in 1979.

An oil field has been established at Rubelsanto in northern Alta Verapaz near the El Peten border, where production is presently 1,000 barrels per day, all of which is used for local consumption for electrical power generation by Empresa Electrica and for the operations at Cementos Progreso in Guatemala City. Authorized commercial production for this field, which has an estimated reserve of 12 million barrels, is substantially higher: 4,000 barrels per day. A second oil field at Chinaja, also in Alta Verapaz, with a potential of about 1,600 barrels per day, was about to be given commercial status as of February 1979. Whereas the the oil from the Rubelsanto fields is heavy (27 degrees API), the oil from the Chinaja fields is lighter (32 degrees).

In connection with the opening of the second field for commercial exploitation, the government in February 1979 authorized PETROMAYA (an association comprised of Basic Resources, Shenandoah Oil, and Saga Petroleum) to construct a pipeline along a yet to be determined route from the wells at Rubelsanto to Amatique Bay on the Caribbean Coast. PETROMAYA also hopes to receive permission to set up a refinery, most likely at Puerto Barrios, from which it could distribute oil to the entire country ("Green Light..." 1979:43-44). The request of another firm, PETROCENTRO, to set up a refinery on the Amatique Bay capable of refining 40,000 barrels of heavy crude oil per day, was recently rejected by the government.

Presently oil is refined only at Escuintla, which is also the site of the thermal electricity generating plant that supplies Guatemala City. Oil refined at Escuintla is piped fifty miles after being discharged from offshore tankers.

4.6.1.3 copper

As reported by Goodland and Tillman in 1975 (13), copper mining is carried out on the Oxec River near the confluence with the Cahabon River; supplies are anticipated to last ten years. Ore with a copper content of 28,000 tons was mined in 1974.

4.6.1.4 limestone and other minerals use for cement manufacture

Limestone deposits north of Guatemala City are exploited for cement production. In addition, as reported by the United Nations in 1972, there are two mines producing 55 per cent and 70 per cent iron oxide for use in cement manufacture; silica was also reported to be produced for this purpose (United Nations, Department of Economic and Social Affairs 1972: 98).

4.6.1.5 antimony

Several small mines in the Department of Huehuetenango produced antimony intermittently during the 1960's. Production in metal content during that period ranged from 40 tons in 1962 to 15 tons in 1968; average production for the years 1970 to 1973,

however, was reported to be considerably higher: about 1,000 tons (United Nations, Department of Economic and Social Affairs 1972: 98; Germany, Federal Statistical Office 1976: 98).

4.6.1.6 salt

Salt from seawater evaporation is produced mainly for local consumption; yearly production has remained constant at about 50,000 tons for many years.

4.6.1.7 other minerals

Other minerals mined on a small scale have been: magnesium, reported in 1963 as being mined by about 100 workers using primitive methods in the Department of Huehuetenango; block and scrap mica produced intermittently from the Acaualpa area in the Department of Quiche; and small scale output of lead, tin, and tungsten from Huehuetenango. Small quantities of zinc (about 1,000 tons per years) are reported for the early 1970's.

4.6.2 Pollution arising from mining operations

4.6.2.1 nickel mining

At El Estor, the focus of Guatemalan nickel mining operations, the hillsides are already scarred as a result of open cast mining. Goodland and Tillman 1975 assess the potential impact of increased mining and smelting operations on the area of El Estor as well as on Lake Izabal. One possible detrimental effect could arise when water for cooling purposes, taken from the lake at the rate of three cubic meters per second, is returned some 7 degrees C warmer. However, since the natural temperature variation of the Lake already exceeds 10 degrees C, it is expected that this warming effect will be negligible. Goodland and Tillman, however, observing that many tropical species of fish and other aquatic organisms, live near their upper thermal limit, urge the Department of Fisheries to consider consider if even a slight change in temperature may not be harmful to aquatic life.

As for slag generated by the mining operations, it is thought that it may actually be less "environmentally contagious" than the iron-rich ore from which it has been derived; it has been proposed, therefore, that it be used to reclaim large swampy areas adjacent to the smelter. (Goodland and Tillman 1975: 20).

4.6.2.2 copper mining

The Oxec River, the site of active copper mining operations, carries a heavy load of silt from the mine at the point where it enters the Cahabon River.

There is the further probability that when the copper resource is exhausted some time in the mid-1980's, the abandoned mine or its workings could contribute toxic products such as cyanide or colloidal

copper salts to the reservoir presently planned for this area. (Goodland and Tillman 1975: 13).

4.6.2.3 Petroleum operations

The environmental impact of the construction of the pipeline from Rubelsanto to Amatique Bay does not appear to have been assessed, and no data was available either on pollution from the present oil refinery at Escuintla or potential pollution from the planned refinery on Amatique Bay.

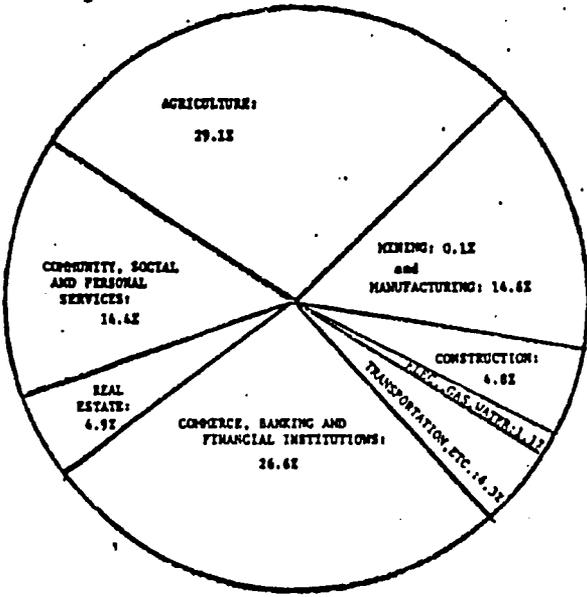
Another and highly controversial petroleum-related issue, one which has not yet been resolved as of early 1979, is the plan to construct a 227-mile pipeline across Guatemala to transport Alaskan Oil for the United States. This project has been opposed from several quarters, not only because of contamination risks which it would entail but also because of political problems, including the issue of the stationing of U.S. troops on Guatemalan soil to protect the pipeline.

5.0 THE ECONOMY OF GUATEMALA

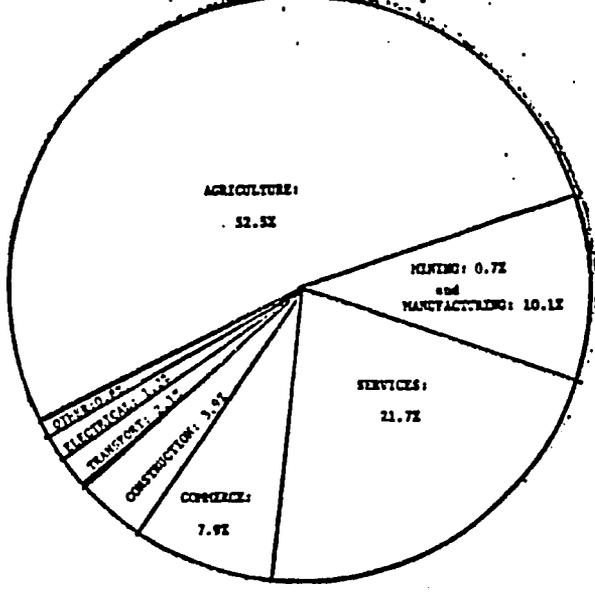
5.1 GENERAL ECONOMIC PICTURE

GNP: \$5,485 million (1977 est.); Per capita share of GNP: \$840
Average annual real growth rate(1971-76): 5.3%
Monetary conversion rate: 1 quetzal=US\$1 (official)

GDP by SECTOR (1977)



EMPLOYMENT IN GUATEMALA

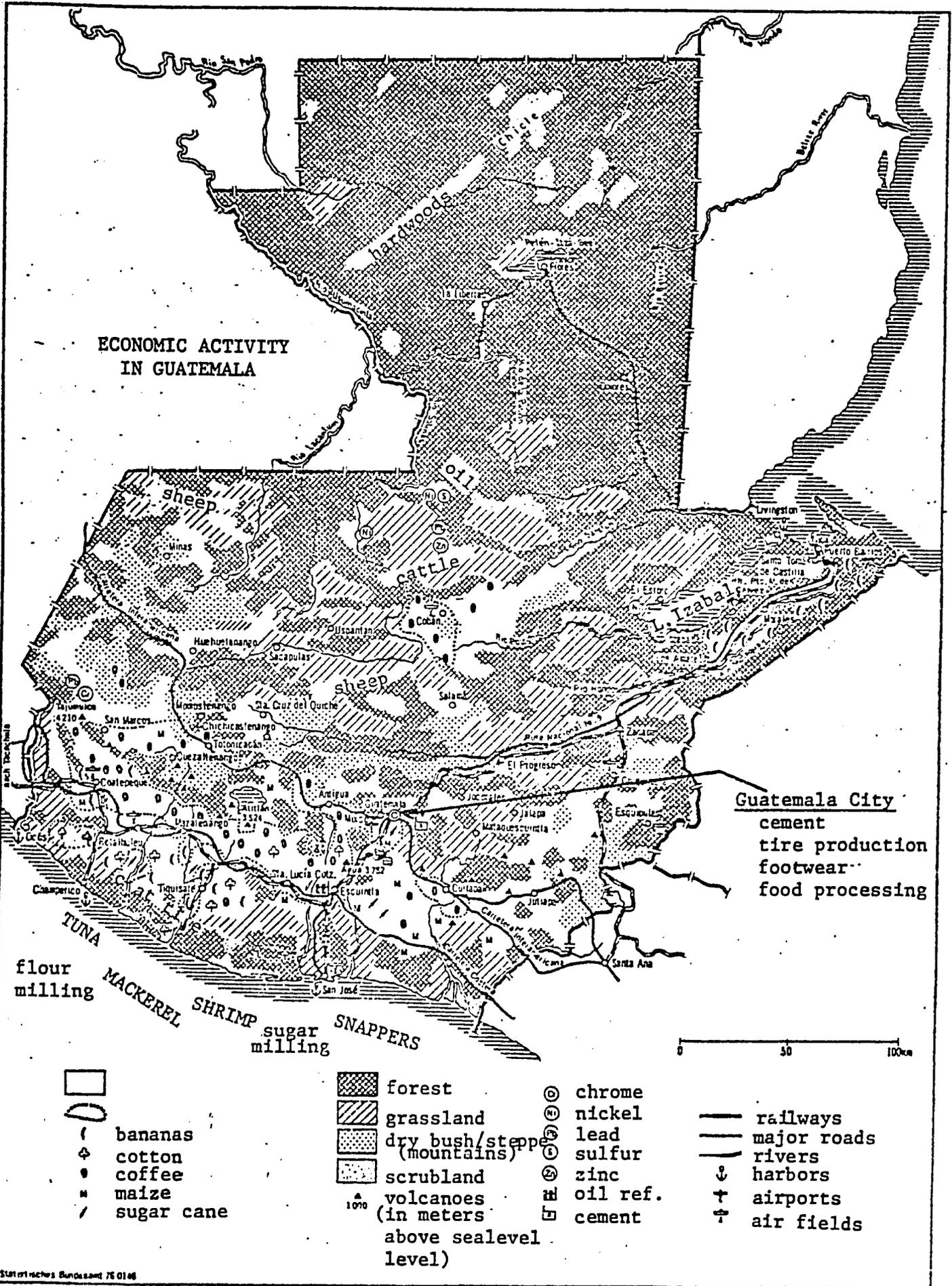


Unemployment is quite high. Although official figures for 1973 indicated unemployment levels of about 3%, other estimates, taking extensive underemployment into account, place unemployment in urban areas at 12.2% and in rural areas at 42%. Many farmers find it necessary to take employment as farm laborers for wages averaging 22 Central American pesos (UNEP 1976?:4).

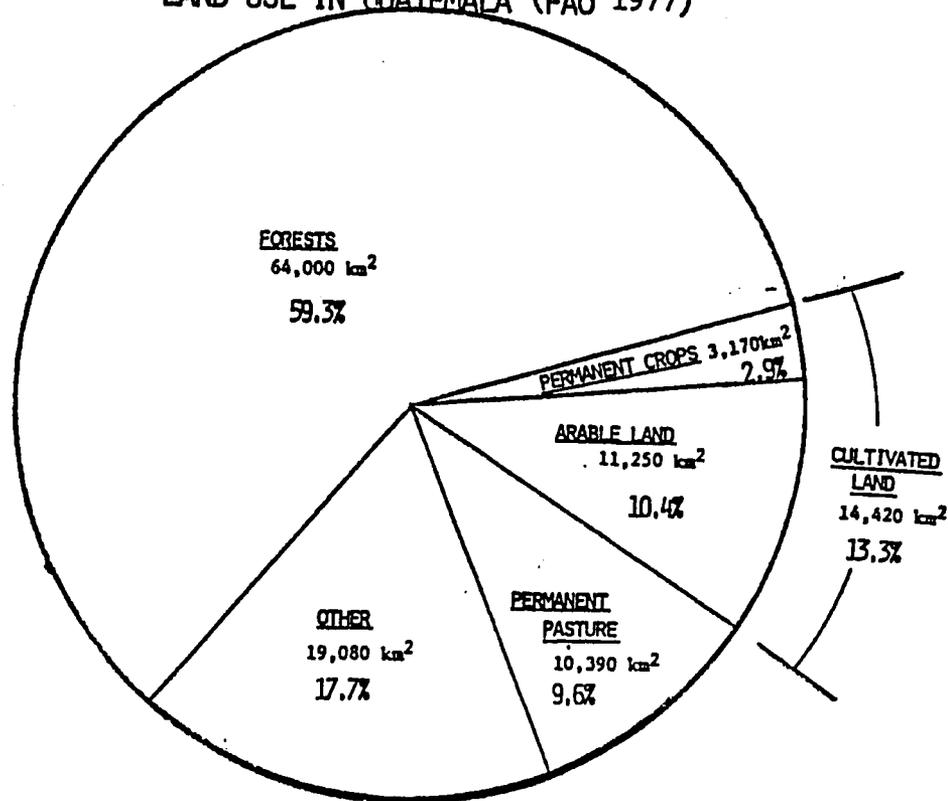
Inflation, as high as 13% in recent years is also a problem but has recently shown signs of decreasing in late 1978.

5.2 Agriculture

Agriculture is the mainstay of the economy of Guatemala, providing not only a livelihood for over half of the country's population but also supplying its largest exports: coffee, cotton and cottonseed, bananas, cardamon, and chicle. Maize (corn) continues to be the most common subsistence crop, although, expansion of land for sugar production, among other things, has reduced the hectarage devoted to this crop in the last few years.



LAND USE IN GUATEMALA (FAO 1977)



5.2.1 Land use and farm size

Land use figures show a distinct split between large and small farm holdings. At the time of the last agricultural census (1964), an estimated 87 percent of the farm holdings were under 7 hectares, and a recent assessment of the situation indicates that about nine out of 10 people in rural Guatemala live on plots of less than five hectares, holdings which are insufficient to produce basic income needs under present farming techniques. Most of these small farms are located in the Western Highlands, where an estimated 60% of the population, predominantly Indian, occupies the 26% of land area represented by this highland area. Furthermore, much of this land is of poor quality and steeply sloped and is located in areas where agricultural development is difficult and hampered by lack of: farm-to-market roads, accessible input and product markets, irrigation, and energy for irrigation and agribusiness-related activities. In 1964 more than three-fifths of the total number of farms were operated by Indians, farming less than one-fourth of the total farm area. Major problems on these farms are erosion and consequent loss of productivity.

Subsistence farms are of two types. In parts of the lowlands and on mountain slopes in the highlands, slash and burn cultivation is still practiced; plots in the forest are cleared and burnt during the dry season and planting takes place when the rains begin. Such plots are usually worked for 2 to 3 years and then allowed to lie fallow for between 8 to 20 years as farmers move on to new plots. Reduction of this fallow period has been a trend in many developing countries which slash and burn cultivation is practiced; it could not be ascertained to what extent this is also true of Guatemala. Milpa agriculture--the more prevalent type of subsistence agriculture--involves the interplanting of corn, beans, and squash in a fashion designed to provide food for both humans and animals throughout the year; this type of agriculture, centered around the farmer's hut, uses both human, animal, and vegetable wastes as fertilizer and employs burning during the dry season for weed control. (Wylie 1970:13; Carter 1969).

Large farms are the commercial sugar, coffee, and cotton-growing enterprises of the Pacific Piedmont and the coastal plains. These produce bananas and cotton in the lowlands and coffee at the higher altitudes. Relatively modern methods are employed in producing major crops, but laborers farm their own plots using the traditional methods described above.

Medium-sized farms are located mainly in the eastern highlands, while some specialized farms of small to medium-size are scattered among milpa areas. Such farms concentrate on wheat, vegetables, and flowers for the market, but farmers also grow subsistence crops for family use (Wylie 1970:14).

5.2.2 Major crops

(See tables on pages 69 and 70).

5.2.3 Recent trends in agricultural production

Recent agricultural trends, as reviewed by the United Nations Economic Survey of Latin America in 1977 (CEPAL 1977) include an increase in the volume of coffee production (2%) and increased exports of bananas, cardamon, and meat. During most of the year there was a boom in the export sector, as prices for both coffee and cotton rose. In general recent years have seen a shift from grain and beans to sugar and cotton in farms on the coastal plain, because of the higher prices available for these products.

Drought conditions, particularly pronounced in the eastern part of Guatemala, had a particularly bad effect on the 1977 bean harvest and also reduced coffee production. Furthermore, although land sown to basic grains actually was higher in 1977, the lowered production caused by the drought kept output in these areas more or less stable. It is also thought that a low minimum guaranteed price for maize, rice, and beans may also have played a role in lowering production. Toward the end of 1977, INDECA (Instituto Nacional de Comercializacion Agricol) was forced to import both maize and beans.

MAJOR SUBSISTENCE CROPS(Figures from FAO Production Yearbook)

CROP	Area of country in which grown	1,000's of hectares	(1,000's of metric tons)	
			yield per hectare	annual product.
basic grains				
CORN	throughout the country: the most important basic staple crop of Guatemala	1969-71: 671 1977:590	1969-71: 1,118 1977:1,281	1969-71: 751 1977:756
WHEAT	generally in the Western Highlands, where lower temperatures prevail; principally in Solola, Quezatltenango, Totonicapan and San Marcos	1969-71: 31 1977:44	1969-71: 1,119 1977:1,023	1969-71: 35 1977:45
RICE	mainly in the northern agricultural zone (Alta Verapaz, El Peten, and Izabal), and the southeastern agricultural zone (Santa Rosa and Jutiapa) : these account for 80% of production	1969-71: 11 1977:17*	1969-71: 2,187 1977:2,059	1969-71: 25 1977:35
SORGHUM (feed grain)	throughout the country	1969-71: 50 1977:54**	1969-71: 915 1977:1,722	1969-71: 1,722 1977:95
beans				
BEANS	throughout the country: production varies with area: high in the south west (Santa Rosa and Jutiapa) and lower in the northwest (Huehuetenango and El Quiche)	1969-71: 109 1977:144	1969-71: 614 1977:485	1969-71: 67 1977:70

Other crops, accounting for about 35,000 hectares of cultivated land in 1977, include roots and tubers, potatoes, cassava, onions, cabbages, tomatoes, and groundnuts.

PRINCIPAL EXPORT CROPS
(Figures from FAO Production Yearbook)

export crops	areas of country in which grown	1,000s of hectares	(1,000s of metric tons)	
			yield per hectare	annual production
COFFEE	in valleys and on hill- sides chiefly on the southern slopes of the Sierra Madre; best coffee grown at 3,000 to 3,500 ft.; highest production in San San Marcos, Quetzaltenango, Santa Rosa and Suchitepequez; some coffee produced for lo- cal consumption; coffee ac- counts for 70% of Guatemala's export revenues.	1969-71: 256 1977:270	1969-71: 514 1977:544	1969-71: 131 1977:147*
COTTON	mostly in the Escuintla and Retalhuleu (Pacific Coast) on large holdings with hired labor	1969-71: 77 1977:122	1969-71: 2691 1977:3,067	1969-71: 207 1977:375
SUGAR CANE	principal regions are Escuintla, Santa Rosa, Suchitepequez and Retal- huleu (Pacific Coastal Plain)	1969-71: 38 1977: 85**	1969:71 71,713 1977: 80,000	1969-71: 2,692 1977: 68,000
BANANAS	on the Pacific Coastal Plain (chiefly in Es- cuintla and Suchitepe- quez) and in Izabal (Caribbean Coastal Plain)	1970: 4.4 1976: 5.0	1970: 44,500 1976: 53,400	1970: 195 1976: 267.1

Other crops directed toward the export market are essential oils (lemon and citronella), produced chiefly in Suchitepequez, Retalhuleu and Escuintla; sesame seed; and cardamom, which has recently grown in importance as an export item. There are more than 60,000 small cardamom producers in the Department of Alta Verapaz; the firm which buys local cardamom and processes it for export is by some reports the largest cardamom producing firm in the world. Rubber is also grown in some areas; about 3,500 hectares were cultivated in 1970.

5.2.4 Use of pesticides and environmental and health effects

5.2.4.1 Pesticide use

Pesticide use in Central America has been associated most particularly with cotton cultivation, but although cotton has been grown in the region since the beginning of this century, heavy applications of pesticides were not administered until cotton entered its so-called "exploitative phase" in the 1950's. The most common organosynthetic pesticides employed at that time were DDT, BHC, and Toxaphene at the rate of eight applications per surface per season. Later organophosphorous insecticides were also introduced. The increased use of pesticides, however, was accompanied by an increase in the number of harmful species reaching pest levels from two in the 1950's to eight in the 1960's. In the 1960's a large number of organosynthetic pesticides, many of them not approved for sale in the country of production, appeared on Central American markets and were used in various combinations in cotton farming. By this time the number of applications per season had increased to 28 and the pests being attacked varied, new pests appearing as old ones were brought under control. As pesticide use increased it reached 50% of production costs in some areas. Major pesticides have been DDT, Dieldrin, Toxaphene, Methyl parathion, Ethyl parathion, and endrin.

Heavy use of pesticides is common throughout Central America, but has been especially prevalent in Guatemala and El Salvador; in Guatemala total use of pesticides increased from 5,292,127 kilograms in 1972 to 13,471,388 in 1975. In cotton production average use grew from 45.6 kilograms per hectare in 1972/73 to 79.9 kilograms per hectare in 1974/75. Although cotton production still accounts for the greater part of pesticide use, overall yearly consumption of pesticide use increased 57.5% between 1972 and 1974 while use in cotton production increased only 12.5% (ICAITI 1976).

5.2.4.2 Effects of pesticide use

Detrimental environmental effects traceable to overuse of pesticides are a major problem throughout the entire Central American Region. A recent UNEP report, for example, identifies pesticide related problems as the most critical problem in the region because of its short-term implications in fields such as public health, the economy, and the ecological balance in extensive areas of Central America (UNEP 1976).

It has been confirmed throughout the region that pesticides are being transmitted in food chains and nutrient cycling, thereby affecting not only wildlife but also foods consumed by humans. Pesticides are also polluting water sources, rivers, and estuary zones that have traditionally been important as sources of fish and seafood.

Pesticide problems have occurred for several reasons. One has been pesticide drift during aerial application, which is often used where spot

application would be more efficient; it has been ascertained that large quantities of pesticides applied from the air settle on neighboring fields rather than on the crops being treated. Soil erosion in areas after heavy pesticide application also contributes to pesticide movement, leading to contamination of water bodies, especially rivers and estuaries.

Documentation of the effects of pesticides is provided by a major study conducted by UNEP and ICAITI (ICAITI 1976), which revealed, among other things that contamination levels were highest in animals and animal products and lowest in water.

Finding of the study show a definite correlation between cotton cultivation and pesticide levels in milk, meat and other foods as well as in human blood and fat tissue, contamination in Guatemala being highest in the major cotton growing areas of the departments of Retalhuleu, Escuintla, and Suchitepequez.

5.2.4.2.1 Milk contamination

Milk was found to be an especially reliable indicator of pesticide contamination. A study of samples taken in Guatemala between May 1975 and May 1976 shows a significant correlation between levels of milk contamination and factors such as seasonal use of pesticides and proximity of dairy farms to cotton-growing areas. The average level of contamination in Guatemalan milk was high at 4.52 parts per million (ppm), 90 times greater than the U.S. standard of 0.05 ppm.

5.2.4.2.2 Meat contamination

Meat contamination occurs most frequently when, as is so often the case in Guatemala, cattle graze areas which have received pesticide drift from cotton fields, drinking water contains pesticide runoff, and cattle eat cotton stalks. Such meat consumed locally or in other areas leads to the buildup of pesticide residues in human tissue as well. The contamination of meat can have unfavorable economic repercussions as well, leading in some cases to the rejection of meat by importing countries. About 26% of 685 samples analyzed in Guatemala between 1972 and 1976 had pesticide levels above the tolerance levels of importing nations.

5.2.4.2.3 Human health

About 364,000 Guatemalans lived in cotton growing areas in 1975, but because of the continuing increase in the land planted to cotton such populations have been growing at the rate of about 3.3% per year. The living conditions of these people, including their housing and access to water and sanitary facilities, contribute to the potential hazards of pesticide use. Health problems suffered by these people as a result of pesticide use are: pesticide poisoning; an increase in malaria; and the accumulation of sub-clinical levels of pesticides in body tissue.

5.2.4.2.3.1 Poisonings

Although pesticide poisonings remain a problem in Guatemala, the number

of such cases (taking mild, moderate, and severe cases into account), has been declining steadily in recent years, dropping from 2,313 in 1972 to 804 in 1975. Poisonings in cotton growing areas, which accounted for 93% of all cases in Guatemala were about 3.64 cases per thousand population. A significant correlation has been established between rates of poisonings and the use of organophosphate pesticides (parathions). The number of cases in El Salvador, where such pesticides account for 48% of total pesticide, are much higher than in Guatemala, where they account for 27%.

5.2.4.2.3.2 Malaria

Sustained use of DDT for the control of cotton pests, has tended to increase resistance of the anopholes mosquito, the chief carrier of malaria, to this pesticide as used in mosquito control. Such resistance has been found to be substantially higher in cotton growing areas of Central America, average resistance having grown from 58% to 86% per cent between 1972 and 1975. Unless substitute pesticides, usually much more expensive than DDT, are used, the rates of illness from malaria have tended to increase as well. Guatemalan malaria rates are strongly associated with resistance and have been clearly related to the percentage of the country planted to cotton. In Guatemala, where propoxur has been substituted for DDT, however, the rate of malaria morbidity has remained about the same (4.6 cases per thousand in 1972, 1.4 in 1973, 7.2 in 1974, and 3.32 in 1975); in El Salvador, on the other hand, where DDT remains the prime agent for mosquito control, the rate has grown. There is, however, reason to believe that mosquitoes are becoming increasingly resistant to propoxur as well.

5.2.4.2.3.3 Residues of DDT in human tissue

Another problem, the effects of which can not as yet be gauged, is the accumulation of pesticides, especially DDT, in human tissue. Samples show that the average level of accumulation has been as high as 520 part per billion for cotton areas, about 6.8 times higher than among urban dwellers. A significant correlation between DDT levels in blood and the length of residence in cotton areas has also been established. Residue levels in fat tissue are also high: 40.9 ppb for cotton areas and 22.96 for non cotton areas.

5.2.4.3 Control of pesticides

Little serious attention has been given in any Central American country to possibilities other than pesticides for insect control, such as, for example, the use of predators, parasites, pathogenic organisms, and genetic control. However, the region has been alerted to the problem, and attempts are being made to confront it. In June 1978, for example, a Regional Seminar in the Use and Management of Pesticides was held in Guatemala City, Guatemala. On the legislative side, a new law regulating pesticides has been in effect in Guatemala since 1974.

5.2.5 ANIMAL HUSBANDRY

LIVESTOCK NUMBERS AND USE: (FAO Production Yearbook, 1977)

	<u>In thousands of heads</u>							
	1969-71 nos.	1977 nos.	slaughtered	meat	milk *	cheese	eggs	skins
Horses	149	125	81	97				
Mules	49	40						
Asses	5	3						
Cattle	1474	2220	417	71				9,591
Milk cows	292	358			329	13,559		
Pigs	810	667	309	12				
Sheep	567	612	175	3				438
Goats	71	76	26					65
Chickens	9507	11,239					33,100	

*fresh milk: does not include 2,328,000** mt of dried milk
butter production: 4,170,000** mt

In conflict with the above FAO figures, which show an increase in cattle production during the last decade, are the figures presented in a recent article indicating that between 1968 and 1977 the number of heads of cattle decreased by 9.7% as a result of response to lower prices on the export market. Furthermore, cattle production of has decreased, the article continues, exports have increased, and such increased exports coupled with a drop in the number of cattle has led to a decrease in the amount of meat available for local consumption in recent years. Such meat shortages have prompted the Minister of Economy to suspend temporarily all meat Guatemalan meat exports as of March 2, 1979. (See "Meat Crisis"1979:83-84.)

The greatest concentration of cattle, Guatemala's principal livestock animal, has been in the Pacific Plains, where large ranches have put considerable efforts into the improvement of both pasturage and livestock quality. Work animals are found chiefly in the highlands but are of significance in other areas as well. The principal hog raising areas are in the departments of Quiche,

Alta Verapaz and Huehuetenango, while by far the greatest numbers of sheep are found in San Marcos, Huehuetenango, and Quiche. Most of the poultry is on farms but a considerable is kept for home food supply in both rural and urban areas.

5.2.5.1 Problems with livestock and livestock raising

Guatemalan cattle have tended to be plagued by a variety of livestock ailments, including viruses, parasites, and insects, but are free of foot-and mouth disease (aftosa). Another problem, one which threatens the acceptability on the international market of Guatemalan meat products, is the exposure of cattle to pesticides, which appear as residues in meat. This is of particular urgency since cotton production, the cultivation of which employs the largest quantities of pesticides, takes place in the areas where large cattle ranches are also located; in fact, in many areas, cattle cultivation has given way to cotton growing, which has become the more lucrative enterprise.

5.3 INDUSTRY

5.3.1 Industrial activity

Industrial development, still in its initial stages, has been hampered by political developments as well as by the lack of markets within the nation. The most important industrial branches are involved in the production of food and beverages (about 40% of production value) as well as in textile production; through the means of the Central American Common Market (CACM), these industries have been able to extend their markets into other Central American countries. Although investments for industrial development have come principally from private capital, laws promoting industries have been improved, and an industrial bank providing assistance for the establishment of new and the expansion of existing industry has been operating since 1966. This has contributed to a marked growth in industrial production; however, industry still tends to be small scale, to be based on raw materials available in Guatemala, and to be involved in the production of consumer goods, chiefly handicrafts.

Industries set up under industrial development acts include those producing kenaf sacks, paper bags, fluorescent lamps and other electrical products, paints, plastic products, fibreglass boats, metal furniture, toys, hats, cotton goods, animal feeds and concentrates, nylon stockings, lingerie, cotton textiles, tin and glass containers, bottle caps, macaroni products, and wood products.

Industries and employment offered (1972)

Industrial establishments (with more than five employees)

<u>Type</u>	no.	% of establ.	nos. of employees	% of ind. workers
Food and beverages	613 ?	33.4%	21,000	35%
Clothing and shoe production	360	19.6%	15,000	24%
Wood and furniture	204	11.1%	4,100	5.5%
Paper production	15	0.8%	1,000	1.6%
Printing	118	6.4%	3,300	5.3%
Chemicals	85	4.6%	3,600	5.8%
Rubber products	20	1.0%	1,200	1.9%
Processing of stone and earth, including brick and cement production	143	7.7%	4,000	6.5%
Metal industries	130	7.1%	3,400	5.5%
<u>Totals</u>	<u>1,838</u>		<u>62,000</u>	

If smaller establishments are included, the total number of industrial establishments is much higher; the 1965 Industrial Census, for example, listed a total of 16,500 establishments, about 2,100 of which accounted for about 73% of industrial production and only about 1,200 of which were actually organized firms. Because communications and supplies of electricity

are more plentiful in those areas, larger plants have tended to be concentrated about the cities of Guatemala and Quezaltenango, but some factories are found around Mazatenango, Retalhuleu, and Escuintla, the last of which boasts a 311-acre industrial park and the supplies of water and electricity required for new industry.

The industrial sector experienced an 11% expansion in 1977. There was increased cement production and also increased in the major consumer goods: textiles, clothing, footwear, and processed foods. Furthermore, Guatemala's single plant producing glass containers--the only one of its kind in Central America--was unable to satisfy the heavy regional demand. Construction activities were also up in 1977. (CEPAL 1977).

Decentralization of industry

In order to bring employment to the rural areas, where most of the poor live, the Guatemalan government is currently attempting to decentralize industry to rural areas. Apart from bringing jobs to rural areas and thereby helping to stem the tide of population moving toward urban centers, particularly Guatemala City, decentralization would offer the additional benefits of permitting better advantage to be taken of raw materials originating in various parts of the country, increasing and strengthening the home market, and creating stronger links between the primary agriculture sector and industry.

The move toward decentralization has received strong support from the government of President Fernando Romeo Lucas, which came to power in July 1978. Under the government's plan, basic infrastructure would be provided in three specifically designed areas throughout the country and special tax benefits would serve as an incentive to attract industries to these areas. Government investment for this program would run from 50 to 100 million dollars.

5.3.2 Industrial and urban pollution

- 5.3.1.1 It has recently been estimated that the total amount of pollution caused by Central American industry in urban centers is about 20%. However, data is not yet available to allow for a complete analysis of environmental problems caused by industry (GTZ 1978, page 8).

Observations relevant to the role of industry in air pollution were conducted in October 1978 and are reported on in ROCAP 1978 (section one, pages 5-6). Polluting sources visited in the area of Guatemala City included battery plants, a glass plant, a brewery, a cement plant, foundries, and a coffee plant; observations were made both from the ground and from the air. It was found that most of the industrial activity was very small and had very little visible emissions. However, the cement plant in the north of the city seemed to need additional control, and the glass plant in the southern section was the source of considerable visible emissions; this plume, with an opacity ranging from 25-40%, was thought to contain fluorine.

Guatemala City is reported to have a general problem with fallout of

particulate matter, much of which appears to be traceable not so much to industrial activity as to dust from truck and car traffic and construction work. Poorly maintained diesel buses are a source of odor, particulates, carbon monoxide and visible emission, while heavy trucks and aircraft probably mean that there is also a probably with oxidants, as evidenced by a light visible smog layer in the city. Readings from the monitoring station of the Pan American Air Pollution Monitoring Network in Guatemala City indicated no problems with total suspended particulates or sulfur dioxide (ROCAP, section 1, page 3).

REFERENCE LIST

- Agency for International Development [A.I.D.] (U.S. Department of State). 1979. Country Development Strategy Statement. FY 1981. Guatemala. Washington, D.C.: Agency for International Development.
- A.I.D. Guatemala. January 1979. "Environmental Information." U.S. Department of State Telegram.
- Berquist, Wenonah E., and others, comps. 1978. Worldwide Directory of National Earth-Science Agencies. Geological Survey Circular 771. Washington, D.C.: United States Department of the Interior, Geological Survey.
- Caribbean Yearbook [CYB] 1977/78. 1977. Toronto: Caribook Limited. [See "Guatemala," pages 499-519.
- Carter, William E. 1969. New Lands and Old Traditions: Kekchi Cultivators in the Guatemalan Lowlands. Gainesville, Florida: University of Florida Press.
- CEPAL [United Nations, Economic Commission for Latin America]. 1978. Economic Survey of Latin America, 1977. vol. 1 (E/CN 12/ Survey 1977). (Guatemala: pages 434-468).
- Dombrowski, John, and others. 1970. Area Handbook for Guatemala. Washington, D.C.: Government Printing Office.
- Evaluation Technologies, Inc. Nov. 1978. Guatemala: A Country Profile. Washington, D.C.: Office of U.S. Foreign Disaster Assistance, Bureau for Private and Development Cooperation, Agency for International Development.
- "Fish in the Area Beware." 1979. Central America Report, vol. 6, no. 4, January 22, 1979, pages 28-29.
- "Forestry Law May Be Too Late." 1979. This Week in Central America and Panama, April 9, 1979. page 108.
- "Forests in Danger." 1978. Central America Report, vol 5, no. 50, December 18, 1978, pages 393-394.
- Garcia Montenegro, Hugo Leonel. May 1974. Necesidad de Leyes para la Proteccion y Conservacion del Medio Ambiente. Guatemala City: Instituto Geografico Nacional, Division Geografica.
- Germany, Federal Republic of. Federal Statistical Office. 1976. Allgemeine Statistik des Auslandes: Laenderkurzberichte: Guatemala. Wiesbaden: Verlag W. Kohlhammer.
- Gomez, Julio Padilla. 1975. A Statement of the Laws of Guatemala in Matters Affecting Business. 3rd edition revised and enlarged.

- Washington, D.C.: General Secretariat, Organization of American States.
- Goodland, Robert and Richard Pollard. April 1974. Chixoy Development Project: Environmental Impact Reconnaissance. Millbrook, N.Y.: The Cary Arboretum of the New York Botanical Garden.
- Goodland, R. and G. Tillman. 1975. National Energy Master Plan: Environmental Assessment. Instituto Nacional de Electrificación, I.N.D.E. Guatemala. Millbrook, New York: Cary Arboretum of the New York Botanical Garden.
- GTZ (Deutsche Gesellschaft fuer technische Zusammenarbeit--West German Agency for Technical Cooperation). October 1978. Summary-Environmental Protection of Urban Centers in Central America. Results of a Fact-Finding Mission of Joint Teams -(ROCAP-USAID-GTZ-ICAITI). Preliminary Report on Water and Solid Wastes (German part).
- Guatemala. Consejo Nacional de Planificacion Economica. 1968. Recopilacion de la Legislacion Agraria y de Pesca. Guatemala: Consejo Nacional de Planificacion Economica.
- Guatemala. Instituto Geographico Nacional. 1976. Inventario del Recurso Agua en Guatemala. Atlas Hidrologico. Guatemala: Ministerio de Comunicaciones et Obras Publicas.
- Guatemala. Office of the President. July 1978. Informe al Honorable Congreso de la Republica: Cuarto Ano de Gobierno. Guatemala City: Office of the President.
- Guatemala. Secretaria General del Consejo Nacional de Planificacion Economica. March 1971. Informe Nacional a la Conferencia sobre el Medio Humano (National Report to the Conference on the Human Environment). Guatemala City.
- Ibarra, Jorge A. 1975. Conservation in Guatemala: True Stories and Fables. Guatemala City: Editorial "Jose de Pineda Ibarra."
- IDBa. August 1977. IDB[International Development Bank] News, vol. 4(6), pages 1-3.
- ICAITI (Instituto Centroamericano de investigacion y tecnologia industrial). [Central American Research Institute for Industry]. January 1977. An Environmental and Economic Study of the Consequences of Pesticide Use in Central American Cotton Production (Final Report). ICAITI Project No. 1412. Guatemala City: ICAITI Headquarters.
- ICAITI. Dec. 1978. Preliminary Findings of Deforestation in Guatemala. DRAFT. Guatemala City: ICAITI Headquarters.

- Kolbusch, P., and Jurgen Orlich. October 1978. Summary: Environmental Protection of Urban Centers in Central America: Results of a Fact-Finding Mission of Joint Teams-ROCAP-USAID-GTZ-ICAITI.
- LaBastille, Anne. 1973. "Establishment of a Quetzal Cloud-Forest Reserve in Guatemala." Biological Conservation, vol. 5, no. 1, pages 60-62.
- "Meat Crisis." 1979. Central America Review, vol. 6, no. 11, March 12, 1979.
- "Oil Tax Evasion." 1978. Central America Report, vol. 5, no. 27, pages 212-213.
- Prior, Penny, and others. 1977. "IUD Effectiveness in an Urban Guatemalan Clinic." Bulletin of the Pan American Health Organization, vol. 11, no. 2.
- "Quetzal Shelter in Tucuru, A.V. Shall Have the Name of Jorge A. Ibarra." 1975. Historia Natural y Pro Natura, vol. 5, no. 6, page 32.
- Report of the Regional Preparatory Meeting of the Countries of Latin America and the Caribbean for the United Nations Water Conference. Lima, Peru 30 August--3 September 1976. E/Conf.70/5: 25 November 1976. Mar del Plata, Argentina: United Nations Water Conference.
- ROCAP. 1978. Proposed Regional Urban Environmental Baseline Study. Project Development Reports. Three sections: Summaries of Trips to C.A. Capital Cities; Proposed Project Description (Air and Noise); Development of Uniform C.A. Pollution Standards.
- Shanz, Douglas R. March 1978. A Latin American Dilemma: Current Efforts to Develop the Tropical Forest Areas of Thirteen Latin American Nations. (Information presented during a slide-lecture at U.S. Strategy Conference on Tropical Deforestation, June 12-14, 1978, Washington, D.C.).
- Simmons, Charles S., and others. 1958. Clasificacion de Reconocimiento de los Suelos de la Republica de Guatemala. GUATEMALA: Ministerio del Agricultura. 1000 pages.
- Tikal National Park: Master Plan for Protection and Use. 1976?
[Produced by a special planning project involving various government agencies under the coordination of the Consejo Nacional de Planificacion Economica; assisting were representatives of the U.S. National Park Service under a technical assistance program of U.S.A.I.D.] Library of Congress Call No: F 1435 .1 .T5 M24.
- "Tree Troubles." 1978. Central America Report, vol. 5, no. 38, pages 300-302.

- Trzyna, Thaddeus C. 1976. Population: An International Directory of Organizations and Information Resources. Claremont, Calif.: Population Project.
- United Nations, Department of Economic and Social Affairs. 1972. Small Scale Mining in the Developing Countries. ST/ECA/155. New York: United Nations, 1972. p. 98.
- UNEP (United Nations Environmental Program). 1976?. Environmental Matters of Regional Importance and Suggestions for Action [Central America]. 37 pages.
- Wadsworth, Frank H. 1971? "Forestry Potential and Its Development in Central America." [Source not indicated]:171-189.
- Weiss, Charles M. 1971a. Water Quality Investigations Guatemala: Lake Atitlan 1968-1970. ESE Pub. No. 274. Chapel Hill, North Carolina: Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina.
- Weiss, Charles M. 1971b. Water Quality Investigations Guatemala: Lake Amatitlan 1969-1970. ESE Pub. No. 281. Chapel Hill, North Carolina: Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina.
- Weiss, Charles M. 1971c. Water Quality Investigations Guatemala: Guatemalan Rivers 1969-1970. ESE Pub. No. 282. Chapel Hill, North Carolina: Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina.
- Wylie, Kathryn H. 1970. A Survey of Agriculture in Guatemala. ERS-Foreign -305. Washington, D.C.: U.S Department of Agriculture, Economic Research Service.

APPENDIX AWildlife protected under the 1970 Hunting Law (see 3.1.3.1)

1. It is forbidden to capture or hunt down throughout Guatemala any of the following useful species:

- insectivorous birds which beautify the countryside and benefit farms and forest areas;
- songbirds and ornamental birds;
- birds and other scavenging animals beneficial to public health;
- resident birds which have a great aesthetic value;
- certain useful wildlife species which are beneficial to the country and which are not considered to be game animals;
- hunting of animals and reptiles not authorized by this decree is prohibited in specified reserve zones, in refuges, and in national parks and forest reserves; it is also prohibited to hunt birds during nesting periods.
- native animals considered rare or endangered:

<u>Scientific name</u>	<u>Common Spanish name</u>	<u>Common English name</u>
------------------------	----------------------------	----------------------------

REPTILIA

<u>Crocodylus moreletti</u> */**	Lagarto del Peten	Morelet's crocodile
----------------------------------	-------------------	---------------------

AVES

<u>Pharomachrus mocinno</u> */**	Quetzal	Resplendent Quetzal
<u>Podilymbus gigas</u> */**	Poc de Atitlan/ Zambullidor	Atitlan Grebe
<u>Oreophasis derbianus</u> */**	Faisan de cuerno/ Pavo de cacho	Horned Guan
<u>Pelecanus occidentalis</u> */**	Pelicano Pardo	Brown Pelican
<u>Burhinus bistriatus</u>	Peretete	Thick knees

MAMMALIA

<u>Myrmecophaga tridactyla</u> *	Oso Homiguero	Giant Anteater
<u>Tapirus bairdii</u> */**	Danta	Central American Tapir
<u>Felis onca</u> *	Tigre	Jaguar
<u>Felis pardalis</u> */**	Tigrina	Ocelot
<u>Felis weidii</u> */**	Tigrillo	Margay
<u>Trichechus manatus</u> */**	Manati	Manatee
<u>Odocoileus virginianus</u>	Venado	White-tailed Deer
<u>Mazama americana</u>	Cabruto	Brocket Deer
<u>Tamandua tetradactyla</u>	Oso Colmenero	Tamandua
<u>Ateles geoffroyi</u>	Mico	Spider Monkey
<u>Alouatta villosa</u>	Mono Zaraguata	Howler Monkey
<u>Lutra annectens</u>	Perro de Agua	Otter

* Species included in the IUCN Red Data Book of Endangered Species

** Species in the U.S. Fish and Wildlife Service's List of Endangered and Threatened Wildlife and Plants (1977)

SOIL CLASSIFICATION FROM FAO/UNESCO
1975.

LUVISOLS: 22% L

Orthic Luvisols: 14% (Lo)

- associations: -orthic acrisols, dystric and other cambisols;
- largest single association (755,000 ha.) is with orthic acrisols and gleyic luvisols in a lithic phase, on hilly to steep sloped terrain with coarse texture;
- occur in level to hilly areas and on hilly to steep sloped areas;
- medium to coarse texture
- some lithic phases
- land suitability:

Ferric Luvisols: 4.3%; 427,000 ha. (Lf)

- interior ranges of Guatemala, usually in association with dystric cambisols and andosols
- occur in hilly to steep areas
- of medium texture
- land suitability: traditional
 - fair yields of maize on land used at 6 to 10 year intervals;
 - phosphate and nitrogen deficiencies
- improved
 - crop yields uneconomic except with regular fertilizer programs
 - nitrogen and phosphate needed for all crops and for pasture
 - drainage problems during rainy season;

Gleyic Luvisols: 3.2% ; 313,000 hectares (Lg)

- upland plateaus in Guatemala
- associations: -eutric gleysols, pellic vertisols, eutric planosols
- on level areas
- medium texture
- land suitability: traditional: used for sugarcane and non-irrigated rice, root crops and as grazing land for a few cattle;
- the soil exhibits low natural fertility in combination with slow internal drainage
- doesn't respond well to traditional cultivation
- improved: involved expense of improving drainage; heavy farm machinery may only compact soil and hinder drainage; long rotation between grass and rice is suggested;

Chromic Luvisols: 0.8% (Lc)

- associations: eutric cambisols, and vertic cambisols
- occur in both level to rolling and hilly to steep terrains;
- texture is coarse
- land suitability: traditional: moderately good farming soils, low but consistent yields year after year in the same area;

- in lowlands: sugarcane, coffee, rice and pasture;
- uplands: potatoes, wheat, apricots, fibre and oil crops, pasture
- improved: both phosphate and nitrogen essential for good yields but irrigation even more essential; application of irrigation water brings danger of erosion

CAMBISOLS: 20%

Eutric cambisols: 8.1% (Be)

- associated with rendzinas and lithosols and orthic luvisols
- occur in both hilly and steep terrains (289 + 516 hectares)
- texture is coarse
- lithic in phase
- land suitability: traditional: popular soils for maize, yield adequate crops from the same area at intervals or only three to five years in most countries;
- improved: usually suitably for tree crops and pastures;

Dystric cambisols: 6.4% (Bd)

- in northern Guatemala;
- in association with both eutric and humic cambisols
- in hilly to steep terrains
- medium and coarse in texture
- lithic in phase (occur mainly in steep mountain slopes in the lithic phase)
- suitability: traditional: yield such poor crops that farmers seldom return for a second planting of maize
- improved: of little value because of the steepness and ruggedness of terrain and the prevailing shallowness of the soils;

Chromic cambisols: 2.8% (Bc)

- northern Guatemala
- in association with Rendzinas, lithisols, eutric cambisols;
- on hilly to steep slopes
- coarse in texture
- lithic in phase
- suitability: traditional: moderate crops of maize and beans, fair yields or bananas, plantains, and root crops;
- such systems require five to eight years fallow on lithic phases
- improved: tree crops: nutmeg, avocado, and, to a lesser degree: citrus, coffee, and cocoa

-regular applications of phosphate necessary to maintain production because high content of ferrous iron and aluminum compounds restricts the availability of soil phosphates

calcic cambisols: 2.2% (Bk)

-associations: vertisol cambisols, lithisols
 -on hilly terrains
 -coarse texture
 -lithic phase dominant
 -suitability: traditional: because of marked seasonal dryness, useful only for grazing when the xerophytic woodland has been destroyed

improved: limited by lack of irrigation water; soils are generally shallow, even on easy relief, and are highly erodible; but: quite fertile: where seasonal rainfall is adequate and slopes permit, regular crops of maize can be grown by mechanized farming; but erosion control measures necessary for sustained yields;

RENDZINAS: 14% (E)

-common in Peten sector of Guatemala: rendzinas derived from hard white crystalline limestones or from lutites and related calcareous rocks
 -associations: with cambisols and gleysols
 -the largest single subgrouping occur in association with chromic cambisols, vertic cambisols and lithosols (1,148,000 hectares)
 -on all terrains: level to rolling, rolling, hilly to steep
 -coarse in texture
 -lithic in phase
 -common: in areas of adequate seasonal rainfall, the preferred soils of the ancient Mayan farmers for growing maize; today still highly prized by Amerindians;
 -suitability: traditional: suitable because they are fertile and well drained, can be used on fairly quick rotation (3 to 5 years), and their second growth vegetation is easy to dispose of
 -much depends on adequate rainfall at proper time

improved: not so suitable; rocky and patchy nature of the soil unsuitable for mechanization; modern farmers on rendzinas usually abandon arable land in favor of permanent grassland; best tree crop: avocado

ACRISOLS: 10.5% (A)

orthic acrisols: 9.7% (Ao)

-widely in Guatemala

-in association with eutric cambisols; cambic luvisols; orthic luvisols and plinthic luvisols;

-on plains to hilly terrain; on hilly to steep terrain;

-texture is medium

-phase is lithic for eutric cambisols and ferric luvisol association

-general limitations: fertility, drainage and erosion problems

-suitability: traditional: cattle grazing is only economic use on landscapes of gentle relief; on lithic phases of the mountainsides: moderate to poor yields of maize with 12-15 year recuperative cycle

-upland rice in some areas

improved: of little agricultural value; some citrus, and coffee and pineapple possible on more gentle relief; but erosion and damage must be controlled by contour planting

ferric acrisols: 0.87% (Af)

-in a few localities along the Pacific and Caribbean coasts

-strongly acid, low to very low in plant nutrients

-in association with gleyic acrisols and orthic luvisols

-on plains

-medium texture

-suitability: traditional: poor production of subsistence crops; -rough grazing land

improved: high investment needed to bring them to point where they can yield good pasture and crops; pineapple is the cheapest crop to establish and maintain

NITOSOLS: 9.3% (N)

eutric nitosols 9.3% (Ne)

-of rare occurrence, says handbook

-in association with eutric cambisols, vertic cambisols, vitric andosols

-on plains; on rolling terrain; on steep slopes

-lithic phases common

-generally deep soils with good drainage and high natural fertility, derived from basic parent materials (usually of volcanic origin) under humid, subhumid, tropical, and subtropical environments

- suitability: maize, sugarcane, nutmeg, coffee, cocoa, beans, rice, pasture

traditional: mostly an adequate annual return; crop yields may decline because of erosion of topsoil;

improved: erosion is main problem

-on steeper slopes contour cultivation should be mandatory; advisable also on gentler slopes
-phosphate fertilizers necessary

VERTISOLS: 8.3% V 826,000 ha.

pellic vertisols: 7.7% (Vp)

- associations with rendzinas, gleysols,
- on the plains, mostly in Peten
- texture: 2,3
- suitability: depending on climatic factors: small grains, peas, beans, vegetables to sunflower and other oilseeds, to cotton, sugarcane, maize and rice, to permanent beef and dairy pastures rice and livestock production becoming most popular use;
- traditional- fairly good with primitive methods, including planting stick; good living possible with rice and grazing;
- improved: much machinery needed to take advantage of the relatively short interval when the soils are in the right stage of moisture for working;
- problems: drainage; soils are tight and sticking in the rainy season but shrink and fissure in the dry season; fissures can be detrimental to roots;
- have high fertility; problem is with their physical properties
- little fertilizer necessary

chromic vertisol: 0.5% (Vc)

- associations with pellic vertisols;
- on the plains
- texture: 2
- similar properties to pellic vertisols; phosphate necessary for good yields

ANDOSOLS: 6.4% T 638,000 ha

- general: important because of their reserves of soil fertility, which have supported large numbers of farmers for many centuries;
- free draining, have natural fertility for moderate yields of maize, and other traditional subsistence crops;
- limitations: erodibility and deficiency of phosphate
- humic andosols: 4% (Th)
- associations: vitric andosols, lithosols, orthic acrisols
- on rolling to steep slopes and on steep slopes
- in more humid areas of Guatemala: coffee, citrus, bananas, plantains, pasture; beans, maize
- texture: 2
- suitability: traditional: problem with good yields of maize because of low phosphate yields;
- improved: permanent grassland should be first step; phosphate level must be raised; become erodible when dry;

vitric andosols 1.8% (Tv)

- in association with chromic luvisols
- on plains and rolling areas

-texture: 2

-suitability: traditional: generally good yields of wheat, tobacco, bananas, coffee, maize
-better if phosphate applied

improved: measures must be taken to avoid soil erosion; sprinkler erosions preferable because of erodibility; properly fertilized and irrigated are among best banana-growing soils

mollic andosols 0.6% (Tm)

- in association with chromic luvisols, vitric andosols

-on slopes

-texture 2

-suitability: moderately productive but potentially erodible
-less acid and of higher base and available phosphate status than the Humic Andosols; erosion control necessary under improved farming

GLEYSOLS: 3.8% G

generally characteristics: poor drainage and excess of water in the subsoil during the greater part of the year

eutric gleysols (Ge)

- in association with regosols, mollic gleysols, pellic vertisols

-texture: 2

-occurrence: plains

-suitability: traditional: grazing and crops that tolerate excess water (rice)

-fairly good yields with primitive drainage systems (but such systems must be general to be effective)

improved: if water table brought under control, little fertilizer needed; can be used for grazing and land can be ploughed and used for sugar-cane or vegetable crops

REGOSOLS: 3.6% 353,000 ha. R

eutric regosols (Re)

- in association with vitric andosols, gleysols

-occurrence: plains along coast

-texture: 1

-suitability: on plains near coast: coconut plantations

traditional: no drainage problems: used for root crops, coconuts, melons, melons, groundnuts, melons

improved: full producing with appropriate fertilizer;
-must watch out for salinization

FLUVISOLS: 1.8% J

eutric fluvisols (Je)

- in association with gleysols/dystric fluvisols/eutric fluvisols
- occurrence: plains, river valleys: dominate in some of the river valleys of Guatemala
- texture: 2
- in some countries the volume of production is a considerable proportion of the total subsistence crops available to people
- suitability: produce well as both traditional and improved
- eutric fluvisols little modified by fertilizer applications

PLANOSOLS: .13% W

dystric planosols (We)

- in association with gleysols, chromic luvisols
- on the plains
- texture: 3
- feature a tight and almost impervious clay horizon in the upper part of the subsoil; low fertility; become flooded during rain
- suitability: traditional: rough pasturage
- improved: little benefit