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DRAFT  
ENVIRONMENTAL PROFILE

of

NICARAGUA

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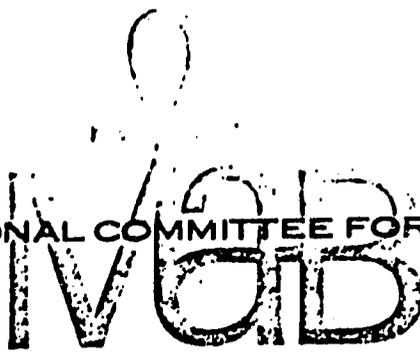
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THE UNITED STATES NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE

Department of State, IO/UCS



WASHINGTON, D. C. 20520

An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (A.I.D.), Bureau of Science and Technology (ST/FNR) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the A.I.D. Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or A.I.D. Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

Comments on the attached draft report would be welcomed by USMAB and ST/FNR and should be addressed to either:

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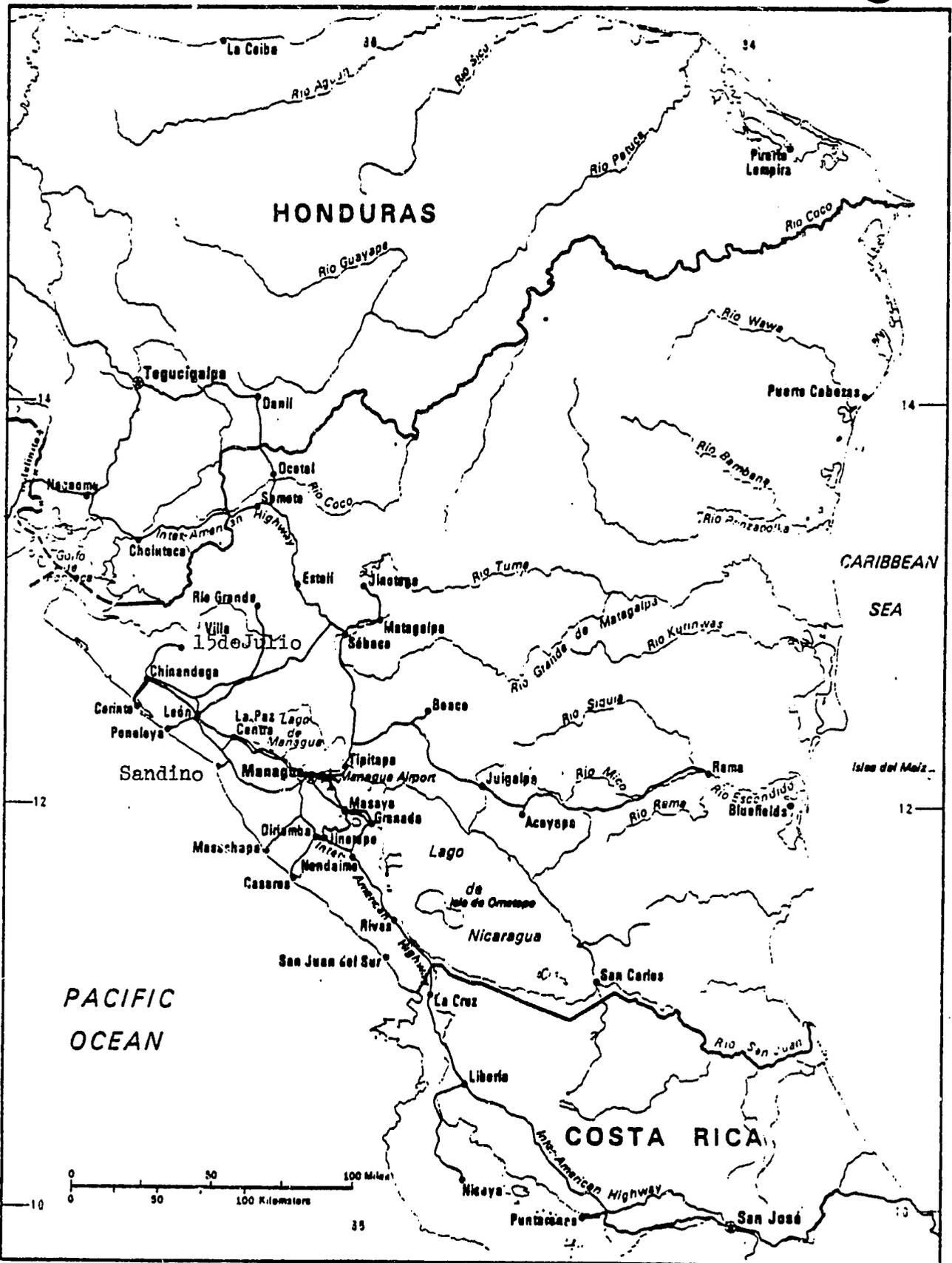
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# Nicaragua



502479 1-78 5414081  
 Lambert Conformal Projection  
 Standard parallels 9°20' and 14°10'  
 Scale 1:3,200,000  
 Boundary representation is  
 not necessarily authoritative

- Railroad
- Road
- ✈ Airport

## SUMMARY

Nicaragua's environmental problems stem from an absence of environmental and land use planning, aggravated by the destructive effects of the 1972 earthquake and the 1978 civil war. Virtually all natural vegetation has been cleared for agriculture on the heavily populated Pacific slope, and inappropriate land use has led to soil erosion and a failure to obtain maximum production from the land. Urban areas in western Nicaragua suffer from human health and resettlement problems caused by the destruction of housing and municipal water and sewage systems during both the earthquake and the war. In contrast, the largely unpopulated and extensively forested Caribbean slope represents a renewable natural resource of considerable potential, but one that must be used with great care. Its fragile soils would be quickly ruined by the pressures of traditional agriculture and massive deforestation that accompany uncontrolled colonization. Land use planning for Nicaragua should therefore emphasize increasing production in both the industrial and agricultural sectors on the Pacific coast so as to relieve colonization pressure on the Caribbean slope until suitable methods are developed for using the Caribbean forest lands. Nicaragua's main environmental problems are:

Inappropriate land use. Annual crops are frequently cultivated on slopes too steep for such purposes, causing soil erosion. Soil erosion is reported to be severe in several regions of western Nicaragua. At the same time, pastures in western Nicaragua are often on fertile volcanic soils that could be used for more productive intensive cropping.

Deforestation. Logging of the upland pine forests has not been followed with effective reforestation. Uncontrolled colonization and firewood demand are diminishing the remaining forest reserves. Forest management and effective reforestation are required to ensure the future of Nicaragua's pine forests. Fuelwood plantations on slopes unsuited for agriculture in western Nicaragua could help relieve exploitative pressure on the remaining natural forests.

Human health. Malaria is still widespread and has shown increasing resistance to traditional pesticide controls, suggesting the need for a more integrated control program. Better water supply and sewage systems are needed, as is a program of public education to improve sanitation.

The widespread use of agricultural pesticides, especially in the northwest, is leading to general environmental contamination by these chemicals. Alternatives to chemical pest control should be developed, and pesticide levels in water and food supplies should be carefully monitored.

Dr. Steven Hilty  
Compiler

## 1.0 Introduction

This draft environmental report summarizes information available in the United States on the natural resources and environment in Nicaragua. The report reviews the major environmental problems of Nicaragua and the impact of the development process upon resources and the environment. This draft report represents the first step in the process of developing an environmental profile for use by U.S. Agency for International Development (U.S. AID) and Nicaraguan government officials. The next step in this process should be a field study to evaluate the information presented here, obtain additional information, and define the issues, problems, and priorities in more detail. This entire process should help provide direction in future efforts to deal with the management, conservation, and rehabilitation of the environment and natural resources.

The information and interpretations in this report are preliminary in nature and are not intended to attain the detail and accuracy needed for development planning. The report represents a cooperative effort by the staff on the MAB project in the Arid Lands Information Center, which includes: Mark Speece - profile coordinator, Dr. James Silliman - profile editor, Eric Arnold, Dr. Steven Hilty, and Robert Varady.

The primary focus, research, writing, and analysis of the Nicaragua Profile were done by Dr. Steven Hilty, with particular thanks extended to Dr. Silliman for assistance on several sections. The cooperation of U.S. AID personnel in the State Department is gratefully acknowledged.

## 2.0 General Description

### 2.1 Geography

#### 2.1.1 Land Forms <sup>1/</sup>

The Central American republic of Nicaragua is located approximately between latitudes 10°45'N and 15°15'N, and rests squarely in the middle of the Central American isthmus. It shares its international boundary with Honduras (992 km) on the north and Costa Rica (300 km) on the south. There are 478 km of Caribbean coastline and 346 km of Pacific coastline. Nicaragua is the largest of the Central American republics. Its total land area, including the rift lakes, is about 140,000 square km although estimates vary from a low of 128,409 square km (G. and C. Merriam and Co. 1972) to as high as 147,900 square km (U.S. AID 1979). Rift lakes comprise about 9000 square km of the total land area (Cole in Thorson 1976) although again estimates vary widely, ranging from as low as 7770 square km (U.S. AID 1979) to as high as 19,000 square km (Kurian 1978). The western half of the country consists of a Pacific coast chain of volcanic cones rising generally to about 900 m or more, and a much more extensive and older central highland area of inactive weathered volcanics. These two mountainous regions are separated by the Central (Rift) Depression, a wide troughlike valley containing Nicaragua's great lakes and most of its major urban centers. The central highlands trend predominantly east-west and along their eastern extremity become deeply dissected by eastward flowing valleys separated by fingerlike mountain ridges. These ridges, the last remnants of the highlands, slope toward the Caribbean and gradually merge with the wide flat Caribbean lowlands.

Three topographic regions may be distinguished:

- 1) The drier Pacific region which consists of the Central (or Rift) Depression and associated lakes, and an active coastal volcanic chain that frequently causes damage to people, crops, livestock and buildings. This region contains about 15 percent of the land area but nearly 60 percent of the population.
- 2) The central highlands which consist chiefly of a wedge-shaped block of mountains that form the southern terminus of a much more extensive massif stretching north to

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1

Sources: Anon. n.d. (a)  
G. and C. Merriam Co. 1972.  
Kurian.. 1978.  
McCormick and Guffey. 1980.  
Thorson. 1976.  
U.S. AID. 1979.

southern Mexico. It includes about 35 percent of the total land area and is settled chiefly by subsistence and commercial farmers in the drier western valleys that drain toward the Rift Depression.

- 3) The Caribbean lowlands, a largely uninhabited region of humid lowland forest and pine savanna that contains about half of the total land area but less than 5 percent of the population. Most settlement is confined to coastal towns and mining areas.

#### 2.1.2 <sup>2/</sup> Lakes and Drainage

The Rift Depression lakes dominate Nicaragua's western land surface (Fig. 1). They include Lago Managua, 63 km long and 17-26 km wide, and larger Lago Nicaragua, 166 km by 75 km. The former has no natural outlet except during flood when it drains via the swampy, hyacinth-choked Rio Tipitapa into Lake Nicaragua; the latter drains continually via the San Juan into the Caribbean. Lake Nicaragua has an area of about 8264 square km and lies only 31 m above sea level, fluctuating about 0.65 m between the dry (April) and wet (October) season. Lake Managua has an area of about 1049 square km and an elevation 9 m higher than Lake Nicaragua. Both are shallow but navigable and with bottoms gently sloping at an average of less than one percent gradient. Mean depths are about 12.4 m for Lake Nicaragua, and 8.6 m for Lake Managua, with maximum depths of about 43 and 28 m respectively. Both are turbid due to shallowness and the effect of wind, and there is no prolonged temperature stratification. Because it occupies a closed basin most of the time, Lago Managua's dissolved solids are nearly five times more concentrated by weight than those of Lake Nicaragua. A comparison of the lake fish faunas is given in Section 3.5.4.

Navigable or partially navigable east-flowing rivers include the Coco, Wawa, Prinzapolka, Grande, Escondido, and San Juan (Fig. 2); there are no west-flowing rivers that are even partially navigable.

#### 2.1.3 <sup>3/</sup> Seismicity

Nicaragua is one of the world's most active centers of seismicity. The circumpacific belt of seismic activity passes directly through western Nicaragua and forms an active fault zone along the southwestern and northeastern boundary of the Rift Depression (Fig. 2). Volcanic activity has been continuous in recorded history with both lava and pyroclastic

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2  
Sources: Thorson. 1976.  
U.S. AID. 1979

3  
Source: U.S. AID. 1979.

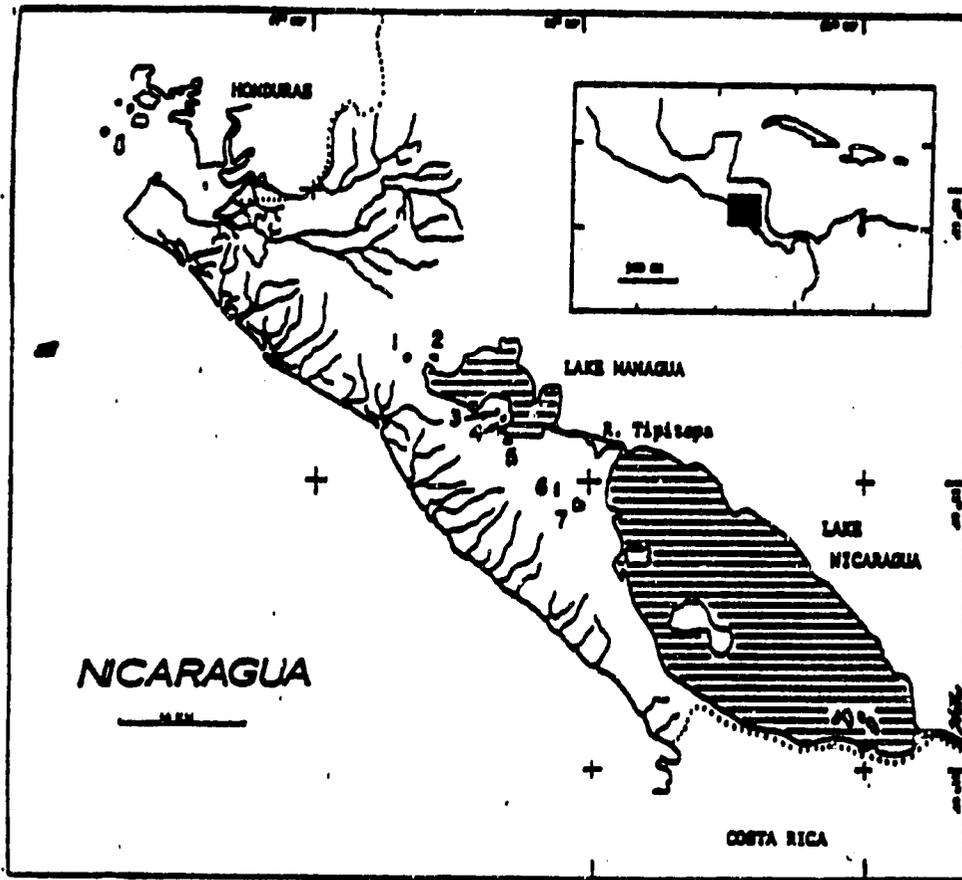


Figure 1. The Lakes of Pacific Nicaragua. Volcanic crater lakes (numbered) are: (1) Asososca, (2) Monte Galan, (3) Apoyegua, (4) Xiloa, (5) Asososca, (6) Masaya, and (7) Apoyo.

Source: Thorson. 1976.

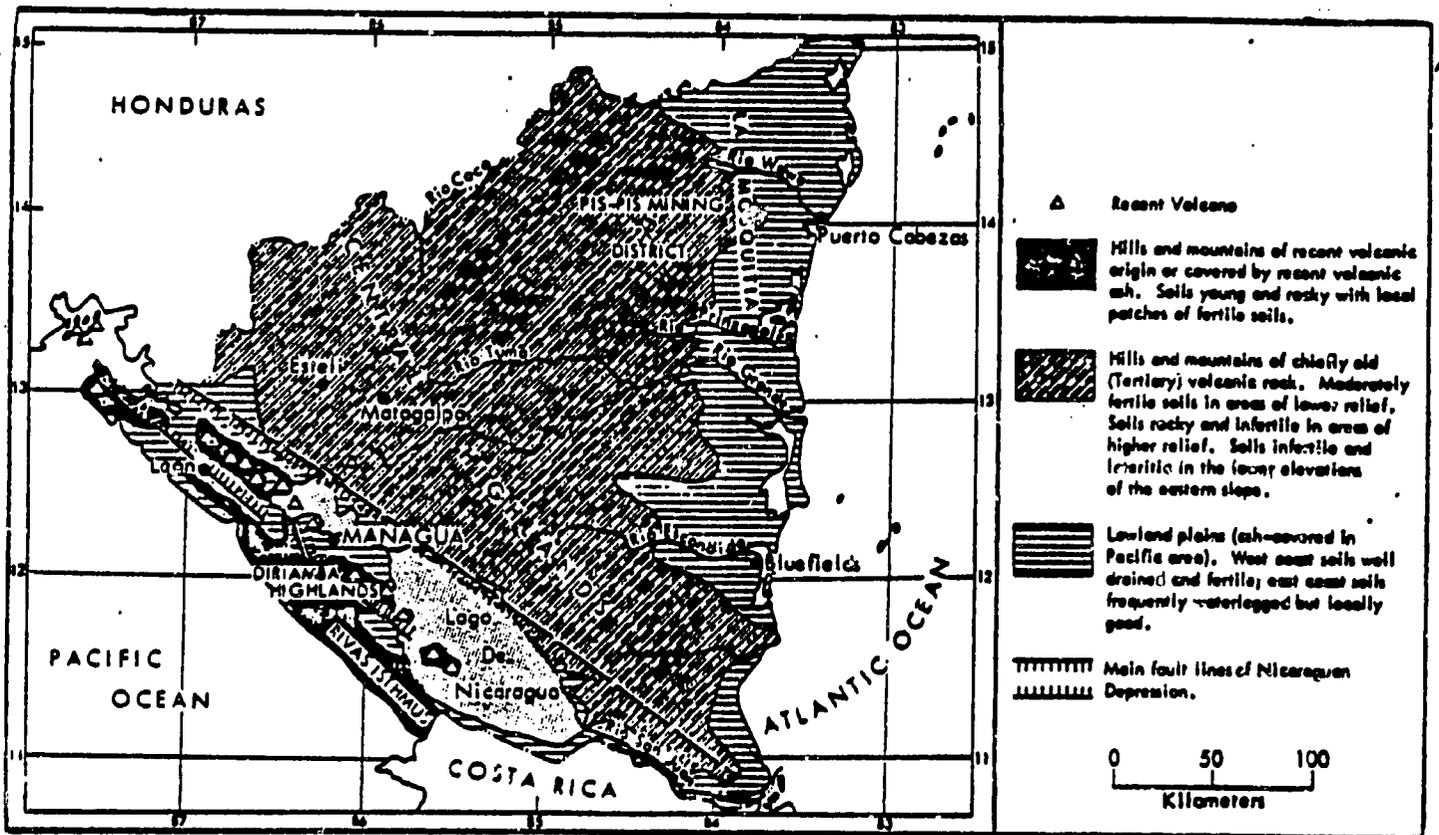


Figure 2: Land Forms

Source: American University, 1970.

eruptions. The most recent major eruption was that of Cerro Negro northwest of Managua in 1968. A history of Nicaragua's volcanic activity is shown in Table 1. Earthquakes are also frequent, though not necessarily associated with volcanic activity. Earthquakes have affected Leon in 1898, and Managua in 1931, 1968, and 1972, the last causing extensive damage.

Table 1. Volcanic Activity

Volcano Name	Height (ft)	Location	Activity Dates
Cerro Negro	3,204	50 mi NW of Managua	1850-52, 1867, 1946, 1960-68 1971
Concepción	5,106	Se of Managua	1883-85, 1902-05, 1957
Cosiguina	5,106	140 mi NW of Managua	1952
El Viejo	5,840		1971
La Pilas Mombacho		20 mi Se of Managua	1850-52
Momotombo	4,199	30 mi NW of Managua	1850-52, 1883-85, 1902-05, 1952
Nindirí		15 Mi se of Managua	1772
Santiago	1,969	S of Managua	1902-05 (Formed), 1946, 1965
Telica	3,409	S of Managua	1965, 1971

Source: U.S. AID. 1979.

#### 2.1.4 Rainfall and Climate<sup>4/</sup>

Nicaragua has a warm tropical climate with two seasons, dry from about January to late April, and wet from May to December. Although there is considerable variation in this pattern, three regional climates may be distinguished: a tropical wet, a tropical wet and dry, and a mild highland climate. In all regions of Nicaragua the climate is dominated by moist air masses moved across the country by the northeast trade winds. The total rainfall and its seasonal distribution is determined largely by the effect of topography on these air masses, although some precipitation is derived from Pacific air masses moving inland. These Pacific air masses cause widespread light rain near the end of the wet season in the western part of the country, but even close to the Pacific coast their effect is small compared to the shorter but heavy rains derived from Atlantic air masses.

Wet tropical climate. This is the prevailing climate of the eastern third of the country including all of the Caribbean lowlands and the east-facing slopes of the central highlands. There is no marked dry season and no significantly cooler period during the year. It is generally hot and humid throughout the year, tempered only occasionally by polar air masses that move across Central America during the north temperate winter months. In Nicaragua the accompanying storms and cooler winds are known as papagayos (parrot storms). Rainfall of this region ranges from a 2000 mm annual average in the northeast to 6000 mm in the southeast (Table 2, Fig.3).

Tropical wet and dry. Almost all of Nicaragua west of the continental divide has a tropical wet and dry climate, including the Pacific coastal area, the Pacific volcanic chain, the Rift Depression, and the west-facing slopes of the central highlands. The entire Pacific region is, in some sense, a rain shadow, being blocked from the prevailing northeast moisture-laden winds of the Caribbean by the central highlands. The tropical dry portion (months with less than 100 mm rainfall being considered dry) is severe and extends from November to April. The wet season, when

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Sources: American University. 1970.  
Kurian. 1978.  
Schwerdtfeger. 1976.  
Taylor. 1963.  
U.S. AID. 1979.

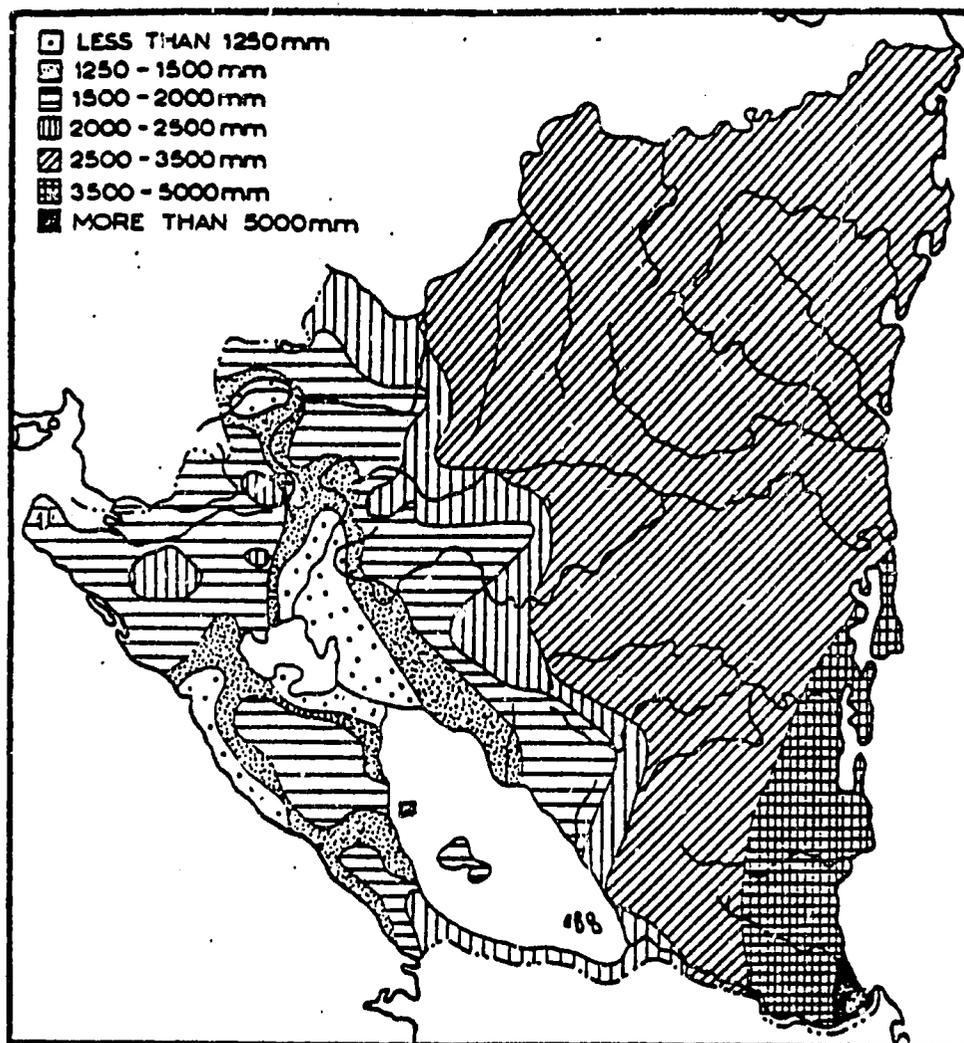


Figure 3. Mean Annual Rainfall (mm) Distribution.

Source: Taylor. 1963.

approximately 92 percent of the total annual precipitation falls, extends from May to October. Rainfall averages about 1000-2000 mm per year depending upon slope and exposure; a few valleys lying almost wholly within rain shadows receive even less than this. During dry or drought years, the availability of water in the Pacific region can have an important social and economic impact. As in the Caribbean region, the tropical wet and dry climate is warm throughout the year, although temperatures are somewhat cooler during the wetter months.

Mild highland climate. This is the coolest climate in Nicaragua and the least extensive, due to the relatively small highland area. Much of the area experiences a mean annual temperature of about 21°C; higher elevations are correspondingly cooler. Areas above 1500 m are usually cool and humid throughout the year, although the somewhat drier southern highlands are markedly drier from February to May. Throughout the region climatic contrasts are strong as is true of most mountainous regions.

Table 2. Selected Rainfall Records (mm). San Juan, Bluefield, and Pto. Cabezas from Caribbean versant, remainder from west of Central Highlands.

	San Juan del Norte	Blue- fields	Puerto Cabezas	San Miguelito	Chichi- galpa	San Marcos	Granada	Managua	Tipitapa
January	466	267	201	60	1	16	6	2	4
February	271	101	85	25	1	5	2	0	1
March	117	69	61	11	3	7	6	2	3
April	170	75	50	19	25	8	21	16	4
May	396	322	204	157	255	208	152	144	108
June	611	479	457	419	343	308	284	226	192
July	823	639	442	424	193	156	165	135	122
August	655	522	391	321	273	178	170	120	112
September	335	319	401	381	414	301	276	230	199
October	545	320	374	359	499	413	289	293	229
November	879	351	343	151	84	74	75	43	59
December	805	372	281	105	7	35	23	11	13
Annual	6003	3846	3290	2432	2098	1709	1469	1222	1047

Source: Taylor. 1971.

### 2.1.5 Temperature

Temperature variation in Nicaragua is primarily a function of elevation with the warmest average temperatures occurring in the drier lowlands and the cooler temperatures at progressively higher elevations. There is little month-to-month variation although humid regions usually average a few degrees cooler than corresponding dry regions. Pacific zone (below 500 m) temperatures range from about 24 to 30° C; with an annual mean of 25.6, and corresponding Caribbean zone temperatures vary from 23.9 to 26.5° C. Managua, at an elevation of 56 m, reports an extreme minimum of 20.0° in December and extreme maximum of 34.3° C in April; the daily temperature range varies about 8 to 12° C.

## 2.2 Population <sup>5/</sup>

### 2.2.1 Cultural and Political Background

Nicaragua, named in honor of the Indian chief Nicarao, was first discovered by Europeans in 1502 when Christopher Columbus landed at Cabo Gracias a Dios. Conquistadors first arrived in 1522 and by 1527 the country was under complete Spanish control. Spanish rule continued until 1821 when the captaincy general of Guatemala, with Nicaragua as one province, was proclaimed. This entity was superseded in 1823 by the emergence of the Central American Federation. The next two years were turbulent, culminating in 1825 with the independence of each of the five constituent states. Nicaragua's present civil boundaries are shown in Figure 4.

Since proclaiming its independence, Nicaragua has had eight written constitutions. Following the overthrow of Somoza in 1979, the government has been governed by decrees.

Spanish is the official language, although there is an English speaking minority, mostly black, on the Caribbean coast. The population is about 95% Roman Catholic.

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Sources: American University, 1970  
MITRE. 1980  
U.S. AID. 1979.  
U.S. Dept. of Commerce. 1980.  
World Bank. 1978.

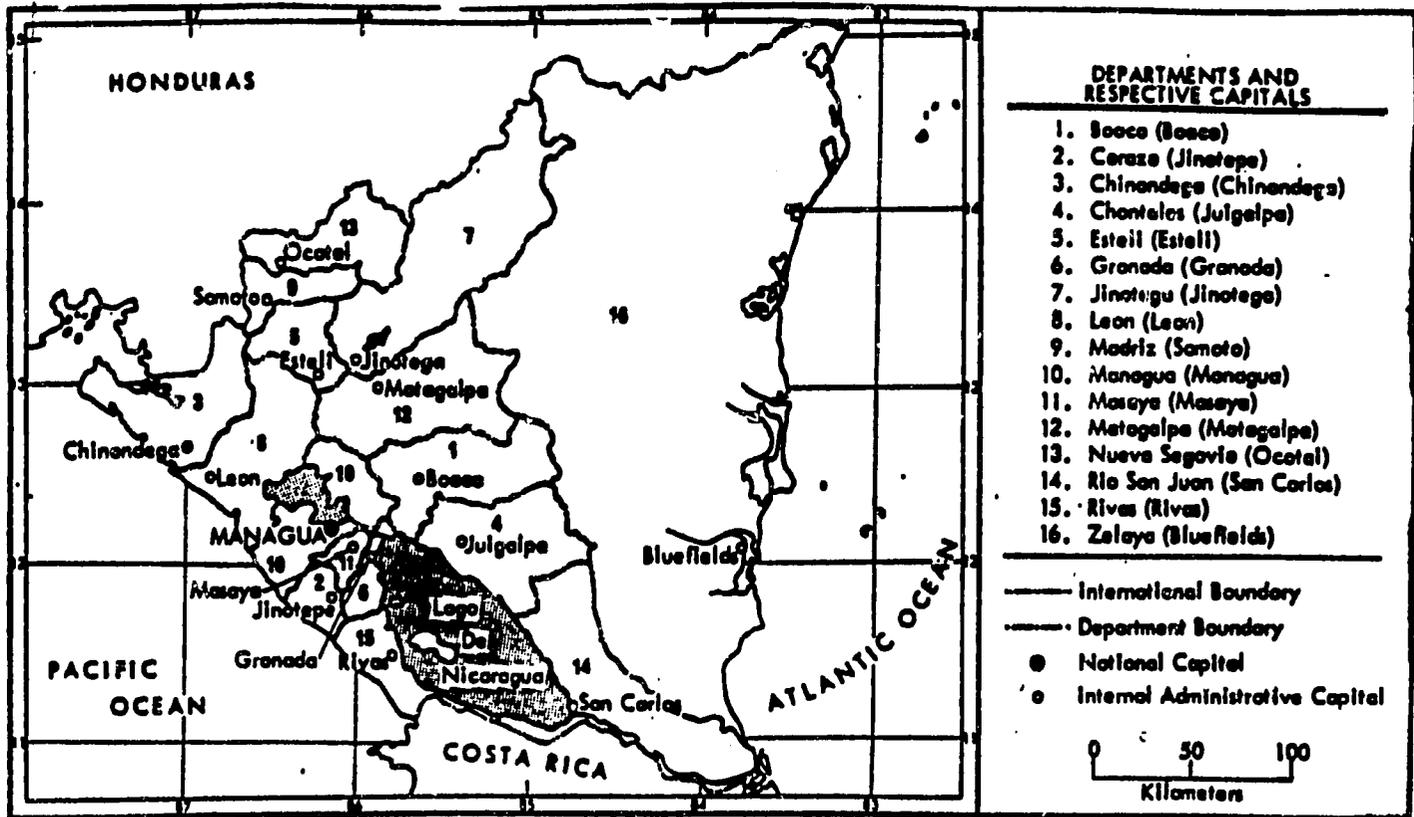


Figure 4. Civil Boundaries.

Source: American University. 1970

### 2.2.2 Population Growth and Distribution

Nicaragua is the least densely populated of the Central American republics, with an average of 18 persons per square km compared to 44 per square km for the neighboring republics. The population was estimated about 2.7 million in July 1979, up from 1.9 million in 1970 and 1.4 million in 1960. The national growth rate has shown the steepest increase during the last two decades (Fig. 5). The average annual growth rate, estimated at 3.3 percent in 1979, is higher than an estimated 2.9 percent rate during the 1950's. The marked increase is attributed to rising birth rates and declining infant mortality. Data on birth rate, death rate, and other vital statistics appear in Table 3.

The Nicaraguan population is very young; 43 percent of this population was under 15 years of age in 1950 (Table 4). The 1970 and 1978 figures are 48.6 and 48.1 percent respectively, indicating that the age distribution is stabilizing (U.S. AID 1980).

Table 3. Vital Statistics

	1960	1970	1970-75	1977
Crude Birth Rate <sup>a</sup>	-	-	-	45
Crude Death Rate <sup>a,c</sup>	19	15	13.9	13
Infant Mortality (0.1 yr) <sup>b,d</sup>	70	54	46	46
Mortality Rate (1-4 yr) <sup>a</sup>	-	-	-	17
Life Expectancy (years)	47	50.4	51.2(♂) 54.6(♀)	55

<sup>a</sup> Per 1000 population.

<sup>b</sup> Per 1000 live births.

<sup>c</sup> Values in U.S. Dept. of Commerce (1980) slightly higher

<sup>d</sup> World Bank (1980) figures are somewhat lower.

Sources: U.S. AID. 1979.  
U.S. AID. 1980.

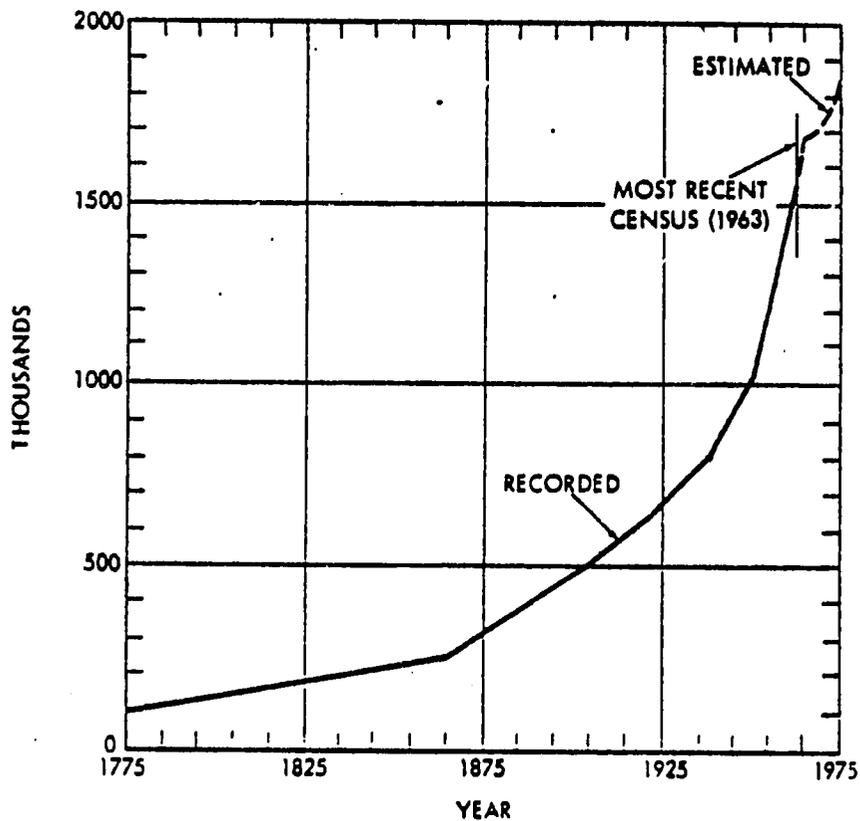


Figure 5. Population Growth, 1775 to Present

Source: American University. 1970. 11

Table 4. Population Age Structure, 1950-1978 (%)

Age	Year			
	1950	1960	1970	1978
Under 15	43.	47.8	48.6	48.1
15-64	-	49.7	49.0	49.4
Over 65	-	2.5	2.4	2.5

Source: U.S. AID. 1980.

The geographic distribution of the population in Nicaragua is markedly uneven with two principal core areas (Fig. 6). About 59 percent of the population resides in the narrow Pacific region, the primary core, and most of the remainder, about 35 percent, in a secondary core in the central highlands. The eastern lowlands, with about 6 percent of the population, are practically uninhabited except for scattered small coastal towns. Population by region and by department as of 1978 is given in Table 5. The ethnic composition of the population is about 70 percent mixed European and Indian ancestry (mestizo), 17 percent white, 9 percent negro and 4 percent Indian.

Urban population in 1978 accounted for 52 percent of the total, an increase from 47.2 in 1970 and 41.1 in 1960. During the period 1970-75 Managua grew at an average annual rate of 6 percent, and all other urban areas at a rate of 4.6 percent. These values are considerably above the national average annual rate of growth and indicate a new population flow toward urban centers.

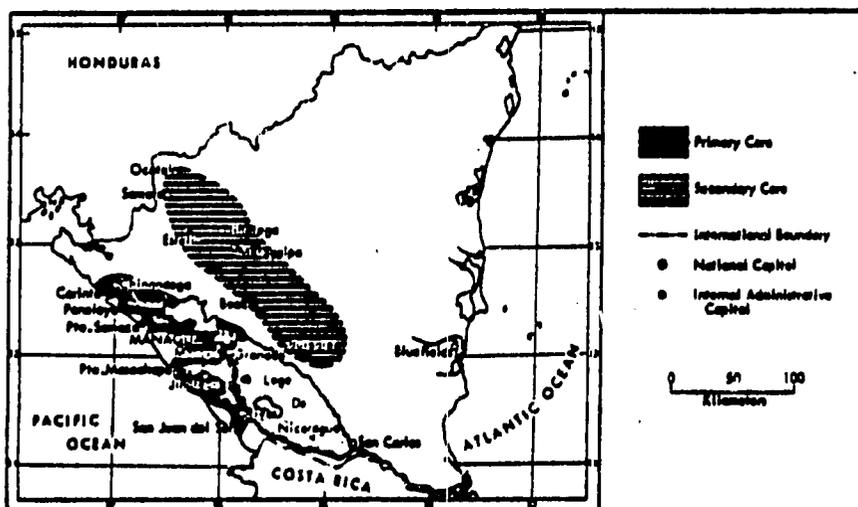


Figure 6. Core Population Centers

Source: American University. 1970.

Table 5. Regional Population Distribution (Mid-1978)

Region/Department	Est. pop.	Area (sq km.)	Density (persons/sq km)
<b>PACIFIC ZONE</b>	<b>1,346,770</b>	<b>18,219</b>	<b>74</b>
Chinandega	187,798	4,662	40
León	208,814	5,234	40
Managua	558,029	3,635	154
Masaya	116,033	543	214
Granada	93,216	964	97
Carago	91,887	1,032	89
Rivas	90,993	2,149	42
<b>NORTH &amp; CENT. ZONE</b>	<b>695,090</b>	<b>33,597</b>	<b>21</b>
Chontales	83,391	4,947	17
Boaco	78,026	4,982	16
Matagalpa	190,717	6,794	28
Jinotega	107,090	9,576	11
Esteli	93,005	2,199	42
Madriz	62,152	1,758	35
Nuevo Segonia	80,709	3,341	24
<b>ATLANTIC ZONE</b>	<b>190,835</b>	<b>66,542</b>	<b>2.9</b>
Rio San Juan	21,146	7,488	2.8
Zelaya	169,689	59,094	2.9
<b>Total</b>	<b>2,232,695</b>	<b>118,358</b>	<b>18.9</b>

Source. U.S. AID. 1979.

### 2.2.3 Health and Nutrition<sup>6/</sup>

Overall health conditions in Nicaragua remain substandard and health services are inadequate. Vital statistics for the period 1960-1978 are summarized in Table 3. The leading cause of death in 1969 was enteritis and other diarrheal diseases (17.3 percent of all deaths), attributable in large measure to the fact that only 34 percent of the rural population has access to safe water supplies. Other important diseases include malaria, gonococcal infections, tuberculosis, syphilis, bacillary dysentery, measles, whooping cough and tetanus. Polio is epidemic and goiter affects at least one third of the population. Contaminated water supplies cause widespread intestinal parasitic infections that afflict more than 80 percent of the population and raise their susceptibility to other diseases.

Malnutrition is common among children under 15 years old and is an important cause of death in the 0-14 year old group. It is also important at the subclinical level because it underlies or augments other health problems. Anemia is also common, especially among pregnant or lactating women. The daily per capita intake of food is estimated at 2450 calories, including 71 grams of protein, compared to a recommended daily minimum of 2600 calories and 65 grams of protein (Kurian 1978). Caloric intake is lowest in the Caribbean region, highest in urban areas.

Family planning has been government supported since 1967. Estimates of active users of contraceptives among women of child-bearing age, 15-44 years, vary from a low of 6 percent (U.S. AID. 1979) to as high as 24 percent (U.S. AID n.d.b).

## 2.3 Land Use

### 2.3.1 Background and Trends

Nicaragua is divided into three principal regions, the Pacific region, which is the bread basket of the country, the central highlands, with relatively infertile soils, poor yields, and land suited chiefly for such permanent crops as coffee or for forest management, and the largely undeveloped eastern plains region. Presently about 5.3 percent of the

<sup>6</sup>  
Sources: Kurian, 1979  
U.S. AID. 1979.  
U.S. AID. N.d.b

total surface area (6 percent excluding the rift lakes) is under cultivation. This represents only about one-fourth of the total area that is available for cultivation but is a 27 percent increase over that utilized in 1964 (Kurian 1978). However, Kurian's figures (above) for percentage of cultivated area to total area differ somewhat from that of van der Leeden's (1975) estimate of 13 percent and suggests that the information should be viewed with caution.

Forests (also see section 3.4.2) are estimated to cover about one-half of the total area but virtually all forested land is found in the eastern portion of the country. No undisturbed stands of forest remain in Pacific Nicaragua, nor are there any stands remaining in the Pacific region that are suitable for commercial exploitation.

Estimates of the change in land use between 1961 and 1974, in terms of arable land, permanent pasture, permanent crops, and total forests, are shown in Table 6. The following trends are evident: 1) steady increase in amount of arable land (land under temporary crops or pastures), 2) increase in permanent pasture (pasture longer than 5 years), 3) increase in permanent crops, e.g. coffee, citrus, and 4) a steady decline in the total forest and woodland area (FAO 1975).

These patterns are a direct reflection of the Nicaraguan economy which has been and is primarily based on agriculture. During the latter 1960s and most of the 1970s agricultural development was characterized by rapid expansion of the area under cultivation, but not by an increase in production per unit area. Thus agriculture has expanded at the expense of dwindling forest and natural resources. Land use planning under the new government should lie within the responsibility of the Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA). Current land use policy and planning of IRENA, if any, is unknown.

Table 6. Land Use (1000 ha)

Land use <sup>1</sup>	1961- 1965	1966	1968	1970	1972	1974
Arable Land <sup>2</sup>	710	730	750	750	750	790
Perm. Crop	155	160	160	165	170	170
Perm. Past.	1710	1750	1750	1750	1800	1800
Forest	6432	6360	6300	6240	6180	6150
Other	3592	4000	4040	4095	4100	4090

<sup>1</sup>based on total land area of Ca. 13000 exclusive of lakes.

<sup>2</sup>does not include land under permanent crops.

Source: FAO. 1975.

### 2.3.2 Farm Size

The distribution of land ownership is very uneven in Nicaragua although efforts to seek a more equitable distribution of agricultural land have been underway since the civil war. Prior to the war 2 percent of the farms (all over 364 ha) accounted for over 40 percent of the land area, while half of the farms occupied only 3.5 percent of the total area (Kurian 1978). The governmental agency for land reform, the National Agricultural Institute set up in 1964, was not effective in redistributing land.

Since the civil war almost half of the better agricultural property in the nation has been expropriated, including the very large acreage of commercial farms formerly owned by Somoza and his partners. Most are severely decapitalized through removal or destruction of machinery, livestock, and buildings. Much of the burden of redistribution falls to the Instituto Nicaraguense de la Reforma Agraria (INRA) that was created from several previously existing agencies. INRA proposes to maintain the former productivity of the estates by operating them as collective farms with professional managers and employees composed of a dozen to a hundred or more families (Brown 1979), rather than by subdividing to provide land for landless labourers, most of which would lack the expertise and capital to farm their land efficiently or productively. The private sector remains active in agriculture, but all commodities destined for export are first sold to nationalized trading agencies. Production targets have now been worked out that include both the private and state sectors (Quart. Econ. Review. 1980).

### 2.3.3 Crops

Nicaragua's food production cycle begins in April or May with the onset of the rainy season. In all but the drier parts of the country, two crops are possible in a year. The first is usually corn or dryland rice, followed by corn, beans, or sorghum, depending on the length of the rainy season. Considerable quantities of rice are also produced under irrigation (Brown 1979).

The most important crops, their approximate area under cultivation, their production, and yield, are shown in Table 7. Table 7 shows that the areas of cotton and tobacco under cultivation have more than tripled, and those of sugar cane, beans and corn have nearly doubled, yet increases in yield are modest or nonexistent, with the exceptions of rice and coffee. If yields do not improve, more land will have to be brought into crop production to feed Nicaragua's rapidly expanding population. As much of the remaining land may not be suitable for agriculture, research and efforts should strive to increase future yields.

Corn, the staple of Nicaragua's subsistence agriculture, is grown throughout, while coffee is grown primarily in the highlands, and cotton in the Pacific region. The most important crops for export are coffee, sugar and cotton, although during the civil war of 1979-80 cotton production dropped to only 20 percent of peak production. From 1970-78, the total land area under temporary crop cultivation was increasing at an average rate of 4.5 percent per year. Area under permanent crop cultivation (e.g. about 85,000 ha of coffee) has increased relatively little.

The amount of irrigation in Nicaragua is small. According to van der Leeden (1975), irrigated areas comprise about 1.6 percent of the total cultivated area, or about 29,000 ha out of an estimated 1,812 million ha under cultivation. Most irrigated land is found on the larger commercial farms, although no data on the proportional distribution is available. No information on fertilizer use was found. Pesticides are discussed in Section 4.2.1.

Table 7. Nicaragua: Area, Production and Yield of Major Crops, 1960/61-1976/77. One Manzana (mz) equals 0.7 ha (1.7 acres); One Quintal (qq) equals 100 kg

		1960/ 1961	1969/ 1970	1970/ 1971	1971/ 1972	1972/ 1973	1973/ 1974	1974/ 1975	1975/ 1976	1976/ 1977	<sup>1/</sup>
Cotton:	Area Harvested	('000 mz)	81.5	155.1	136.3	156.1	210.9	259.4	254.4	264.6	283.0
	Production	('000 qq)	721.8	1488.5	1711.5	2231.4	2303.7	3173.7	2670.0	2396.8	2557.0
	Yield	(qq/mz)	8.9	9.6	12.6	14.3	10.9	12.2	10.5	11.7	9.0
Sesame:	Area Harvested	('000 mz)	19.9	16.4	14.0	11.0	7.3	13.0	10.0	12.0	13.0
	Production	('000 qq)	179.0	160.0	146.0	101.2	48.1	104.6	84.0	120.0	..
	Yield	(qq/mz)	9.0	9.8	10.4	9.2	6.6	8.0	8.4	10.0	..
Rice:	Area Harvested	('000 mz)	30.5	36.9	47.7	48.3	42.6	35.6	46.8	42.2	30.0
	Production	('000 qq)	462.0	1018.9	1151.5	1183.8	1060.6	1121.7	1469.3	1223.8	825.0
	Yield	(qq/mz)	15.1	27.6	24.1	24.5	24.9	31.5	31.4	29.0	27.5
Coffee:	Area Harvested	('000 mz)	117.7	124.3	120.1	118.4	118.6	118.9	119.0	120.0	120.0
	Production	('000 qq)	571.4	737.1	856.9	913.3	762.5	797.7	890.7	1068.2	1287.5
	Yield	(qq/mz)	4.9	5.9	7.1	7.7	6.4	6.7	7.5	8.9	10.7
Sugar Cane:	Area Harvested	('000 mz)	22.9	42.7	45.6	44.0	43.1	44.6	51.5	58.7	59.6
	Production	('000 qq)	16897.0	39548.0	42174.0	38650.0	35066.0	39132.0	45850.2	58200.2	54992.0
	Yield	(qq/mz)	737.9	926.2	924.9	878.4	813.6	877.4	890.3	991.6	922.7
Beans:	Area Harvested	('000 mz)	54.1	58.0	66.6	69.5	57.0	67.1	93.0	80.2	96.5
	Production	('000 qq)	605.5	689.3	790.2	819.0	622.3	742.7	1012.7	962.4	1177.3
	Yield	(qq/mz)	11.2	11.9	11.9	11.8	10.9	11.1	10.9	12.0	12.2
Corn:	Area Harvested	('000 mz)	187.2	261.4	299.0	294.4	244.4	292.7	374.0	298.3	323.8
	Production	('000 qq)	2588.0	4039.7	4136.3	4042.5	3171.0	4152.8	4414.0	4176.2	4371.3
	Yield	(qq/mz)	13.8	14.4	13.8	13.7	13.0	14.2	11.8	14.0	13.5
Sorghum:	Area Harvested	('000 mz)	72.0	68.1	59.1	61.7	51.0	59.8	79.3	85.4	80.0
	Production	('000 qq)	847.0	1127.0	977.0	1004.3	820.7	961.0	1127.6	1366.4	1200.0
	Yield	(qq/mz)	11.8	16.5	16.5	16.3	15.2	16.1	14.2	16.0	15.0
Tobacco:	Area Harvested	(mz)	658	1474	1599	1678	1417	1894	2431	2600	3000.0
	Production	(qq)	12500	40122	45431	44420	39278	52954	67700	66000	..
	Yield	(qq/mz)	19.0	27.2	28.4	26.5	27.7	28.0	27.8	25.4	..
Total Area under Major Temporary Crops		(000 mz)	468.8	640.1	669.9	686.7	660.6	774.1	911.4	784.0	888.9

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<sup>1/</sup> Estimate

Source: World Bank. 1978.

#### 2.3.4<sup>7/</sup> Livestock and Pasture

Nicaragua is the largest cattle raising country in Central America. It has traditionally exported more than 50 percent of its total beef production to other Central American countries and has shipped a full quota of boneless beef to the United States in recent years (Table 8). Because of a costly civil war and the collapse of the government in mid-1979, cattle were liquidated rapidly and Nicaraguan beef exports to the United States in 1979 exceeded those of previous years by 3.2 million pounds. These extensive exports have had a devastating and lasting impact on Nicaragua's herd because they have greatly reduced breeding stock. Out of an estimated national herd of two million cattle, some 450,000 were slaughtered in Nicaragua for export and another 44,000 were slaughtered in Honduras. In addition, it is conservatively estimated that 25,000 breeding cows and 150,000 heifers were lost (Brown 1979). There are higher estimates according to Brown (1979).

Before his fall, former President Anastasio Somoza had extensive holdings in all aspects of the cattle industry, and the government until 1979 promoted development activities in the eastern department of Zelaya. What policies the new government may encourage in this region will probably depend upon the rate of recovery of the economy.

Statistical information on the amount of pasture land in Nicaragua is sketchy and incomplete, but it is reported that in the decade between 1960-70, pasture land in Nicaragua increased by 48 percent. More recent figures are not available but based on continuing interest in cattle raising by both the government and private sector, it may be assumed that ever-increasing areas of tropical forest will continue to be consumed to provide pasture for cattle.

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<sup>7/</sup>  
Sources: Brown. 1979.  
Quart. Econ. Rev. 1980.  
Shane. 1980.

Table 8. Beef and Veal Trends (thousands of metric tons, by carcass weight)

	1961	1965	1970	1975 <sup>a</sup>	1979 <sup>b</sup>
Production <sup>c</sup>	27.6	32.3	62.6	60.8	98.4
Consumption <sup>d</sup>	19.3	19.6	29.6	30.6	63.5
Imports	0	-	0	0	-
Exports	8.3	12.7	33.0	29.6	43.8

<sup>a</sup>Reflects 1973-76 market slump

<sup>b</sup>preliminary statistics

<sup>c</sup>Based on carcass weight, equivalent basis (incl bones and meat) rather than product weight.

<sup>d</sup>Approximate, based on estimates.

Source: Shane. 1980.

### 3.0 Environmental Resources

### 3.1 Geology and Soils <sup>8/</sup>

#### 3.1.1 Geologic Formations

The main geological features of Nicaragua have been described by Sapper (1937) and summarized by Taylor (1971) and the U.S. Army Corps of Engineers (1966). The geology of western Nicaragua has been mapped by Zoppis and Giudice (1958) and is discussed briefly by Halasz and Halasz (1975). A fuller descriptive treatment of the geology may also be obtained from Weyl (1980) and references therein.

The surface of Nicaragua can be divided into four physiographic regions: (1) the western region, including the Pacific coastal plains and the young volcanic chain of the southwest Pacific coast, (2) the Rift Depression, also called Central or Nicaraguan Depression, (3) the central highlands, including the northern sierras and the older volcanic highlands, and (4) the Caribbean coastal plain. The first three of these regions are shown in schematic cross-section in Figure 7.

The Western coastal range of Nicaragua consists of Cretaceous and Tertiary sediments, mostly sandstones together with tuffaceous schists, limestones and breccias, as well as some Quaternary rocks about 60 million years old or less. (Figs. 3, 7 and 8). All are covered in part by very deep deposits of recent volcanic ash (Taylor 1971). Western Nicaragua is one of the world's most active tectonic regions, with most rock layers strongly modified by faulting. Earthquakes are common, major destructive quakes occur from time to time, and active and dormant volcanos extend in a line from Mount Cosiguina near Honduras southward through and along the western side of Lake Nicaragua and into northwestern Costa Rica.

The Central Depression is likewise covered by young volcanic ash but on its western boundary this plain consists of Quaternary alluvium deposited by erosion from the central Cordillera. The Central Depression is believed to have been formed by subsidence during the late Tertiary and early Quaternary, and its low points were filled by interior

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Sources: Taylor. 1963.  
Thorsor. 1976.  
U.S. Army Corps of Engineers. 1966.  
Weyl. 1980.

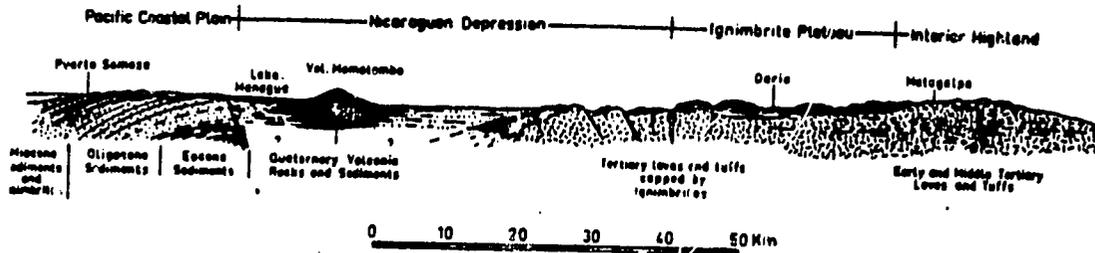


Figure 7: Generalized geological section through southwestern Nicaragua.

Source: Weyl. 1980.

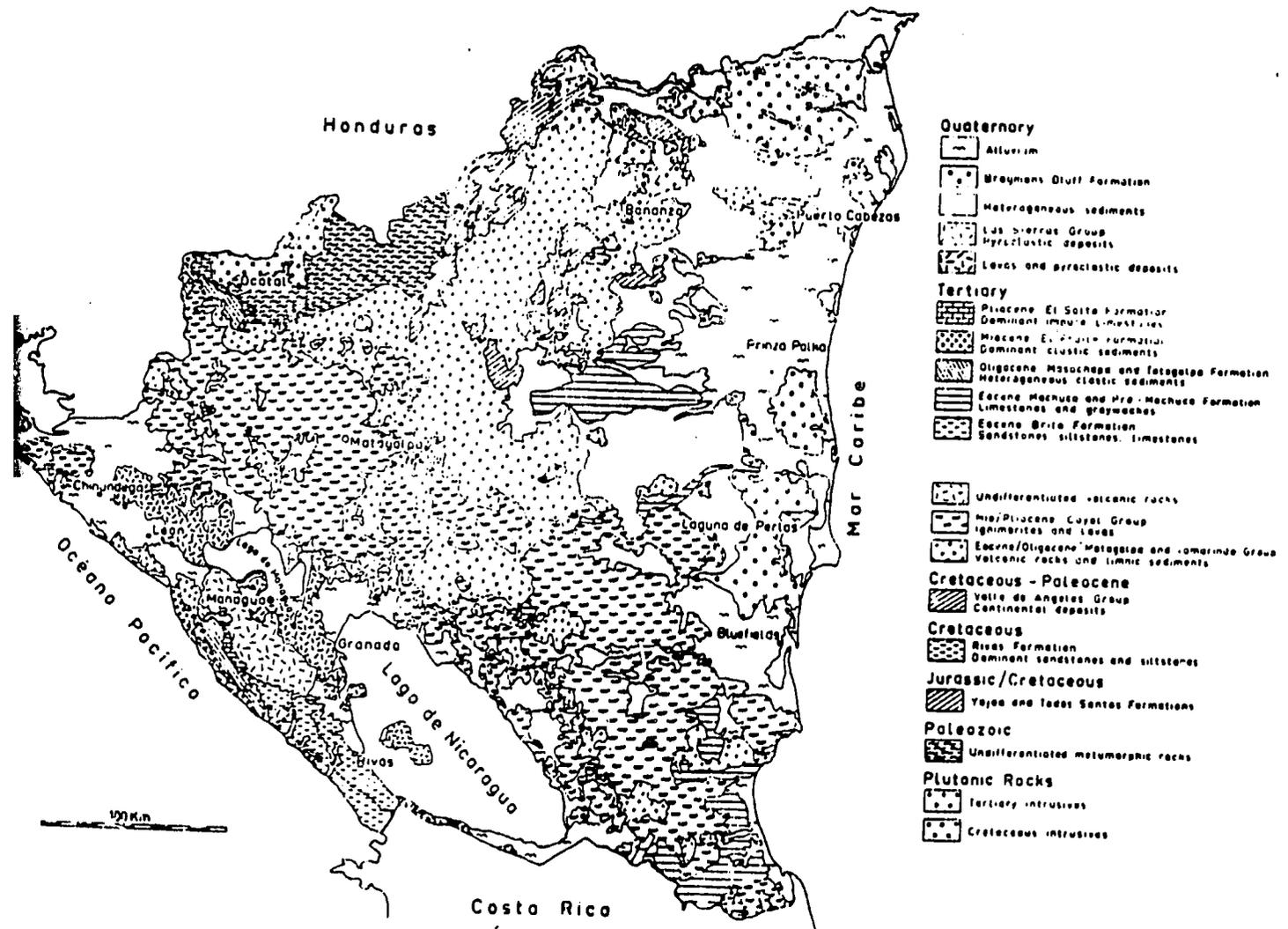


Figure 8. Surface Geology of Nicaragua

Source: Weyl. 1980.

runoff forming the present lakes Nicaragua and Managua. Thus the lakes are tectonic rather than volcanic in origin and are not believed to have ever been connected directly to the sea.

The Central highland region is geologically less well known but its main features are clear. The northern sierras consist of a folded belt of older Paleozoic and Mesozoic metamorphic and sedimentary rocks which have been intruded and cut by igneous rocks such as granites and diorites. These mountains generally trend from northeast to southwest and represent the core of the Nicaragua-Honduras structural unit known as the Cordillera Isabelia, Cerro de Villaguire, and the associated Cordillera de Darien and Montanas de Huapi. The oldest volcanic highlands are known as the Cordillera de Amerrisque and consist of a deeply dissected ridge running northwest to southeast from Honduras to Costa Rica along the eastern side of the Central Depression. Tertiary volcanics predominate south of the Rio Coco in both highland regions, although there are small areas of Tertiary sediments, mostly conglomerate or sandstone, and of Tertiary and Quaternary alluvium. The Tertiary volcanics are largely andesite but there are moderate extents covered by acidic lavas, rhyolite, dacite and porphyry, as well as areas of diabasics, basalts and other basic volcanics (Taylor 1971).

The geology of the Atlantic region is not well known. There is an extensive area on the North Atlantic coast that is covered by a series of marine sediments mostly of Pleistocene age, as well as large areas covered by Quaternary alluvium, but the greater part of this region is alluvium composed of recent unconsolidated material such as sand, clay, boulders and gravels derived from weathering and erosion of the Northern Sierras and older volcanic highlands. Areas of Pleistocene marine sediments are today delineated approximately by the distribution of the lowland pine savannas that flourish on these soils (see Section 3.4.1).

### 3.1.2 Mineral Deposits, Oil and Coal Reserves

Mining is a relatively insignificant sector, contributing about 3 percent of the GNP and experiencing a negative growth during the 1970's. Until recently the extent and nature of most mineral resources were largely unproved. Gold production, formerly important, declined to 2153 kg by 1975. In 1977 only gold (1904 kg exported), silver (5 tons exported), copper (500 tons in 1977 down from 11,500 tons in 1968), lead and zinc (6000 and 17,000 tons exported were mined).

Large deposits of tungsten were found in 1961 and known iron deposits are estimated at 30 million tons. Both are untouched. In 1971 the Vestibio Lead and Zinc mine, 140 km from Managua, was opened. Exploration for mineral deposits has been carried out in the Departments of Esteli, Leon and Zelaya. The mining industry was nationalized in 1979 following the overthrow of Somoza and the new government hopes to increase gold production (Quart. Econ. Rev. of Nicaragua, Costa Rica and Panama 1980). There are no other known deposits of commercially valuable minerals.

Oil reserves are unproved at the moment, although about 43 concessions in a 7.6 million ha area of both coasts had been granted before Somoza's fall, following which all activity ceased. There are indications of petroleum deposits but as yet no official estimates exist. Union Oil has concessions in the northeast near the Honduran border, Chevron has 10,000 sq km further south, and Amjon, Signal and Occidental have concessions near Prinzapolka. Other companies with interests include Texaco in partnership with Amerada Hess, Western Caribbean, Franks Petroleum, General Crude Oil, and Oceanic Exploration in partnership with El Paso, Shell, Texasgulf, Santa Fe and Atlantic Richfield. Esso operates a 13,000 b/d refinery at Managua (Quart. Econ. Rev. of Nicaragua, Costa Rica and Panama 1980, MITRE 1980).

Very small coal reserves may exist but at the present no information is available and it is unknown if they are exploitable (MITRE 1980).

### 3.1.3 Soils

A number of national and regional soil surveys have been conducted in Nicaragua. One of the best and most detailed surveys covers the Pacific region (Parsons Corporation 1971). The survey conforms to the guidelines established by the U.S. Soil Conservation Service (Soil Survey Staff 1951, 1962) and includes the comprehensive soil taxonomy nomenclature. Other useful studies pertaining to Nicaragua include Alexander (1973), Banco Central de Nicaragua (1977), Blasco et al. (1975), Burbano and Blasco (1975), Catastro e Inventario de Recursos Naturales (1976, 1977), Forsythe (1975), Incer (1975), Juarez (1977), Knox (1969), Marin (1977), Ogg (1977), Swain (1961), Tahl Consulting Engineering Ltd (1970), Taylor (1961) and Valencia (1961). Much of the following discussion is summarized from Taylor (1963) and U.S. Army Corps of Engineers (1966). The distribution of major Nicaraguan soil types, following the terminology of Bramao and Dudal (1958),



Figure 9. Distribution of the Predominant Soil Groups.

Source: Taylor. 1971

is discussed briefly in Figure 3 and is shown in Figure 9.

Latosols. The majority of soils in tropical forest areas belong to this nutrient-deficient group, also known as ferralsols, or lateritic soils. The group is characterized by having their more soluble mineral elements such as calcium, nitrogen, magnesium, phosphorus and potassium leached by heavy rainfall, while relatively insoluble elements such as silicates, clay, iron and aluminum remain concentrated in the upper layers of the soil. The reddish color of many of these soils is due to oxides of iron. They occur on volcanic rocks or acidic schists in Nicaragua. A yellow-red latosol is formed over Pleistocene marine sediments of the northeast. As the nutrient content of most latosols is very low, and they are rapidly leached after the forest cover is removed, their potential for annual crop production is limited. Their continual fertility, according to present knowledge, is dependent upon a covering of forest vegetation that retards the leaching and weathering effects of heavy rainfall, high temperature and solar radiation. The nutrient supply of the forest is inextricably bound up in the vegetation and the animals over these soils, and if lost, the forest is replaced by grasses, scrub and other short cycle crops (Shane 1980).

Soils of volcanic ash (Andosols and Regosols). This is a group of soils with silt-size particles formed from wind-born volcanic ash and limited to the Pacific region. They are dominated by silt loams but include layers of clay, clay loams, and deposits of volcanic tufts, breccias, sand, pumice, etc. These are the most intensively cultivated soils in Nicaragua at the present.

Black soils of the tropics (Grumosols). These are soils with deep heavy clay topsoil of 1 m depth or more, montmorillinitic, black or dark in color, very sticky when wet, and tending to crack deeply when dry. They may concentrate lime in their lower levels, and are mostly found in older deposits of Quaternary alluvium but also on flatter areas of basic Tertiary volcanics and Tertiary sediments. These soils occur spottily on the Pacific drainage, especially in the present coffee belt.

Brown tropical soils. These are dark, coarsely granular soils and blocky subsoils of well drained, uneroded, moderate to gentle slopes. Formerly they supported semievergreen or deciduous forest. These, with the volcanic ash soils, comprise the most prevalent Pacific slope soil type.

Hydromorphic soils (hydrosols). This is the dominant soil group of the Caribbean northwest. They include a variety of humic gley soils, ground-water latosols, muck soils and peat soils. Their exact composition and nature is determined by drainage, extent of flooding and ground water composition. They are typical of coastal areas that are water-logged or marshy.

Alluvial soils. These are immature river valley soils composed of successive alluvial deposits of variable composition, often sandy near rivers and clayey away from them. They are usually inundated annually and often are deep and mineral-rich although their fertility may vary depending on the amount of prior leaching and the source of the parent material. They can be used successfully for agricultural purposes, whereas most of the above soils (with the exception of the volcanic ash soils) require massive applications of fertilizers for sustained crop yields.

Saline soils. These are soils associated with salt meadow communities and are found in Nicaragua only near the Gulf of Fonseca. They are subject to occasional sea water flooding. These shallow gray silt or silty loam topsoils often have a surface layer of salt crystals during the dry season.

Lithosols: These are immature erosional soils of steep slopes and predominant in the central highlands. Gradient and frequent deficiencies of nitrogen and phosphorus make them generally unsuitable for annual crops although they are often used for such.

Regosols. These include a variety of soil types of scattered distribution in Nicaragua; they are formed from volcanic ash, volcanic soils, beach soils, and silica derived from weathered granites.

## 3.2 Water Resources

### 3.2.1 Water Resource Information

Water resource data currently available for Nicaragua are based on information collected by CEPAL (van der Leeden 1975) or estimates by the U.S. Army Corps of Engineers (1966). Information exists for most important watersheds, although some surface drainage data, especially for the Caribbean region, are based on brief sampling periods and should be considered only as a relative indicator. Surface drainage for smaller tributaries is usually based on estimates; suspended sediment loads are not inventoried.

Both surface water runoff and ground water yield for Nicaragua are the highest in Central America. During a normal year surface water runoff to the Caribbean is estimated at 5302 cubic meters per second (cumecs), that to the Pacific at 218 cumecs (Table 11), for a total annual surface water runoff of about 174 billion cubic meters (van der Leeden 1975). Total estimated dependable yield of ground water is about 16.8 billion cubic meters with an estimated dependable yield of ground water of 527 cumecs. Current (1980) total water usage is estimated at 123 cumecs of which 119 cumecs are used for irrigation (Table 12); less than 2.5 percent of the potential hydroelectric power, estimated to be in excess of 4000 MW, is now harnessed (MITRE 1980, also see Section 3.3). Total drinking water and industrial usage is small, as is the percentage (1.2 percent) of cultivated land that is irrigated.

Nicaragua's total surface water supply is abundant but not evenly distributed. The Caribbean region has by far the largest surface water runoff but for the most part is practically uninhabited while the densely populated Pacific belt receives much less rainfall. Flow characteristics of selected rivers on both slopes are given in Table 13.

### 3.2.2 Urban and Rural Water Quality <sup>9/</sup>

Water supply and quality are critical problems in every urban area of Latin America. The problem is exceptionally acute in Nicaragua because of the extensive damage caused by the 1972 earthquake in Managua, the delays in reconstruction following the earthquake, and the 1978-79 civil strife that disrupted most populated sectors of country. In addition, the large migration of people from rural to urban areas has placed additional strains on the water supply and quality in

Table 11. Available Water Resources'

Area	Mean flow of Surface water runoff (cubic meters/sec)		Ground water; estimated dependable yield (cubic meters/sec)
	Normal year	Dry year	
Caribbean slope	5302	3952	428
Pacific slope	218	150	39
Total	<u>5520</u>	<u>4102</u>	<u>527</u>

Source: van der Leeden . 1975.

Table 12. Water use in Nicaragua, 1970-80

Year	Net water use (cumecs)	Total irrigation water demand (cumecs)	Total drinking water and indust. supply demand (cumecs)	Installed Hydroelectric Power Gener- ation HW
1970	51.0	49.4	1.7	50
1980	123.	119.1	3.9	100

Source: van der Leeden 1975.

Table 13. Flow Characteristics of Selected Rivers. Coco, Grande and Tuma drain to Caribbean, Viejo and Malacatoya to Lake Managua and Nicaragua respectively, Tamarindo to Pacific.

River	Station	Basin area km <sup>2</sup>	Discharge, m <sup>3</sup> /s			% runoff between June to November	Period of record
			Mean	Max.	Min.		
Coco	Guanas	6,803	62.2	698.5	2.9	85	1958-66
Grande	Dario	771	3.2	311.5	0.0	98	1952-66
Tuma	El Dorado	579	12.7	386.5	0.0	80	1953-64
Tuma	Yacica	838	20.8	1,305.2	1.3	86	1952-65
Viejo	Santa Barbara	1,185	6.6	635.2	0.0	98	1953-63
Malacatoya	Las Banderas	894	6.7	783.0	0.0	85	1952-66
Tamarindo	Tamarindo	198	2.9	378.6	0.0	84	1954-64

Source: van der Leedens. 1975.

Table 14 Proportion of Population With Reasonable Access to Safe Water<sup>a</sup>

Year	Rural %	Urban %	Total %
1970	16	58	35
1975	14	100	46

<sup>a</sup>Number of people with reasonable access to safe water (includes treated water or untreated boreholes, springs and sanitary wells) as a percentage of their population. Reasonable access indicates a source not more than 200 m from the house.

Source: U.S. AID. 1980.

in urban areas.

Water supply problems range from lack of adequate delivery systems to lack of sufficient sources of water. Water quality problems are the result of inadequate sewage and waste disposal systems and the contamination of both surface and undergrown water sources. Currently only 38 percent of dwellings have access to piped water. Values for urban areas are somewhat higher than the overall, those for rural areas much lower (Table 15). The corresponding values for access to safe water are somewhat higher (Table 14) but indicate that the majority of rural people do not have access to safe water.

Water quality in Nicaragua is an increasingly serious problem, compounded by an inadequate internal and external financing, and an inadequate legal framework. There is currently no precise information on the degree of contamination of surface water or of undergrown water sources, or of the sources of the pollutants. This base of environmental information is badly needed. One undeniable source of contamination is the treatment of solid waste. Inadequate at the present, it is likely to become an increasingly serious problem as consumer product use, increased packaging, and increasing population all exert a growing influence in the future.

Table 15. Proportion of Population With Reasonable Access to Piped Water

Year	Rural %	Urban %	Total %
1963	0.3	28.6	12.5
1971	3.1	54.1	29.9
1979	-	-	38 <sup>b</sup>

<sup>a</sup>Inside or outside water as a percentage of all occupied dwellings. Source may be a community system or an individual installment. Reasonable access indicates within 200 m of the house.

<sup>b</sup>From U.S. AID. 1979.

Source: U.S. AID. 1980.

### 3.3 Energy Resources

Nicaragua's energy resources as of 1979 are shown in Table 16. Each is discussed briefly below. The approximate locations of the major energy sites are shown in Figure 10.

Hydroelectric potential, estimated in excess of 4000 MW (Sec. 3.2.1) accounts for about 100 MW of energy at present generating capacity. This is derived from two 50 MW plants. Two proposed projects, Copalar and Brito, would contribute an additional 560 MW (MITRE 1980).

Geothermal exploration is now a decade old in Nicaragua but the tapping of this resource has barely begun. Geothermal energy is estimated in excess of 1000 MW for a period of more than 30 years. Exploration is taking place chiefly at three areas, Managua, the Masaya-Mandame area, and the Marrabios Range. At the Momotombo field near Managua it is expected that a geothermal plant with a 35 MW capacity will be installed by 1981. Thirty-two wells have been drilled at this site and 21 will be productive. The Momotombo well water is very hot and contains high concentrations of dissolved mineral salts and silica. One of most challenging problems facing successful operation of the plant at present is the disposal of large quantities of this water without causing significant surface environmental pollution, principally due to heat and to high mineral water build-up. There are plans to test reinjection techniques in the near future. In addition to environmental problems, the project faces other obstacles including 1) enormously high cost, 2) lack of funding, and 3) lack of experienced drilling personnel.

Oil exploration, as noted in Section 3.1.2, is in its infancy in Nicaragua. There are indications that deposits exist.

Coal deposits are believed to be insignificant. There is currently no information on exploitability.

Wind and solar power are two interesting alternate energy resources. No specific research or development has been done on either in Nicaragua although it is believed that solar energy, in particular, may represent a vast untapped resource.

Forest products represent an important energy resource for Nicaraguan households at present as about 77 percent use wood in some form for cooking. Unfortunately a significant proportion of this resource has already been used or squandered in the western half of the country. Reforestation has been limited although IRENA does have plans for environmental forest projects. The Instituto de Reforma Agraria (INRA) is considering the growth of Taiwan grass and leucaena, a fast growing tree, for fuel replacement in thermal electric plants. Before these are used successfully to replace current fuel resources in

Table 16. Energy Resource Summary, 1977.

<p><b>Hydroelectric Potential</b></p> <p>Theoretical Capacity: 4,416 MW<sup>1</sup></p> <p>Installed Capacity: 100 MW<sup>2</sup> (33% of total installed capacity)</p>
<p><b>Geothermal</b></p> <p>For 1981, 35 MW are scheduled at Momotombo. The potential is for 4,000 to 6,000 MW.<sup>2</sup></p>
<p><b>Oil Reserves</b></p> <p>Proven: None.</p> <p>Estimated: Unknown.</p> <p>Refining Capacity: 20,000 barrels/day.<sup>3</sup></p>
<p><b>Gas Reserves</b></p> <p>Proven: None.</p>
<p><b>Coal</b></p> <p>Small unexploited deposits exist.<sup>4</sup></p>
<p><b>Wind</b></p> <p>There are a small number of potential sites.<sup>4</sup></p>
<p><b>Solar</b></p> <p>Data are limited to the number of sunlight hours.</p>
<p><b>Biomass</b></p> <p>Forests: Forests and woodlands cover 6.3 million hectares.</p> <p>Sugar: The sugarcane harvested in 1978 amounted to 219 thousand hectares. The land available to sugarcane for alcohol is 7 thousand hectares.<sup>5</sup></p>

<sup>1</sup> Master Plan for Electricity Supply, Vol. 1, Instituto Nacional de Electrificación (INDE), Guatemala.

<sup>2</sup> Instituto Nicaraguense de Energía.

<sup>3</sup> Interview with Rodolfo Narvaes, Esso Standard Oil, S.A.

<sup>4</sup> Interview with Jerge Jenkins, Director, Instituto de Recursos Naturales (IRENA).

<sup>5</sup> Interview with Saul Lewites, Director, AGRO-INRA.

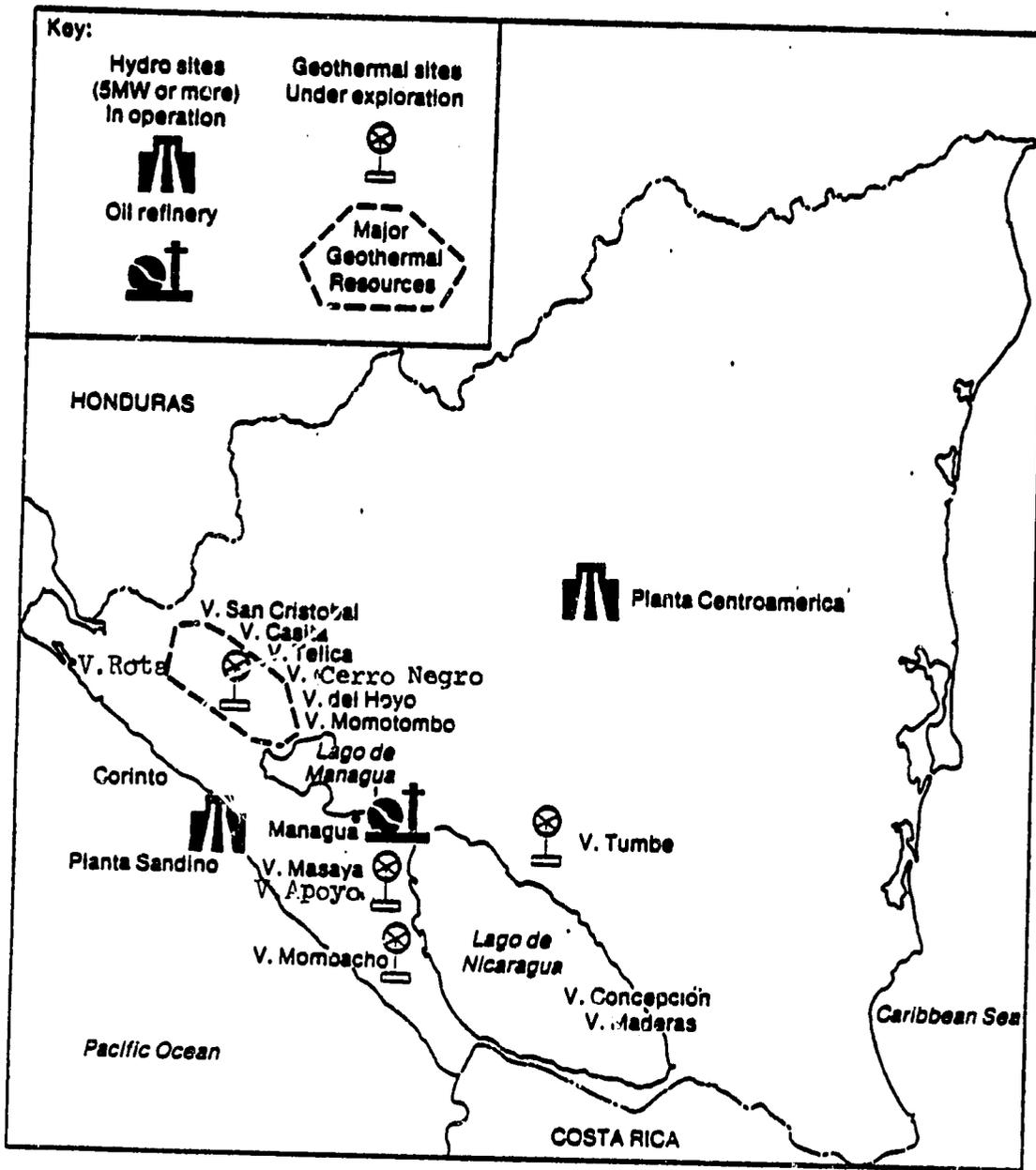


Figure 10. Energy Resources

Source: MITRE 1980.

two Managua generating plants, a number of land management problems should be addressed. The potential of these two fast growing plants appears significant (MITRE 1980).

AGRO-INRA is also interested in developing a gasohol program using sugarcane as the alcohol source. A feasibility study was completed during the Somoza regime but current financial support is uncertain.

### 3.4 Vegetation

#### 3.4.1 Flora and Vegetation

The flora of Nicaragua is very rich, with well in excess of ten thousand species known and many more yet to be discovered. The earliest and still the only flora treating the entire country is that of Goyena (1909). It is incomplete and very out of date. Other botanical publications dealing with Nicaragua are few, but several important regional works have been completed, including one for the upland pine forests by Denevan (1966) and another for the Caribbean coast by Radley (1960). A few timber species are discussed in a report by Salter (1956).

Taylor's (1963) general outline and map of the vegetation communities of Nicaragua treats the major plant communities and their features (Fig. 11). Taylor's study, the most extensive for Nicaragua, forms the basis of the following discussion. Deforestation and land use practices have to some extent altered the basic features and composition of the communities. There is presently almost no undisturbed natural forest remaining in western Nicaragua. Five zonal plant communities may be broadly distinguished in Nicaragua. These are, 1) lowland evergreen rain forest, which includes the lowland rain forest and lowland wet forest of Holdridge, 1963, 2) lower montane rain forest, 3) seasonal evergreen rain forest, 4) semievergreen rain forest, and 5) deciduous forest. Azonal communities, including swamps and beaches as well as an edaphic pine savanna climax can also be added. The most important factor controlling the distribution of the plant communities is the length and severity of the dry season, but where there are elevational differences the effect of temperature prevails (Taylor 1963).

Lowland Evergreen Rain Forest. This is the dominant community of the Caribbean lowlands and is the least disturbed or exploited plant community in Nicaragua. The forest is typically tall, usually exceeds 30 m, with emergent canopy trees well above this height. There are four layers of

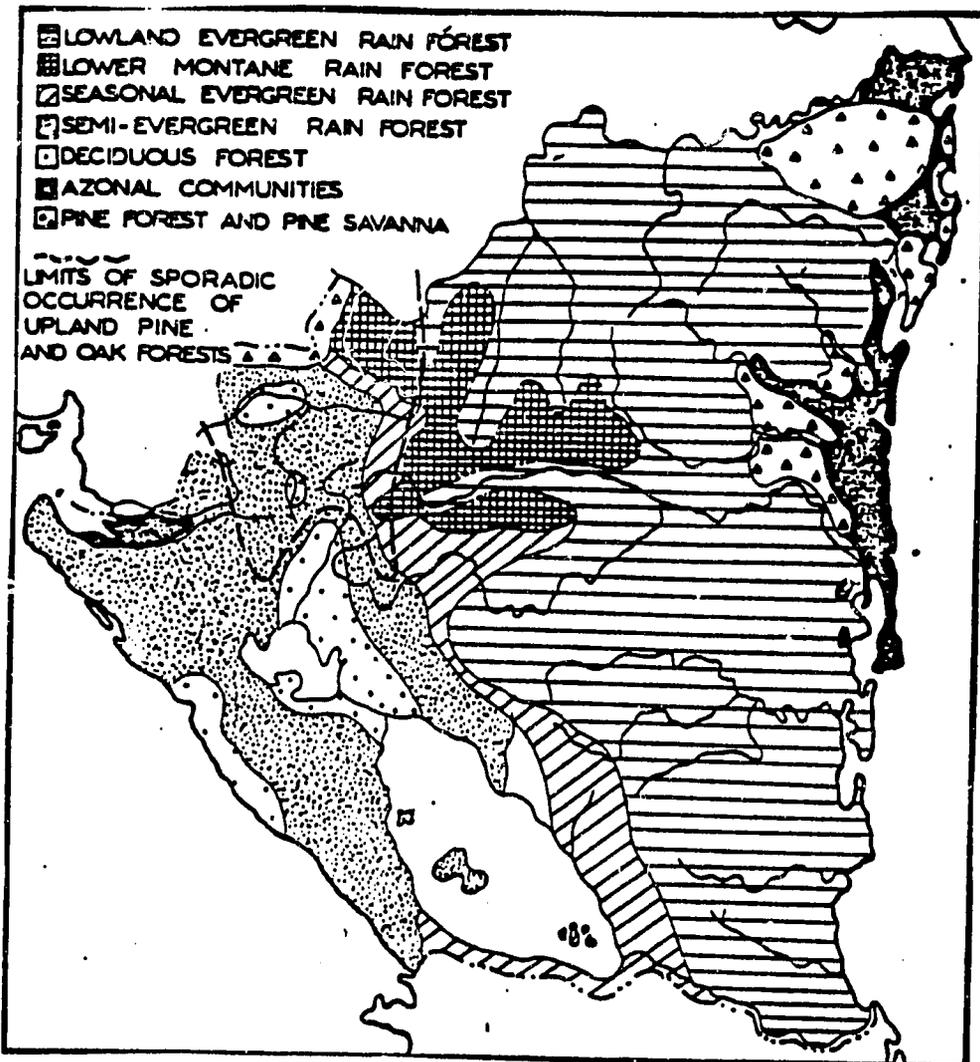


Figure 11. Distribution of the major vegetation zones.

Source: Taylor 1971.

vegetation, and the species composition is diverse. Species in the families Leguminosae, Rubiaceae, Melastomataceae, Apocynaceae, and Palmae are the most frequently encountered, although usually no single species or species group predominates. In adjacent northwestern Costa Rica a legume, *Penteclothra* may account for up to 30 percent of the total number of canopy trees at some sites (OTS 1972). Curiously this species is not on Taylor's list. Cedar and mahogany have been selectively extracted over a wide area but their removal has had little effect on the overall composition of the flora. The only significant areas of forest disturbance within this

plant community in Nicaragua occur near the few settlements, mostly coastal, and along the banks of all the major rivers for varying distances inland. Within these disturbed areas are three stages of secondary growth, including one dominated by *Cecropia peltata* and *Ochroma lagopus* in the earliest woody regrowth, a second dominated by *Vochisia hondurensis*, *Xylopia aromatica* and *X. frutescens* in a more advanced and diverse regrowth, and a third of predominantly *Guadua amplexifolia* (an introduced bamboo) on regularly cultivated fertile alluvial soils. A list of the most frequently encountered canopy species is given in Appendix I. The species composition of the very wet southeastern Caribbean region (lowland rain forest of Holdridge, 1967) is likely to be somewhat different than the less humid northeastern region (lowland wet forest of Holdridge, 1967).

Lower Montane Rain Forest. This is the dominant plant community of the highlands. Less floristically diverse than the preceding community, it is nevertheless complex. Only one tree, *Chaetoptelea mexicana*, ever becomes dominant in this community. The eastern portion of this zone is largely undisturbed except near rivers, however the western zone that extends toward the Central Depression has been almost wholly converted to various agricultural uses. This is Nicaragua's most important coffee growing zone, where stands of mature forest remain only on the steepest slopes. Early stages of secondary growth in this zone usually include *Cecropia peltata*, *Croton panamensis*, *Zexmania frutescens*, *Lippia myrioccephala* and *Senecio panamensis*, as well as a diverse assortment of other species. Tree species of the canopy are given in Appendix I.

Seasonal Evergreen Rain Forest. This type and lower montane rain forest are much less extensive than the wetter and drier communities to the east and west. In addition, much of this zone has been deforested and converted to various agricultural uses, especially for grazing. Taylor (1963) reported that the only extensive mature stands of this formation are in the area lying to the east of Lake Nicaragua.

The floristic composition of this zone is a transition between wetter lowland evergreen rain forest and drier semi-evergreen forest. The main floristic variation within this zone is due to the effects of elevation. Commoner canopy species of this community, all of which occur elsewhere in smaller numbers, include *Bombax*, *Cassia*, *Hymenacea*, *Nectandra*, and *Platymiscium*. Regrowth stages are likewise a composite of species intermediate between evergreen and semievergreen areas; *Miconia* and *Citharexylum* are characteristic regrowth species.

Semievergreen Seasonal Forest. This is the dominant vegetation community of most of the Central Depression and Pacific region of western Nicaragua. According to Taylor (1963) no primary stands of this formation remain in Nicaragua and mature secondary stands are uncommon. The area formerly covered by this zone is now a mosaic of numerous small secondary communities of various ages. Where successions develop, usually in ungrazed pastures, the invading species are diverse, but where both grazing and fire are prolonged and repeated the most common plants are *Pithecolobium dulce* and several species of *Acacia*, notably, *A. costaricensis*, and *A. farnesiana*, at higher elevations *A. pennatula* is common. On volcanic soils the succession is different with *Cochlospermum vitifolium* and *Tecoma stans* the most frequent, on abandoned cultivated lands *Guazuma ulmifolia* and *Luehea candida* dominate drier areas include *Bursera simaruba* and *Lysiloma* spp., and wetter cultivated areas have *Gliricidia sepium*. Older successions are progressively more diverse and contain species exceeding 30 m in height (Appendix I).

Deciduous Seasonal Forest. As with semievergreen forest this plant community has been largely replaced by various secondary communities. It occurs only in the Central Depression and on the Pacific coast, and several of Nicaragua's most densely populated urban areas lie within this zone. The predominant species are often the same ones that occur in similar types of successional stages leading to semievergreen forest. Deciduous forest differs most obviously from semievergreen forest in a greater degree of deciduousness (often as long as six months), lower height, and in the composition of the secondary associations which may range from open to dense stands of small deciduous trees and large shrubs. Vines, cacti and other spiny plants are often locally abundant. Where they occur, trees large enough for timber are usually of poor quality. Trees more than 10 m tall occurring in this formation are given in Appendix 1.

Riverine and Swamp Formations. These azonal plant communities occur chiefly along rivers or in other low-lying sites marked by increased water supply and poor soil aeration. They differ in both physiognomic structure and in species composition from the adjacent vegetation communities growing on more well-drained sites. Within drier zones the vegetation community is usually an *Enterolobium cyclocarpum*--*Ceiba pentandra* riverine forest. Structurally this formation resembles a semievergreen rain forest, but exhibits very little deciduousness, even when surrounded by deciduous forest. Other species particularly common in this riverine forest are *Astronium graveolens*, *Sterculia apetala*, and *Albizia caribaea* in the upper layer, and *Inga spuria* in the lower layer. Where the low-lying area is very extensive and poorly drained the *Enterolobium*--*Ceiba pentandra* riverine forest gives way to

a tall swamp forest, usually in excess of 25 m high, occasionally as high as 40 m. Here six canopy species are always dominant: *Anacardium excelsum*, *Couroupita nicaraguensis*, *Luehea seemanii*, *Terminalia chiriquensis*, *Guarea excelsa* and *Pithecolobium saman*.

Swamp and riverine communities of the wetter rain forest zones, primarily on the Caribbean slope, are similar although floristically more complex. They are often divided into five environmental sequences that grade into each other as follows: 1) *Anacardium--Bravaisia* sequence, found only at the headwaters of small streams on the western edge of the evergreen rain forest community, 2) *Calophyllum--Symphonia* sequence, found only on the North Atlantic coast and adjacent low-lying regions with waterlogged soils. It is a tall swampy rain forest, often growing in small "islands" surrounded by pine savanna, and its species composition is altered where recurring fires from adjacent savannas enter it. 3) *Pterocarpus* sequence, a very common swamp forest community of the southern half of the Atlantic coastal plain. It grows on low-lying sites of rapidly fluctuating water level, such as along small streams, or with mangrove communities, usually as a well-demarcated band just inland from the mangroves. 4) *Carapa--Camptosperma* sequence, found on low-lying, waterlogged, high mineral soils, such as the floodplains of larger rivers. 5) *Erythrina--Pachira* sequence, an edaphic climax swamp forest found extensively along the banks of the lower Rio Coco but rare elsewhere. Near the river the vegetation is dominated by *Erythrina glauca*, but as the soil changes away from the river, *Pachira aquatica* completely dominates. Thorny lianas are common and there is no ground layer firm enough to support footing.

Mangroves. This plant formation is similar on both coasts, though of far greater extent on the Caribbean.

Salt meadows. Found only on the river delta formed by the Rios Real and Negro that flow into the Gulf of Fonseca, the salt meadows are a series of climax herbaceous or savanna communities that grow on very low-lying sandy flats subject to occasional seawater flooding. Soil salt concentration is very high and often evident as a thin crust on the topsoil. Near muddy channels the salt meadows give way to mangroves.

Beach communities: The Nicaraguan littoral consists of several zones beginning with a pioneer community of low, trailing

and sand-binding plants and progresses through a closed herbaceous zone, a bush zone, shrub zone, and finally a woodland that merges with the climax community behind. The community is well developed on both the Caribbean and Pacific shores, as well as the freshwater beaches of Lake Nicaragua and Lake Managua. The dominant pioneer in the sand-binding zone in all areas is *Ipomoea pes-caprae*.

Upland pine and oak forest. The genus *Pinus* is of interest in Nicaragua because it is here that it reaches its southernmost limit of occurrence in North America. Upland pine forests are estimated to cover more than 1500 square km in Nicaragua, mostly in the northern highlands in the Cordillera Segovia. Typically they grow on a largely acidic and sandy soil in moderate to well-drained regions between 400 and 700 m; none occur in poorly drained areas. Stands of upland pine consist chiefly of 3 species but all are tall, 25-30 m, and are logged to varying degrees.

Highland pine communities in Nicaragua are believed to be maintained by a combination of human disturbance, soil type, fire and perhaps other factors, and thus do not represent a true climax forest type. Where burning is prevented upland pine communities are invaded by mixed hardwood species, often one or more species of oak (*Quercus*). Excessive and repeated burning of pine forest, however, may also lead to its replacement by one or more species of fire-resistant oaks.

Pine savanna. The lowland pine savannas are regions composed primarily of grassland with scattered pines (*Pinus caribaea*) although they are frequently invaded by fingerlike extensions of evergreen rain forest or swamp forest (Fig. 1.2). They occur most extensively over Pleistocene marine sediment soils of the northeastern lowlands. The lowland pine savannas have been continuously logged since the 1920's and few large pines remain in accessible areas (Howell 1971). The age and origin of the pine savannas is unclear though they are certainly ancient. At least within historic times they appear to have been maintained by fire and thus represent a fire-caused disclimax (Taylor 1963).

#### 3.4.2 Timber Resources and Timber Exploitation <sup>11/</sup>

Nicaragua has the largest land area of any Central American country and also the most extensive area of remaining forests. Over half of the country is still covered with various kinds of tropical forests, virtually all of which is in the eastern mountain and lowland region. However, estimates of total

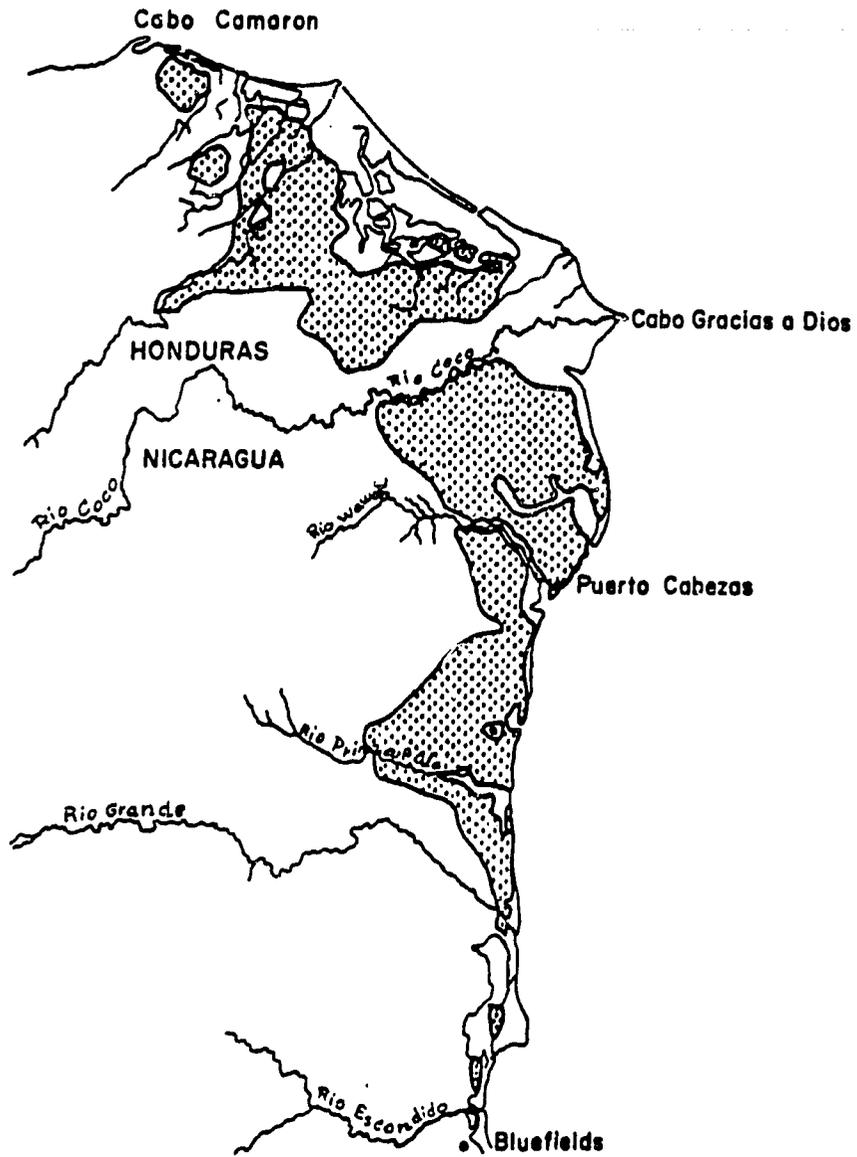


Figure 12. Eastern Honduras and Nicaragua Showing the Extent of Lowland Pine Savanna (stippled area)

Source: Howell. 1971.

forest to nonforest land show a steady decline in forest land (Fig. 13) and this is likely to accelerate as efforts to develop the eastern region are just beginning.

Usable timber stands have been estimated at 4 million acres. (Quart. Econ. Rev. 1980). Of this about 1.5 million acres of lowland pine (*Pinus caribaea*) are the most important commercially. There are also large stands of pines (*Pinus occarpa*) in the northern highlands. Both species produce good lumber, that of *P. caribaea* being much like Slash Pine of the southeastern United States. Both species also produce good commercial quality resin. Almost all tracts of pine in Nicaragua have been exploited to varying degrees. No estimates of the annual pine harvest or yield, or potential yield could be found.

According to 1971 census figures, forest products are used in 77 percent of all Nicaraguan households, chiefly for firewood for cooking. However, the main source of forest exploitation is for lumber exports. Sawn wood exports amounted to 88,000 cubic m in 1976. Plywood is an important export product, and all types of wood exports earned U.S. \$7.6 million in 1978.

The tropical forests of the eastern coastal region contain a variety of hardwoods, but unlike pines, these are not in pure stands, therefore economic exploitation is often difficult due to problems of access and transportation. Present production is principally in mahogany and Spanish cedar. There are also stands of balsa in the southeast. Other trees yielding lumber in lesser commercial quantities include rosewood, guayacan, lignum vitae, nambar, dyewood, ebony and gum. Rubber is found in small quantities in a wild state. No estimates of the annual hardwood yield, or of the total managed forest in plantations could be found.

About 50 percent of the forests are state-owned but commercial lumber concessions are operated mainly by U.S. and Canadian firms. An Israeli company is engaged in the production of plywood. Roundwood removals in 1975 totaled 2.9 million cubic meters (102 million cubic feet).

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Sources: Caltagirone et al. 1972.  
Kurian. 1978.  
Quart. Econ. Rev. 1980.  
Shane. 1978.

Eastern Nicaragua's tropical forest areas have been exploited extensively since logging operations began some forty years ago, but until 1976 no reforestation legislation existed. Nicaragua's Department of Forestry (now within IRENA following the revolution) established guidelines for the harvesting of timber species and in the first six months of 1977 collected about \$55,000 (U.S.) in fines from violators. Current plans for the country's tropical forests include intensified logging, pulp and paper mills, and plywood factories which should increase commercial extraction of lumber for newsprint, paper board, domestic tissue, containers, packaging, textiles, clothing, and wood panels. Plans also call for a natural reforestation program under which loggers must spare parent stock for regeneration. Enforcement of reforestation programs remains a problem.

The Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA) has plans to establish priorities for environmental forest projects, rural development forest projects, new facilities for training, education and research, and industrial forest projects. These projects are aimed at reducing the undesirable effect of uncontrolled forest exploitation.

Data could not be found on the rate of loss of pine and of hardwood, or of the proportion of loss due to fire, insect or other biological damage, firewood gathering, or clearing for agrarian purposes. An FAO report described the insects that attack *Pinus caribaea* in northeastern Nicaragua (FAO 1971).

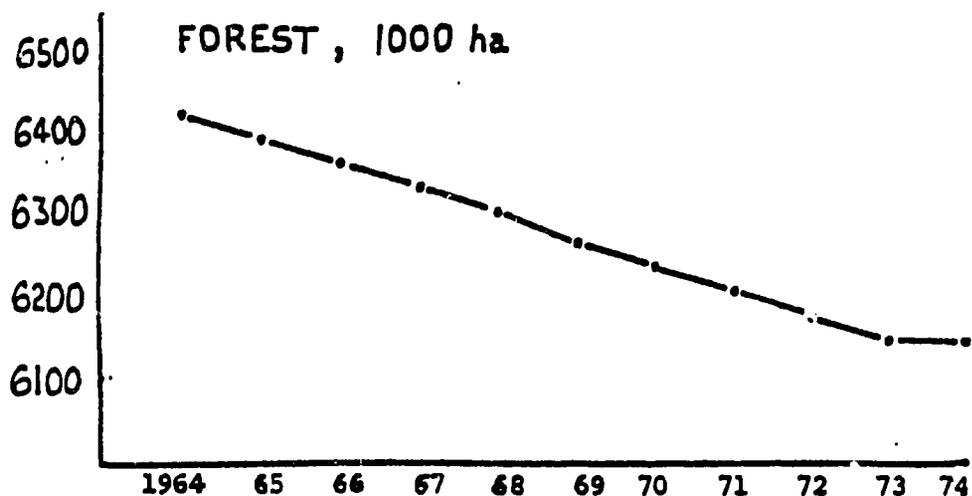


Figure 13. Decline of Total Forest, 1964-74

Source: FAO. 1975.

### 3.5 Fauna and Conservation

The native terrestrial vertebrate fauna of Nicaragua has not been extensively studied. No systematic distributional studies of any of the vertebrate classes (mammals, birds, reptiles and amphibians, or fishes) have been completed for the entire country, although portions of the country's ichthyofauna are well inventoried (Sect. 3.5.2). There are, however, a number of studies of a more limited scope, including: for sharks (Thorson 1971, 1976), fish (Astorqui 1971; Miller and Carr 1974; Bussing 1976; Davies 1976; Koenig et al. 1976; Thorson 1976; Villa 1976b), amphibians (Villa 1972a), reptiles (Villa 1972b; Wilson and Villa 1972), birds (Howell 1957, 1969, 1971), and mammals (Jones and Genoways 1970; Jones et al. 1971; Yates et al. 1979). Many of these studies pertain to limited geographical areas or do not provide information on populations, so their usefulness in conservation planning is limited.

#### 3.5.1 Mammals

More mammals have been placed on the endangered list in Nicaragua (US Dept. Interior 1978; IUCN 1976) than for all other vertebrates combined (Table 17). Significantly, all are large species or species of potential commercial value (e.g. pelts, pet trade) that are likely to be affected rapidly and strongly by human pressures or by destruction and alteration of their habitat. The absence of small mammals from the list doubtless reflects the lack of information on populations and distributions of many of these less well known species. Many of these may also be included on the list when they are better known or brought to the attention of conservationists. It is also important to note that part of the information used for inclusion or omission of species on the endangered list is derived in part from neighboring countries or from the "best current knowledge", some of which is not necessarily backed by scientific studies. There have been no population studies of any of the larger mammals in Nicaragua.

#### 3.5.2 Birds

Birds have likewise been little studied in Nicaragua. No species are currently listed by the Red Data Book (1979); Nicaraguan species listed by the Federal Register as endangered (Table 17) are primarily ones that are rare throughout their breeding and wintering range, or ones that are relatively low density, low visibility species wherever they occur. Given the large amount of undisturbed habitat in eastern Nicaragua, populations of the latter species may be near normal. But as with other vertebrate groups, those birds

whose ranges are confined to the dry Pacific slope are those that are likely to be most seriously affected by man's activities. Almost certainly a number of larger species formerly resident in western Nicaragua have been largely or wholly exterminated there including Muscovy Duck (*Chairina moschato*) Great Curassow (*Crax rubra*), Crested Guan (*Penelope purpurascens*), Scarlet Macaw (*Ara Macaco*) and Yellow-headed Parrot (*Amazona ochrocephala*), among others.

There are no species of birds endemic to Nicaragua. The Nicaraguan Grackle (*Cassidix nicaraguensis*) was formerly confined to the central lakes area of western Nicaragua but it has profited greatly from deforestation and cattle raising and now is found throughout most of western Nicaragua. It has recently spread into northwestern Costa Rica. Two other species occur only in Nicaragua and Costa Rica, the Tawny-chested Flycatcher (*Aphanocaudax capitalis*) and the Mangrove Hummingbird (*Amazilia boucardi*); a third, the Green-breasted Mountaingem (*Lampornis sybillae*) occurs only in Nicaragua and Honduras. The current status of the latter three species is unknown. The first is confined to Pacific mangroves, the second to the Caribbean lowlands, and the last to lower montane forest. The habitat of these three species have not been significantly altered.

Nicaragua represents the terminus of range for 44 species of birds, most of which are species of more northern affinity; several are chiefly north temperate or even boreal species that occur in Nicaragua and adjacent Honduras only in the upland pine regions or in the pine savannas of the north-eastern Caribbean region, far to the south of their primary range.

Nicaragua's large reserve of forest lands serves as an important winteringground for migrant birds from North America (Terborgh in Keast and Morton 1980). Space is crucial, because migratory species breeding throughout temperate North America must crowd into a wintering area far smaller than their breeding area. Furthermore, most migrant species prefer the cooler, darker, interior forest habitats, rather than patches of disturbed or second growth woodland. Consequently, deforestation and forest degradation in Central America are reducing the amount of available habitat for wintering migrants to even less than what was originally available.

Data presented in Figure 13 show that forest lands in Nicaragua are rapidly decreasing. Morse (in Keast and Morton 1980) quotes FAO data which suggest that if the 1955-70 rate of forest loss is maintained, the remaining primary

forest in Central America will have disappeared by the end of the century. Under these circumstances the relatively large extent of primary forest still remaining in Nicaragua is uniquely important to the survival of migrant birds and deserves the highest priority for long term management and protection.

### 3.5.3 Amphibians and Reptiles

No Nicaraguan amphibians are listed in the IUCN Red Data Book (1976) but as with other vertebrate groups, inventories and information are incomplete. No terrestrial reptiles are listed but it is likely that native terrestrial reptiles of the Pacific slope have been subject to considerable habitat loss or alteration as a result of the widespread alteration of the region by human activities. The Federal Register (1979) lists two species of sea turtles as endangered, and two others as threatened (Table 17). At least three other species of sea turtles occur in Nicaraguan coastal waters, the Carey, Green, and Hawksbill sea turtles. None are considered endangered at present although surveys of populations, seasonal distribution, and breeding status of these species do not appear to have been carried out in Nicaraguan waters.

### 3.5.4 Ichthyofauna

No fish are currently listed under any category by the IUCN Red Data Book, even though one species, *Rhamdiz managuensis*, a Lake Managua endemic, has not been reported since 1907 (Villa 1976b) and is perhaps extinct. Lake Nicaragua and Lake Managua appear to have been relatively thoroughly inventoried (Thorson 1976) but the fish of many watersheds elsewhere in Nicaragua are poorly known.

The native freshwater fish fauna of Nicaragua is depauperate, and is a reflection of the low species diversity throughout Central America from the Isthmus of Tehuantepec to eastern Panama. The region from the isthmus south to Nicaragua is especially devoid of fish species with only 27 obligatory freshwater species distributed among 5 families; additional inventories in poorly explored river systems may increase these figures slightly. The number of species with some tolerance for normal sea water is higher (Myers 1966). A full list of obligatory freshwater species for Nicaragua can be found in Miller (1966).

Forty-five species of fish occur in Lake Nicaragua and Lake Managua; at least 25 occur in both lakes (Table 18), and six others are uncertain, *Belonesox*, *Gymnotus*, *Hemibryon*, *Rhamdia* sp., *Rhoadsia* and *Rivulus* (Villa 1976b). Only one species, *Rhamdiz managuensis* occurs only in Lake Managua

and it is apparently very rare. By contrast, eleven species occur in Lake Nicaragua and not in Lake Managua including a shark (*Carcharhinus*), the sawfish (*Pristis*), the tarpon (*Tarpon*), the grunt (*Pomadasys*) and the robalo (*Centropomus*). Several of these 11 species do not reproduce in Lake Nicaragua and spend only part of their life cycle there (Thorson 1976). Unlike Lake Managua, many of Lake Nicaragua's species are of marine origin or have a high tolerance for saline water, reflecting the direct marine connection via the Rio San Juan. Several barriers now prevent the fish of Lake Nicaragua from entering Lake Managua.

Table 17. Vertebrates Listed by the Federal Register as Endangered in Nicaragua. T=threatened, E=endangered.

Group	Scientific Name	Common Name	Status
Mammals <sup>b</sup>	<i>Alouatta villosa</i>	Howler Monkey	E
	<i>Ateles geoffroyi frontalus</i>	Spider Monkey	E
	<i>Felis concolor coastaricensis</i>	Costa Rican Puma	E
	<i>F. pardalis</i> <sup>a</sup>	Ocelot	E
	<i>F. wiedii</i>	Margay	E
	<i>F. yagouaroundi fossa</i>	Jaguarundi	E
	<i>F. y. panamensis</i>	Jaguarundi	E
	<i>Panthera onca</i> <sup>a</sup>	Jaguar	E
	<i>Trichechus manatus</i> <sup>a</sup>	Caribbean (W.Indian) Manatee	E
	<i>Tapirus bairdii</i> <sup>a</sup>	Central Am. Tapir	E
Birds <sup>c</sup>	<i>Falco peregrinus turdinus</i> <sup>d</sup>	Arctic Peregrine Falcon	E
	<i>Harpia harpyja</i>	Harpy Eagle	E
	<i>Numenius borealis</i> <sup>d</sup>	Eskimo Curlew	E
	<i>Pharomachrus mocinno mocinno</i>	Resplendant Quetzal	E
Reptiles/Amph. <sup>c</sup>	<i>Caretta caretta</i>	Loggerhead Sea-Turtle	T
	<i>Dermochelys coriacea</i>	Leatherback Sea Turtle	E
	<i>Lepidochelys hawaiiensis</i>	Atlantic Ridley Sea Turtle	E
	<i>L. olivacea</i>	Pacific Ridley Sea Turtle	T
Fish	(None)		

<sup>a</sup>Also listed by the IUCN Red Data Book (1978, 1979).

<sup>b</sup>The IUCN Red Data Book (1976) also lists as endangered, *Myrmecophaga tridactyla* (Giant Anteater).

<sup>c</sup>The IUCN Red Data Books (1976; 1978) list no birds or reptiles.

<sup>d</sup>Migratory north temperate breeding species; neither yet recorded in Nicaragua but both possible.

Table 18. Fishes of the Great Lakes Basin, and their Presence or Absence in the Atlantic and Pacific Versants. Symbols: + present, - not known to be present, ? status uncertain, (probably not present).

Species	Pacific	Atlantic	L. Xiló	L. Managua	L. Nicaragua
<i>Alfaro cultratus</i>	-	+	-	-	+
<i>Astyanax fasciatus</i>	+	+	-	+	+
<i>Astyanax</i> sp. (nasutus?)	-	?	-	+	+
<i>Belonesox belizanus</i>	-	+	-	+	+
<i>Bramocharax bransfordi</i>	-	+	-	+	+
<i>Bryconamericus scleroparius</i>	-	+	-	-	+
<i>Carcharhinus leucas</i>	-	+	-	-	+
<i>Cichlasoma centrarchus</i>	+(1)	+	-	+	+
<i>Cichlasoma citrinellum</i>	-	+	+	+	+
<i>Cichlasoma dowi</i>	+(1)	+	-	+	+
<i>Cichlasoma friedrichsthalii</i>	+(1)	+	-	+	+
<i>Cichlasoma labiatum</i> (2)	-	-	+	+	+
<i>Cichlasoma longimanus</i>	+(1)	+	+	+	+
<i>Cichlasoma maculirauda</i>	+(1)	+	-	-	+
<i>Cichlasoma managuaense</i>	+(1)	+	+	+	+
<i>Cichlasoma nigrofasciatum</i>	+(1)	+	+	+	+
<i>Cichlasoma rostratum</i>	+	+	+	+	+
<i>Centropomus parallelus</i>	-	+	-	-	+
<i>Dorosoma chavesi</i>	-	-	+	+	+
<i>Gobiomorus dormitor</i>	-	+	+	+	+
<i>Gymnotus cylindricus</i> (3)	?	+	-	?	+
<i>Hemibrycon</i> sp.	-	+	-	?	+
<i>Herotilapia multispinosa</i>	+(1)	+	-	+	+
<i>Hyphessobrycon tortuguerae</i>	-	+	-	+	+
<i>Lepisosteus tropicus</i>	+(1)	+	-	+	+
<i>Melaniris sardina</i>	-	?	+	+	+
<i>Neotroplus nematopus</i>	+(1)	+	+	+	+
<i>Neoheterandria umbratilis</i>	-	+	?	-	+
<i>Poecilia</i> sp. a	+	+	?	+	+
<i>Poecilia</i> sp. b	+	?	?	+	+
<i>Poecilia</i> sp. c	-	?	?	-	+
<i>Poeciliopsis gracilis</i>	+(1)	-	+	+	+
<i>Pemadasys boucardi</i>	-	+	-	-	+
<i>Pristis pectinatus</i> (4)	-	+	-	-	+
<i>Pristis perotteti</i>	-	?	-	-	+
<i>Rhamdia barbata</i>	-	-	-	+	+
<i>Rhamdia managuaensis</i>	-	-	-	+	-
<i>Rhamdia</i> sp.	-	-	-	?	+
<i>Rhoadsia eigenmanni</i>	-	+	-	?	+
<i>Rivulus isthmensis</i> (5)	-	+	-	?	+
<i>Symbranchus marmoratus</i>	+	+	+	+	+
<i>Tarpon atlanticus</i>	-	+	-	+	+

(1) Not present throughout most of the Chiapas-Nicaraguan Province, but limited to areas by "Atlantic intrusion" (Bussing, 1976).

(2) Not reported from Xiló (Villa, 1968, 1971b) but collected since.

(3) Astorqui's (1972) *G. carapo*.

(4) Extremely rare, if present, in Lake Nicaragua.

(5) Miller (1966) states this species to be present in the Pacific versant of Nicaragua, but no records are available (see Villa, 1971a).

Source: Thorson. 1976.

### 3.5.5 Commercial Fisheries

The fishing potential in general has not been developed in Nicaragua but the Instituto de Fomento Nacional (INFONAC) has begun a program to reorganize and expand the fisheries industry. Crab, crayfish and tuna fisheries are all being encouraged. Shrimp and lobster exports have been growing and were valued at \$22.4 million in 1977 (Quart. Econ. Rev. 1980).

Nicaragua's large inland lakes support an active fresh-water fishery industry that supplies primarily local markets. Most of this catch is taken by Lake Nicaragua's 600 plus fishermen, most of whom fish mainly during the November to March dry season. Lake Managua fishing supplies only local markets. Two of the cichlids (*C. citrinellum* and *C. dovii*) are important Lake Managua fishery species. An average fish harvest of 4.8 kg/ha/yr for Lago de Managua during the mid-1970's is comparable to or a bit above the yields of most lakes with similar dimensions and dissolved solids (Cole in Thorson 1976). This yield of 4.8 kg/ha/yr is substantially higher than that of 2.7 kg/ha/yr reported in 1960 (McCormick and Guffy 1980).

The only commercial fish processing plant on Lake Nicaragua (as of 1972) is at Granada. Sawfish are the company's primary interest but guapote, mojarra (*Cichlasoma citrinellum*) gar and shark are also processed. A 1972 survey supported by U.S. AID (Davies 1976) indicated the possibility of overexploitation of sawfish and shark. However, if market demand could be increased, the fishing industry for the other species (above) could also be rapidly expanded. For example, the eastern shore of Lake Nicaragua is yielding what has been roughly estimated to be less than 0.45 kg/ha/year, an extremely low average figure. Probably higher rates of cropping occur locally but even the current estimate (1972) for the entire lake, of 45,455 kg (1 million lb/acre), amounts to a yield of only 0.56 kg/ha.

Indications are strong that the fish catch from Lake Nicaragua could be doubled by the existing population of fishermen, using the same equipment, if market conditions were such as to encourage greater fishing effort. In addition, it is believed that the high productivity of Lake Nicaragua and Managua could be further increased (except sawfish and shark) through improvements in fishing techniques, introduction of additional piscivorous fishery species, and the management of breeding and feeding habitats for increased production of fishery species (McCormick and Guffey 1980). But such programs to augment production should not precede basic

research on food webs, breeding, ecology, parasitology and biomass of various species in the food chain.

Fishing on the eastern side of Lake Nicaragua has greater potential because it is wind-protected, shallow and weedy. The weedy areas are prime habitats for gar, guapote, and mojarra. A main disadvantage of fishing in this area is that the principal markets are almost all far away on the west side. Consequently most of the catch from this area is sold in the salt-dried form, a method satisfactory for gar which is usually not eaten fresh, but not suitable for guapote and mojarra because their quality is poor when dried. For dried gar there is another problem. They cannot be dried properly in the wet season, and as a result are usually over-salted or nearly spoiled before they reach market. The poor quality of fish in the wet season is one reason demand (and price) is low at this time of year. As a result there is little gar fishing in the wet season even though the catch rate is highest then. Smoking is also impractical because wood is scarce and costly. Gar fishing, as well as fishing for the other species, if it is to be a commercial success, awaits economical methods for drying or smoking or preserving by other methods (Davies in Thorson 1976).

Fisheries information was not found on the following topics for coastal species: 1) inventory of species, 2) estimate of number of persons engaged in commercial marine fisheries, 3) fisheries facilities, 4) exploited fish, and 4), annual fish catch. Likewise no information was located on current fish culture projects, sea farms, shrimp farms, or on legal control, regulations and enforcement within the industry.

### 3.5.6 Sport Fisheries

Sport fishing is done chiefly on Lake Nicaragua in the quiet ~~er~~ waters among the Isles of Granada (Las Isletas). There has been no effort to expand the industry, particularly during the recent civil strife and political instability. Tarpon and snook (*centropomus parallelus*) are present in low numbers. The biggest obstacles to sport fishing in Lake Nicaragua are probably the rough water conditions and the distance from a tourist camp to the best fishing areas. The major exception is the tarpon fishing camp located on the upper Rio San Juan where fishermen are flown directly from Managua. As of 1976 the cost was about \$100 (U.S.) per day; the camp can accommodate up to 16 persons. Another fishing camp has reportedly been established nearby and problems have developed over fishing rights. The best snook fishing,

according to reports by fishermen, is in the San Carlos area although rough water limits fishing activities to only four to six months of the year (Davies in Thorson 1976).

### 3.5.7 Reserves and Protected Areas

Nicaragua began a land use and land capability survey, including its wildlands, following the Central American Meeting on the Management of Natural and Cultural Resources held in San Jose, Costa Rica in 1974. The initial phase, the Pacific region, was completed and the second phase, the northern and central highlands, was initiated by 1978 (La Bastille 1978). Within the western region, highest priority was given to the new Volcan Masaya Pilot National Park, in large part because of its nearness to heavily urbanized areas and value as an educational area. The wildlands unit of the Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE), based in Costa Rica, has provided training, consultant services, planning assistance, and interpretative expertise for this park project. Although Nicaragua under the Somoza regime did not have an agency specifically dealing with national parks, the project received a million dollars U.S. from the Central Bank of Nicaragua. An additional \$8,000,000 US was promised from the Central American Bank for Economic Intergration if national planning gave it top priority ( La Bastille 1978).

Following the civil strife of 1979 the new government established the Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA), a natural resources agency charged with responsibility and control of the nation's natural resources. A number of previously autonomous institutions, including the Centro de Investigaciones Cientificas Nicaragua del Banco Central de Nicaragua, and the Project Parque Nacional Volcán Masaya del Banco Central have now been placed under the direct supervision of IRENA (La Gaceta, Oct 25, 1979). No current information on the allocation funds for Parque Nacional Volcán Masaya or the status of the project is available. Prior to the 1979 civil strife, Parque Nacional Saslaya (Fig. 13), a mountainous 11,800 ha area in the north central highlands, was the only area to have been officially declared a national park. The undisturbed tropical forests within its boundaries are isolated, wholly undeveloped, and known to provide suitable habitat for such species as jaguar, margay, deer, peccary, and boas (La Bastille 1978).

One other mountainous region and several volcanos in the west have been recommended for preservation or for national park status by the Organization of American States (OAS 1978), or by the Catastro e Inventario de Recursos Naturales

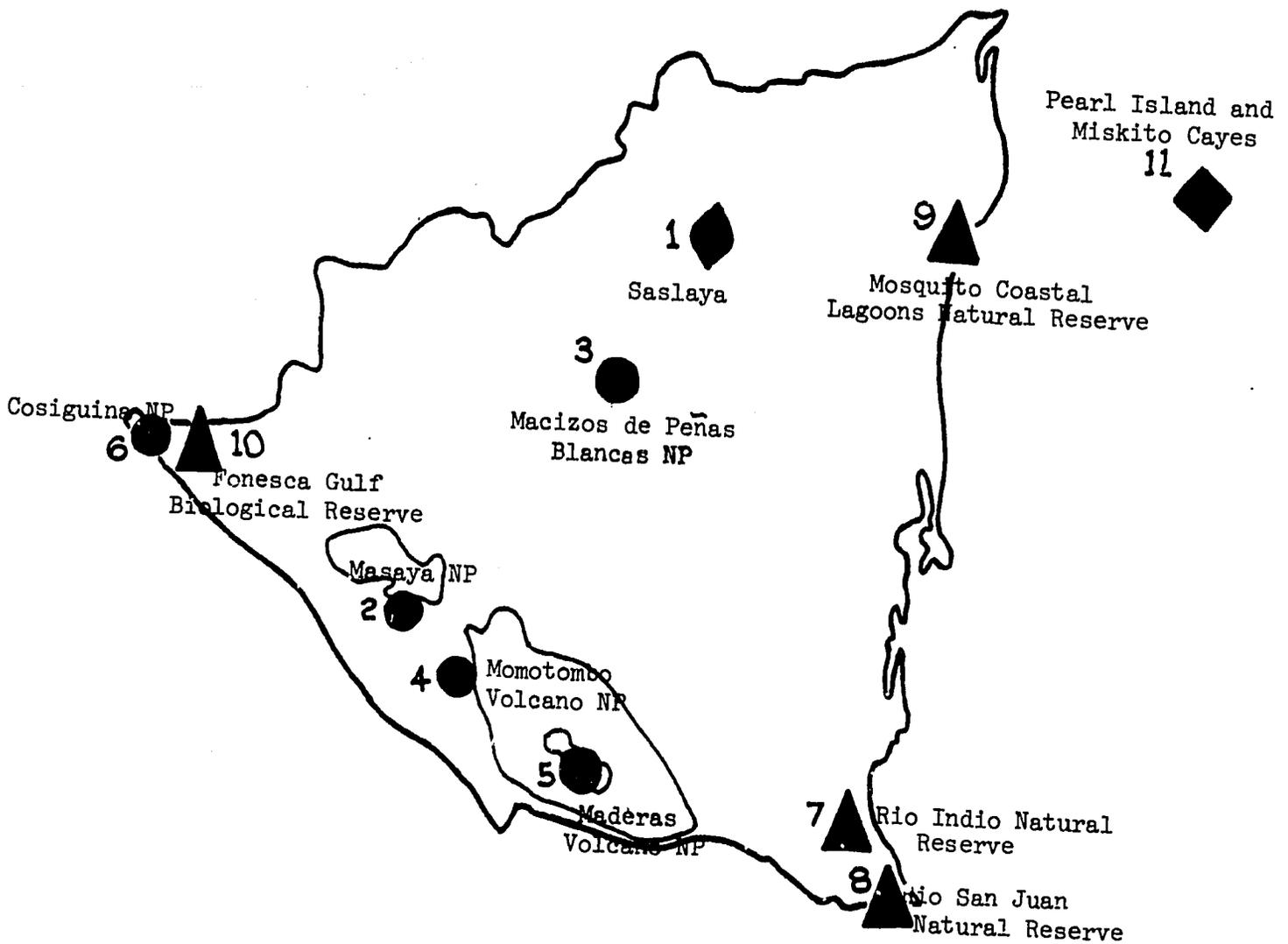


Figure 14. Location of one declared and two proposed national parks, natural reserves, or other special interest areas in Nicaragua. Declared national parks  $\blacklozenge$  ; proposed national parks  $\bullet$  ; proposed natural areas  $\blacktriangle$  ; interest areas with specific recommendations at the present  $\blacklozenge$  . 1. Saslaya N. P. 2. Masaya National Park. 3. Macizos de Peñas Blancas N. P. 4. Momotombo Volcano N. P. 5. Maderas Volcano N. P. 6. Cosiguina N. P. 7. Rio Indio Natural Reserve. 8. Rio San Juan Natural Reserve. 9. Mosquito coastal lagoons Natural Reserve. 10. Fonseca Gulf Biological Reserve. 11. Pearl Isl. and Miskito Cayes.

(McCormick and Guffey 1980). These include the proposed Parque Nacional Macizos de Penas Blancas, a region of pine and oak in the central highlands, Parque Nacional Cosiguina, a volcano in the extreme northwest that still contains considerable expanses of dry forest and savanna, the proposed Momotombo Volcano and Maderas Volcano parks (Fig. 13), and the Peninsula de Chiltepe, an area with remanent deciduous seasonal forest, most or all of which is disturbed or modified in various ways.

The salt meadows, mangroves and dry forest and scrub surrounding the river deltas of the Bay of Fonseca have also been recommended for biological preserve status by the OAS (1978). This is an important Pacific coast brackish water community and provides habitat for a variety of wildlife (Table 19).

Several areas on Nicaragua's Caribbean coast have also received considerable interest. The Pearl and Miskito Cayes mentioned by La Bastille (1978) are two tiny remote islets of the northwestern coast that are of particular importance. The region contains coral reefs, wild beaches and sandbanks, and is an important feeding area for both the Green and Carey sea turtles. Miskito Indians are scattered throughout the region on the coast and on the cays and depend upon the turtles as a major source of protein. Two processing plants already on the islets process shrimp and other shellfish; formerly they also processed sea turtle meat.

The Rio Indio reserve a prime tract of lowland evergreen rain forest, has also been recommended for preservation because of its wilderness condition and because of its representative flora and fauna. It includes a coastline, a canal, and a huge tract of rain forest (Table 19).

Table 19. Declared and Proposed National Parks and Proposed Natural Reserves.

Declared National Parks

Saslaya (1971)

humid tropical forest and cloud forest; forms part of larger wilderness area, which is proposed as a biosphere reserve.

Proposed National Parks

Masaya

dry low tropical forest, very modified and altered; high human density; protects interesting geology.

Macizos de Peñas Blancas

pine and oak, and cloud forest; very modified due to logging of pine.

Momotombo Volcano

remnants of second-growth semi-evergreen seasonal forest

Maderas Volcano

remnants of second growth semi-evergreen seasonal forest

Cosiguina

savanna and dry tropical and humid subtropical forest; last remaining habitat of its type of some size; preservation considered urgent.

PROPOSED NATURAL RESERVES

Rio Indio

representative and virtually undisturbed lowland evergreen rain forest; coastline includes one of last remaining nesting sites of Hawksbill Sea Turtle.

Rio San Juan

representative lowland evergreen rain forest in Nicaragua's wettest zone.

Mosquito coastal lagoons

representative lowland evergreen rain forest; indigenous Amerindian population.

Fonseca Gulf Biological Reserve

hot arid lowland with mangroves, winding creeks, brackish lagoons, and salt meadows; contains herons, egrets, waterfowl, parrots, howler monkeys, and crocodiles.

Table 19.continued.

Peninsula of Chiltepe

Remnants of deciduous seasonal Forest, mostly second growth; near Lago Managua.

Areas identified of special interest  
Pearl Isl. and Miskito Cayes

island-reef-sandbank zone of northeastern coast; feeding ground for Green and Carey sea turtles; contains substantial Miskito Amerindian population; presence of seafood processing plant represents potential conflict.

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Sources: La Bastille. 1978.  
McCormick and Guffey. 1980.  
OAS. 1978.

## 4.0 Environmental Problems

### 4.1 Land Use Problems

This section reviews environmental problems in Nicaragua. The major environmental and land use problems facing Nicaragua are similar to those of other developing Latin American countries, with one exception. Much less of Nicaragua's land surface has been exploited or degraded, and nearly half still remains in undisturbed natural forest. Thus, in some respects, Nicaragua is in a better position to embark on an enlightened course of management, exploitation and preservation of its land and resources than are its neighbors. The major land use problems, as elsewhere, fall within the categories of soil conservation, water conservation, and timber and natural resource conservation and exploitation. The first section discusses these problems. The second section treats environmental problems caused by intensive development in both urban and rural areas. In each case the problems are outlined, their causes discussed, and in some cases, corrective steps are that could be taken are also mentioned.

#### 4.1.1. Land Use Problems Caused by Current Agricultural Practices 12/

At the root of both soil and water conservation and management problems is the unrestricted spread of subsistence-based agriculture. As elsewhere in Latin America, where a large proportion of the population is employed in agriculture and there is a rapidly growing land-hungry peasantry, subsistence agriculture will continue to expand, often into areas that are wholly unsuitable for the types of agriculture attempted. Even where the land is of high quality for agriculture, subsistence-based methods often result in extremely inefficient yields and a general deterioration of the soil and water quality. The most frequent types of land degradation associated with subsistence agriculture are loss of soil productivity, soil erosion, and a deterioration of the water supply and quality.

Soil erosion plagues many parts of Nicaragua, and seems to be almost an unavoidable consequence of present agriculture activity. It is most serious in the Matagalpa, Esteli, and Ocotal areas, but occurs to a greater or less degree

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Sources: Caltagirone. 1972.  
Shane. 1978.  
Shane. 1978.  
UNEP. 1976.

virtually throughout on cleared and sloping land irrespective of whether the rainfall is light or heavy. According to Taylor (in UNEP 1976), in areas with less than 1400 mm of annual rainfall erosion has eliminated the arable layer of soil on steep slopes over thousands of square kilometers. No additional details were given. The main causes of the erosion are: a) removal of natural forest or vegetative cover on steep slopes or other areas sensitive to soil loss, b) planting crops (often corn) on slopes that are too steep, c) burning pastures which then exposes the soil to heavy rainfall at the beginning of the rainy season, d) local flooding of land adjacent to low-lying areas or along rivers.

McCormick and Guffey (1980) mention particularly severe erosion in the area immediately south of Managua. This area is hilly with some moderately steep slopes. It is heavily cultivated, primarily with temporary crops such as cotton, corn, sorghum and vegetables, which are susceptible to erosion by both water and wind. Wind erosion is particularly acute near the end of the dry season (April to May), water erosion more severe in the first part of the rainy season (May and June).

Even areas under cultivation with permanent crops are not immune to problems of soil erosion. Where coffee is grown on very steep slopes, water runoff is rapid and the land is subject to erosion. Coffee now accounts for over 60 percent of all land under permanent crops and is particularly important in the northern and Pacific regions. Perhaps the major cause of soil loss or soil degradation is the conversion of tropical forest to pasture land. The difficulty is that most of the most productive lands throughout Nicaragua are already owned and usually intensively cultivated or used for pasture for cattle. Whenever roads are constructed, it is usually into previously inaccessible forested areas for purposes other than agriculture, such as logging, mining, or petroleum exploration. The land hungry poor from both urban and rural areas usually follow and accelerate the deforestation, and in addition, government-sponsored colonization projects may bring many more. Most of these settlers practice subsistence agriculture on soils wholly unsuited for it.

Cattle raising also frequently comes into direct conflict with the wisest and most efficient use of land. Until recently the most productive land in Nicaragua was primarily owned by a minority that grew cash crops such as cotton, or raised cattle, both primarily for export. Consequently, much of the most productive land was often devoted to pastures while small cash crop farmers were forced to exploit marginal lands on steep slopes and with poor soils.

In addition to the irreversable loss of soil that occurs as forest clearing continues, water supplies will also be jeopardized by the rapid runoff and siltation. Nicaragua has vast water resources, still largely untapped, on the Caribbean slope. At least formerly there were plans to harness some of the potential energy of these resources through a hydroelectric plant on the Rio San Juan.

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#### 4.1.2 Pesticide Pollution

Pesticide use in Nicaragua has grown to alarming proportions and is now an important environmental problem as well as an economic one. Heaviest pesticide use has been concentrated on the large commercial farms, although the use of chemical pest control has spread to all parts of the agricultural sector. A major cause of the dramatic rise in pesticide use during the past twenty years has been the increasing importance of cotton as an item of export. Table 20 gives pesticide consumption for cotton cultivation during 1973-74. The rise in use of pesticides has resulted in an increase in imports and an increase in insecticides formulated in Nicaragua. Examples demonstrating the increase in imported pesticides may be seen in Table 21. Most of this rise has occurred since 1965. It can also be seen in Table 21 that the amount of formulated insecticide manufactured domestically is much larger than that imported.

Three important problems associated with chemical control of cotton pests have been 1) the creation of new cotton insect pests, 2) the aggravation of pest problems in surrounding crops, and 3) high resistance of pests to chemical control. Insecticides formerly used on cotton or other crops to eliminate a few harmful species also eliminated beneficial species that acted as biological controls. This allowed the rise of a number of new harmful species that were formerly unimportant pests economically. For example, the most serious cotton pests in most of Central America were formerly the red boll weevil (*Anthonomus grandis*) and the leafworm (*Alabama argillacea*). Following widespread applications of insecticides DDT, DMC, toxaphene and later organo-phosphorated products, there was a rise in the bollworms (*Heliothis spp.*), the cotton aphid (*Aphis gossypii*) and the false pink boll worm (*Sacadodes pyralis*). The urgency of the problem is illustrated by a rise in pests that formerly caused no problem in Central America, e.g.

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Sources: Caltagirone. 1972.  
McCormick and Guffey. 1980.  
UNDP. 1976.

Table 20. Consumption of Pesticides in Cotton Cultivation, 1973/74

Consumpt. of pesticides by cotton (1000 kg)	Pesticides per capita. (Kilos/inhabitants)	Pesticites per sq. km (Kilos/Km <sup>2</sup> )	Pesticides per cotton one (Kilos/inhabitants)
7809	4.12	66.1	43.02

Source: UNDP. 1977.

Table 21. Pesticide Consumption and Production

	1966-1967	1971
A. Use of Imported Pesticides		
1. Azodrin	5075 lbs. (1966)	246,210 lbs.
2. BHC-DDT-MP 3-15-1.5	30,000 lbs. (1967)	50,000 lbs.
B. Imported vs. domestic production		
1. Liquid		1.36 m lbs. vs. 18.44 m. lbs
2. Solid		ca 117,000 gal vs. 1.8 m gal.

Source: UNDP. 1977.

army worm (*Prodenia spp.*), the white fly (*Bemisia tabaci*), and the cabbage looper (*Trichoplusia*).

In addition to the problems mentioned above, several less obvious but no less serious problems that result from massive reliance on chemical pest control include the incorporation of pesticides into the wildlife food chain, into nutrient cycling, and ultimately into exportable meat and foodstuffs used for human consumption. Most alarming of the latter is unacceptably high levels of chemical pesticides in human milk.

In cotton-growing areas of Guatemala, nursing infants were consuming up to 400 times the maximum acceptable milk intake of DDT (UNDP 1976). Similar values could probably be found in Nicaragua where cotton production is even more intensive. Finally, pesticide runoff into streams and coastal areas may ultimately affect marine and estuary fish and other commercial seafood resources. However, if the results of McCormick and Guffey (1980) are correct, pesticide levels are apparently still negligible at Corinto Bay on the Pacific, despite the fact that it is the marine outlet for a heavily agriculturalized watershed. Currently Malathion and Parathion are the pesticides mostly commonly used to control insects in this area. The concentration of both were below detectable limits in bottom sediments, and at present the insecticide runoff entering this bay is so low that, according to McCormick and Guffey (1980) there is not likely to be any adverse effect on the benthos and related estuary food chains. Apparently concentrations of DDT and other less degradable chemicals used previously, and for much longer periods of time, were not monitored. No other analyses were found for Nicaraguan coastal waters.

Despite the increasing use of pesticides, a program of integrated cotton pest control was initiated in 1968. The basic objective of establishing an integrated control method rather than depending primarily upon chemical control represents a step forward. Other objectives of the government-sponsored program were to: 1) reduce the use of pesticides by half, 2) improve the unemployment problem, 3) preserve environmental quality, and 4) rehabilitate cotton production. By 1970-71 some progress was reported in each of the above areas. In fact, the program was successful enough to provide a model for other countries and institutions and resulted in a 1974 FAO publication entitled "Guidelines for Integrated Control of Insect Cotton Pests" and other more recent publications.

#### 4.1.3 <sup>14/</sup> Forestry Management Problems

The forest resources of Nicaragua have been pillaged and squandered almost since the Spanish conquest, and as a consequence almost 40 percent of the land has been affected

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Sources: Shane. 1978.  
Shane. 1980.  
UNDP. 1976.  
UNESCO. 1977.

by changes in climate, hydrology, soils, and biology (UNESCO, 1977). The causes of the forest destruction in Nicaragua are relatively clear, and are in general similar to those occurring elsewhere in Latin America. The losses are due to forest-related industries, spontaneous and government-sponsored colonization of forested lands by the landless poor, engineering projects such as the flooding of large tracts of land for hydroelectric projects, exploration for minerals and petroleum, road construction through previously undisturbed wilderness, firewood cutting, and lack of regulation or protection by the government.

The short term benefits of such projects may bring a measure of temporary prosperity to the regions and peoples involved. However, the long term environmental effects almost inevitably seem to lead to a general degradation in environmental quality, and a greatly diminished potential for exploration by future generations.

In the past, Nicaragua's forest resources represented enormous potential and wealth for the country, but these resources are often wasted before their potential can be realized. One of the most pervasive causes of forest destruction is the conversion of tropical forest to agrarian purposes, particularly for cattle raising. Other factors include indiscriminate felling of trees, inappropriate technologies for exploiting forest resources, excessive burning, lack of reforestation, negligence and lack of both regulations and a suitable forest policy within the general framework of the country's economic development. The seriousness of these factors is only beginning to be felt. This is perhaps most evident in the rapid exhaustion of lumber resources, particularly in the Pacific region, where wood for local consumption may have to be transported up to 200 kilometers from its place of origin.

One of the two logging methods most commonly used is selective cutting, in which only certain desired species within an area are harvested. This method causes minimal impact to the remaining area. The other, clear-cutting, involves cutting entire tracts of forest for removal of a few desired species. The exploitation of timber through commercial clear-cutting in the tropics is particularly unfortunate not only because large tracts of forest are eliminated, but because reforestation programs are rarely carried out. Although all Central American countries have legislation requiring reforestation by logging companies, none have an effective method of enforcing the laws.

Natural regeneration, when it is allowed to proceed, leads at first to very fast growing softwood trees of little commercial value. More often, however, clear cut areas are not allowed to regenerate themselves because the logging roads provide natural corridors for the settlement of peasant populations. In many areas, once a logging road is opened, timber companies may find themselves competing with the campesinos for valuable tracts of land (Shane 1978). Consequently, Nicaragua's wood resources, which should be a stable and renewable resource capable of providing sustained exports equal to cotton and coffee, are instead gradually being exhausted.

The pine industry suffers extensively from forest fires. These are caused in large part by deficient management, and negligence on the part of the local people. Pine fires are serious not only because they represent loss of a natural resource; but because they represent an annual economic loss. The pine industry is the principal source of income for the Puerto Cabezas - Rio Coco area, and in 1955 accounted for 54 percent of the country's total wood production (UNEP 1977).

Soil erosion is also a problem associated with lack of proper timber management. Erosion is often severe in areas that have been cleared out or burned but not reforested.

The new government has created the Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA), a natural resources agency charged with the preservation and management of Nicaraguan forest resources. Information on their present activities and efforts was not available for this study.

#### 4.1.4 National Land Use Policy and Environmental Law

Prior to the 1978 civil unrest, Nicaragua did not have a national land use policy. It did have various laws and entities that were aimed at promoting the country's general economic and social development. Environmental considerations were not specifically included, but isolated environmental problems were occasionally considered within the framework of one of the following: 1) The National Planning Law of Nicaragua, 2) agencies in the agricultural public sector (including the National Council for Rural Development), and 3) the United Nations Development Program (UNDP) for 1977-1979. The National Planning Council dealt primarily with regional and urban development and economic development and did not explicitly include environmental matters. The

agriculture public sector agencies primarily coordinated agricultural development and rarely grappled with the broader applications of an integrated agro-environmental policy. A proposed Natural Institute for Natural Resources and the Environment would have represented a partial solution but was never implemented. Thus in the absence of a unified national land or environmental policy, efforts to deal with environmental matters were dissipated, and seldom successful.

Following the civil strife, the new Nicaraguan Government published in the daily newspaper "La Gaceta" for October 25, 1979, a decree (no. 112) establishing the Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA) and its constitutional framework. This document sets forth a series of land and environmental policies (Chapter III), and the legal framework to implement and enforce them. The decree establishing IRENA, and its executive and judicial powers are appended in this report as they appeared in Spanish in La Gaceta (Appendix II). Although no information on the effectiveness of IRENA was available for this study, the policies as outlined at least offer the potential for rational preservation and exploitation of the country's natural resources.

Nicaraguan hunting legislation, enacted in 1956, was updated in 1972 to establish hunting seasons on most animals and prohibit hunting indefinitely on all endangered species except the large cats, which remain on the seasonal list. The 1972 law was updated in May 1977 when legislation was passed regulating the number of skins and live animals that could be exported. Many rare species, however, may still be hunted and trapped legally in season.

The following international environmental law sources were consulted but had no information on Nicaragua: Johnson and Johnson (1977), ROCAP (1978) and Environmental Report Summaries (EPA 1976). The IUCN Environmental Law Center in Bonn has been contacted for information in environmental policies. Information is available but has not been received in time for the preparation of this report.

## 4.2 Urban and Rural Development Problems

### 4.2.1 Human Resettlement

Nicaragua has faced major human resettlement problems during the past decade. The most important of these have been resettlements following the 1972 earthquake in Managua,

and government-sponsored resettlement projects on the eastern frontier.

The Managua earthquake received considerable international attention because of its magnitude and the seriousness of its consequences. In addition to destroying the housing of large segments of the Managuan population, it caused major environmental problems, including erosion, pollution, and damage to the water supply and sewage systems. With the help of various international agencies and governments, plans for reconstruction and resettlement in and near Managua have been developed and some reconstruction has taken place. There is still an urgent need to improve the human settlements constructed as temporary emergency dwellings after the 1972 earthquake in Managua. Many of these have become permanent dwellings as a result of the severe housing shortage. Government sponsored development programs of more questionable value have been designed to provide economic opportunities for landless peasants and to exploit the natural resources of the still largely undisturbed eastern frontier. One of the most controversial development projects of this type in Nicaragua is the IAN (Instituto Agrario de Nicaragua) sponsored Proyecto Rigoberto Cabezas, now a sixteen year old colonization project in the Department of Zelaya in southeastern Nicaragua. Comprising 24 towns and some 12,000 people, Proyecto Rigoberto Cabezas is based on crop production and cattle ranching. Officials claim that the project is self supporting even though massive amounts of phosphorus, potassium and magnesium are required to grow beans, corn, rice, bananas and pasture grass. However, residents of the largest town, Nueva Guinea, claim that most of their food has to be imported from western Nicaragua.

This project demonstrates a fundamental and recurring problem of the colonization of tropical forest lands for traditional agricultural uses, which is the inability of latosolic soils to maintain high fertility. Even with the best modern technology, tropical latosols are subject to intense compaction, loss of fertility and erosion after only a few crop cycles. Even worse, land which is not allowed to revert to woodland after a few crop cycles may suffer such severe compaction and nutrient loss that natural succession does not occur even after cropping ceases.

Criticisms notwithstanding, the Interamerican Development Bank, as of 1978, invested some \$8 million (U.S.) for expansion of Proyecto Rigoberto Cabezas. There were also plans to open new areas for colonization throughout eastern Nicaragua, and to introduce new crops such as pineapple, yucca, ginger and citrus in the hope of providing the colonization efforts with a measure of economic stability (Shane 1978).

#### 4.2.2 Malaria Control

Malaria continues to be a significant environmental problem in Nicaragua. The government and several international agencies have been attempting to reduce or eradicate the disease but with only limited success. The following information is condensed from UNEP (1977) as no current or post war information could be obtained.

The Nicaraguan Government initiated a malaria eradication program in 1956 with technical assistance provided by the Pan American Health Organization (PAHO) and World Health Organization (WHO), with material provided by UNICEF. Within the Nicaraguan government, the National Malaria Eradication Service (SNEM) of the Nicaraguan Ministry of Public Health was in charge of the program. Dieldrin was used from 1957 to 1958, thereafter DDT. Initial successes were reversed somewhat when by 1963 *Anopheles albimanus* began developing resistance to DDT. Since then the program has continued to be plagued with difficulties stemming chiefly from increased resistance to DDT as well as newer insecticides such as WHO-33 or Propoxur. An additional problem has been the inability of large cities such as Managua to control breeding sites that develop when streets flood during the rainy season.

Malarial treatment has been based on the incidence of infection, within four principal malarial areas. The first two are on the Caribbean side and include parts of the central region where the vector *Anopheles albimanus* is susceptible to DDT. In area one regions of high human occupation are sprayed weekly; in area two, where the incidence of infection is low, affected individuals are treated on an individual basis. Area three is on the Pacific, primarily within the great agricultural basin of the north; here *A. albimanus* is resistant locally to DDT and treatment consists of household spraying. The fourth area lies on the western spurs and slopes of the central Cordillera where *A. albimanus* is also resistant to pesticides but the incidence of infection is low and treatment is on an individual basis.

During 1976, a meeting between members of UNEP and PAHO/WHO shed new light on the status of the Nicaraguan malaria eradication control program. Among their findings were the following: 1, Prior to 1976 DDT and similar insecticides were still being used in the Atlantic region, as well as WHO-33 or Propoxur insecticides; 2, on the Pacific side WHO-33 no longer was effective in controlling mosquito populations, many of which were becoming increasingly resistant to both DDT

and WHO-33;3, policies toward malaria control were being shifted from insecticides to long term and more effective (though also more costly) drainage systems and to an increased emphasis on sanitation; 4, incidence of malaria rose dramatically from 1973 to 1975, increasing from 4000 to 24000 cases detected.

Among reported cases of malaria in 1973-1975, 70 percent were in the departments of Chinandega, Leon and Managua, with Managua the highest of the three. The incidence of infection was small in Managua in 1972. However, as a result of the December 1972 earthquake in Managua, much of the urban population was forced to move to the northeast portion of the city where the best mosquito habitat is found, and the incidence of malaria rose dramatically (Table 22).

Table 22. Cases of Malaria in Managua

year	no. of cases	samples taken	Percentages of population infected
1973	17	2749	0.6
1974	1990	18101	11.0
1975	5262	32205	16.3

Source: UNEP. 1977.

The increase in infection was augmented by the high rate of movement of people in this area, especially during travel back and forth to work within the city or to the heavily infected cotton and cane regions of the north. In view of these developments, SNEM, with international assistance, began a more intensive program of eradication and control in 1976. The program included increased applications of larvicide and permanent evaluation of the results, household sprays with Propoxur in selected areas, individual and mass chemotherapy, epidemiological evaluations, entomological studies, sanitation control, and larva study.

The principal obstacle to the success of the malaria program remains the increasing resistance of the chief vector *A. albimanus* to chemical pesticides. A second obstacle of importance is the seasonal movement of laborers into or out of cotton and cane regions during harvest periods, with the resultant inability of the malaria programs to prevent epidemiological conditions from occurring. A final difficulty has been a chronic shortage of trained personnel to staff the eradication program.

Malaria continues to proliferate and to remain a significant environmental problem in Nicaragua. The change in policy of PAHO/WHO toward less reliance on chemical control, and more emphasis on environmental control and sanitation, is a significant step forward. Despite their higher initial cost, the preventative programs should produce benefits greatly outweighing those of the ineffective and environmentally damaging pesticide programs used until 1976.

Further eradication programs may want to consider a broader range of environmental factors that influence mosquito populations and to attempt to effect control through agricultural practices, irrigation techniques, housing, and education. A variety of bio-environmental methods could also be explored. Educating and organizing the populations in affected areas probably also remains one of the most potent yet largely unexplored techniques that could be implemented.

#### 4.2.3 Air and Noise Pollution

These are primarily problems of larger metropolitan areas. No information on these problems was available for this study. Rural air pollution caused by uncontrolled burning of woodland and pasture during the dry season is an increasing important environmental problem in tropical America. It is especially severe in areas that are being deforested and then burned. The extent of occurrence or severity of this problem is not known in Nicaragua.

#### 4.2.4 Water Supply and Waste Disposal

Rainfall and watershed management constitute important environmental problems in Nicaragua because of the heavily agriculturalized Pacific sector and the severe dry season in this region. Most rainfall on the Pacific falls between June and October and detailed monitoring of this resource could contribute materially to agricultural development and planning, erosion control, water conservation and water quality. Water quality is particularly critical from the standpoint of health, as poor water is responsible for a substantial proportion of Nicaragua's health problems (Section 2.2.3).

The Nicaraguan National Department of Aqueducts and Sewerage Systems (DENACAL), as of 1977, had projects underway for water and sewage systems for urban areas, and was planning to extend such services to certain rural areas where there were groups of more than 200 people in settlements. The program was conceived by the Division of Environmental Sanitation of the Ministry of Health of Nicaragua. The present status of the program is unknown.

The Division of Environmental Sanitation's program for latrine construction is hampered by technical and budget shortages. With proper support this program could be instrumental in providing the resources and technical support for household waste disposal that is needed throughout. Special attention should be given to Lake Managua which is used as a receptacle for all kinds of waste material and raw sewage. This latter problem was exacerbated by the 1972 earthquake that destroyed sewer systems, and caused the relocation of much of Managua's population along its shores.

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#### 4.2.5 Environmental Impact of Proposed Development Projects

Because of the civil war and subsequent restructuring of the government, priorities for development that were established by the former Somoza government are not necessarily the same as those of the current Sandinista government. In addition, severe economic problems are likely to be of highest priority as the country seeks to reestablish itself.

A brief review of Nicaragua's economic difficulties may be helpful as an illustration. Nicaragua's economic woes began in 1972 when an earthquake destroyed downtown Managua and surrounding areas. Production loss, reconstruction and the importation of goods produced a huge trade deficit. The economy was further disturbed in 1973 as oil prices rose. Nicaragua was particularly vulnerable because most of its electricity was generated by oil-fired generators. Problems continued in 1976-77 as various Nicaraguan governmental agencies borrowed vast sums of money in a way largely uncontrolled by the Central Bank of Nicaragua, resulting in total debt service and amortization payments in 1979 being greater than the country's total exports.

Coupled with this huge foreign debt, the new Sandinista government now faces a tremendous rebuilding task. One of the most pressing is to rebuild the agricultural sector which plummeted in production during 1978-79 and 1979-80. For example, coffee production, the second largest export, was off 80 percent for 1978-79 levels, corn, beans and rice were off 55 percent, 24 percent and 15 percent respectively, and livestock and poultry losses were estimated at about 30 billion dollars (U.S.).

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Sources: Brown. 1979.  
Keast and Morton. 1980.  
UNEP. 1976.

Added to the severe agricultural problems, the industrial base was damaged during the war; an estimated 10 percent of its capacity was destroyed. The commercial sector also sustained heavy losses in inventory, uncollectible accounts and delays to building and equipment.

To deal with these problems, the government has developed a national reconstruction program aimed at restructuring the economy with well defined private, public and mixed sectors. Agriculture in all sectors will be given highest priority for reconstruction. Approximately 55 percent of the land confiscated after Somozas's overthrow will be used as the basis for extensive agricultural reforms.

Development projects, at least in the near future, will be aimed primarily at reconstruction, and their environmental impact is likely to be small. The present condition of Nicaragua's economy and the need to rebuild large segments of both rural and urban areas following the ravages of earthquakes and war suggest that economic development will receive higher priority than environmental protection in the immediate future. The longer-term environmental impact of this course of action remains to be assessed.

#### 4.2.6 Prospectus

If the present methods of land use in Nicaragua continue unchanged as the population grows, most of the country's remaining forests will soon be destroyed. The kind of natural equilibrium between forest and agriculture that was possible with traditional slash and burn agriculture and a low population density is not sufficiently productive for today's bigger population. Current land use patterns therefore tend towards a permanent and intensive style of agriculture that does not allow the forest to regenerate. Among the factors mentioned by Terborgh (1980), as contributing to the loss of natural forests are population growth, replacement of labor-intensive farming by capital-intensive agriculture, rising land values, and profitable export markets for timber and beef. Government support of colonization projects and extension of services to remote areas further accelerates the process. The loss of native forests caused by this kind of land use necessarily equates with a loss of native wildlife, as has already happened in western Nicaragua.

Reforestation as currently practiced is not an effective means of reversing the loss of natural forests. Due to minimal efforts to reforest denuded lands, deforestation is proceeding much faster than reforestation. Furthermore, reforestation as currently practiced uses monocultures of exotic species of eucalyptus, pine, cedar or teak that do not support populations

of native wildlife. Parks and other reserves preserve relatively little of the original forest, and even those areas that escape clearing because of rugged terrain or poor soil will eventually succumb to demands for charcoal, building materials, firewood, or grazing. This last stage of devastation often occurs when population densities in non-industrialized nations reach approximately 150 persons per square km (Terborgh 1980). This value has already been exceeded in nearby areas, such as Haiti, Jamaica, and El Salvador.

The harsh conditions of severe land degradation and poverty that plague Haiti and other deforested countries are not inevitable in Nicaragua. With its relatively extensive unspoiled forest on the Caribbean slope, Nicaragua has the potential for farsighted environmental planning that is no longer an option to many of its neighbors. The eastern lowlands could provide a vast array of renewable resources such as forest commodities, pharmaceuticals and other products as yet undiscovered. Available logging technology allows valuable softwoods and hardwoods to be selectively cut with minimal damage to the surrounding forest. Other forest products could be extracted as technology develops, but only when exploitation can be combined with prudent long-term management programs. The forest, thus exploited, will remain intact to await the use of future generations, new technologies, new markets, and the development of sounder land management policies.

Reducing the pressure from colonization and the resultant deforestation should be a major goal. To curb the loss of forest resources, more jobs should be developed on the Pacific slope where environmental impact would be minimal. This could be accomplished by attracting new industry, expanding existing industry, and developing more labor-intensive agriculture. Reforestation by monocultures of exotic trees on the already denuded Pacific slope could provide a convenient source of fuelwood and low grade wood products which would reduce the pressure on the remaining native forests.

Birth rates do not inevitably have to rise, or remain high. In little more than a decade neighboring Costa Rica has sharply curbed a birth rate that was formerly one of the highest in Central America. These lessons, and the natural resources that Nicaragua possesses, could be combined with sound management to chart a prosperous future, but there is no room for complacency.

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**Appendix I**

**Trees of Nicaraguan Vegetation Communities**

## Appendix I

The following tree species lists were derived from surveys of the major vegetation communities discussed in Section 3.3.1. The lists (from Taylor 1963) are displayed in four tables as follows:

Table 1. Canopy tree species recorded in lowland evergreen rain forest.

Table 2. Canopy tree species recorded in lower montane rain forest.

Table 3. Canopy tree species recorded in semievergreen seasonal forest.

Table 4. Canopy tree species recorded in deciduous seasonal forest.

Table 1. Canopy Tree Species Recorded in Lowland Evergreen Rain Forest (Taylor 1963)

<i>Andira inermis</i> (Swartz.) H.B.K.	<b>Most common</b>	<i>Dipteryx panamensis</i> (Pitt.) Record.
<i>Carapa nicaraguensis</i> C.DC.		<i>Luehea seemanii</i> Tr. & Pl.
<i>Dialium guianense</i> (Aubl.) Steud.		<i>Terminalia amazonia</i> (Gmel.) Exell.
 	<b>Common</b>	
<i>Astronium graveolens</i> Jacq.		<i>Guarea guara</i> (Jacq.) P. Wilson
<i>Brosimum terrabanum</i> Pitt.		<i>Hieronyma aichorneoides</i> Alamao
<i>Calophyllum brasiliense</i> Camb.		<i>Licania hypoleuca</i> Benth.
<i>Cedrela odorata</i> L.		<i>L. platypus</i> (Hemsl.) Fritsch.
<i>Ceiba pentandra</i> (L.) Gaertn.		<i>Nectandra glabrescens</i> Benth.
<i>Cordia alliodora</i> (Ruiz & Pavon) Cham.		<i>Swietenia macrophylla</i> King
<i>C. collococca</i> L.		<i>Tabebuia guayacan</i> (Seem.) Hemsl.
<i>Dalbergia retusa</i> Hemsl.		<i>Terminalia chiriquensis</i> Pitt.
<i>Ficus glabrata</i> H.B.K.		<i>Virola kotschyii</i> Warb.
 	<b>Occasional</b>	
<i>Achras calcicola</i> Pitt.		<i>Manilkara spectabilis</i> (Pitt.) Standl.
<i>Albizia caribaea</i> (Urb.) B. & R.		<i>Miconia guianensis</i> Aubl.
<i>Amanoa potamophila</i> Croiz.		<i>Mosquitoxylon jamaicense</i> Krug. & Urban
<i>Anacardium excelsum</i> (Bert & Balb.) Skeels.		<i>Nectandra gentlei</i> Lindl.
<i>Belotia panamensis</i> Pitt.		<i>Ocotea nicaraguensis</i> Miq.
<i>Bravaisia integerrima</i> (Spreng.) Standl.		<i>Ormosia schippilii</i> Pierce
<i>Brosimum utile</i> (H.B.K.) Oken.		<i>Pentaclethra macroloba</i> (Willd.) Kuntz.
<i>Calocarpum viride</i> Pitt.		<i>Platymicium pleiostachyum</i> Benth.
<i>C. shankii</i> Standl. & L. Wms.		<i>Podocarpus</i> sp. cf. <i>guatemalensis</i>
<i>Camptosperma panamensis</i> Standl.		<i>Poulsenia armata</i> (Miq.) Standl.
<i>Cedrela mexicana</i> Roem.		<i>Prioria copaifera</i> Griseb.
<i>Cusia flava</i> Jacq.		<i>Pterocarpus officinalis</i> Jacq.
<i>C. rosea</i> Jacq.		<i>Quercus olcoides</i> Cham. & Schl.
<i>Erythrina glauca</i> Willd.		<i>Schizolobium perahybum</i> (Vell.) Blake
<i>Ficus padifolia</i> H.B.K.		<i>Sloanea picapica</i> Standl.
<i>Goethalsia meiantha</i> (D. Sm.) Burret		<i>Spondias mombin</i> L.
<i>Guarea aligera</i> Harms.		<i>Symphonia globulifera</i> L.f.
<i>Hura crepitans</i> L.		<i>Tetragastis stevensonii</i> Standl.
<i>Hymenaea courbaril</i> L.		<i>Trichilia tuberculata</i> (Tr. & Pl.) C.DC.
<i>Ilex guianensis</i> (Aubl.) Kuntz.		<i>Trophis macrostachya</i> D. Sm.
<i>Lecythis costaricensis</i> Pitt.		<i>Virola sebifera</i> Aubl.
<i>Licaria cervantesii</i> (H.B.K.) Kosterm.		<i>Vitex cooperi</i> Standl.
<i>Lonchocarpus</i> spp.		<i>Zanthoxylum microcarpum</i> Griseb.
<i>Lyailoma seemanii</i> Britt. & Rose		

**Table 2. Canopy Tree Species of Lower Montane Rain Forest  
(Taylor 1963)**

	Common
Astronium graveolens Jacq.	Juglans olanchanum Standl. & L. Wms.
Calocarpum mammosum (L.) Pierre	Litsea glaucescens H.B.K.
Calophyllum brasiliense Camb.	Mastichodendron capiri (A.DC.) Cronquist
Cedrela odorata L.	Nectandra nervosa Mez. & Pitt.
Chaetoptelea mexicana Liebm.	N. reticulata Meisn.
Ficus glabrata H.B.K.	Quercus asata C. H. Muller
Guarea brevianthera C.DC.	Sapium macrocarpum M. Arg.
Ilex carpinterae Standl.	Styrax polyanthus Perk.
Ilex hondurensis Standl.	
	Occasional
Achras calciocla Pitt.	F. involucrata (Liebm.) Miq.
Beilschmiedia austin-smithii (Standl.) C. K. Allen	Heliocarpus appendiculatus Turcz.
Belotia mexicana (D.C.) Schum.	H. donnell-smithii Rose
Brotimum costaricanum Liebm. & Dansk.	Liquidambar styraciflua L.
Calocarpum viride Pitt.	Lonchocarpus lucidus Pitt.
Carpinus caroliniana Walt.	Matudaea trivervia Lundl.
Clusia flava Jacq.	Meliosma glabrata (Liebm.) Urb.
Cordia alliodora (R. & P.) Cham.	Mosquitoxylon jamaicense Krug. & Urb.
C. heterophylla R. & S.	Persea americana Mill.
Cupania dentata D.C.	P. schiedeana Nees.
Dalbergia sp.	Quercus breneesi Trel.
Dialium guianense (Aubl.) Steud.	Spondias mombin L.
Engelhartia nicaraguensis A. Molina	Swietenia macrophylla King.
Ficus costaricana (Liebm.) Miq. Ann.	Symphonia globulifera L.f.
F. hemsleyana Standl.	Symplocos laconensis Lundel.

**Table 3. Tree Species Exceeding 30m Height of Common and Occasional Occurrence in Semievergreen Seasonal Forest (Taylor 1963)**

<i>Albizzia caribaea</i> (Urb.) B. & R.	<i>Guarea excelsa</i> H.B.K.
<i>Andira inermis</i> (Swartz.) H.B.K.	<i>Heliconia appendiculata</i> Turcz.
<i>Astronium graveolens</i> Jacq.	<i>Hura crepitans</i> L.
<i>Bombacopsis quinatum</i> (Jacq.) Dug.	<i>Hymenaea courbaril</i>
<i>B. fendleri</i> (Seem.) Pitt.	<i>Ledernbergia macrantha</i> Standl.
<i>Bombax barrigon</i> (Seem.) Dcne.	<i>Licania arborea</i> Seem.
<i>Brosimum alicastrum</i> Swartz.	<i>Luehea seemanii</i> Tr. & Pl.
<i>B. costaricanum</i> Liebm.	<i>Mastichodendron capiri</i> (A.DC.) Cronquist
<i>B. terrabanum</i> Pitt.	<i>Pithecolobium saman</i> (Jacq.) Benth.
<i>Calocarpum mammosum</i> (L.) Pierre	<i>Platymiscium pleiostachyum</i> Benth.
<i>Cedrela odorata</i> L.	<i>Pseudosamanea guachapele</i> (H.B.K.) Harm
<i>C. mexicana</i> Roem.	<i>Sciadodendron excelsum</i> Griseb.
<i>Ceiba pentandra</i> (L.) Gaertn.	<i>Simaruba glauca</i> DC.
<i>Chlorophora tinctoria</i> (L.) Gaud.	<i>Spondias mombin</i> L.
<i>Couroupita nicaraguensis</i> DC.	<i>Sterculia apetala</i> (Jacq.) Karst.
<i>Cynometra hemitomophylla</i> (D.Sm.) B. & R.	<i>Swietenia humilis</i> Zucc.
<i>Enterolobium cyclocarpum</i> (Jacq.) Griseb.	<i>Tabebuia chrysantha</i> (Jacq.) Nichl.
<i>Ficus costaricana</i> (Liebm.) Miq. Ann.	<i>T. pentaphylla</i> (L.) Hemsl.
<i>F. glabrata</i> H.B.K.	<i>Terminalia chiriquensis</i> Pittier

Table 4. Canopy Trees of Deciduous Seasonal Forest (Taylor 1963)

	<b>Most common</b>
Bursera simaruba (L.) Sarg.	Haematoxylon brasiletto Karst.
Caesalpinia coraria (Jacq.) Willd.	Luehea candida (DC.) Mart.
Calycophyllum candidissimum (Vahl.) DC.	Lysiloma kellermani B. & R.
Guazuma ulmifolia Lam.	L. seemanii B. & R.
Gyrocarpus americanus Jacq.	Phyllostylon brasiliensis Cap.
	<b>Common</b>
Albizia caribaea (Urb.) B. & K.	Lonchocarpus phaseolifolius Benth.
Astronium graveolens Jacq.	L. minimiflorus D. Sm.
Bombacopsis quinatum (Jacq.) Dug.	Myrospermum frutescens Jacq.
Bursera graveolens (H.B.K.) Tr.	Pisonia aculeata L.
Cedrela mexicana Roem.	P. micranthocarpa D. Sm.
Ceiba pentandra (L.) Gaertn.	Pithecolobium saman (Jacq.) Benth.
Chlorophora tinctoria (L.) Gaud.	Plumaria rubra L.
Cochlospermum vitifolium (Willd.) Spreng.	Simaruba glauca DC.
Cordia alliodora (R. & P.) Cham.	Tabebuia chrysantha (Jacq.) Nickl.
C. nitida Vahl.	Thouliidium decandrum (Humb. & Bonpl.)
Enterolobium cyclocarpum (Jacq.) Griseb.	Radlk.
Gliricidia sepium (Jacq.) Steud.	Trichilia trifida L.
Guaiacum officinale L.	Ximena americana L.
	<b>Occasional</b>
Acacia glomerosa Benth.	Ficus ovalis (Liebm.) Miq.
Acroconia vinifera Oerst.	Guettarda macrosperma D. Sm.
Alvaradoa amorphoides Liebm.	Heliocarpus apperdiculatus Tunz.
Apoplania paniculata Presl.	Hippomane mancinella L.
Andira inermis (Swartz.) H.B.K.	Hura crepitans L.
Antrophora williamsii Jtn.	Hymenea courbarii
Apeiba aspera Aubl.	Juliana astringens Sehl.
Bombax barrigon (Seem.) Dcne.	Licania arborea Seem.
Brosimum alicastrum Liebm.	Lonchocarpus latifolius (Willd.) H.B.K.
B. costaricanum Liebm.	L. phlebophyllus Standl. & Steym.
Bursera excelsa (H.B.K.) Engl.	Luehea seemanii Tr. & Pl.
Caesalpinia eriostachys Benth.	Mastichodendron capiri (A.DC.) Cronquist
Capparis cynophallophora L.	Platymicium pleiostachyum Benth.
Cassia grandis L.f.	Pseudosamanea guachapele (H.B.K.) Harms.
Cecropia peltata L.	Pterocarpus hayesii Hemsl.
Ceiba aesculifolia (H.B.K.) B. & R.	Sapindus saponaria L.
Celtis iguanaea (Jacq.) Sarg.	Sapium thelocarpum Schum. & Pitt.
C. shippii Standl.	Sapranthus nicaraguensis Seem.
Coccoloba caracasana Meissn.	Sciadodendron excelsum Griseb.
Cordia garascanthus L.	Spondias mombin L.
Crataeva tapia L.	Sterculia apetala (Jacq.) Karst.
Dalbergia hypoleuca Pitt.	Swietenia humilis Zucc.
Diospyros nicaraguensis Standl.	Tabebuia pentaphylla (L.) Hemsl.
Erythrina berteriana Urb.	Triplaris americana L.
Eugenia nicaraguensis Amsh.	Vitex gaumeri Greenm.
Ficus glaucescens (Liebm.) Miq.	Zanthoxylum culantrillo H.B.K.
F. involucrata (Liebm.) Miq.	

Appendix II

Decree Establishing Instituto Nicaraguense de Recursos Naturales  
y del Ambiente (IRENA) and Environmental Policies

# LA GACETA

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SECRETARIA GENERAL DE LA JUNTA

**Ley Orgánica del Instituto Nicaragüense de Recursos Naturales y del Ambiente (IRENA)**

Decreto No. 112

LA JUNTA DE GOBIERNO DE RECONSTRUCCION NACIONAL DE LA REPUBLICA DE NICARAGUA

en uso de sus facultades,

Decreta:

La siguiente:

**LEY ORGANICA DEL INSTITUTO NICARAGUENSE DE RECURSOS NATURALES Y DEL AMBIENTE (IRENA)**

Capítulo I

Artículo.—El Instituto Nicaragüense de

Recursos Naturales y del Ambiente, que también se denominará IRENA, creado por el Decreto del 24 de Agosto de 1979, es un ente autónomo con personalidad jurídica, patrimonio propio y plena capacidad para adquirir derechos y contraer obligaciones. Su duración es indefinida.

Art. 2o.—El domicilio del IRENA es la ciudad de Managua, pudiendo establecer agencias, representaciones y otras oficinas subsidiarias en cualquier parte del territorio nacional y en el extranjero.

Art. 8o.—El IRENA tiene por objeto: entre otros regular la política nacional relativa a los Recursos Naturales y el Ambiente, en los términos expresados en el Art. 3o. del Decreto del 24 de Agosto de 1979, y dentro del ámbito señalado en el Art. 1o. de la mencionada Ley Creadora. En tal sentido le corresponde la planificación, administración, control, investigación, manejo y aprovechamiento racional de los Recursos Naturales que son patrimonio exclusivo del Estado; y fundamentalmente tendrá como objetivos generales:

- 1.—Salvaguardar la Soberanía nacional de Nicaragua en lo concerniente a la adecuada conservación y aprovechamiento racional de los Recursos Naturales que conforman la riqueza básica de nuestra Nación.
- 2.—Elaborar y ejecutar el Plan General sobre Política de Conservación y Aprovechamiento Adecuado del Patrimonio Estatal del Ambiente y de los Recursos Naturales, a fin de regular las operaciones que sobre este rubro realicen tanto el sector público como el privado.
- 3.—Investigar, vigilar, administrar y cuando el caso lo requiera, explotar los Recursos Naturales, energéticos y del ambiente del territorio Nacional, bajo la filosofía de que estos deben contribuir al bienestar social de la población nicaragüense.
- 4.—Promover la creación de Empresas

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y/o Corporaciones Estatales asesoradas y coordinadas por IRENA para la extracción, procesamiento y comercialización de algunos Recursos Naturales cuando el caso así lo amerite.

- 5.—Coordinar las acciones, planes y proyectos del sector estatal y privado que se refieren a los Recursos Naturales y energéticos y del Ambiente.
- 6.—Elaborar y dictar, las recomendaciones para un nuevo marco jurídico referente a las leyes, reglamentos, códigos y distintas disposiciones que normen, regulen y sancionen todas las acciones que sobre el Ambiente y los Recursos Naturales se realicen en el país.
- 7.—Vigilar el estricto cumplimiento de la Ley y aplicar las sanciones correspondientes en los casos que así lo ameriten.
- 8.—Propiciar la toma de conciencia de los sectores populares acerca de la importancia de proteger y conservar nuestros Recursos Naturales para el progreso y el ambiente socio-económico de la Patria.
- 9.—Propiciar, coordinar y realizar las investigaciones necesarias para la adecuada planificación del sector de Recursos Naturales y del Ambiente.

**Arto. 40.—**Constituyen el patrimonio del IRENA:

- 1.—Todos los bienes, derechos y obligaciones que pertenecen a la Dirección General de Riquezas Naturales, Servicio Geológico Nacional, adscritas al Ministerio de Industria y Comercio; Dirección General de Recursos Naturales renovables del Ministerio de Desarrollo Agropecuario; División de Pesca, Proyectos Forestal y Pinares del Noreste ambos del antiguo INFONAC; Centro de Investigaciones Científicas Nicaragüenses del Banco Central y el Proyecto Parque Nacional Volcán Masaya del Banco Central.
- 2.—Los bienes y derechos que el Estado le asigne para su funcionamiento.
- 3.—Las aportaciones iniciales de capital que el Estado le autorice.
- 4.—Las sumas anuales que con destino al IRENA asigne al Presupuesto Nacional.
- 5.—El producto de concesiones, permisos, multas, sanciones o cualquier otro acto sobre bienes bajo la supervisión o dominio del IRENA.

- 6.—El valor de los servicios técnicos que preste.
- 7.—Los empréstitos que se otorguen al IRENA.
- 8.—Los Recursos Naturales renovables y no renovables que tengan categoría de bienes nacionales asignados al IRENA, por el Estado para su administración.
- 9.—Todos los bienes que adquiera a cualquier título.
- 10.—El patrimonio del IRENA también podrá ser incrementado por nuevos aportes en efectivo por cualquier otros ingresos que le cediere al Estado, o por traspasos al IRENA de propiedades, partidas presupuestarias o derechos, o cualquier otro ingreso destinado al cumplimiento de sus objetivos.

**Arto. 50.—**Pasarán a formar parte del IRENA las siguientes dependencias estatales: Dirección General de Riquezas Naturales, Servicio Geológico Nacional, ambas del Ministerio de Industria y Comercio; Dirección General de Recursos Naturales Renovables del Ministerio de Desarrollo Agropecuario; División de Pesca, Proyecto Forestal y Pinares del Noreste, ambos del antiguo INFONAC; Centro de Investigaciones Científicas Nicaragüenses del Banco Central de Nicaragua y el Proyecto Parque Nacional Volcán Masaya del Banco Central; las facultades y atribuciones que conforme las disposiciones legales vigentes le correspondían a las anteriores dependencias pasarán a ser propias del IRENA, y cualquiera otros organismos o dependencias que determine la Junta de Gobierno.

**Arto. 60.—**La asunción por el IRENA de los derechos y obligaciones de las dependencias mencionadas en el Arto. anterior y de cualesquiera otras, se hará mediante Beneficio de Inventario, y en caso de que en el Estado de Cuenta se determine la existencia de un excedente del Pasivo sobre el Activo, el excedente será asumido por el Estado.

## Capítulo II

**Arto. 70.—**La dirección, administración y vigilancia del IRENA estará a cargo de un Director General que será nombrado por la Junta de Gobierno de Reconstrucción Nacional, debiendo ser mayor de 25 años de edad, nicaragüense, en el ejercicio de sus derechos de reconocida capacidad técnica para el cargo y no haber estado vinculado a la corrupción administrativa del régimen anterior.

El Director ejercerá la representación judicial y extrajudicial del IRENA, con

plenas facultades; pudiendo otorgar mandatos generales o especiales y dictar las instrucciones necesarias para el mejor funcionamiento de la Institución.

Arto. 8o.—Habrà un Sub-Director General nombrado por la Junta de Gobierno, que deberá tener las mismas calidades que el Director General. Colaborará en el Despacho subordinado al Director General, teniendo áreas determinadas de responsabilidad y hará las veces de éste en caso de ausencia temporal o en su defecto.

Arto. 9o.—Para el mejor funcionamiento del IRENA, el Director General podrá nombrar y remover todo el personal necesario en las dependencias, agencias y delegaciones regionales, fijándoles sus atribuciones y orden jerárquico de conformidad con los requerimientos del Instituto.

### Capítulo III

Arto. 10.—El IRENA tiene las siguientes atribuciones:

- 1.—Realizar el estudio e inventario de los Recursos Naturales: clima, agua, suelos, subsuelo, minerales, bosques, vegetación, pesca y vida silvestre, en sus ambientes terrestres, lacustres, fluviales, litorales, mar territorial y patrimonial y espacio aéreo.
- 2.—Evaluar la información sobre Recursos Naturales para planes y proyectos de desarrollo y la conservación de los mismos.
- 3.—Reglamentar el uso y el aprovechamiento de los Recursos Naturales del país, para lo cual tendrá a su cargo lo relativo al otorgamiento, supervisión y suspensión de las concesiones, licencias y permisos respectivos; a la movilización de los productos forestales, de fauna, minerales y energéticos.
- 4.—Llevar un registro de las personas naturales o jurídicas que aprovechen los recursos Naturales bajo licencia, concesión o permiso.
- 5.—Diseñar, implementar y supervisar las políticas relacionadas con el mantenimiento del ambiente, para asegurar el equilibrio ecológico Nacional.
- 6.—Implementar la política de desarrollo y manejo de los Recursos Naturales.
- 7.—Vigilar y asesorar las actividades y obras necesarias para el desarrollo, la conservación y aprovechamiento racional y sostenido de los recursos Naturales y del Ambiente.
- 8.—Reservar y conservar aquellas áreas que presentan condiciones especiales para la ecología, la flora, la fauna y los lugares escénicos, con fines cien-

tíficos, educativos, recreativos y turísticos de interés nacional e internacional en coordinación con otros organismos del Estado.

- 9.—Proteger en coordinación con el Instituto Nicaragüense de Acueductos y Alcantarillados (INAA), las cuencas hidrográficas con el conveniente manejo de suelos y aguas, encaminadas a su desarrollo integral y múltiples para obtener los beneficios de la conservación y aprovechamiento de sus recursos.
- 10.—Supervisar en coordinación con el Instituto Nicaragüense de Acueductos y Alcantarillados (INAA) proyectos de riego y manejo de agua.
- 11.—Realizar, fomentar y coordinar actividades de repoblación forestal, ictiológica y de fauna silvestre en sus respectivos ambientes.
- 12.—Prospectar el territorio nacional en busca de recursos minerales y fuentes energéticas para su debido aprovechamiento por parte de las agencias que el Estado designe.
- 13.—Reglamentar el uso de las costas y playas marítimas, lacustres y fluviales, estanques y embalses, esteros, lagunas litorales, cayos, arrecifes, bancos submarinos, volcanes, calderas y lagunas cratéricas y todas las tierras nacionales otorgadas y transferidas al IRENA, quien coordinará dichas actividades con todos aquellos organismos estatales que tengan ingerencia en cada caso.
- 14.—Mantener un sistema de vigilancia y control, a través de Inspecciones sobre el uso racional de los recursos naturales y del ambiente, en coordinación con los organismos estatales del caso.
- 15.—Establecer las normas de supervisión y control de las personas, instituciones, industrias, procesos y otros factores que propicien la contaminación ambiental en campos y ciudades.
- 16.—Establecer las normas mínimas de calidad ambiental del aire, agua y suelo, cuya observancia propicie el bienestar físico y social de nuestra población en coordinación con otros organismos estatales.
- 17.—Reglamentar el tratamiento y destino de los efluentes y emisiones de las industrias urbanas y rurales.
- 18.—Propiciar campañas divulgativas, cursos, seminarios y otras actividades de carácter educativo y de motivación acerca de la conservación ambiental y el aprovechamiento racional de los recursos naturales en coor-

- dinación con otras organizaciones estatales.
- 19.—Crear un banco de datos en materia de recursos naturales y del Ambiente que centralice toda la información dispersa existente.
  - 20.—Realizar y promover programas de investigación científica y tecnológica en materia de recursos naturales y conservación ambiental.
  - 21.—Asesorar las distintas dependencias estatales y privadas que lo soliciten en todo lo relacionado con la materia de recursos naturales y calidad ambiental.
  - 22.—Promover en las comunidades, proyectos pilotos de desarrollo integral no dependientes, con el fin de demostrar la conveniencia práctica del manejo ordenado de los recursos naturales y del ambiente.
  - 23.—Para todos aquellos proyectos de infraestructura que afecten directa o indirectamente los recursos naturales y el ambiente se requerirá la autorización del IRENA.
  - 24.—Ejecutar en relación con sus bienes muebles o equipos todos los actos o contratos que fueren necesarios o conducentes para el cumplimiento de sus objetivos. En relación a sus bienes inmuebles, necesitará aprobación previa de la Junta de Gobierno, para ser gravados, enajenados o permutados. Sin embargo, en ningún caso podrán ser objeto de venta permuta o arrendamiento de parte del IRENA, las riquezas naturales objeto de la presente Ley.
  - 25.—Valar por el estricto cumplimiento de esta Ley, y su reglamento.
  - 26.—Dictar la reglamentación necesaria, para la organización y buen funcionamiento del IRENA y de los programas que ésta desarrolle.
  - 27.—Dictar cualquier otra medida inherente a sus objetivos.

#### Capítulo IV

Arto. 11.—El Director General ejercerá sus funciones bajo las instrucciones directas de la Junta de Gobierno, dentro de los nuevos lineamientos de reorientación administrativa y técnica, en función del desarrollo socio-económico del país y su proceso revolucionario y conforme a la Ley y los reglamentos vigentes.

#### Capítulo V

Arto. 12.—Corresponderá al IRENA el conocimiento y despacho de todos los asuntos relacionados con los recursos natura-

les y el ambiente, cumpliendo con las normas de procedimientos establecidos en las leyes vigentes sobre la materia.

#### Capítulo VI

Arto. 13.—Es facultad del IRENA, tomar las medidas y providencias que sean del caso, a fin de evitar o corregir el uso indebido de un recurso natural sobre el que no existe legislación específica, con la limitación de que tales medidas sean las estrictamente necesarias y de tal naturaleza que la falta de intervención del IRENA pudiera causar daños irreparables. Para la toma de medidas y providencias a que se refiere este Artículo, se tomará en cuenta las prácticas internacionales y las normas técnicas aplicables al caso.

#### Capítulo VII

Arto. 14.—Dentro de los primeros tres meses de cada año, el IRENA debe presentar a la Junta de Gobierno de Reconstrucción Nacional, la Memoria Anual en que dará a conocer el desarrollo de las actividades efectuadas en el curso del año anterior.

Arto. 15.—El IRENA debe ajustar sus operaciones y programas a la política general determinada por la Junta de Gobierno de Reconstrucción Nacional, así mismo deberá coordinar sus actividades con otras instituciones del Estado, a fin de evitar duplicidad de funciones.

Arto. 16.—Para los efectos de lo que señala el inciso 3) del Arto. 10 de esta Ley, el IRENA será la única institución del Estado facultada para otorgar, supervisar y cancelar permisos de reconocimiento, licencias y concesiones de exploración y explotación de los recursos naturales.

Arto. 17.—Esta Ley se complementa con todas las disposiciones legales y reglamentarias vigentes en materia de recursos naturales y deroga cualquier disposición que se le oponga.

Arto. 18.—La presente Ley entrará en vigencia hoy, desde el momento de su publicación por cualquier medio de comunicación colectiva, sin perjuicio de su publicación posterior en el Diario Oficial.

Dado en la ciudad de Managua, a los nueve días del mes de octubre de mil novecientos setenta y nueve. — "Año de la Liberación Nacional".

JUNTA DE GOBIERNO DE RECONSTRUCCION NACIONAL. — Sergio Ramírez Mercado. — Moisés Hassan M. — Alfonso Robelo Callejas. — Daniel Ortega Saavedra.

**Appendix III**

**U.S. AID Programs of Environmental Significance**

**Appendix III. U.S. AID Programs of Environmental Significance**

**1.0 Land Use**

**2.0 Health**

.....  
 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5240067 SUB-PROJECT: 00 \*  
 \* PROJECT TITLE: NICARAGUA-IRRIGATION DEVELOPMENT INITIAL FY: 70 FINAL FY: 74 \*  
 .....

**PROBLEM:** MUCH OF NICARAGUA'S AGRICULTURAL AREA RECEIVES RAINFALL ONLY DURING PART OF THE YEAR. DATA FROM CONTROLLED IRRIGATION OPERATIONS MUST BE COLLECTED AND EVALUATED AND RECOMMENDATIONS MUST BE DEVELOPED ON HOW TO TRAIN FARMERS TO USE IRRIGATION WATER, AS WELL AS ON PROPER TIMING OF FARM ACTIVITIES DURING WET AND DRY SEASONS.

**STRATEGY:** DEVELOP AWARENESS OF NEEDED FOR NATIONAL IRRIGATION PROGRAM BY DEMONSTRATING AT THE FARM LEVEL THE HIGHER RETURNS RESULTING FROM PROPER IRRIGATION AND SELECTED CROPS.

**SUMMARY:** IN 1966 THE MINISTRY OF AGRICULTURE SIGNED A 2 YR AGREEMENT WITH A CONTRACTOR TO PROVIDE TECHNICAL ASSISTANCE TO AN IRRIGATION DEMONSTRATION KNOWN AS PROYECTO ADELANTE. IN 1970 THE PROJECT WAS UPGRADED TO INCLUDE AN APPLIED IRRIGATION RESEARCH STATION ON GOVERNMENT CONTROLLED LAND. EMPHASIS ON THIS SITE WAS ON THE PRODUCTION OF NEW TRADITIONAL CROPS AND THE DEVELOPMENT OF CROPPING AND MANAGEMENT PRACTICES. FOUR PRIVATE SITES SELECTED; A SYSTEM OF COMPLETE IRRIGATION DURING THE 6-MONTH DRY SEASON AND SUPPLEMENTAL IRRIGATION THE REMAINDER OF THE YR. NEW TRADITIONAL STUDIED AT THE FIELD RESEARCH STATION-PEANUTS, SAFFLOWER, OKRA AND CASAVES. TRAIN LOCAL TECHNICIANS/FARMERS IN MODERN IRRIGATION PRACTICES.

**GOALS:** ASSIST THE GOVERNMENT OF NICARAGUA IN INCREASING AND DIVERSIFYING THE PRODUCTIVE CAPACITY OF THE ECONOMY.

**PURPOSE:** THE PROPER USE OF IRRIGATION AND CROPPING PATTERNS USED BY NICARAGUAN FARMERS IN THE PRODUCTION OF CROPS IDENTIFIED BY THIS PROJECT TO FIT INTO AN IRRIGATED CROPPING PATTERN.

**OUTPUTS:** AGREEMENTS NEGOTIATED AND IRRIGATION SYSTEMS ESTABLISHED IN COOPERATING FARMS. IRRIGATED CROPS EXPERIMENTAL STATION ESTABLISHED. CROPS IDENTIFIED WHICH MAY BE PROFITABLE PRODUCED IN A YEAR-ROUND FARMING SYSTEM WITH IRRIGATION. LOCAL TECHNICIANS AND FARMERS TRAINED IN MODERN IRRIGATION PRACTICES AND IN PRODUCTION OF NEW POTENTIAL CROPS.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5240079 SUB-PROJECT: 00 \*  
 \* PROJECT TITLE: BASIC CROP PRODUCTION INITIAL FY: 68 FINAL FY: 74 \*  
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**PROBLEM:** SMALL FARMERS IN NICARAGUA USING TRADITIONAL AGRICULTURAL METHODS ATTAIN LOW PRODUCTIVITY OF BASIC FOOD CROPS.

**STRATEGY:** LOAN IS GRANTED TO NICARAGUAN GOVERNMENT TO FINANCE AGRICULTURAL PROGRAM.

**SUMMARY:** NICARAGUAN GOVERNMENT RECEIVES LOAN TO FINANCE AGRICULTURAL PROGRAM. BULK OF LOAN IS USED FOR IMPORTATION OF FERTILIZER AND PESTICIDES. WHILE A PORTION IS USED TO TRAIN SMALL FARMERS IN MODERN FARMING PRACTICES. INCREASED AMOUNT OF CREDIT IS EXTENDED TO SMALL FARMERS THROUGH THE NATIONAL BANK OF NICARAGUA THAT THEY MAY PURCHASE FERTILIZER AND PESTICIDES NEEDED TO INCREASE PRODUCTIVITY.

**GOAL:** NICARAGUA BECOMES SELF SUFFICIENT IN BASIC FOOD CROP PRODUCTION. 1

**PURPOSE:** INCREASE BASIC FOOD PRODUCTIVITY OF SMALL FARMERS AT A LOWER UNIT COST IN NICARAGUA. 1

**OUTPUTS:** SMALL FARMERS ARE TRAINED IN MODERN FARMING TECHNIQUES. A LARGER AMOUNT OF FERTILIZER, PESTICIDES, INSECTICIDES AND HERBICIDES IS IMPORTED. INCREASED AMOUNT OF CREDIT IS EXTENDED TO SMALL FARMERS FOR PURCHASE OF FERTILIZER AND AGRO CHEMICALS. 1

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 \* COUNTRY/BUREAU: NICARAGUA PROJECT DESIGN INFORMATION \*  
 \* PROJECT TITLE: PENETRATION ROADS BETTERMENT LUAN PROJECT: 5240066 SUB-PROJECT: 00 \*  
 \* INITIAL FY: 71 FINAL FY: 75 \*  
 .....

**PROBLEM:** CERTAIN SEMI-ISOLATED RURAL AREAS ARE UNABLE TO PARTICIPATE FULLY IN NATIONAL ECONOMY. EXISTING ROADS ARE LITTLE MORE THAN DIRT TRACKS IN MANY PLACES AND ARE PASSABLE ONLY IN DRY SEASON, DUE TO LACK OF PROPER DRAINAGE AND SURFACE DESIGN TO PREVENT ANNUAL WASHOUTS.

**STRATEGY:** FINANCE FOREIGN EXCHANGE COSTS ASSOCIATED WITH CONSTRUCTION OF ALL-WEATHER FEEDER ROADS.

**SUMMARY:** PROJECT PROVIDES FOR CONSTRUCTION OR RECONSTRUCTION OF 7 FEEDER ROADS TOTALING APPROXIMATELY 210 KM IN VARIOUS ISOLATED AREAS OF COUNTRY OVER PERIOD OF 3 YRS. ROADS ARE ALL-WEATHER, BUT BUILT TO LIMITED DESIGN STANDARDS AND SURFACED WITH SELECTED LOCALLY AVAILABLE MATERIALS (NOT PAVED). ROADS BUILT UNDER PROJECT REPRESENT FIRST PHASE OF LONG RANGE FEEDER ROADS PLAN AIMING AT CONSTRUCTION OF ABOUT 5000 KM OF PENETRATION ROADS IN COUNTRY. FIRST ROADS SELECTED LINK AREAS SERVED BY THEM TO MAIN HIGHWAYS, ROADS, PROJECT PROVIDED ROAD CONSTRUCTION EQUIPMENT TO HELP BUILD CAPACITY OF HIGHWAY DEPARTMENT TO CONTINUE PROGRAM.

**GOAL:** INTEGRATE INTO NATIONAL ECONOMY CERTAIN SEMI-ISOLATED RURAL AREAS IN NICARAGUA. 1

**PURPOSE:** PROVIDE YEAR-ROUND ACCESS TO MARKETS, SERVICES FOR RURAL POPULATION. 1

**OUTPUTS:** 1. 210 KM OF PENETRATION ROADS UPGRADED TO ALL-WEATHER STANDARDS. 2. HIGHWAY DEPARTMENT PROVIDED WITH EQUIPMENT TO CONTINUE PROGRAM AND PROVIDE MAINTENANCE. 1

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 \* COUNTRY/BUREAU: NICARAGUA PROJECT DESIGN INFORMATION \*  
 \* PROJECT TITLE: AGRIC PRODUCTION & DIVERSIFICATION PROJECT: 5240073 SUB-PROJECT: 00 \*  
 \* INITIAL FY: 70 FINAL FY: 76 \*  
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**PROBLEM:** MARKETING/PRICE STRUCTURE INADEQUATE; STORAGE METHODS INADEQUATE; MARKET INFORMATION SYSTEM TOO POOR TO PROVIDE DATA FOR PROPER FARM MANAGEMENT.

**STRATEGY:** INCREASE APPLIED PLANT/ANIMAL RESEARCH; BEGIN ON-FARM IRRIGATION DEMONSTRATIONS; EXTEND CREDIT AND LAND TITLING TO SMALL/MEDIUM FARMS; INCREASE QUALITY/VOLUME OF GRAIN STORAGE THROUGHOUT NICARAGUA; ACCELERATE PROGRAM OF IMPROVED INSECT CONTROL; MARKET SYSTEM TO BE ANALYZED/REVAMPED.

**SUMMARY:** APPLIED RESEARCH WILL INCREASE EFFICIENCY OF AGRICULTURAL PRODUCTION AND ACCELERATE RURAL DEVELOPMENT THROUGH EFFECTIVE USE OF EXISTING RESOURCES; IT WILL SUPPORT FORMULATION OF SOUND POLICY AS WELL. GOV WILL APPOINT A HIGH LEVEL MARKETING ADVISORY BOARD WITH RESPONSIBILITY FOR COORDINATION AND FUNDING. PROGRAMS ARE NEEDED FOR TRANSMISSION OF DATA, PRICE STABILIZATION & SOUND MARKETING POLICY. A CRITICAL NEED EXISTS FOR ANALYSIS OF A TWO-CROP EXPORT-ORIENTED AGRICULTURE TO HELP RAISE FARMERS ABOVE SUBSISTENCE FARMING IF RURAL LIFE IS TO BE IMPROVED. GOV, WITH AID TECHNOLOGICAL HELP, WILL ATTEMPT TO CREATE THE CORRECT TOTAL PACKAGE FOR MAXIMUM USE OF SOIL, WATER AND HUMAN RESOURCES.

**GOAL:** INCREASING AND DIVERSIFYING THE PRODUCTIVE CAPACITIES OF THE ECONOMY OF NICARAGUA, WITH PARTICULAR EMPHASIS ON RURAL DEVELOPMENT.

**PURPOSE:** ESTABLISH A SCIENTIFIC BASIS FOR INCREASED PRODUCTION OF SELECTED CROPS THROUGH RESEARCH STUDIES; ESTABLISH A SCIENTIFIC BASIS FOR INCREASED MEAT PRODUCTION THROUGH APPLIED NUTRITION RESEARCH; ESTABLISH THE BASIS FOR AN EXPANDING MARKET, IN FOOD AND FEED CROPS, LIVESTOCK AND LIVESTOCK PRODUCTS, THROUGH EXECUTION OF PRODUCTION, TRANSPORT, STORAGE, PRICE, DEMAND, AND RELATED STUDIES/SURVEYS AND THE INITIATION OF A FUNCTIONING MARKET NEWS SERVICE.

**OUTPUTS:** 1. RICE, SORGHUM, FORAGE CROP RES: SEVERAL HUNDRED VARIETIES TESTED; 2. PURE SEED PRODUCTION/MULTIPLICATION PROGRAM ESTABLISHED; 3. STUDY FOR MODERN C. FERTILIZER RECOMMENDATIONS DEVELOPED; 4. NATIONWIDE GRAIN/MILK PRICES STABILIZATION; 5. CROP STATISTICS & FORECASTING PROGRAM WITH SHORT TRAINING PROGRAMS FOR TECHNICIANS/FARM LEADERS; 6. LIVESTOCK PROCESSING/MARKETING IMPROVED; 7. OPIMUM RATE OF SEEDING DETERMINED; 8. STUDY FOR MODERN C. FERTILIZER RECOMMENDATIONS DEVELOPED; 9. PURE SEED PRODUCTION/MULTIPLICATION PROGRAM ESTABLISHED; 10. STUDY FOR MODERN C. FERTILIZER RECOMMENDATIONS DEVELOPED; 11. NATIONWIDE GRAIN/MILK PRICES STABILIZATION; 12. CROP STATISTICS & FORECASTING PROGRAM WITH SHORT TRAINING PROGRAMS FOR TECHNICIANS/FARM LEADERS; 13. LIVESTOCK PROCESSING/MARKETING IMPROVED; 14. SECTORAL ANALYSIS.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5240112 SUB-PROJECT: 00 \*  
 \* PROJECT TITLE: LAKE PILON IRRIGATION PROJECT INITIAL FY: 75 FINAL FY: 78 \*  
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**PROBLEM:** THE AGRARIAN REFORM COLONY, COLONIA ANGELICA DE SCHICK, LACKS FINANCIAL/TECHNICAL CAPABILITY TO IMPROVE QUALITY AND INCREASE NUMBER OF YEARLY HARVESTS. THE COLONY NEEDS TO INCREASE & IMPROVE HARVESTS IF ITS LOWER INCOME FARMERS ARE TO IMPROVE, HOWEVER SLIGHTLY, THE QUALITY OF LIFE.

**STRATEGY:** A CAPITAL INTENSIVE, LONG-TERM PUBLIC SECTOR APPROACH UTILIZING EXISTING TECHNOLOGY.

**SUMMARY:** PROJECT FUNDS & CONSTRUCTS IRRIGATION SYSTEM FOR COLONIA ANGELICA DE SCHICK WHILE ESTABLISHING A CAMELAGUARIAN INSTITUTE OF NICARAGUA (IAN) REVOLVING ACCOUNT FINANCED BY REPAYMENTS MADE BY BENEFICIARIES OF IRRIGATION SYSTEM. IRRIGATION EXPECTED TO IMPROVE HARVEST & FARMER INCOMES BY 64%. FARMERS MOVED OFF CULTIVABLE LANDS TO A POPULATION CENTER WHICH INCLUDES A SCHOOL, CLINIC, WAREHOUSE, ADMINSTRATION BLDG, HOUSING, ELECTRIC SYSTEM & POTABLE WATER. FARMERS WORK COOPERATIVELY & MARKET RICE, BEAN, SORGHUM CROP THROUGH IAN. CROP HARVESTED IN 3 PHASES, EACH PHASE ENCOMPASSING 100 MANZANAS (1.74 ACRES) WHICH IS HARVESTED 3 TIMES YEARLY, IN ORDER TO IMPROVE PRODUCTION DURING CONSTRUCTION OF IRRIGATION SYSTEMS.

**GOAL:** IMPROVE QUALITY OF LIFE OF LOWER INCOME FARMERS. 1

**PURPOSE:** INCREASE NUMBER OF HARVEST AND AMOUNT HARVESTED BY LOWER INCOME FARMERS OF THE COLONIA ANGELICA DE SCHICK. 1

**OUTPUTS:** 1. 3-STAGE IRRIGATION SYSTEM DESIGNED, INSTALLED, OPERATING & MAINTAINED. 2. IRRIGATION SYSTEM OPERATORS TRAINED. 3. SEEDS, FERTILIZERS, INSECTICIDES DISTRIBUTED TO COLONISTS BY COLONIST COOPERATIVE. 4. CROPPING PLANS FORMULATED & IMPLEMENTED BY A COLONIST COOPERATIVE. 5. ELECTRICAL SYSTEM & POTABLE WATER SYSTEM INSTALLED. 6. REVOLVING ACCOUNT ESTABLISHED INCLUDING FORMULATION OF PROCEDURES & CONTROLS FOR BOTH COLLECTIONS & DISBURSEMENTS. 7. FARMERS MOVED TO POPULATION CENTER. 1

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5240105 SUB-PROJECT: 00 \*  
 \* PROJECT TITLE: AGR PLANNING AND STATISTICAL SERVICES INITIAL FY: 73 FINAL FY: 79 \*  
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26 **PROBLEM:** NICARAGUAN AGRICULTURE LACKS ADVANTAGE OF EFFECTIVE PLANNING BECAUSE THEIR CURRENT STATISTICS ARE INACCURATE. ANALYSIS OF AGRICULTURAL SECTOR DEMONSTRATES ERRORS AND CONFLICTING FIGURES USED BY DIFFERENT AGENCIES.

**STRATEGY:** DEVELOP AND INSTITUTIONALIZE GON CAPACITY TO PLAN, ORGANIZE AND IMPLEMENT AGRICULTURAL PROGRAMS BASED ON RELIABLE STATISTICS AND METHODOLOGY.

**SUMMARY:** AN AGRICULTURAL STATISTICS UNIT FORMED IN CENTRAL BANK'S STATISTICAL AND CENSUS OFFICE USING PERSONNEL TRAINED TO PERFORM 1971 CENSUS. SAMPLE WILL BE DESIGNED EMPHASIZING BASIC GRAINS AND CATTLE INVENTORIES IN INITIAL PHASES. AS BASIC SYSTEMS BECOME FUNCTIONAL, THE PROGRAM WILL EXPAND TO OTHER COMMODITIES AND MORE REFINED ESTIMATES OF THEM. TECHNICAL ASSISTANCE TO ASSIST CONDUCTING OF SPECIAL STUDIES DURING LAST THREE YEARS OF PROJECT. AN ANALYSIS, PLANNING AND EVALUATION UNIT WILL BE FORMED TO ANALYZE AND EVALUATE STATISTICAL DATA AND TO PLAN NEW ACTIVITIES.

**GOAL:** GON PLANS, ORGANIZES AND IMPLEMENTS LONG-TERM DEVELOPMENT ACTIVITIES. 1

**PURPOSE:** GON UNITS COLLECT AGRICULTURAL STATISTICS REQUIRED FOR RURAL DEVELOPMENT PLANNING, AND ACCOMPLISHES THE NECESSARY ANALYSIS, PLANNING AND EVALUATION. 1

**OUTPUTS:** NATIONAL PROGRAM FOR DEVELOPMENT AND CONSERVATION OF INCOME DISTRIBUTION; RECOMMENDATIONS FOR REDUCTION RURAL UNEMPLOYMENT; EVALUATION GOVT POLICIES FOR RURAL INVENTORIES; ACCURATE AND TIMELY AGRICULTURAL DATA. 1

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 52-0104 SUB-PROJECT: 00 \*  
 \* PROJECT TITLE: CENTER FOR EARTHQUAKE HAZARDS REDUCTION INITIAL FY: 73 FINAL FY: 79 \*  
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NICARAGUA'S LONG HISTORY OF SEISMIC AND VOLCANIC ACTIVITY HAS BEEN SO SPORADIC THAT EARLIER CATASTROPHES HAVE NOT GENERALLY INFLUENCED LATER DECISIONS. AS A DEVELOPING NATION, NICARAGUA MUST NOW DETERMINE SEISMIC RISK FACTORS FOR PROJECT PLANNING THROUGHOUT THE NATIONAL DOMAIN SO THAT, THROUGH PROPER SITE SELECTION AND DESIGN, FUTURE HAZARD TO THE POPULACE AND LARGE ECONOMIC LOSSES CAN BE REDUCED. TO ACCOMPLISH THIS, SEISMIC MONITORING AND GEOLOGIC AND SEISMIC HAZARD ANALYSIS ARE NEEDED IN MANAGUA AND IN OTHER POPULATED AREAS.

STRATEGY: THREE-YEAR GRANT TO THE GOVERNMENT OF NICARAGUA (GON) WILL FINANCE COSTS OF TECHNICAL ASSISTANCE, PARTICIPANT TRAINING, AND COMMODITIES OF CENTER FOR EARTHQUAKE HAZARDS REDUCTION (CEHR) PROJECT. ALL TECHNICAL ASSISTANCE WILL BE PROVIDED UNDER PASA WITH US GEOLOGICAL SURVEY AND INTERAMERICAN GEODETIC SURVEY. GON WILL PROVIDE TECHNICIANS, OFFICE AND LABORATORY SPACE, COMPUTER COSTS, MAINTENANCE AND OPERATION OF VEHICLES AND OTHER COSTS.

GRANT TO THE GOVERNMENT OF NICARAGUA (GON) TO DEVELOP IN NICARAGUA AN ORGANIZATION FOR APPLIED SEISMIC AND RELATED GEOLOGICAL RESEARCH CAPABLE OF PREDICTING THE POTENTIAL FREQUENCY, LOCATION, AND DESTRUCTIVENESS OF SEISMIC EVENTS. ACTIVITIES WILL BE IMPLEMENTED, UNDER PASAS WITH AID, BY LONG AND SHORT TERM SPECIALISTS FROM THE US GEOLOGICAL SURVEY AND THE INTERAMERICAN GEODETIC SURVEY IN CONJUNCTION WITH COUNTERPART NICARAGUAN SCIENTISTS AT A CENTER FOR EARTHQUAKE HAZARDS REDUCTION (CEHR) TO BE BUILT IN NICARAGUA.

A NETWORK OF 12 SENSITIVE SEISMOGRAPHS WILL BE INSTALLED AT A MINIMUM OF 12 SITES IN THE MORE DENSELY POPULATED AND SEISMICALLY ACTIVE WESTERN PORTION OF NICARAGUA, TOGETHER WITH RADIO EQUIPMENT TO RELAY ALL DATA TO THE CENTER. SEISMOGRAPH READINGS WILL BE TAKEN AND GEOLOGICAL FAULT LINES MAPPED OUT. NEW DATA WILL BE CORRELATED WITH EXISTING DATA TO DEVELOP A SEISMIC RISK MAP OF NICARAGUA DEPICTING THE REGIONAL PATTERN OF FAULTS AND OTHER STRUCTURES. IN ORDER TO DETERMINE THE RELATIONSHIP OF REGIONS OF HIGH EARTHQUAKE ACTIVITY TO DENSELY POPULATED AREAS, DATA CORRELATION WILL ALSO PERMIT CONTINUOUS MONITORING OF NICARAGUA'S EARTHQUAKES AS A MEANS OF PROVIDING EARLY WARNING OF ERUPTION AND OTHER HAZARDS SUCH AS LANDSLIDES. IN ADDITION, EXISTING SEISMIC EQUIPMENT WILL BE AUGMENTED TO BUILD UP A NETWORK OF 10 STRONG MOTION ACCELEROGRAPHS AND 30 SEISMOSCOPES TO ANALYZE TYPES OF GROUND MOTION AND THEIR EFFECT ON LOCAL BUILDINGS. COUNTERPART NICARAGUAN SCIENTISTS AND TECHNICIANS WILL BE GIVEN ON-THE-JOB TRAINING BOTH IN NICARAGUA AND THE US. IN THE USE AND REPAIR OF MODERN SEISMIC INSTRUMENTS, THE INTERPRETATION OF INSTRUMENTAL DATA, AND ENGINEERING GEOLOGY.

NICARAGUA'S SCIENTISTS ARE EXPECTED TO MAINTAIN CONTACT WITH THE US GEOLOGICAL SURVEY AFTER THE INITIAL ASSISTANCE PHASE IS COMPLETED. IN ORDER TO KEEP AHEAD OF NEW DEVELOPMENTS IN SEISMOLOGY AND EARTHQUAKE ENGINEERING SO THAT INFORMATION COLLECTED UNDER THIS PROGRAM CAN BE DIRECTLY LINKED TO THE DESIGN OF COMMUNITIES AND STRUCTURES, THE GON HAS AGREED TO ASSUME FULL COSTS FOR CONTINUED OPERATION.

TO MINIMIZE DEATH, DAMAGE, AND DISRUPTION OF PUBLIC SERVICES CAUSED BY EARTHQUAKES AND VOLCANIC EVENTS IN NICARAGUA BY INCORPORATING THE BEST POSSIBLE SEISMIC INFORMATION IN LOCATIONAL AND DESIGN DECISIONS.

PURPOSE: TO CREATE, EQUIP, STAFF, AND TRAIN AN ORGANIZATION INCLUDING A MODERN SEISMOGRAPH NETWORK FOR APPLIED SEISMIC AND RELATED GEOLOGICAL RESEARCH IN NICARAGUA WITH THE CAPABILITY OF PREDICTING (WITHIN THE STATE OF THE ART) THE POTENTIAL FREQUENCY, LOCATION, AND DESTRUCTIVENESS OF SEISMIC AND VOLCANIC EVENTS.

1. A CENTER FOR EARTHQUAKE HAZARD REDUCTION STAFFED BY FOUR NICARAGUAN EARTH SCIENTISTS AND ENGINEERS, 2. A NETWORK OF SENSITIVE SEISMOGRAPHS AT A MINIMUM OF 12 REMOTE SITES WITH ALL DATA RELAYED BY RADIO TO THE CENTRAL LOCATION, 3. COMPILATION OF EXISTING SEISMIC DATA AND CORRELATION WITH NEW DATA GATHERED BY THE ABOVE NETWORK, 4. A CAPABILITY FOR CONTINUOUS MONITORING OF THE SEISMIC ACTIVITIES OF THE VOLCANOES TO PROVIDE EARLY WARNING OF ERUPTIONS, 5. A NETWORK OF 10 STRONG MOTION ACCELEROGRAPHS AND 30 SEISMOSCOPES IN NICARAGUA, 6. INSTALLATION OF SEISMOGRAPHS TO DETERMINE LOCAL BUILDING RESPONSES TO MODERATE EARTHQUAKES, 7. A MAP OF THE SEISMICITY OF NICARAGUA.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5246657 SUB-PROJECTS: 06 \*  
 \* PROJECT TITLE: AGRICULTURAL REFORM AND RURAL DEVEL INITIAL FY: FINAL FY: \*  
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**PROBLEM:** THE TOTAL AGRICULTURAL PRODUCTION IN NICARAGUA HAS LEVELED OFF SINCE 1949. BECAUSE THE GOVT OF NICARAGUA (GON) LACKS TECHNICAL CAPABILITY TO CONDUCT AGRICULTURAL RESEARCH, TO IMPLEMENT LAND REFORMS AND TO ESTABLISH AGRICULTURAL CREDIT, HALF OF THE TOTAL LABOR FORCE AND MORE THAN HALF OF THE RURAL FARM WORKERS ARE NOT ABLE TO PRODUCE ENOUGH FOOD, FACE LOWER EARNINGS, LACK OF RURAL JOB OPPORTUNITIES AND A LOWER STANDARD OF LIVING; ALSO THE COUNTRY FACES ECONOMIC STAGNATION.

**STRATEGY:** 2-YEAR PROJECT CONSISTS OF LOAN AND TECHNICAL ASSISTANCE (TA) TO ASSIST THE GOVT OF NICARAGUA (GON) IMPROVE ITS AGRICULTURAL PRODUCTIVITY THROUGH AGRARIAN REFORM AND A VIABLE CREDIT PROGRAM. USAID PROVIDES FUNDS FOR A DEPT OF AGRICULTURE EXTENSION ADVISOR, 4 SHORT-TERM CONSULTANTS, BACKSTOP SUPPORT BY A COUNTRY OFFICER PLUS SECY; AID FUNDS INCLUDE SALARY, PERSONAL BENEFITS, LOCAL/INTL TRAVEL, QUARTERS ALLOWANCE FOR ADVISOR, TRNG AIDS, IN-KIND. GOVT STAFF, OFFICE, TRNGP, PUMPKNS.

**SUMMARY:** PASA WITH DEPARTMENT OF AGRICULTURE PROVIDES TECHNICAL ASSISTANCE (TA) TO THE GOVERNMENT OF NICARAGUA (GON) TO IMPROVE ITS AGRICULTURAL PRODUCTIVITY THROUGH AGRARIAN REFORM AND THE DEVELOPMENT OF A VIABLE CREDIT PROGRAM. PROJECT ACTIVITIES INCLUDE EFFORTS TO ASSIST 1000 FARMERS ANNUALLY IN OBTAINING TITLES TO LAND IN THEIR POSSESSION, SETTLING 500 LANDLESS RURAL FAMILIES ON ECONOMIC-SIZED FARM UNITS ANNUALLY, MAKING LOANS AVAILABLE ANNUALLY TO 1000 FARMERS WHO PREVIOUSLY HAVE NOT HAD ACCESS TO CREDIT, CONDUCTING CONTINUOUS EVALUATION TO DETERMINE THE BEST LAND USE AND THE BEST FARM SIZE IN VARIOUS FARMING AREAS. BENEFICIARIES WILL BE RURAL FARMERS AND THEIR FAMILIES, AND, IN THE LONG RUN, THE COUNTRY WITH AN IMPROVED ECONOMY.

IMPLEMENTING AGENCY WILL BE THE NICARAGUAN AGRARIAN INSTITUTE (IAN). USAID PROVIDES FUNDS FOR SALARIES, BENEFITS, TRAVEL AND QUARTERS FOR A DEPARTMENT OF AGRICULTURE EXTENSION ADVISOR; SALARY BENEFITS AND TRAVEL FOR 4 SHORT-TERM CONSULTANTS AND FOR A BACKSTOP COUNTRY OFFICER PLUS SECRETARY; ALSO FOR TRAINING AIDS AND OVERHEAD. USAID ALSO PROVIDES A LOAN FOR SERVICES FOR A SUPERVISORY AGRICULTURAL CREDIT SPECIALIST AND FUNDS FOR TRAINING A GROUP OF AGRICULTURAL CREDIT TECHNICIANS IN COLOMBIA. GOVT WILL PROVIDE DIRECT SUPPORT TO CONSULTANT SERVICES INCLUDING A NICARAGUAN STAFF TO WORK DIRECTLY WITH THESE CONSULTANTS; FOR OFFICE AND SECRETARIAL REQUIREMENTS, TRANSPORTATION, AND PUBLICATION SERVICES AS THE NATURE OF THE WORK REQUIRES.

**GOALS:** AGRICULTURAL PRODUCTION IN NICARAGUA INCREASED.

**PURPOSE:** AGRARIAN REFORM PROGRAM IN NICARAGUA IMPLEMENTED.

**OUTPUTS:** 1. 1000 FARMERS EACH YEAR OBTAINED TITLES TO THE LAND IN THEIR POSSESSION. 2. 500 LANDLESS RURAL FAMILIES SETTLED EACH YEAR ON ECONOMIC-SIZED FARM UNITS. 3. LOANS MADE ANNUALLY TO 1000 FARMERS WHO PREVIOUSLY HAD NO ACCESS TO CREDIT. 4. BEST LAND USE DETERMINED AND OPTIMUM SIZE OF FARMS RECOMMENDED.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5240057 SUB-PROJECTS: 02 \*  
 \* PROJECT TITLE: AGR REFORM/RURAL DEV-INSTIT DEVEL INITIAL FY: FINAL FY: \*  
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**PROBLEM:** SINCE 1964, COTTON PRODUCTION IN NICARAGUA DECLINED. ALTHOUGH FOOD GRAINS AND LIVESTOCK EXPORTS INCREASED, THESE INCREASES WERE INSUFFICIENT TO OFFSET THE LOSS OF EXPORT EARNINGS FROM TRADITIONAL EXPORT CROPS SUCH AS COTTON. BECAUSE THE GOVT OF NICARAGUA (GON) LACKS TECHNICALLY COMPETENT AGR PERSONNEL WITH LEADERSHIP CAPABILITY AND USES OUTDATED AGR EXTENSION SERVICES AND TRAINING PROGRAMS, THE RURAL, AGR SECTOR SUFFERS FROM INEFFICIENT AGR AND MARKETING PRACTICES RESULTING IN LOW AGR PRODUCTION, INSUFFICIENT EMPLOY OPPOR, LOW STAND/LIVING

**STRATEGY:** 4-YEAR PROJECT CONSISTS OF A GRANT (THROUGH A PASA) PROVIDING TECHNICAL ASSISTANCE, PARTICIPANT TRAINING, COMMODITIES, SALARIES, BENEFITS, TRAVEL AND QUARTERS FOR AGR ADVISORS; ALSO SHORT-TERM CONSULTANTS, IN-COUNTRY OFFICER, SECRETARY, TRAINING AIDS AND OVERHEAD. MOST COUNTRY PROVIDES IN-KIND CONTRIBUTIONS. OTHER DONORS: CAKE AND CARITAS.

Land use, cont.

**SUMMARY:** GRANT AND TECHNICAL ASSISTANCE THROUGH A FASA WITH THE DEPARTMENT OF AGRICULTURE ARE PROVIDED TO THE GOVERNMENT OF NICARAGUA (GON) TO IMPROVE ITS AGRICULTURAL PRODUCTIVITY THROUGH AGRARIAN REFORM AND RURAL DEVELOPMENT. ONE OF SEVERAL EFFORTS TO ACHIEVE THESE GOALS, THIS PROJECT FOCUSES ON IMPROVING THE INSTITUTIONAL CAPABILITY OF AGRICULTURAL AGENCIES WITHIN THE GON, AND THE MINISTRY OF AGRICULTURE IN PARTICULAR. THE PROJECT ALSO SEEMS TO UPGRADE AGRICULTURAL EXTENSION PROGRAMS AND PROVIDE SPECIALIZED TRAINING IN MODERN AGRICULTURAL TECHNIQUES FOR QUALIFIED NICARAGUAN PARTICIPANTS. TO ACHIEVE THESE TARGETS, THE PROJECT WILL: PROVIDE AN AGR EXTENSION ADVISOR TO WORK WITH THE DIRECTOR OF EXTENSION AND HIS STAFF TO IMPROVE PROGRAM PLANNING AND IMPLEMENTATION; TRAIN 50 EXTENSION PERSONNEL OF THE CENTRAL OFFICE AND FROM 22 FIELD OFFICES IN THE USE OF COMMUNICATIONS MEDIA FOR INFORMAL EDUCATION; DEMONSTRATE WAYS TO INCREASE THE PRODUCTION OF BASIC FOODCROPS. ABOUT 4000 DEMONSTRATIONS WILL BE CARRIED OUT ANNUALLY. THEY WILL DEMONSTRATE IMPROVED SEEDS, FERTILIZERS, INSECTICIDES, AND NEW CULTIVATING PRACTICES. UNDER THE EXTENSION PROGRAM, TECHNICIANS WILL PROVIDE ASSISTANCE IN AREAS SUCH AS ENTOMOLOGY, POTATO AND SWINE PRODUCTION. TECHNICIANS WILL ALSO HELP UPGRADE LEADERSHIP AND PLANNING CAPABILITY IN THE GON AGRICULTURAL DEPARTMENTS. OUT-OF-COUNTRY TRNG IN MANY SPECIALIZED AREAS OF AGR WILL INVOLVE THE EQUIVALENT OF 8 TO 10 MAN YEARS IN US OR THIRD WORLD COUNTRIES. BY 1973, BENEFICIARIES WILL BE 250000 OF 1 MILLION RURAL PEOPLE. PROJECT RESULTED IN CONSIDERABLE PROGRESS IN EXT PRGAMS TO PROMOTE THE USE OF IMPROVED SEEDS AND AGR CHEMICALS; IN HOME GARDENS AND IN CROP DIVERSIFICATION. HOWEVER, INADEQUATE BUDGETING AND THE LOW PRIORITY GIVEN THE PROJECT BY GON RESTRICTED FURTHER PROGRESS. PROJECT WAS TERMINATED ON 8/71. USAID FUNDS SALARIES, TRANSPORTATION, TRAVEL, SUPPLIES FOR SUPPORT OF EXTENSION ADVISORS/SPECIALISTS/CONSULTANTS. GON PROVIDES IN-KIND CONTRIBUTIONS. OTHER DONORS: CARE, CARITAS.

**GOALS:** AGRICULTURAL PRODUCTION IN NICARAGUA PROMOTED. **PURPOSE:** NICARAGUAN AGRICULTURAL AGENCIES' PERSONNEL AND PROGRAMMING UPGRADED.

**OUTPUTS:** 1. GON PROFESSIONAL AGR PERSONNEL TECHNICALLY TRAINED THROUGH IN-SERVICE OR OUT-OF-COUNTRY COURSES. 2. EXTENSION PROGRAMS IMPROVED THROUGH ON-FARM DEMONSTRATIONS OF SEEDS, FERTILIZERS, INSECTICIDES, FUNGICIDES; SWINE, HAREBITS, POTATO CULTIVATION, BEE-KEEPING; ALSO EXTENSION PROGRAMS IMPROVED THROUGH INCREASED 4-S CLUB ACTIVITY, SOIL GARDENS. 3. VOLUNTEERS TRAINED TO ASSIST WITH EXTENSION PROGRAMS. 4. DEMONSTRATIONS OF SOIL TESTING, CROP DIVERSIFICATION, IRRIGATION.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 52-0037 SUB-PROJECT: 04 \*  
 \* PROJECT TITLE: AGR REFORM/RURAL DEVEL-IRRIG/SOIL/WATER INITIAL FY: FINAL FY: \*  
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**PROBLEMS:** MUCH OF NICARAGUA'S AGRICULTURAL AREA RECEIVES RAINFALL ONLY PART OF THE YEAR AND THE PACIFIC ZONE RECEIVES NO RAIN DURING AN ANNUAL 6-MONTH PERIOD. BECAUSE THERE HAS NEVER BEEN A COMPREHENSIVE PROJECT TO COMPILE INFORMATION ON DEVELOPING A VIABLE IRRIGATION PROGRAM, NICARAGUAN FARMERS AND AGRICULTURISTS LACK THE KNOWLEDGE AND RESOURCES WHICH COULD HELP THEM INCREASE FOOD PRODUCTION IN ARID LANDS.

**STRATEGY:** 2-YEAR PROJECT CONSISTS OF PILOT PROJECTS AND INFORMATION GATHERING ON VIABLE, ECONOMIC METHODS FOR EXTENDING IRRIGATION IN ARID AND SEMI-ARID AREAS OF NICARAGUA. USAID GRANT PROVIDES TECHNICAL ASSISTANCE FOR AGR SPECIALISTS AND SUPERVISORY PERSONNEL; ALSO WELL & IRRIGATION EQUIPMENT, VEHICLES AND TECH EQUIPMENT, OPERATING COSTS & OTHER EXPENSES. MOST COUNTRY PROVIDES FUNDS FOR OFFICE SUPPLIES, SALARIES, OFFICE SPACE, SOME ASSISTANCE. 5 FARMERS CONTRIB WELL & PRODUCT COSTS.

Land use, cont.

SUMMARY:

GRANT AND TECHNICAL ASSISTANCE PROVIDED TO THE GOVERNMENT OF NICARAGUA (GON) HELP SET UP AN IRRIGATION PILOT PROJECT IN ORDER TO OBTAIN AND DISSEMINATE INFORMATION AND DATA VITAL TO THE DEVELOPMENT OF IRRIGATION IN NICARAGUA. SUCCESSFUL IRRIGATION IN TURN WILL ASSIST FARMERS TO ACHIEVE GREATER AGRICULTURAL PRODUCTIVITY. PROJECT ACTIVITIES INCLUDE: ESTABLISHING AN IRRIGATION DEPARTMENT WITHIN THE MINISTRY OF AGRICULTURE (MAG) TO COORDINATE THE PROJECT'S VARIOUS ASPECTS; SELECTING 5-8 FARMS TO SERVE AS DEMONSTRATION PROJECTS; MAKING ARRANGEMENTS WITH THE FARMS FOR WELL-DRILLING OR OTHER WATER SOURCES; FINANCING IRRIGATION EQUIPMENT; SETTING UP METHODS FOR ACCOUNTING AND RECORD-KEEPING BY THOSE INVOLVED IN THE DEMONSTRATIONS; SELECTING A CONTRACTOR AND REVIEWING REPORTS MADE PREVIOUSLY ON IRRIGATION; DEVELOPING STANDARDS AND PROCEDURES ON LAND SELECTION, WELLS, WATER APPLICATION, CROP CULTIVATION AND SOIL TYPES; DEVELOPING DATA ON FEASIBILITY OF INTRODUCING NEW CROPS AS RELATED TO THE COSTS, RETURNS, PLANTING SCHEDULES; COMPLETING STUDIES AND RESOURCE INVENTORIES AS GUIDES FOR FUTURE IRRIGATION DEVELOPMENT. SATISFACTORY PERFORMANCE DATA FROM 3-5 OF THE DEMONSTRATION FARMS COULD LEAD TO IRRIGATING A SIZEABLE AREA OF THE PACIFIC ZONE.

ALL THE INVOLVED GOV AGENCIES WILL EXCHANGE PERTINENT INFORMATION. SUCH AGENCIES INCLUDE: INSTITUTO DE FOMENTO NACIONAL (INFONAC) WHICH IN 1954 STARTED ON SOME IRRIGATION STUDIES; THE NATIONAL BANK, AGRARIAN INSTITUTE, NATIONAL RESOURCES INVENTORY PROJECT AND THE AGRICULTURAL COORDINATING COMMITTEE. MAG WILL COORDINATE THE FINDINGS OF THE IRRIGATION DIVISION WITH INFORMATION FROM THE AGRICULTURAL EXTENSION SERVICE, SECTION OF AGRICULTURAL ECONOMICS, AGRICULTURAL RESEARCH SERVICE, SCHOOL OF AGRICULTURE AND THE SECTION WORKING WITH INSECT AND PLANT DISEASES.

PRIMARY BENEFICIARIES OF THIS PROJECT WILL BE THE NICARAGUAN FARMERS. USAID WILL PROVIDE FULL-TIME TECHNICIANS, PART-TIME CONSULTANTS; ARRANGE FOR WELL AND IRRIGATION EQUIPMENT, VEHICLES AND TECHNICAL EQUIPMENT, OPERATING COSTS AND OTHER COSTS. MOST COUNTRY PROVIDES NIC SALARIES, OFFICE SUPPLIES, 2 DRIVERS, SECY, CLERK, FIELDMAN, SPACE.

GOAL: AGRICULTURAL PRODUCTIVITY IN NICARAGUA PROMOTED. PURPOSE: IRRIGATION DEVELOPMENT PROGRAM ESTABLISHED.

OUTPUTS: 1. 5-8 FARMS SELECTED FOR PILOT PROJECTS PROVIDE INFO ON WATER RESOURCES AS WELL AS THE FINANCING & RECORD-KEEPING INVOLVED. 2. IRRIGATION DEPT SET UP WITHIN MOA TO COORDINATE THE PROJECT'S VARIOUS ACTIVITIES. 3. CONTRACTORS SELECTED TO CONDUCT EXPERIMENTS. 4. RESULTS OF SURVEY ON SOIL, TERRAIN AND OTHER INFO COMPILED. 5. INDIGENOUS TRAINING OF IRRIGATION TECHNICIANS COMPLETED. 6. STANDARDS & PROCEDURES DEVELOPED ON SELECTION OF AREAS, PREPARATION OF LAND, ESTABLISHING WELLS OR OTHER WATER SOURCES, WATER APPLICATION & CROP CULTIVATION. 7. DATA DEVELOPED ON FEASIBILITY OF NEW CROPS AS RELATED TO IRRIGATION. 8. STUDIES COMPLETED WHICH CONTAIN DETAILS THAT CAN BE APPLIED TO FUTURE IRRIGATION DEVELOPMENT.

2.0 Health

	PROJECT DESIGN INFORMATION	
• COUNTRY/BUREAU: NICARAGUA		PROJECT: 52-0080 SUB-PROJECT: 06
• PROJECT TITLE: HEALTH CENTERS RURAL MOBILE		INITIAL FYE 68 FINAL FYE 75
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PROBLEM: HEALTH SERVICES AT BEGINNING OF PROJECT REACH ONLY 50% OF TOTAL POPULATION AND MUCH SMALLER PERCENTAGE OF RURAL POPULATION EVEN THOUGH GOVERNMENT OF NICARAGUA ALREADY OPERATES A DECENTRALIZED GENERAL HEALTH SERVICE WITH HEALTH CENTERS, HEALTH POSTS AND RURAL MOBILE HEALTH UNITS (PUMAR). OUTREACH TO MOST RURAL AREAS INADEQUATE DUE TO DENSITY RURAL POP, LONG DISTANCE FROM URBAN CNTRS & HIGH COST PERMANENT RURAL HLTH FACILS. GON MUST IMPROVE OUTREACH PROG TO PROVIDE GOOD QUALITY HLTH SVCS AT ACCEPTABLE COST TO MORE PEOPLE--ESPLC RURAL POP. STRATEGY: LONG-TERM, PUBLIC SECTOR APPROACH UTILIZES EXISTING INSTITUTIONS.

SUMMARY: PROJECT TO BRING HLTH-MED'L SVCS TO LARGER PERCENTAGE OF POPULATION, ESPECIALLY IN RURAL AREA. ALSO WILL ACHIEVE BETTER COORDINATION AND INTEGRATION OF HEALTH ACTIVITIES CARRIED OUT BY VARIOUS NATIONAL HEALTH AGENCIES. HEALTH CENTER AND PUMAR WILL BE BASIC IMPLEMENTING UNITS OF BROAD RANGE OF DECENTRALIZED HLTH SRVCS TO INCLUDE: ENVIRONMENTAL SANITATION, MOTHER-CHILD HEALTH, IMMUNIZATION, CONTROL OF COMMUNICABLE DISEASES, FAMILY PLANNING, NUTRITION, HEALTH EDUCATION, AND OUTPATIENT CLINICAL SERVICES. WILL EXPAND BASIC HEALTH FACILITIES TO AREAS OF 1,500,000 BY END OF 3-YR PROJECT, OR 80% OF 1971 POPULATION. IN 3 YRS COUNTRY'S HEALTH SERVICES WILL ACHIEVE COVERAGE THAT WOULD OTHERWISE TAKE 8 YRS TO ACHIEVE.

GOAL: IMPROVE HEALTH STATUS OF NICARAGUA. 1 PURPOSE: NICARAGUAN POPULATION, ESPECIALLY IN RURAL AREAS, HAS ACCESS TO PREVENTIVE AND CURATIVE HEALTH SERVICES. 1

OUTPUTS: 1. HEALTH CENTERS CONSTRUCTED, STAFFED, AND EQUIPPED AND EXISTING CENTERS IMPROVED. 2. RURAL MOBILE HEALTH PROGRAM CONTINUED AND STRENGTHENED THROUGH PROVISION OF NEW VEHICLES, EQUIPMENT AND MEDICINES. 3. NEWLY GRADUATED PHYSICIANS AND OTHER UNIVERSITY-TRAINED MEDICAL PERSONNEL INCORPORATED INTO PROJECT UNDER OBLIGATORY SOCIAL SERVICE LAW. 1

Health, cont.

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\* PROJECT DESIGN INFORMATION \*  
\* COUNTRY/BUREAU: NICARAGUA \* PROJECT: 52-0102 SUB-PROJECT: 00 \*  
\* PROJECT TITLE: HEALTH SECTOR ASSESSMENT \* INITIAL FY: 75 FINAL FY: 76 \*  
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**PROBLEM:** LACK OF INFORMATION CONCERNING HEALTH PROBLEMS, RESOURCES, AND TARGET POPULATIONS; LACK OF PLANNING CAPABILITY; ADMINISTRATIVE PROBLEMS; LACK OF PROGRAM DIRECTION AND EVALUATION; AND RURAL-URBAN DIFFERENCES IN EXPECTATIONS AND DEMAND FOR HEALTH SERVICES. SEPARATION OF CURATIVE AND PREVENTIVE SERVICES. LACK OF COORDINATION AND INTEGRATION OF HEALTH SERVICES BY DIFFERENT GOVERNMENT OR NICARAGUA AGENCIES. RELIANCE ON EXTERNAL RESOURCES FOR NEW INITIATIVES IN HEALTH SECTOR. LACK OF MANPOWER TRAINED IN HEALTH PLANNING AND ADMINISTRATION.

**STRATEGY:** LONG TERM APPROACH UTILIZES TECHNICAL ASSISTANCE TO EXISTING INSTITUTIONS.

**SUMMARY:** HLTH SECTOR ASSESSMENT LIMITED BY LACK OF QUALIFIED NICARAGUAN HEALTH PERSONNEL; SATISFIES ONLY MINIMAL REQUIREMENTS. WEAKNESS OF ASSESSMENT TO PROVIDE AID WITH SOUND BASIS FOR PROGRAM DEVELOPMENT OR GIVE WITH PLANNING INFORMATION CAN BE ALLEVIATED BY: 1. INTEGRATING LIMITED ASSESSMENT INTO NICARAGUAN INSTITUTIONS; 2. CONSIDERING INITIAL ASSESSMENT AS PRELIMINARY TO BE UPGRADED AT INTERVALS; 3. PLACING PRIORITY IN AID SUPPORT ON HLTH PLANNING, ASSESSMENT TO FOCUS ON: 1. ADMINISTRATION; 2. USE OF FACILITIES; 3. HLTH MANPOWER; 4. DELEGATION OF RESPONSIBILITY TO DELIVER HLTH SERVICES; 5. RESOURCE IMPLICATIONS OF ALTERNATIVE HLTH DELIVERY SYSTEMS; 6. NUTRITION; 7. MALARIA; 8. RURAL WATER SUPPLY; 9. OCCUPATIONAL HLTH; 10. FAMILY PLANNING.

**GOAL:** IMPROVE HEALTH OF NICARAGUANS, ESPECIALLY THOSE LIVING IN MOST RURAL AND POOREST PORTIONS OF COUNTRY.

**PURPOSE:** IMPROVE HEALTH SERVICES, PARTICULARLY FOR RURAL POPULATION IN NICARAGUA.

**OUTPUTS:** 1. HEALTH SECTOR ASSESSMENT COMPLETED. 2. HEALTH SECTOR ANALYSIS GROUP ESTABLISHED. 3. CONTENT AND COSTS, INCLUDING EXTERNAL FINANCING, DETERMINED FOR PROGRAM. 4. ADEQUATE AND INTEGRATION/COORDINATION OF EXISTING CURATIVE AND PREVENTIVE SERVICES.

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\* PROJECT DESIGN INFORMATION \*  
\* COUNTRY/BUREAU: NICARAGUA \* PROJECT: 52-0072 SUB-PROJECT: 00 \*  
\* PROJECT TITLE: FAMILY PLANNING \* INITIAL FY: 68 FINAL FY: 76 \*  
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**PROBLEM:** WHILE DEATH RATES HAVE DROPPED THE PAST TWO DECADES IN NICARAGUA DUE TO INCREASED MEDICAL AND PUBLIC HEALTH SERVICES, THERE HAS BEEN NO CORRESPONDING DECLINE IN THE BIRTH RATE. WITH A 3.5% GROWTH RATE, NICARAGUA'S POPULATION WILL MORE THAN DOUBLE WITHIN 25 YEARS, CREATING SHORTAGES OF FOOD, SCHOOLS, HOUSING, HEALTH, AND OTHER ESSENTIAL SERVICES.

**STRATEGY:** SIX-YEAR PROJECT PROVIDES GRANT FOR A TECHNICAL ADVISOR, CONSULTANTS, EQUIPMENT, PHARMACEUTICALS, EDUCATIONAL MATERIALS, VEHICLES, PART OF LOCAL COSTS, AND IN-COUNTRY AND PARTICIPANT TRAINING TO ESTABLISH A FAMILY PLANNING SYSTEM. MUST GOVERNMENT WILL PROVIDE LOCALLY PURCHASED SUPPLIES AND PHARMACEUTICALS, PERSONNEL, OFFICE AND CLINIC SPACE, UTILITIES, AND OTHER OPERATIONAL COSTS. OTHER DONORS INCLUDE: INTL PLANNED PARENTHOOD FEDERATION; PATH-INUR, & THE POPULATION COUNCIL.

continued

Health, cont.

SUMMARY:

GRANT TO THE GOVERNMENT OF NICARAGUA TO ESTABLISH A NATIONAL FAMILY PLANNING SYSTEM. FAMILY PLANNING SERVICES WILL BE ESTABLISHED AT 75 EXISTING HEALTH FACILITIES OPERATED BY THE MINISTRY OF HEALTH (MOM - 60 CLINICS), THE NATIONAL SOCIAL SECURITY INSTITUTE (INSS - 10 CLINICS), AND PRIVATE FACILITIES (5 CLINICS). AT THE 60 MOM FACILITIES, FAMILY PLANNING SERVICES WILL BE OFFERED IN THE AFTERNOONS AFTER REGULAR HEALTH CENTER HOURS. CLINICAL SERVICES WILL CONSIST OF A PHYSICAL EXAMINATION, A PAPANICOLAUS SMEAR, AND SELECTION OF A CONTRACEPTIVE. CLASSES ON RESPONSIBLE PARENTHOOD AND FAMILY PLANNING WILL ALSO BE OFFERED AT THE CLINICS. A CENTRAL FAMILY PLANNING ORIENTATION & TRAINING CENTER WILL BE ESTABLISHED IN MANAGUA TO PROVIDE INFORMATION & TRAINING TO PROFESSIONAL & LAY GROUPS. THE NICARAGUA DEMOGRAPHIC ASSOCIATION (ADN) WILL OFFER FAMILY PLANNING EDUCATIONAL/MOTIVATIONAL COURSES FOR SUCH GROUPS AS LABOR LEADERS, NATIONAL GUARD, TEACHERS, AND FACTORY WORKERS. ADN WILL ALSO PROVIDE SHORT, IN-SERVICE TRAINING COURSES FOR DOCTORS, NURSES, AUXILIARY NURSES, SOCIAL WORKERS, AND HEALTH EDUCATORS. SOME TRAINING WILL BE CONDUCTED IN OTHER LATIN AMERICAN COUNTRIES. USAID WILL FUND A TECHNICAL ADVISOR TO MOM AND INSS, CONSULTANTS, PERSONNEL COSTS, EQUIPMENT, PHARMACEUTICALS, AND EDUCATIONAL MATERIALS. MOM AND INSS WILL FUND LOCALLY PURCHASED SUPPLIES, PERSONNEL, CLINIC SPACE, AND OTHER OPERATIONAL COSTS. SUPPLIES FOR CONTRACEPTIVES, EDUCATIONAL MATERIALS, TRAINING, AND OTHER COSTS WILL BE PROVIDED BY THE POPULATION COUNCIL, PATHFINDER FUND (INCLUDING RADIO CAMPAIGN SUPPORT), INTERNATIONAL PLANNED PARENTHOOD FEDERATION, GOVERNMENTS OF SWEDEN AND GREAT BRITAIN, LATIN AMERICAN DEMOGRAPHY CENTER, AND PAN-AMERICAN HEALTH ORGANIZATION.

GOAL: CRUDE BIRTH RATE IN NICARAGUA REDUCED FROM 45/1000 (AVERAGE 1965 - 1969) TO 40/1000 BY 1977.

PURPOSE: ASSIST IN THE DEVELOPMENT OF A GOOD INSTITUTIONAL CAPACITY TO BOTH MOTIVATE PEOPLE TO MAKE AND ACTIVELY DELIVER FAMILY PLANNING SERVICES.

OUTPUTS: 1) DELIVERY OF FAMILY PLANNING SERVICES THROUGHOUT COUNTRY (72 FP CLINICS FUNCTIONING BY 6-30-71). 2) COMPREHENSIVE INDIVIDUAL AND GROUP MOTIVATIONAL ACTIVITY IMPLEMENTED. 3) MASS COMMUNICATION CAMPAIGN IMPLEMENTED. 4) EFFICIENCY/EFFECTIVENESS OF PROGRAM ADMINISTRATION AND CONTROL IMPROVED. 5) PROGRAM PERSONNEL TRAINED (ONE-WEEK ORIENTATION COURSE ON FAMILY PLANNING, IN-COUNTRY REFRESHER COURSES ONCE EVERY 18 MONTHS, PUBLICATION OF A PROCEDURAL MANUAL). 6) RECORD-KEEPING SYSTEM INSTALLED TO PROVIDE STATISTICS FOR PLANNING, IMPLEMENTATION, AND EVALUATION. 7) RESEARCH COMPLETED ON TOPICS RELATED TO POPULATION/FAMILY PLANNING.

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PROJECT DESIGN INFORMATION  
\* COUNTRY/BUREAU NICARAGUA PROJECT: 52-0110 SUB-PROJECT: 00 \*  
\* PROJECT TITLE: NICARAGUA-RURAL COMMUNITY HEALTH SERVICE INITIAL FY: 76 FINAL FY: 79 \*  
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PROBLEM: NICARAGUA LACKS CAPABILITY TO PLAN AND TEST AN INTEGRATED RURAL HEALTH DELIVERY SYSTEM. IF NICARAGUA DOES NOT DEVELOP THE INITIAL STAGES OF AN INTEGRATED SYSTEM, ITS PREVIOUS PROGRESS IN SELECTED BUT SEPARATE HEALTH AREAS WILL NOT ACHIEVE MAXIMUM POTENTIAL BENEFIT. BASIC ADMINISTRATIVE PROBLEMS IN MINISTRY OF HEALTH ORGANIZATION INCLUDE FAILURE TO INSURE COORDINATED SUPERVISION AND QUICK RESOLUTION OF IDENTIFIED PROBLEMS.

STRATEGY: A LONG-TERM PUBLIC SECTOR APPROACH TO IMPROVING AN EXISTING INSTITUTION.

SUMMARY: LARGE-RANGED PROJECT DEVELOPS INTEGRATED HEALTH SERVICE INFRASTRUCTURE AT COMMUNITY LEVELS BY TRAINING HEALTH EDUCATORS AND PROMOTERS TO DELIVER BASIC PREVENTIVE/CURATIVE SERVICE AS WELL AS TO FORM COMMUNITY HEALTH COMMITTEES; UTILIZING COMMUNITY COMMITTEES TO SOLVE HEALTH & RESOURCE PROBLEMS WITH SMALL PROJECTS IN POTABLE WATER, WATER SUPPLY AND WASTE DISPOSAL; USING PREVENTIVE HEALTH EDUCATION RADIO MESSAGES TO REACH MAXIMUM POPULATION; AND IMPROVING COORDINATION OF MOM AGENCIES SUPPORT FOR RURAL HEALTH PROGRAMS. CURRICULUM FOR HEALTH EDUCATORS/PROMOTORS DEVELOPED BY CEPAD OF CHURCH WORLD SERVICES. COMMUNITY HEALTH COMMITTEES COMPOSED OF VILLAGERS CHOSEN BY LOCAL OFFICIALS FROM HEALTH/EDUCATION/RELIGION AREAS.

GOAL: IMPROVE HEALTH STATUS OF RURAL AND SUBURBAN POPULATION.

PURPOSE: INSTITUTE AN INTEGRATED RURAL HEALTH DELIVERY SYSTEM.

OUTPUTS: 1. HEALTH EDUCATORS TRND IN RURAL HEALTH. 2. HEALTH PROMOTORS TRND IN HEALTH ORGNZTN, PREVENTIVE CARE. 3. COMMUNITY HEALTH PROBLEMS, RESOURCES ASSESSED USING ANALYTIC METHODS. 4. COMMUNITIES PARTICIPATING IN HEALTH EDUC PROGRAMS STRESSING ORGANIZATN/TRNG. 5. COMMUNITY ACTION PROGRAMS FUNCTIONING IN ENVIRONMENTAL SANITATION, NUTH, MCH. 6. INTLR, INTRA-AGENCY ADMIN/COORD IN MOM IMPROVED. 7. EVAL METHODOLOGY TESTS 8. HEALTH EDUC TECHNIQUES. 9. PILOT PROJECT PROVIDES BASIS FOR REPLICATION.

Health, cont.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA \*  
 \* PROJECT TITLE: RURAL HEALTH INSTITUTIONAL DEVELOPMENT \* PROJECT: 524011 \* SUB-PROJECT: G1 \*  
 \* INITIAL FY: 76 \* FINAL FY: 80 \*  
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**PROBLEM:** EXTENDED AND IMPROVED RURAL HEALTH COVERAGE IS NECESSARY TO ELIMINATE PROBLEMS OF HIGH MORTALITY AND MORBIDITY AMONG RURAL POOR. **STRATEGY:** CAPITAL INTENSIVE, PUBLIC SECTOR, MULTI-SECTORAL, CENTRALIZED APPROACH.

**SUMMARY:** HEALTH SECTOR PROGRAM DESIGNED TO EXTEND, IMPROVE AND INTEGRATE RURAL HEALTH COVERAGE IN SELECTED AREAS. MAIN PROGRAM COMPONENTS- ONE GRANT AND THREE LOANS: 1. GRANT COMPONENT DESIGNED TO STRENGTHEN INSTITUTIONAL CAPABILITIES OF THE MIN AND NATIONAL BOARD FOR SOCIAL ASSISTANCE AND WELFARE (JNAPS) IN PLANNING MANAGEMENT, EVALUATION, AND TECHNICAL SKILLS; 2. LOAN COMPONENTS ARE DESIGNED TO INITIATE AND SUPPORT COMMUNITY HEALTH ACTIVITIES THAT REDUCE/PREVENT BASIC HEALTH PROBLEMS, IMPROVE AND EXPAND HUMAN RESOURCE CAPACITY OF HEALTH SECTOR AND UPGRADE AND EXPAND RURAL HEALTH REFERRAL SYSTEM BASED ON RURAL OPERATIONAL AND COORDINATED REFERRAL PATTERNS. ACCELERATES DEVELOPMENT ALONG MANAGERIAL & PROGRAMMATIC LINES.

**GOAL:** IMPROVE THE HEALTH STATUS AND WELL BEING OF NICARAGUA'S RURAL POOR. **PURPOSE:** EXTEND, IMPROVE AND INTEGRATE RURAL HEALTH COVERAGE IN TARGET AREAS OF NICARAGUA. 1

**OUTPUTS:** 1. HUMAN RESOURCE CAPABILITY FOR RURAL PUBLIC HEALTH SERVICES IMPROVED; 2. REFERRAL SYSTEM UPGRADED; 3. MANAGEMENT SYSTEMS UPGRADED AT NATIONAL LEVEL.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA \*  
 \* PROJECT TITLE: RURAL HEALTH INSTITUTIONAL DEVELOPMENT \* PROJECT: 524011 \* SUB-PROJECT: G2 \*  
 \* INITIAL FY: 76 \* FINAL FY: 80 \*  
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**PROBLEM:** UNDERDEVELOPED INSTITUTIONAL CAPABILITIES LIMIT DEVELOPMENT OF THE INFRASTRUCTURE VITAL TO THE EFFECTIVE OPERATION AND EXPANSION OF THE RURAL HEALTH SYSTEM. **STRATEGY:** CAPITAL INTENSIVE, LONG TERM, MULTI-SECTORAL, CENTRALIZED APPROACH.

**SUMMARY:** GRANT COMPONENT OF HEALTH SECTOR PROGRAM. ORIENTED TOWARD IMPROVING MANAGEMENT AND TECHNICAL CAPABILITIES OF HEALTH SECTOR PERSONNEL, PLANNING SKILLS & METHODOLOGIES, & DEVELOPING A MODEL INFORMATION SYSTEM AS PREREQUISITE FOR IMPROVING AND EXPANDING RURAL HEALTH COVERAGE. OUTPUTS INCLUDE: 1. DESIGN AND IMPLEMENTATION OF CONTINUING EDUCATION PROGRAMS FOR HEALTH PROFESSIONALS; 2. DESIGN AND IMPLEMENTATION OF FRAMEWORK MAXIMIZING HEALTH MANPOWER SKILLS; 3. TECHNICAL TRNG IN EMERGENCY AND MATERNAL/CHILD HEALTH ADDRESSES BROAD RANGE OF NEEDS WITH ACTIVITIES DESIGNED TO INTEGRATE WITH RURAL HEALTH SERVICES FROM BUT AT SAME TIME DEVELOP SKILLS AND INFORMATION THAT ARE BY THEMSELVES ASSETS TO HEALTH SECTOR GROWTH AND MANAGEMENT.

**GOAL:** EXTEND, IMPROVE AND INTEGRATE RURAL HEALTH COVERAGE. **PURPOSE:** STRENGTHEN INSTITUTIONAL CAPABILITIES OF MIN AND THE NATIONAL BOARD FOR SOCIAL ASSISTANCE AND WELFARE (JNAPS).

**OUTPUTS:** 1. CONTINUING EDUCATION PROGRAMS FOR HEALTH PROFESSIONALS DESIGNED AND IMPLEMENTED; 2. FRAMEWORK FOR MAXIMIZING HEALTH MANPOWER SKILLS DEVELOPED AND IMPLEMENTED; 3. METHODOLOGY FOR TRANSFERRING HEALTH SECTOR HUMAN RESOURCE NEEDS INTO CURRICULUM DESIGNS FOR HEALTH SECTOR TRNG INSTITUTIONS DESIGNED AND IMPLEMENTED; 4. HEALTH INFORMATION SYSTEM DEVELOPED; 5. MID-LEVEL MANAGERS AND ADMINISTRATORS TRAINED; 6. TECHNICAL TRAINING PROVIDED IN EMERGENCY AND MATERNAL/CHILD HEALTH.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 52-0116 SUB-PROJECT: 03 \*  
 \* PROJECT TITLE: RURAL HEALTH INSTITUTIONAL DEVELOPMENT INITIAL FY: 76 FINAL FY: 80 \*  
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PROBLEM: LACK OF RURAL OUTREACH MECHANISMS PRECLUDES LARGE SCALE EXTENSION OF EFFECTIVE PREVENTIVE AND PRIMARY HEALTH CARE TO THE RURAL POPUL. STRATEGY: CAPITAL INTENSIVE, LONG TERM, MULTISECTORAL, CENTRALIZED APPROACH.

SUMMARY: LOAN COMPONENT ONE COMPRISES PENETRATION EFFORT TO HELP CONTROL MAJOR DISEASE PROBLEMS BY EXTENDING PREVENTIVE HLTH COVERAGE IN FORMS OF POTABLE WATER, LATRINES AND IMMUNIZATIONS TO 297 RURAL COMMUNITIES. BIPHASIC APPROACH: 1. INVOLVES INITIATION OF COMMUNITY BASED HEALTH SYSTEMS THRU USE OF HLTH EDUCATOR WHO SENSITIZES COMMUNITY TO HLTH PROBLEMS AND ORGANIZES COMMUNITY HLTH COMMITTEES THAT SELECT HLTH COLLABORATOR FROM WITHIN COMMUNITY; 2. INVOLVES SPECIFIC SELECTION AND IMPLEMENTATION OF HEALTH IMPROVEMENT PROJECTS (ENVIRONMENTAL SANITATION, IMMUNIZATION, ETC.). COLLABORATORS TRAINED AT NATIONAL HLTH DELIVERY SCHOOL AND WORK WITHIN-THEIR LOCAL COMMUNITY IMPLEMENTING PROJECTS AND COLLECTING BASELINE DATA.

GOAL: EXTEND, IMPROVE AND INTEGRATE RURAL HEALTH COVERAGE. PURPOSE: DEVELOP COMMUNITY CAPACITY TO INITIATE AND SUPPORT COMMUNITY HEALTH ACTIVITIES.

OUTPUTS: 1. 297 WATER SYSTEMS INSTALLED; 2. 10,000 LATRINES INSTALLED. 3. 65,000 FULL VACCINATION SERIES ADMINISTERED TO 0-4 AGE GROUP; 4. 20 HEALTH EDUCATORS TRAINED. 5. 297 HEALTH COLLABORATORS TRAINED.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 52-0114 SUB-PROJECT: 04 \*  
 \* PROJECT TITLE: RURAL HEALTH INSTITUTIONAL DEVELOPMENT INITIAL FY: 76 FINAL FY: 80 \*  
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PROBLEM: TO PROVIDE THE BASIS FOR LONG-RANGE HEALTH SECTOR IMPROVEMENT NICARAGUA'S EXTREME MANPOWER UTILIZATION PROBLEMS MUST BE RESOLVED. STRATEGY: CAPITAL INTENSIVE, LONG TERM, MULTISECTORAL, CENTRALIZED APPROACH.

SUMMARY: PROVIDES RESOURCES TO TRAIN PRIMARY SUPPORT PERSONNEL FOR RURAL HLTH SYSTEM BY INSTITUTING INTEGRATED TEAM VIEW OF RURAL HLTH & NUTRITION DELIVERY SYS THRU CONSTRUCTION AND DEVELOPMENT OF NATIONAL HEALTH DELIVERY SCHOOL (NHDS). PERSONNEL DATA REVEALS NICARAGUA RELATIVELY WELL OFF IN TERMS OF PHYSICIAN AVAILABILITY BUT LAGGING IN AVAILABILITY OF SUPPORT AND PARAPROFESSIONAL PERSONNEL. MODIFICATION OF SUPPORT PERSONNEL TRNG PROVIDES THE NECESSARY LEVEL OF HLTH SKILLS FOR THE DESIRED LEVEL OF HEALTH CENTER SERVICES, OPTIMIZES HUMAN AND FISCAL RESOURCES WHILE PROVIDING CONTINUITY OF ONGOING PROFESSIONAL EFFORTS.

GOAL: EXTEND, IMPROVE AND INTEGRATE RURAL HEALTH COVERAGE. PURPOSE: INCREASE EFFICIENCY OF HEALTH MANPOWER UTILIZATION.

OUTPUTS: 1. NATIONAL HEALTH DELIVERY SCHOOL ESTABLISHED; 2. AUXILIARY AND PARA-PROFESSIONAL HEALTH PERSONNEL TRAINED.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 52-0117 SUB-PROJECT: 00 \*  
 \* PROJECT TITLE: NICARAGUA-NUTRITION PROGRAM DEVELOPMENT GRANT INITIAL FY: 76 FINAL FY: 80 \*  
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PROBLEM: GON LACKS TECHNICAL/ADMINISTRATIVE CAPABILITY TO FORMULATE A NATIONAL FOOD AND NUTRITION POLICY AND CARRY OUT ITS DIRECTIVES. GON NEEDS ASSISTANCE IN TECHNICAL EVALUATIONS AND NUTRITION PROGRAM PLANNING. STRATEGY: THIS PROJECT IS LONG-TERM PUBLIC SECTOR CENTRALIZED APPROACH CREATING A NEW INSTITUTION IN NUTRITION.

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Health, cont.

**SUMMARY:** TO ESTABLISH POLICY, PLANNING & DECISION-MAKING BASE FOR A NATION FOOD & NUTRITION PROGRAM, AID ASSISTS DEVELOPMENT OF 3 INTERRELATED ELEMENTS: 1. NATIONAL POLICY; 2. A HIGH-RANKING NUTRITION COMMISSION WITH AUTHORITY OVER POLICY SUPPORTED BY A TECHNICAL COMMITTEE WITH ADVISORY/EVALUATION SKILLS; AND 3. PROGRAM PLAN INCLUDING PRIORITY AREAS, MANPOWER TRAINING, BUDGETING & EVALUATION. TRAINING PROVIDED TO COMMISSION/COMMITTEE IN PLANNING/MGMT/POLICY. NUTRITION SURVEILLANCE SYSTEM DESIGNED USING SURVEYS/ADP. FEASIBILITY STUDIED UP-RADIO DISSEM, NUTRITION CURRICULA, COOP NUTRITION PROMOTION, MANPOWER NEEDS IN UNIVERSITY/NURSING SCHOOL/HEALTH DELIVERY SCHOOL & INDUSTRIES, VITAMIN A FORTIFICATION OF SUGAR, IODIZATION OF SALT, BLENDED FOODS, SUPPLEMENTARY FEEDING, FOOD DISTRIBUTION, & IMMUNOLOGY.

**GOAL:** IMPROVE NUTRITIONAL STATUS OF THE POPULATION OF NICARAGUA, PARTICULARLY THAT OF LOW-INCOME FAMILIES, PREGNANT AND LACTATING MOTHERS, INFANTS AND CHILDREN UNDER THE AGE OF FIVE.

**PURPOSE:** ESTABLISH THE PRECONDITIONS NECESSARY FOR EFFECTIVE IMPLEMENTATION OF A NATIONAL FOOD AND NUTRITION PROGRAM: 1. CREATE AN INSTRUMENT THAT WILL FOCUS SUPPORT AND PROVIDE LONG TERM GUIDANCE FOR MNFP; 2. ESTABLISH A MECHANISM THAT HAS THE CAPACITY TO PROVIDE THE CONTINUOUS PLANNING, COORDINATION, AND EVALUATION OF THE MNFP; 3. DISSEMINATE THE INITIAL DETAILED PLAN FOR THE EXECUTION OF THE MNFP.

**OUTPUTS:** 1. NUTRITION PLANNERS TRAINED. 2. FEASIBILITY STUDIES, SURVEYS, EVALUATIONS AND PROJECT DESIGNS COMPLETED. 3. POLICY PROPOSAL PREPARED.

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 \* PROJECT DESIGN INFORMATION \* \* \* \* \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5240116 SUB-PROJECT: 00 \* \* \* \* \*  
 \* PROJECT TITLE: NICARAGUA-RURAL DEVELOPMENT SECTOR LOAN INITIAL FY: 75 FINAL FY: 86 \* \* \* \* \*  
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**PROBLEM:** LACK OF ADEQUATE SECTOR PLANNING AND COORDINATING MECHANISMS AMONG RURAL DEVELOPMENT AGENCIES, SHORTAGES OF FINANCIAL, MANAGERIAL AND HUMAN RESOURCES FOR RURAL DEVELOPMENT, AND MAJOR IMPLEMENTATION PROBLEMS OF PROJECTS UNDERWAY CREATES SENSE OF URGENCY ABOUT RURAL DEVELOPMENT POLICIES AND PROGRAMS.

**STRATEGY:** GOVERNMENT WILL PROVIDE FOR ADVISORY SERVICES, TRAINING, SPECIAL STUDIES AND OTHER RESOURCES TO FACILITATE THE RESTRUCTURING OF THE MINISTRY OF AGRICULTURE (MDA) SO THAT IT CAN CREATE THE MECHANISMS TO ENSURE NICARAGUA'S RURAL DEVELOPMENT.

**SUMMARY:** LOAN PROVIDES ADVISORY SERVICES, TRAINING, COMMODITY ASSISTANCE AND RURAL EXTENSION ACTIVITIES TO ASSIST IN CREATION OF INSTITUTES FOR CAMPESINO LEVEL. GOVERNMENT PROVIDES SALARIES AND OPERATING COSTS OF INSTITUTES. LOAN ALSO ASSIST INSTITUTE LEVEL ITS RURAL SERVICES AND DELIVERY SYSTEM BY PROVIDING TECHNICAL ASSISTANCE, AGRICULTURAL CREDIT, A LAND RESOURCE ADJUSTMENT PROGRAM AND DELIVERY OF INPUT SUPPLIES AND MARKETING CRUPS. THESE ACTIVITIES CREATE AN INTEGRATED AGRICULTURAL DEVELOPMENT PROGRAM THAT IS GOVERNMENT'S MAJOR INSTRUMENT FOR IMPACTING INCOMES OF SMALL FARMERS. FUNDING ALSO PROVIDED GOVERNMENT TO DEVELOP RURAL AND MARKETING TOWNS IN AN INTEGRATED REGIONAL PLAN. THIS PROGRAM PROVIDES FINANCING FOR ACCESS ROAD MAINTENANCE & CONSTRUCTION, CREDIT, TECHNICAL ASSISTANCE TO IMPROVE MARKETING SYSTEMS OTHER DEVELOPMENT PROGRAMS.

**GOAL:** IMPROVE PLANNING FOR THE AGRICULTURAL PUBLIC SECTOR.

**PURPOSE:** ASSIST GOVERNMENT DEVELOP AND OPERATE NEW INSTITUTE OF CAMPESINO DEVELOPMENT (INVIERNU).

**OUTPUTS:** 1. MDA CONVERTED INTO PLANNING, PROGRAM BUDGETING AND EVALUATION UNIT FOR AGRICULTURE PUBLIC SECTOR. 2. INSTITUTIONAL MECHANISM ESTABLISHED TO CARRY OUT MANDATE OF PLANS FOR RURAL DEVELOPMENT. 3. RURAL DEVELOPMENT SERVICES ESTABLISHED. 4. MODEL DEVELOPMENT PROJECTS IMPLEMENTED. 5. DELIVERY SYSTEM FOR RURAL DEVELOPMENT SERVICES ESTABLISHED. 6. RURAL SMALL BUSINESSES ESTABLISHED. 7. ROAD MAINTENANCE/ CONSTRUCTION PROVIDED.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: NICARAGUA PROJECT TITLE: RURAL HEALTH SERVICES	PROJECT: 5240126 SUB-PROJECT: 60 INITIAL FY: 76 FINAL FY: 80
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**PROBLEMS:**

LESS THAN 20% OF THE NICARAGUAN RURAL POPULATION HAS ACCESS TO AN ADEQUATE COMPLEMENT OF HEALTH SERVICES. THIS SITUATION IS ESPECIALLY EXTREME IN SMALLER COMMUNITIES NOT VISITED BY PLUMAR TEAMS (MOBILE HEALTH UNITS). THIS LIMITED RURAL HEALTH COVERAGE CONTRIBUTES TO LOW LIFE EXPECTANCY (51 YEARS FOR MALES), A HIGH INFANT MORTALITY RATE (140 DEATHS PER 1000 IN 0-1 AGE GROUP), AND A HIGH BIRTH RATE (49 PER 1000) AS WELL AS HIGH RATES OF MORBIDITY AND MORTALITY AMONG RURAL DWELLERS IN GENERAL.

**STRATEGY:**

5-YEAR PROJECT CONSISTS OF A GRANT, A LOAN, TECHNICAL ASSISTANCE, IN-COUNTRY TRAINING, CONSTRUCTION, AND COMMODITIES (MEDICAL EQUIPMENT, EDUCATIONAL EQUIPMENT, OFFICE SUPPLIES, AND VEHICLES) TO EXPAND AND IMPROVE RURAL HEALTH COVERAGE. MOST COUNTRY PROVIDES PART OF TECHNICAL ASSISTANCE COSTS, COUNTERPART PERSONNEL, OPERATING COSTS, LAND, AND PART OF TRAINING COSTS. LOCAL COMMUNITIES PROVIDE MAINTENANCE AND 10% OF COMMUNITY-LEVEL PROJECT COSTS. OTHER DONORS: UNDP, PAHO.

**SUMMARY:**

GRANT AND LOAN PROVIDED TO THE GOVERNMENT OF NICARAGUA TO EXPAND AND IMPROVE RURAL HEALTH AND HEALTH SERVICES. PROJECT HAS 4 MAJOR COMPONENTS:

1. INSTITUTIONAL DEVELOPMENT (GRANT FUNDED): IN-COUNTRY SEMINARS WILL IMPROVE MANAGEMENT CAPABILITIES OF 45 MID-LEVEL HEALTH ADMINISTRATORS WITHIN THE MINISTRY OF HEALTH (MOM) AND THE NATIONAL BOARD FOR SOCIAL ASSISTANCE AND WELFARE (JMAPS). TECHNICAL ADVISORS WILL ASSIST IN DEVELOPING AN INFORMATION SYSTEM AS WELL AS PLANNING AND EVALUATION METHODOLOGIES FOR THE HEALTH SECTOR. INTERNATIONAL TRAINING WILL DEVELOP A CADRE OF EMERGENCY CARE NURSES AND RADIOLOGICAL DIAGNOSTIC TECHNICIANS. GRANT WILL ALSO FUND A FEASIBILITY STUDY OF DRILLING HORIZONTAL WATER WELLS.
2. RURAL COMMUNITY ACTION (LOAN FUNDED): PLANSAN (THE NATIONAL PLAN FOR BASIC RURAL HEALTH AND SANITATION), THE RURAL EXTENSION ARM OF THE MOM, WILL IMPLEMENT THIS COMPONENT. HEALTH EDUCATORS, PAID AND SUPERVISED BY PLANSAN, WILL ORGANIZE COMMUNITY HEALTH COMMITTEES (CHC) IN 297 TARGET COMMUNITIES. A COLLABORATOR FROM EACH CHC WILL RECEIVE BASIC INSTRUCTION IN PUBLIC HEALTH, COMMUNITY ORGANIZATION, AND FIRST AID. THE CHC WILL THEN CARRY OUT HEALTH IMPROVEMENT AND SANITARY EDUCATION PROJECTS. APPROXIMATELY 297 POTABLE WATER SYSTEMS WILL BE INSTALLED, SERVING 83,000 PEOPLE; 10,000 FAMILY LATRINES WILL BE INSTALLED; AND 65,000 FULL VACCINATION SERIES WILL BE ADMINISTERED TO THE 0-4 AGE GROUP.
3. RURAL HUMAN RESOURCES (LOAN FUNDED): A NATIONAL HEALTH DELIVERY SCHOOL AND A TEACHING SUBCENTER FOR PRACTICAL EXPERIENCE WILL BE CONSTRUCTED. CURRICULA WILL BE DEVELOPED FOR TRAINING NURSE PRACTITIONERS, AUXILIARY NURSES, RADIOLOGICAL DIAGNOSTIC TECHNICIANS, HEALTH EDUCATORS, PARTERAS (VILLAGE MIDWIVES), AND COMMUNITY COLLABORATORS. SCHOLARSHIPS WILL BE PROVIDED.
4. REFERRAL SYSTEM DEVELOPMENT (LOAN FUNDED): A NATIONAL MAINTENANCE CENTER WITH SUBCENTERS IN 10 RURAL HOSPITALS WILL BE CONSTRUCTED, EQUIPPED AND STAFFED. A MAINTENANCE REFERRAL SYSTEM WILL BE ESTABLISHED FOR MEDICAL EQUIPMENT AND FACILITIES.

**GOAL:**

MATE OF MORBIDITY AND MORTALITY AMONGST NICARAGUA'S RURAL POOR REDUCED.

PURPOSE: INTEGRATED RURAL HEALTH COVERAGE IN NICARAGUA EXPANDED AND IMPROVED.

**OUTPUTS:**

1. PLANNING, MGMT, & EVAL CAPABILITIES STRENGTHENED WITHIN THE MOM OF HEALTH & NATL BOARD FOR SOCIAL ASST & WELFARE. 2. TRNG PROGRAMS DEVELOPED IN EMERGENCY CARE, RADIOLOGICAL DIAGNOSIS, & MATERNAL CHILD HEALTH/FAMILY PLANNING. 3. 297 COMMUNITY HEALTH COMMITTEES ORGANIZED. 4. 297 POTABLE WATER SYSTEMS INSTALLED SERVING 83,000. 5. 10,000 FAMILY LATRINES INSTALLED. 6. 65,000 FULL VACCINATION SERIES ADMINISTERED TO THE 0-4 AGE GROUP. 7. NATL HEALTH DELIVERY SCHL (MDS) & TEACHING SUB-CTR CONSTRUCTED. 8. CURRIC FOR NMUS DEVELOPED FOR TRNG NURSES, AUX NURSES, RADIOLOGIC TECHNICIANS, HEALTH EDUCATORS, MIDWIVES, & COMMUNITY COLLABORATORS. 9. NATL MAINT CTR & SUBCENTERS IN 10 HOSPITALS CONST. 10. MAINT PERSONNEL TRAINED.

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PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: NICARAGUA PROJECT TITLE: FAMILY PLANNING SERVICES	PROJECT: 5240134 SUB-PROJECT: 60 INITIAL FY: 76 FINAL FY: 80
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**PROBLEMS:**

NICARAGUA LACKS SUFFICIENT NUMBERS OF HEALTH WORKERS TO DELIVER MATERNAL-CHILD HEALTH AND FAMILY PLANNING (MCH/FP) SERVICES TO THE 482,900 WOMEN OF CHILD BEARING AGES (15-45). MCH/FP SERVICES DO NOT REACH APPROXIMATELY 80% OF THE POPULATION RESIDING IN DISPERSED, SOMETIMES ISOLATED VILLAGES. THUS, INFANT MORTALITY IS APPROXIMATELY 120/1000. ALSO, THE CRUDE BIRTH RATE OF 47 PER 1000 POPULATION, IF UNCHECKED, COULD DOUBLE THE POPULATION IN 21 YEARS.

**STRATEGY:**

3-YEAR PROJECT CONSISTING OF GRANT, SHORT-TERM TECHNICAL ASSISTANCE, LOCAL SALARY SUPPORT, IN-COUNTRY TRAINING, AND COMMODITIES (HEALTH KITS, ORAL CONTRACEPTIVES, CONDOMS, CLINIC SUPPLIES, VEHICLES), TO IMPROVE MATERNAL/CHILD HEALTH AND FAMILY PLANNING PROGRAMS. MOST COUNTRY PROVIDES PERSONNEL, FACILITIES, AND PROJECT MANAGEMENT. OTHER DONORS INCLUDE INTERNATIONAL PLANNED PARENTHOOD FEDERATION AND PATH-INDER FUND.

Health, cont.

SUMMARY:

GRANT PROVIDED TO THE GOVERNMENT OF NICARAGUA TO IMPROVE MATERNAL-CHILD HEALTH AND FAMILY PLANNING (MCH/FP) SERVICES. IN ADDITION TO STRENGTHENING THE TRADITIONAL CLINIC-BASED PROGRAM OPERATED BY THE MINISTRY OF HEALTH (MOM) AND OTHER AGENCIES, THIS PROJECT WILL DEVELOP A LOW-COST MCH/FP PROGRAM FOR RURAL AREAS THAT WILL UTILIZE THE VILLAGE MIDWIFE (PARTERA). 2000 PARTERAS WILL BE SELECTED AND TRAINED AT THE NEAREST MOM CLINIC OR HEALTH CENTER. THE 5 TO 7-DAY TRAINING COURSE WILL EMPHASIZE STERILE TECHNIQUES OF DELIVERY AND PRINCIPLES OF FAMILY PLANNING. EACH PARTERA WILL BE SUPPLIED WITH A HEALTH KIT CONTAINING BASIC MATERNITY SUPPLIES, CONTRACEPTIVES, AND MINIMUM HEALTH COMMODITIES. IT IS ESTIMATED THAT THE AVERAGE PARTERA WILL ENLIST ABOUT 24 WOMEN TO ACTIVELY PRACTICE FP. USAID WILL CONTINUE TO ASSIST THE REGULAR CLINIC-BASED MCH/FP PROGRAMS. THE MOM WILL INTEGRATE MCH/FP SERVICES INTO AN ADDITIONAL 50 CLINICS, FOR A TOTAL OF 125 CLINICS. USAID INPUTS INCLUDE SALARY SUPPORT FOR CLINIC PERSONNEL, SOCIAL WORKERS, AND THE FAMILY PLANNING SECTION OF THE MOM. SHORT-TERM ADVISORS WILL IMPROVE ADMINISTRATION, CONDUCT RESEARCH (MICROEPIDEMIOLOGICAL SURVEYS AND RURAL LEVEL SURVEYS), AND ASSIST IN THE TRAINING, OPERATIONAL AND SUPERVISORY ASPECTS OF THE MIDWIFE AND CLINIC PROGRAM. USAID WILL ALSO PROVIDE A PORTION OF THE COSTS OF IN-COUNTRY FP TRAINING (IN-SERVICE FOR DOCTORS, NURSES, AND PARTERAS) AND COMMODITIES FOR HEALTH CENTERS, HEALTH KITS, ORAL CONTRACEPTIVES, AND CONDOMS. THE FP SECTION OF MOM, IN COORDINATION WITH AFFILIATED PRIVATE HEALTH AGENCIES AND THE SOCIAL SECURITY SYSTEM (IMSS), WILL BE RESPONSIBLE FOR IMPLEMENTATION. MOM WILL GRADUALLY ASSUME ENTIRE COST OF MCH/FP CLINICAL SERVICES. BY PROJECT END, FERTILE AGE WOMEN ACTIVELY CONTRACEPTING SHOULD HAVE INCREASED FROM 8% TO 25%-30%.

GOALS: 1. REDUCE THE NATL FERTILITY RATE & IMPROVE HEALTH LEVEL FOR WOMEN & INFANTS PRIMARILY IN THE RURAL AREAS OF NICARAGUA. 2. APPROX: 25% OF FERTILE AGE WOMEN ACTIVELY CONTRACEPTING WITH DECREASED MATERNAL & INFANT MORTALITY & MORBIDITY. PURPOSE: TO PROVIDE IMPROVED FAMILY PLANNING & MATERNAL CHILD HEALTH SERVICES THROUGH TRADITIONAL (HEALTH CENTERS) AND NON-TRADITIONAL (COMMUNITY-BASED PARTERAS) MEANS.

OUTPUTS: 1. MOM INCORPORATES FAMILY PLANNING SERVICES IN ADDITIONAL HEALTH CENTERS THROUGHOUT COUNTRY. 2. GRADUATES FROM MEDICAL SCHOOL RECEIVE FAMILY PLANNING TRAINING. 3. UP TO 2000 PARTERAS TRAINED IN MCH/FP. 4. CURRICULUM ESTABLISHED AND IN USE TO TRAIN AND UPGRADE PARTERAS AND OTHER PERSONNEL. 5. SEC MATERIALS AVAILABLE FOR TRAINING AND PROMOTION OF FAMILY PLANNING. 6. SYSTEM IN PLACE FOR REPORTING AND EVALUATION OF CLINIC AND PARTERA ACTIVITIES. 7. CONTRACEPTIVE SUPPLIES AVAILABLE.

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 \* PROJECT DESIGN INFORMATION \*  
 \* COUNTRY/BUREAU: NICARAGUA PROJECT: 5240143 SUB-PROJECT: 00 \*  
 \* PROJECT TITLE: EAST COAST HEALTH DELIVERY INITIAL FY: 77 FINAL FY: 80 \*  
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PROBLEMS: DUE TO THE EXTREME GEOGRAPHICAL ISOLATION MOST OF THE COMMUNITIES WITHIN A 50 KM RADIUS OF PUERTO CABEZA, NICARAGUA, THE bulk OF THE REGION'S RURAL POPULATION IS BEYOND THE REACH OF EXISTING PRIVATE AND PUBLIC HEALTH PROGRAMS. ALTHOUGH THE AREA'S MAJOR HEALTH PROBLEMS (MALARIA, ENTERIC DISEASES, TUBERCULOSIS, AND PREGNANCY RELATED COMPLICATIONS) COULD BE DEALT WITH BY TRAINED PARAMEDICS, THE GOVERNMENT LACKS AN EFFECTIVE PROGRAM TO TRAIN AND PLACE COMPETENT HEALTH MANPOWER IN THIS REGION. STRATEGY: PROJECT CONSISTS OF THREE YEAR OPERATIONAL PROGRAM GRANT TO WISCUNSI/NICARAGUA PARTNERS OF THE AMERICAS, INC TO DEVELOP REGIONAL HEALTH SERVICE INFRASTRUCTURE AND ADMINISTRATION IN EASTERN NICARAGUA.

SUMMARY: OPERATIONAL PROGRAM GRANT TO WISCUNSI-NICARAGUA PARTNERS OF THE AMERICAS SUPPORTS TWO MAJOR HEALTH RELATED ACTIVITIES IN EASTERN NICARAGUA. FIRST OF THESE IS FORMATION OF REGIONAL HEALTH COUNCIL WHICH WILL PROVIDE POLICY AND LEADERSHIP IN HEALTH SECTOR, AND COORDINATE SCATTERED SERVICES PROVIDED BY A VARIETY OF AGENCIES IN THE REGION. SECOND UNDERTAKING IS ESTABLISHMENT OF VILLAGE-CENTERED COMMUNITY HEALTH ORGANIZATIONS (CHOPS) TO SERVE AS FIRST ECHELON OF ACTION IN AN INTEGRATED HEALTH DELIVERY SYSTEM. CHOPS WILL BE ESTABLISHED IN EACH OF 28 VILLAGES WITH A POPULATION OF 1000 OR LESS. CHO CONCEPT WILL PROVIDE EACH COMMUNITY A HEALTH POST STAFFED BY HEALTH LEADERS, RESPONSIBLE FOR THE DELIVERY OF PRIMARY CARE, NUTRITION LEADERS, AND MIDWIVES. COMMUNITY HEALTH COMMITTEE, COMPOSED OF LOCAL VOLUNTEERS, WILL PROVIDE CHO MANAGEMENT. TO ACHIEVE THESE OBJECTIVES, OPERATIONAL PROGRAM GRANT SUPPORTS A NUMBER OF SPECIFIC OPERATIONS WHICH WILL ULTIMATELY BECOME THE RESPONSIBILITY OF THE REGIONAL HEALTH COUNCIL. THESE INCLUDE: DEVELOPMENT OF REGIONAL TRAINING CENTER TO TRAIN COMMUNITY WORKERS, AND TO DEVISE CURRICULA, TRAINING MATERIALS, AND EVALUATION PROCEDURES BASED ON REGIONAL HEALTH PROBLEMS; EXPANSION OF MINISTRY OF HEALTH LOGISTICAL SUPPORT TO CHOPS; ESTABLISHMENT OF OPERATIONAL AND ADMINISTRATIVE GUIDELINES; DEVELOPMENT OF INTEGRATED RADIO COMMUNICATIONS NETWORK TO MAINTAIN REFERRAL, LOGISTICS, AND ADMINISTRATIVE CONTACT.

GOALS: HEALTH OF RURAL POPULATION OF EASTERN NICARAGUA IMPROVED. 1 PURPOSE: COMMUNITY LEVEL HEALTH PROGRAM ESTABLISHED IN EASTERN NICARAGUA. 1

OUTPUTS: 1. REGIONAL HEALTH COUNCIL FORMED. 2. COMMUNITY HEALTH ORGANIZATIONS FORMED. 3. REGIONAL TRAINING CENTER FOR HEALTH WORKERS ESTABLISHED. 4. CURRICULA, TEXTS, AND TRAINING MATERIALS FOR HEALTH LEADERS, NUTRITION LEADERS, AND MIDWIVES DEVELOPED. 5. 3-4 CLASSES OF EACH CATEGORY OF HEALTH WORKER TRAINED PER YEAR (BY THIRD YEAR OF PROGRAM). 6. REFERRAL MECHANISM ESTABLISHED BETWEEN COMMUNITY HEALTH ORGANIZATIONS AND CLINICS AND HOSPITALS. 7. RADIO NETWORK LINKING COMMUNITIES WITH REGIONAL HEALTH COUNCIL ESTABLISHED. 8. LOGISTICAL SUPPORT MECHANISM ESTABLISHED.

**Appendix IV**

**Acronyms Used in this Report**

#### Appendix IV Acronyms Used in this Report

- CATIE:** Centro Agronomico Tropical de Investigacion y Ensenanza  
(Tropical Agricultural Research and Training Center,  
Turrialba, Costa Rica)
- DENACAL:** Departamento Nacional de Acueductos y Alcantarillados  
(Nicaraguan National Department of Aqueducts and Sewerage  
Systems)
- EPA:** U.S. Environmental Protection Agency
- FAO:** Food and Agricultural Organization of the United Nations
- IAN:** Instituto Agrario de Nicaragua  
(Nicaraguan Agrarian Institute)
- INRA:** Instituto de Reforma Agraria  
(Agrarian Reform Institute)
- IRENA:** Instituto Nicaraguense de Recursos Naturales y del Ambiente  
(Nicaraguan Institute of Natural Resources and the Environment)
- IUCN:** International Union for the Conservation of Nature and Natural  
Resources.
- OAS:** Organization of American States
- ROCAP:** Regional Office for Central America and Panama.  
(a regional office of U.S. AID. in Guatemala City)
- PAHO:** Pan American Health Organization
- SNEM:** Servicio Nacional de Eradicacion de Malaria  
(National Malaria Eradication Service)
- UNEP:** United Nations Environmental Program
- UNESCO:** United Nations Economic and Social Council
- UNICEF:** United Nations International Children's Emergency Fund
- U.S. AID:** United States Agency for International Development

## Appendix V Bibliography

1. General and Land Use
2. Physical Resources
3. Biological Resources and Conservation
4. Health and Urban Environment

## Appendix V Bibliography

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