

ANALYSIS OF WATERSHED MANAGEMENT

(El Salvador, Guatemala, Honduras)

Contract No. 596-0000-COO-2030-00

Project No. 596-0000.6

Watershed Management

September 21, 1982

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## EXECUTIVE SUMMARY

### 1. Foreword

An analysis in the field of watershed management was conducted in El Salvador, Guatemala and Honduras. A second Consultant covered Costa Rica, Nicaragua, and Panama.

This report covers the most significant findings, emphasizing the discussion of possible roles in the proposed project for the energy sector and related regional institutions, as well as the principal constraints. It also includes a proposal for the organization of the Regional Watershed Management Project.

### 2. Identification of National and Regional Institutions

Effort was emphasized on the national energy institutions, the national planning offices, and the national institutions where the legal responsibility for watershed management rests. Other related institutions were also visited as necessary.

These institutions were:

#### El Salvador

- . ISREN
- . ISPEN/PLANEDAREI
- . MIPLAN (CC)
- . CEL
- . FAO-UNDP
- . USAID

Guatemala

- . INAFOR
- . INDE
- . SIKSEPLAN
- . USPADA
- . DIGESA
- . ICN
- . UNDP
- . SIECA (COMETUR, PEICA)

Honduras

- . COELHOR
- . PEM: (SEN-USAID)
- . HYDROELECT Services (SENR)
- . ENEE
- . CONSUPLANE
- . USAID
- . SANDA
- . CRRH

3. Interest and Possible Participation of Electrification Institutions  
in the Proposed Project

These institutions are the economically strongest visited in the three countries. All three of them were generally interested, but within their normal activities. Watershed Management activities are incidental to them as related to certain large hydropower projects such as Pueblo Viejo in Guatemala and El Cajón in Honduras. Both INDE and ENEE

have watershed protection units in that sense.

They may not be the proper agencies to execute the proposed project, but they should certainly participate. In that sense, they expressed themselves through the interviewed officials.

4. Interest and Possible Participation of the National Forestry and Natural Resources Institutions

The institutions that have the legal responsibility to undergo watershed management activities are ISREN in El Salvador, INAFOR in Guatemala, and CONDEFOR in Honduras. All three of them could participate at the operational level. Their capacity to do so is not homogeneous, being relatively better in El Salvador and then in Honduras. ISREN covers all aspects of watershed management.

One limitant is the emphasis in forest development for commercial purposes, as well as the focus on isolated reforestation activities. The institutions are relatively weak budget wise, although CONDEFOR may be in a better position relative to ISREN and INAFOR. All three suffer limitations in trained human resources.

5. Possible Participation of Regional Institutions

Regional institutions covered were SIECA and CRRH. SIECA serves as Executive Secretariat for COMENER, and participates in the Central American Energy Program (PEICA). CRRH is formed by the national institutions in charge of hydrometeorological services and general water resources evaluation. It has an Executive Secretariat in Honduras.

Although COMENER has not been active and PEICA faces financial troubles, the participation of SIECA may be useful if the project undertakes activities related to hydroelectric generation watersheds, since

it is an effective channel of communication within the energy and economic sectors in Central America.

CRRH participation may be useful to initiate and coordinate activities related to watershed diagnosis through its member institutions. Also, the lobby for approval of programs and activities related to the project at the International Technical Cooperation Departments of the national planning offices. It may also serve as clearing house for international watersheds data exchange.

6. Interest and Willingness of Governments in the Proposed Project

This depends upon the persons interviewed and their opinions cannot be considered as official. Nevertheless, they are authorized and valuable opinions since they were officials at the technical as well as managerial levels with good knowledge of the situation prevailing in their countries.

From these opinions it is concluded that there are good possibilities for project approval if it is focused on institutional development and if it is related in some sense to activities that already are being given high priority by the governments. These activities are usually related to the large hydroprojects, but not necessarily so.

Investments in watershed management activities are presently not very high. They range in the order of half a million to three and a half million Dollars for 1982, although there are some investment projects with larger financing now being carried on. Nevertheless, there was relatively high interest in the planning offices, specially in El Salvador and signs that priority would rate high if properly presented.

Interest in other institutions was generally high, especially at the technical level.

7. Possible Watersheds to be Used in the Project

It is considered convenient to include in the project some real watershed management activities in pilot areas. No unified opinion was found as to which of these areas should be, except in Guatemala. An envelope of the expressed conveniences and needs is as follows:

El Salvador

- . Watersheds north of Cerrón Grande reservoir;
- . Watersheds contributing between 5 de Noviembre dam and el Tigre proposed dam site;
- . Watersheds in the upper Lerpa.

Guatemala

- . Upper Chixoy river watershed;

Honduras

- . El Cajón watershed;
- . Middle Patuca River watershed;
- . Choluteca River upper watershed.

All but one are severely degraded, three refer to watersheds where large hydropower projects are in operation or under construction, three refer to watersheds where large hydropower projects are being considered for the nineties, and one refers to projects and/or situations other than hydroelectric. Reforestation, soil conservation, and related activities are underway in four of them; one with AID financing, two with United Nations financing, and one financed with local funds.

8. Data Base Available

Available information at national level is generally good as related to hydrometeorology and water resources, as well as topographic and thematic maps and related documents.

Although there is not similar coverage in erosion rates and in other data areas, it is considered not to be a serious limitation. Data exchange, however, is limited, specially between countries.

The Chixoy (Guatemala) and Choluteca (Honduras) areas have a relatively better data coverage than other watersheds.

9. Principal Constraints Identified

The principal constraints that were identified may be grouped as follows:

CONSTRAINTS		IDENTIFIED IN:		
TYPE	DESCRIPTION	EL SALVADOR	GUATEMALA	HONDURAS
Institutional	. Little political interest and backing.	X	X	X
	. Lack of complete diagnosis and prioritization for watershed management	X	X	X
	. Limited funds	X	X	X
	. Inadequate approach for financial requests	X	X	X
	. Limited institutional experience and capability (human resources and otherwise).	X	X	X
	. Lack of adequate regional channels of communication in watershed management	X	X	X

CONSTRAINTS		IDENTIFIED IN:		
TYPE	DESCRIPTION	EL SALVADOR	GUATEMALA	HONDURAS
Institutional	. High cost of corrective measures	X	X	X
	. Hesitancy towards preventive measures.	X	X	X
	. Land tenure and lack of government control on certain variables.	X	X	X
Other	. Lack of water resources master plan.		X	X
	. No links of watershed management to country development.		X	X
	. Violence	X	X	
	. International Watersheds	X		

10. Needs and Opportunities for a Regional Watershed Management Project

- The following most important needs were detected:
  - . Diagnosis of the watershed situation in Central America.
  - . Methodology for project justification in terms of quantitative benefits, to obtain favorable funding decisions.
  - . Training of local personnel at all levels.
  - . Information and cooperation between countries, especially as related to international watersheds.
- Opportunities were also detected, mainly in the following areas where a regional effort will be more adequate than a country-by-country approach:

- . To have a complete diagnosis of the watershed management situation in the area, as a basis for prioritization;
- . To undertake a coordinated institutional development program, taking advantage of economies of scale.
- . To develop a nucleus of trained personnel, with similar economies of scale.
- . To make relevant contributions to practical aspects of watershed management using the greater leverage of a combined national-regional effort.

11. Outline of a Proposed Watershed Management Project

Based on the above, the following guidelines are proposed:

- Project Goal: Institutional development.
- Strategy: Relate it to project situations already receiving high priority attention from the governments, such as large-investment hydroelectric projects.
- Project Organization:
  - . Principal Institutions:

The project would be managed by CATIE with the help from CRFH.

At the national level, the project would be focused towards institutional development of DGF, ISREN, INAFOR, COMDEFOR, IRENA, and RENARE.
  - . Supporting Institutions:

The project would receive cooperation from SIECA at the regional level. At the national level, points of coincidence would

exist with the activities of the planning offices, National Water Resources Committees (representatives of CRRH), National Geographic Institutes, and Electrification institutions.

- Project Components:

The principal project components would be the following:

- . Diagnosis and pilot projects;
- . Technical assistance: one Project Manager and seven regional specialists-instructors, at CATIE; one technical assistant to CRRH, and six country residents. Short-term consultants would also be provided as needed.
- . Institutional development, including human resources training;
- . Consciousness raising in decision makers and institutions;
- . Watershed management and Natural Resource Information System.

- Project Duration:

The duration of the project would be five years. It will be organized during the first year (contracts for specialists, and initiation of diagnosis and selection of pilot projects). During the second year this diagnosis and pilot project definition and characterization would be finished, and institutional development (including human resources training) and other activities would be initiated. These latter activities would be fully developed during the remaining three years. An evaluation of the institutional development effort and other components would be made in the fifth year.

12. Final Word

The report ends with a list of references and suggested readings, a list of important contacts in the countries visited, and annexes with major existing project profiles.

This effort should be considered as complementary to the one written by Paul Dulin for Costa Rica, Nicaragua and Panama, and vice-versa. Agreement on major issues was reached insofar as possible, but preserving each consultant's own viewpoint when it was considered necessary and beneficial.

The contents of the report were enriched from these discussions as well as from discussions with Nabil Kawas (CRRH Representative) and Carlos Quesada and Craig McFarland (CATIE Representatives), as well as with POCAP Officials and staff.

## FOREWORD

An analysis in the field of watershed management was conducted by the Consultant for the Regional Office for Central American Programs (ROCAP), from August 18 to September 21, 1982.

The purpose of this analysis was to provide ROCAP with supporting material for writing a Project Identification Document (PID) for a proposed project entitled "Watershed Management for Sustainable Energy Production" in the Central American Region.

The Consultant covered the northernmost countries of Central America, i.e. El Salvador, Guatemala and Honduras. The activities involved visits to relevant institutions in each country, discussions with institution authorities and staff at various levels, and a review of pertinent literature. They also included discussions and confrontation of findings with a second Consultant performing a similar assignment in Costa Rica, Nicaragua and Panama (Paul Dulin), and with ROCAP staff in Guatemala City.

Technical cooperation was provided to the Consultant by the executive Secretary of the Regional Committee for Water Resources of the Central American Isthmus - CRRH - Nabil Kawas.

This report covers the most significant findings in the tasks assigned to the Consultant, emphasizing the discussion of the possible roles in the proposed project for the energy sector and related regional institutions such as CRRH and SIECA, the principal constraints to management plan development and subsequent plan implementation, and the opportunities envisioned for ROCAP to alleviate such constraints through appropriate project activities.

## 1. INTRODUCTION AND PROBLEM STATEMENT

### 1.1. Importance of Watershed Management in Central America

As of 1980, some 22 million persons inhabited the 508,894 square kilometers between Mexico and Colombia. Population densities range from 19.6 inhabitants per square kilometer in Nicaragua to 229.1 in El Salvador, and per capita income varies from \$639 in Honduras to \$1918 in Panama.

With population growth rates of the order of 3%, and their economies depending largely on the price fluctuations of a few export crops in the international market, the six Central American countries have been severely affected by the energy crisis and world-wide economic depression.

To illustrate the situation, table 1 shows the contribution of the agricultural sector to the Internal Gross Product and table 2 gives the largest percentage of country income from a single export product. Table 3 shows that at least three countries obtained lower levels of food production in 1980 as compared to the period 1969-71. The index was also fairly constant in all six countries during the last five years; an indication that if the consumption levels are to be improved, food production has to be increased more than the population increase, or food imports will have to be increased.

On the other hand, the percentage of the income generated by exports that is used to import oil products is in the order of 24%. Oil and oil derivatives are about 48% of the Central American energy consumption, wood products represent 31%, and hydroelectricity 13%.

Only Guatemala has an active oil production, but still not enough to cover one third of the national oil consumption.

TABLE 1

CONTRIBUTION OF THE AGRICULTURAL SECTOR TO THE INTERNAL GROSS PRODUCT

Country	1976	1977	1978	1979	1980
Costa Rica	20.2	19.0	19.0	18.2	17.7
El Salvador	22.3	21.8	23.1	23.9	24.4
Guatemala	27.3	26.3	25.8	25.5	25.2
Honduras	29.6	30.1	29.2	29.4	28.1
Nicaragua	22.5	23.1	26.0	28.4	23.2
Panamá	16.1	16.8	16.1	15.1	14.3

Source: IIB

TABLE 2

LARGEST PERCENTAGE OF COUNTRY INCOME FROM A SINGLE EXPORT PRODUCT

Country	Product	Percentage of Country Income 1975-79
Costa Rica	Coffee	31.1
El Salvador	Coffee	52.5
Guatemala	Coffee	38.5
Honduras	Coffee	28.0
Nicaragua	Coffee	24.7
Panamá	Bananas	21.3

Source: IIB

TABLE 3

PER-CAPITA FOOD PRODUCTION INDEX ( BASE PERIOD: 1969-71 = 100 )

Country	1976	1977	1978	1979	1980
Costa Rica	115	123	118	115	106
El Salvador	97	98	108	106	100
Guatemala	113	112	113	111	111
Honduras	85	87	94	93	89
Nicaragua	104	103	118	92	99
Panamá	100	104	102	98	92

Source IDB

Thus, all Central American countries are presently hard pressed to obtain hard-currency with which to import needed energy and maybe even food. But this currency is obtained from very vulnerable agricultural export products whose value in the international market diminishes ostensibly each day.

Also, the large dependability of the Internal Gross Product on the agricultural sector and the high rates of population growth, impose a heavy burden upon the natural resources of the Region because of increasing demands for food and cash crops, as well as for fuel.

Cash crops such as sugar cane and the open-soils cotton, have usually displaced food crops in the flatlands. In turn, food crops such as corn and beans planted following the cut and burn procedures of shifting agriculture, have moved to high sloped lands of forest vocation, which are also diminished by logging and firewood cutting.

This has severely deteriorated the conditions of vegetative cover as well as soil and water resources.

In El Salvador, for example, already by 1972 only about 8 percent of the country had an adequate vegetative cover for soil and water resources conservation (see Annex 3.1) and about 45% of the country was subjected to heavy erosive processes.

In a single year (1969-70), about 10 million cubic meters of soil were lost from the upper and middle Lempa watershed (upstream from Colima bridge), representing a layer of about 1.4 millimeters in depth over a 6,695 square kilometers area.

In Guatemala about 64% of its territory are lands of forest vocation. It has been estimated that about 53% of its forest covered lands (some 20,000 square kilometers) have been lost between 1959 and 1982. About 70% of the remainder is deciduous forest, 20% conifers, and 10% mixed species.

Annual suspended sediment yields vary from 20 to 300 metric tons per square kilometer in areas still with vegetative cover and with undeveloped surface drainage networks, to between 700 and 1100 metric tons per square kilometer in unforested areas.

In Honduras, erosion rates of 100 to 500 tons of soil per hectare per year have been estimated. On the average in Central America, the annual sediment yield varies from 40 to 800 metric tons per square kilometer. In Honduras, it was estimated that shifting agriculturists deforest about 80,000 hectares of broadleaf forests annually causing an hypothetical annual loss of approximately 300 million dollars of hardwood timber.

New unplanned inroads of development to previous uninhabited areas such as the middle Patuca river watershed in Honduras and the Peten province in Guatemala, may cause irreversible damage to ecologically fragile areas.

The results of a lack of integrated management of the Region's vital

natural resources: forest, soils, and water are loss of biomass, loss of productivity, loss of energy, loss of soil, increase in damages due to flooding, further deterioration of the balance of payments situation, and hindering of the development efforts of the countries.

One example where lack of management of natural resources may jeopardize the efforts of the six countries of the Region to cope with the prevailing critical economic situation, refers to the energy sector.

#### 1.2. Importance of Hydroelectricity in Central America

About 66% of the energy generation in Central America is presently from hydroelectric sources. There is however, much variation from country to country, as can be seen in the table 4.

TABLE 4

PERCENTAGE OF TOTAL ENERGY GENERATION FROM HYDROELECTRIC SOURCES (1981)

Country	Percentage (%)
Costa Rica	99
El Salvador	53
Guatemala	24
Honduras	89
Nicaragua	48
Panamá	51

Source: SIECA, IRHE

Table 4 does not include the large hydroelectric projects now under construction in various countries such as Corobici in Costa Rica (174 MW for 1983), San Lorenzo in El Salvador (180 MW for 1982), Chixoy in Guatemala (300 MW for 1983), and El Cajón in Honduras (292 MW for 1986).

These projects will not change much the percentage of Table 4 for Costa Rica, but will push even higher the percentage for Honduras and will increase the percentage for Guatemala to an order of magnitude comparable to those two countries.

The amounts spent in 1981 in the importation of oil and oil derivatives were in the order of \$200 million in Costa Rica,, \$150 million in El Salvador, \$400 million in Guatemala, \$150 million in Honduras, and \$180 million in Nicaragua. About 20% of this (about \$200 million) was used for electric generation in these five countries. This percentage, however, could rise if an effort is made to substitute much of the oil consuming transportation by electric transportation. The weight of this related to the revenues obtained from exports is shown in table 5.

TABLE 5

VALUE OF OIL IMPORTS AND TOTAL REPORTS, IN MILLION DOLLARS

COUNTRY	OIL IMPORTS		IMPORTS (1980)	% OF ENERGY USED IN OIL IMPORTS	
	TOTAL (1981)	APPLIED TO ELECTRIC GENERATION (1981)		FOR ALL USES	FOR ELECTRIC GENERATION
Costa Rica	199.2	39.6	1017	19.6	3.9
El Salvador	149.6	29.8	963.5	15.5	3.1
Guatemala	399.9	80.3	1489.8	26.8	5.4
Honduras	153.2	30.6	835.3	18.3	3.7
Nicaragua	175.7	35.1	470	37.4	7.5
Panamá			407		

Sources: IDB  
SIFCA

Although in 1982 the rate of electricity demand as well as the oil imports have diminished in most Central American countries due to the recession in economic activities, long term demand projections to year 2000 reach an order of magnitude of 40,000 GWh. Table 6 shows these projections by country, along with projections of per-capita electric generation.

TABLE 6

ELECTRICITY DEMANDS AND PER - CAPITA GENERATION

COUNTRY	ENERGY GENERATION 1981 (GWH)	ENERGY DEMAND PROJECTION TO 2000 (GWH)	PER CAPITA GENERATION	
			1981 (KWH)	PROJECTION TO 2000 (KWH)
Costa Rica	2291	7213	1026	2465
El Salvador	1436	5866	298	798
Guatemala	1458	9499	207	839
Honduras	975	2923	264	483
Nicaragua	1011	4541	417	1046
Panamá		6768		2806

Sources: IDB, SIECA, MITRE

Although the hydroelectric energy generated has increased more than 500 percent in the last 20 years, there still is ample potential to be developed. The hydroelectric generation potential of the five northernmost countries of the Region has been estimated in the order of 25,500 MW (about 955 MW have been installed to date and about 4,500 MW are projected to be installed by year 2000), and about 111,600 GWH in identified projects (about 4053 GWH are being generated now and about 35,000 GWH are projected to be generated by year 2000). Thus, only about 4% of this energy potential is being used now, and about 30% is projected to year 2,000.

Since the costs involved in thermal energy generation are now from 5 to 10 times those of hydroelectric generation and the countries need to stabilize their balance of payments, many efforts are being made at

Regional level in order to substitute thermal by hydroelectric generation as much as it is feasible and advisable.

These efforts include an institutional framework and several related activities.

The institutional framework includes a Regional technical and advisory body called "Central American Energy Commission" (COMENER) whose secretariat is the "Central American Secretariat for Economic Integration" (SIECA), and the "Regional Committee for Hydraulic Resources" (CRRH). The related activities comprise a UNDP funded Central American Energy Program (PEICA) and an interconnection scheme.

The Central American interconnection efforts have been supported by ECLA since the past decade. One of the first and most complete studies made on this subject, is the one made by ECLA in 1977 in order to evaluate the overall benefits of the interconnection. This study compared the costs involved in meeting the electric demands of the Region from 1980 to 2000 under three alternative schemes:

- a) Each country optimizing the development and operation of its electric system without any interconnection;
- b) The Region optimizes the operation of a Regional system which is formed by all national systems interconnected; and
- c) Each country plans the development of its own system individually, but as interconnection becomes available their operation is optimized in conjunction.

The study showed that the most economic way of meeting the electric demands was alternative b). The present value of savings as compared to alternative a) were more than \$400 million. The more realistic alternative c) gave savings in the order of from 100 to 400 million dollars

as compared to alternative a).

The interconnection would allow a more efficient use of the hydroelectric potential of the Region as a whole, which is not uniform from country to country as can be seen in Table 7.

TABLE 7

ECONOMICALLY FEASIBLE HYDROELECTRIC POWER POTENTIAL IN CENTRAL AMERICA  
( From Identified Projects)

Country	Power MW	Energy in an Average year GWh
Costa Rica	8900	39,000
El Salvador	850	4,100
Guatemala	9900	43,300
Honduras	2800	12,300
Nicaragua	2950	12,900
Panamá	2500	

Source: SIECA, MITRE

The interconnection is presently operating between Costa Rica, Nicaragua, and Honduras. Shortly, as of the beginning of next year, it is expected to operate between Honduras and El Salvador. In 2 or 3 years it is expected to interconnect El Salvador and Guatemala. Studies are under way to interconnect with Panamá.

SIECA in its "Perspectives for Development of the Central American Sub-structure" (July 1982) comments that the solution of the energy problems of Central America would greatly benefit with more regional projects

similar to the interconnection. It also urges to accelerate the use of natural renewable resources, especially the hydroelectric and geothermal, as well as biomass and direct solar energy.

COMENER has proposed to the Central American Governments a mixed plan involving micro hydroplants for small isolated rural areas, as well as large projects to take advantage of economies of scale. Table 8 shows the magnitude of proposed investments for hydropower development as compared to present national budgets.

TABLE 8  
GOVERNMENT SPENDING AND PROPOSED INVESTMENT IN HYDROPOWER DEVELOPMENT  
IN CENTRAL AMERICA

Country	Government Spending (1980)		Proposed Investments for the nineteen eighties (million Dollars)
	% of Gross Internal Product	Million Dollars	
Costa Rica	19.5	662	1338
El Salvador	15.8	518	280
Guatemala	14.4	1217	1647*
Honduras	22.2	524	297
Nicaragua	28.3	615	30
Panamá	27.2	958	

\*It amounts to \$604 million without Chulac and Xalala

Sources: SIECA, IDB

As can be seen in Table 8, the efforts to be made by the countries in order to increase low-cost generation and to appreciably decrease the fuel consumption for thermo electric generation, have a high price tag and involve serious obligations in capital and interest payments.

It is obvious that the paragraph included in the feasibility studies of most large hydroelectric projects, qualifying and subjecting the economic life of the project "to the adoption of adequate measures to prevent the further deterioration of the vegetative cover of the watershed so as not to increase its actual sediment yield" has indeed a lot of weight behind it. Not to heed this prevention, especially when data on sediment yield are scarce is indeed venturous, to say the least.

An example of the economic impact of increased sediment yields can be obtained from the studies undertaken for the Pueblo Viejo - Quixal hydroproject in Guatemala.<sup>1/</sup>

### 1.3 Importance of Watershed Management in Hydroelectric Projects

The Pueblo Viejo - Quixal hydroelectric project is expected to start operations early next year. Located on the Chixoy river in northern Guatemala, it will add 300 MW to the installed capacity of the country, shifting the present balance between hydroelectric and thermal generation. From about 42 percent hydroelectric in late 1982 (including the Aguacapa hydroplant) it will shift to 81 percent hydroelectric in 1983 and to 98-99 percent by 1984, using thermal generation practically for reserve purposes only.

It will decrease the use of diesel fuel for electric generation by 95 percent and the use of bunker by 93 percent from 1982 to 1984. Considering all uses for bunker, the new situation will cause a decrease of about 50 percent (about 1.3 million barrels per year) in projected bunker consumption from 1982 to 1986.

<sup>1/</sup> This example is used with authorization of INDE

The effect is so marked that it has prompted SIECA and other national institutions to consider alternative plans for the refinery in Escuintla to cope with the new situation and not to have excess production from 1983 to 1986.

The Pueblo Viejo - Quixal project has a 110 meter dam with a 460 million cubic meter reservoir. It includes 140 million cubic meters of dead storage for a projected economic life of 50 years. More details about the project are given in Annex 4.6.

It was first designed as part of a comprehensive hydroelectric development of the whole upper and middle Chixoy river basin. However, various subsequent studies have alternatively excluded and included the proposed upstream developments with diverse effects upon Pueblo Viejo. Without the upstream projects (or increased sediment yields from the watershed due to further deterioration of its vegetation cover), sedimentation rates at Pueblo Viejo will be greater than those originally envisioned.

In 1980 a study was made for INDE by a Consulting Firm<sup>1/</sup> to re-evaluate measures to relieve sedimentation in Pueblo Viejo reservoir. With sediment yields in the order of 800 metric tons per square kilometer per year at the dam site, about 600 in the middle reach, and as high as 1100 tons per square kilometer per year in the upper basin, the study recommended the construction of one of the previously considered upstreams projects, no later than 1990.

The conclusions stated that "the detailed study of sedimentation considering areal deposition indicates that Pueblo Viejo will last about 42 years without any measures being taken, and after about 60 years the loss of active storage will increase rapidly and the annual loss of revenue as well as firm generating capacity will accelerate. Eventually, the site will

1/ This is used with authorization from INDE

become unusable. If this is allowed to happen, the power network will suffer a capacity loss of 230 MW and an annual energy loss of 160 GWh and more importantly, a valuable and renewable energy resource will have been rendered useless. One of the most important hydro sites in Guatemala would be lost, and the chances of finding another site to replace it are remote."

Although the proposed project would add 55 MW of capacity and 114 GWh of annual energy to the system, it was chosen mainly because "it is the only measure which provides long-term protection against sedimentation" and "will extend the life of Pueblo Viejo to about 100 years and surely beyond." The economic study showed a benefit cost ratio of 1.23 for the proposed project. A second alternative, a sand trap at the same site but without power generation, also gave a benefit cost ratio of 1.07. Table 9 shows the projected loss of firm energy at Pueblo Viejo without any measures taken. Table 10 shows the reducing effects of upstream measures upon Pueblo Viejo sedimentation. Table 11 shows the results of the preliminary economic analysis.

TABLE 9  
PROJECTED GENERATION OF FIRM ENERGY AT PUEBLO VIEJO WITHOUT MEASURES

PERIOD (YEARS)	MEAN FIRM ENERGY IN PERIOD (GWH)	(%)
0	1024.66	100
0 - 20	1022.42	99
20 - 40	1007.58	98
40 - 60	997.37	97
60 - 80	862.09	84
80 - 100	616.09	60

SOURCE: LAMI - INDE

TABLE 10

PRELIMINARY EVALUATION OF REDUCING EFFECTS OF UPSTREAM MEASURES UPON  
PUEBLO VILLO SEDIMENTATION

MEASURE	DEAD STORAGE FILLED AFTER YEARS	MEAN SEDIMENT TRAFFIC PER YEAR IN C.F. (PUEBLO VILLO SED. INFL. W/ DURING 50 YEARS	PUEBLO VILLO WAS COMPLETELY FILLED AFTER YEARS	PUEBLO VILLO WITH MINOR DEAD STORAGE FILLED AFTER YEARS	ESTIMED LIFE OF PUEBLO VILLO
UPSTREAM DAM WITH HEAVY GENERATION	52	48.9	41	73	32
UPSTREAM SANDTRAP	60	31.2	41	56	15

Source: LAMI - INDE

TABLE 11

PRELIMINARY ECONOMIC EVALUATION OF MEASURES TO EXTEND THE LIFE OF  
FUEBLO VIEJO RESERVOIR

PROPOSED MEASURE	EXTENDED LIFE (Y YEARS)	VALUE OF PRESENTED ENERGY FROM MEASURE 6 (10 <sup>9</sup> )	VALUE OF PRESENTED ENERGY FROM EXTENDED LIFE OF FUEBLO VIEJO 6 (10 <sup>9</sup> )	TOTAL VALUE OF BENEFITS 6 (10 <sup>9</sup> )	COST OF MEASURE 6 (10 <sup>9</sup> )	B/C
Upstream Dam with hydro-generation	35	52.9	55.8	108.7	88.2	1.23
Upstream Sandtrap	16	--	43.9	43.9	41.0	1.07

(All costs and benefits are 1980 present values calculated with an interest rate of

9%) Source: IAMI - INDE

For the purpose of this report, the usefulness of the above results rests on the following:

- a) It is irrelevant whether the increased sediment yield originated from the abandonment of previously considered upstream projects or not. For our purpose, it may well be caused by deterioration of the watershed conditions. The effect is the same.
- b) It is not important if the recommended measure is another hydroproject. The important fact is that upstream sediment controlling measures are needed. The additional hydroproject was part of the hydroelectric development of the Chixoy basin originally envisioned, and the results of the study merely stresses the need to continue with those plans. The new project also has a projected economic life of about 50 years and if the watershed continues to deteriorate, it will also be reduced and so will be its purposed beneficial effect on Pueblo Viejo. The study is oblique in touching this matter when it states that "the results of the present study indicate the area of highest sediment yield is the Río Negro Basin (where the new project would be located) and thus tend to support the views of the two reforestation studies (one by the Consulting Firm LAVALIN for INDE referring specifically to the Chixoy river basin, and another, more general, by UNDP-FAO about national reforestation). A long range plan of reforestation land Management should be given every encouragement, however, the lack of quantitative information precludes any inclusion in this study except for these brief qualitative statements" (the underlining was added for this report).

c) It is thus conceivably that if a reduction of some 30 percent of the sediments expected to reach the Pueblo Viejo reservoir in the 50 years of its economic life could be quantitatively guaranteed by proper watershed management measures, an investment of up to \$40 million would be justified for that purpose.

1.4 Explanation of Projects, Current or Planned, Involving Hydroelectricity in El Salvador, Guatemala, and Honduras.

A brief summary of the major projects is given below. More detailed information about each project is given in Annexes 4.1/4.5.

1.4.1. El Salvador

Table 12 shows the theoretical hydroelectric potential of major rivers of El Salvador.

TABLE 12

THEORETICAL HYDROELECTRIC POTENTIAL OF MAJOR RIVERS  
(GWH IN AN AVERAGE YEAR)

RIVER	THEORETICAL POTENTIAL	DEVELOPED OUTPUT
Lempa	4580	1100
Jiboa	148	
Paz	1190	
San Miguel	454	
Banderas	254	
Grande de Sonsonate	332	26
Goascoran	446	
TOTAL	7404 (at least 9000 if the potential of the tributaries is included)	1126

Source: El Salvador Water Resources Master Plan Supporting Studies -TAHAL Consulting Engineers LTD.

As can be seen, the Lempa is the main actual and potential source of hydroelectric power in El Salvador. It is the largest river in the country and its watershed covers 18,246 square kilometers of which 5,696 are in Honduras, 2,295 in Guatemala, and 10,255 in El Salvador (about 49% of its territory). Its average flow is about 153 cubic meters per second at the Cerron Grande site, about 197 at the 5 de Noviembre site, about 329 at the Río Torola confluence, and about 362 cubic meters per second at the Cuscatlán bridge on the Panamerican highway.

Hydroelectric use of the Río Lempa started in the 1950 decade and the following plants have been built (see location in Annex 3.3).

5 de Noviembre	1954
Guajoyo	1963
Cerron Grande	1977
San Lorenzo	(Under construction)

The 5 de Noviembre project was planned to operate with Guija Lake as a natural reservoir of about 500 million cubic meters at its upstream basin bordering with Guatemala, and with a smaller 250 million cubic meters reservoir built near the Río Sumpul confluence. The useful life of this reservoir was planned for 40 years, but when the immediately upstream Cerron Grande dam was built in 1977 (23 years after its construction), its volume was reduced by sedimentation to about 60 million cubic meters.

Cerron Grande has some 1,400 million cubic meters of active reservoir and thus, 5 de Noviembre is now operated as a run of river base plant.

The Executive Commission of the Río Lempa (CEL) is in charge of all hydroelectric developments in El Salvador. CEL has prepared several studies about the expansion of the national energy system in order to establish an order of priorities for the construction of hydroelectric plants. One such

study is the "Expansion Plan of the Electric's System," prepared in August 1980. Another is a more recent one prepared in May 1982 as part of the activities of the Second Phase of the Central American Energy Program (PEICA) entitled "Alternatives for National Energy Development; preliminary plan 1985-2000."

According to these studies, the recommended expansion program as it relates to hydroelectric plants is as follows:

San Lorenzo (180 MW)	Under Construction
Expansion of 5 de Noviembre (75 MW + 45 MW)	1986
Expansion of Cerron Grande (67.5 MW)	1989
El Tigre (270 MW + 135 MW)	1992 + 1995
Zapotillo (120 MW)	Not yet Scheduled
Paso del Oso (40 MW)	Not Yet Scheduled

The proposed 5 de Noviembre expansion is for peaking capacity and for base energy further development of some 385 MW in geothermal plants, about 1000 MW in coal-fired plants and about 25 MW in gas turbines is planned. Thus, contrary to the situation in Guatemala, an important change in the structure of the power system will take place lowering the present high percentage of hydroelectric generation to about 50% by year 2000. Paso del Oso and Zapotillo which are in the upper Lempa basin have a high energy output because of the regulation offered by Guija. The run of the river El Tigre depends on an international agreement with Honduras. The Master plan for Hydraulic Resources (PLAMDAH) has identified a multipurpose project for the upper Lempa basin involving an enlarged version of the Paso del Oso dam. Beneficial uses involved include hydroelectricity, irrigation, and water supply to San Salvador. PLAMDAH has also studied a flood control project in the lower Lempa making use of the reservoir capacity of the proposed El

Tigre project.

Table 13 gives cost estimates of the proposed hydroelectric developments in the Río Lempa. Developments in the other rivers shown in Table 12 are only at the survey or identification levels.

TABLE 13

COST ESTIMATES OF PLANNED HYDROELECTRIC POWER STATIONS IN THE LEMPA RIVER  
(January 1978 prices in ¢ converted to 1978 \$ with a 2.50 factor)

Project	Cost in Thousand \$
San Lorenzo	200,120 (1979 prices)
Expansion of 5 de Noviembre	39,920
Expansion of Cerron Grande	25,040
El Tigre	254,960
Zapotillo	173,560
Paso del Oso	70,080

Sources: PLAMDAFH - TAHAL - CEL

The planned Río Lempa expansion up to year 2000 will involve investments in the order of \$ 520 million and including plants of all types it reaches about \$1,300 (January 1978 prices). The planned budget for expansion of the electricity system in the period 1978-1982 was about \$300 million.

Most of the regulating capacity in the Río Lempa has been already developed with 5 de Noviembre, Guija (Guajoyo) and Cerron Grande. Only Paso del Oso and Zapotillo remains in the upper reaches (see Annex 3.4). All proposed developments downstream 5 de Noviembre make use of these upstream regulation reservoirs. Therefore, the planned electric generation

expansion for year 2000 has a strong non-hydroelectric component to strengthen generation at the base.

#### 1.4.2. Guatemala

The institution in charge of electric generation development is the National Electrification Institute (INDE).

INDE prepared in 1976 a "National Electrification Plan" which identified four projects for the period 1985-1990: Xalalá in the Chixoy river (276 MW and 1054 GWh/year), El Carmen in the Los Esclavos river (113 MW and 329 GWh/year), Serchil in the Chixoy river (150 MW and 346 GWh/year), and Chulac in the Cahabón river (426 MW and 1848 GWh/year).

One of these was discarded, (El Carmen) and another was postponed until more reliable data are obtained (Serchil). Xalalá and Chulac were studied at feasibility level, and the Chulac construction was started although its conclusion is uncertain at present times. These were revised later.

The Pueblo Viejo - Quixal project (300 MW and 1710 GWh/year) already under construction when the plan was made, is expected to start trial operations in April 1983 and be fully operational by May or June of the same year.

The plan also identified 16 additional hydroelectric projects for long term demands (year 2000), and INDE additionally studied the Santa María II project in the Samalá river (60 MW and 271 GWh/year).

Presently, INDE is revising and updating its National Electrification Plan and is compiling revised data for 38 hydroelectric projects classified as "medium" and "large". Twelve of these have been given higher priority in these studies. Their characteristics can be seen in Table 14 and their location is shown in Annex 3.5 .

Additionally, INDE is undertaking joint preliminary studies with the

Electricity Federal Commission of Mexico (CFE) to define the hydroelectric potential of the Usumacinta river along the border line of both countries, and to select the best alternatives for further study. CFE had previously studied the Boca del Cerro project whose civil works would be in Mexico but whose reservoir would be in both countries with an approximate 2000 Mw capacity and 9000 GWh/year generation.

TABLE 14  
PRIORITY HYDROELECTRIC PROJECTS IN PHASE II OF THE NATIONAL ELECTRIFICATION PLAN

No.	Project	Capacity (MW)	Energy (GWh)	Type of Development	Dam Height (M)	Average Flow (M <sup>3</sup> /s)
3	Sinacapa	84	216	ROR*	10	..5
4	Buena Vista	66	162	ROR	10	11
5	Guayabo	74	184	ROR	65	61
6	Sisimate	90	225	RES**	65	37
7	Ulpán	196	1147	ROR	10	36
10	La Tinta	103	266	RES	105	41
11	Guayacán	32	79	ROR	10	7
18	Jocotules	64	164	RES	97	25
19	Las Tapachulas	63	162	RES	83	34
20	Palzapal	35	92	RES	80	21
21	Sanchal	81	210	RES	120	15
22	Nahilic	360	1468	RES	98	260

Source: INEE

\* ROR = Run of River

\*\* RES = Reservoir

None of the projects in Table 14 as well as Santa María II and Usamacinta are scheduled yet, and the fate of Santa María II as well as the initiated Chulac is presently uncertain.

Estimated Cost of the major projects, in million dollars, are as follows:

Pueblo Viejo - Quixal (Chixoy)	410
Santa María II	63
Chulac	660
Xalalá	380

1.4.3. Honduras

MAJOR EXISTING OR STUDIED HYDROELECTRIC PROJECTS IN HONDURAS ARE AS

FOLLOWS:

Project	Capacity (MW)	Energy (GWh/yr)	Status
Yojoa-Río Lindo	110		In operation since 20 years
El Nispero	22.5		For 1982
El Cajon	296	1695	For 1986
Naranjito	84		Feasibility
Camrejal	40-60		Pre-Feasibility

Source: ENEE, SIECA

All of these are located in the northwestern portion of the country (see map in Annex 3.6 ) and were identified in a survey made in 1967. This region is covered by the National Enterprise for Electric Energy (ENEE) network which has two major consumption centers: One in the Tegucigalpa area and the other in the north-central part of the country. Into this network links the interconnection with Nicaragua and will link the interconnection

with El Salvador in 1983.

The Yojoa - Río Lindo project covers about 90% of the electricity generated in Honduras. About 95% of the demand of the ENEE system is now being supplied by hydraulic sources, but the percentage of the total generation is about 89%. This percentage has decreased from 90.5 in 1979 due to the installation of small fuel type plants outside the ENEE system.

With El Cajon ENEE expects to reach hydro percentages close to 100 until 1990. From 1990 new thermo electric plants will be considered.

Although there is no expansion plan defined yet by ENEE, they are revising and updating a 1975 project inventory for the eastern portion of the country (see map in Annex 3.6). These projects will be considered beyond 1990 and ENEE feels that in this decade a project of the magnitude of El Cajon will be needed. This need has been established although lately, Honduras as well as other countries in the Region, has experienced a relative decrease in demand. This is attributed to the economic recession now prevailing, but it is expected to reverse in the future mainly because of the population growth. Such a need will demand a great financial effort, since the project that is selected for the nineties will require an investment of about \$500 to \$750 million at present times and about \$1000 million by the time it is built.

Among the projects being considered for the nineteen nineties are the following (see location in Annex 3.6 ):

Piedras Amarillas (200 MW)

Portal del Infierno ( 200 MW)

Cuyamel o Valencia ( 300 - 500 MW)

Waru

Sico (80 - 100 MW)

The first four of these projects are located in the Patuca River basin (about 23,000 square kilometers).

2. STATUS OF WATERSHED MANAGEMENT IN EL SALVADOR, GUATEMALA AND HONDURAS

2.1 National Agencies Dealing With Hydroelectric Energy Generation, Natural Resources and Watershed Management

The information provided in this section will vary from country to country and from institution to institution, as it depends on the material obtained and the answers given to questions posed by the Consultant to the staff members that were interviewed. Nevertheless, a uniform format was attempted for the sake of uniformity and comparative analysis.

2.1.1. El Salvador

a) Salvadorean Institute of Natural Resources (ISREN)

i) Profile:

- Main Objectives and Attributions:

-General: Contribute to socio-economic development by formulation of policies and strategies towards the conservation, restoration and comprehensive development of natural resources.

-Specific: Soil restoration and development; land use. Incorporation of new agricultural areas through irrigation and drainage. Natural resources conservation. Water resources evaluation. Providing data bases in hydrology and climatology for national planning efforts. Development of plans, programs, and projects for rational use and management of forestry resources.

- **Geographical Area of Competence:**

All the country

- **Administrative Structure and Dependence:**

Created by Decree No.937, published in the Official Gazette No. 235, vol. 273, December 29, 1981. It is a dependence of the Ministry of Agriculture and Livestock. Its administrative structure is pyramidal from the Executive Director.

- **Principal Executive and Address:**

Dr. Francisco Ferrano

Executive Director

Soyapango, El Matasano

San Salvador, El Salvador

Phone: 270490

- **Organizational Chart:**

See Annex 2.1.

- **Staff and Funds:**

It has a total budget for 1982 of ¢ 21,631,840 (\$6,180,526 at current exchange rate of ¢ 3.50 per Dollar), and about 617 employees.

	ITEM	DIVISION				
		Administration and General Services	Watershed Management and Soil Conservation	Hydrometeorology	Irrigation & Drainage	National Parks and Wildlife
BUDGET	Regular	¢ 3,554,530	¢ 475,120	¢ 843,750		¢ 510,750
	Investment		6,245,600	1,857,140 *	7,844,950	300,000
STAFF	Professionals	22	17	15	6	10
	Technicians	82	11	90	9	5
	Administrative & Other	221	46	46	25	12

\*There is also a non-reimbursable grant of ¢ 1,312,906 from UNDP for the Water Resources Master Plan.

SOURCE: ISREN

Current Exchange rate: ¢ 3.50 = US\$ 1.00

ii) Projects Related to Subject Matter

- Water Resources Master Plan: The objectives of this ISREN-UNDP project are to evaluate the quantity and quality of the water resources of El Salvador, to evaluate water demands for all potential beneficial uses of water, and to define an outline of needed actions to satisfy those demands according to existing resources. The project has also drafted a water law and an administrative structure in the Ministry of Planning (the "specialized Water Office") to take care of water related activities beginning in 1983. The Master Plan is in its last year and has published 16 technical reports, including a proposal for multiple use of El Tigre and Paso del Oso hydroprojects (see Annex 4.4 and 4.5).

As part of the project, TMIAL Consulting Engineers, Ltd. of Israel has finished a draft report entitled "El Salvador Water Resources Master Plan Supporting Studies." Funding included Q 853,440 from El Salvador Government (GOES) in 1982, and Q 1,312,906 from UNDP.

- Setting of a National Park and Reserve System: This involves the drafting of plans and laws for the conservation of natural areas and wildlife, wildlife inventories, definition of normative procedures and measures of wildlife management, and definition of projects for park development.

Although included as an investment project with local funds, it is more of a continuous nature. Funding for 1982 was Q 300,000 from GOES.

- Potential Land Use: An ISREN funded program of soil mapping and related soil studies of a continuous nature. Funding for 1982 was Q 580,600 from GOES.

- Soil Erosion: Its objective is to determine the degree of erosion in the country by photointerpretation, as a basis for soil conservation projects and measures. It will have a one-year duration and assistance is being sought from AID, IDB or BCIE to obtain stereoscopic equipment. The amount of the investment is not yet defined.

- Soil Conservation Law: AID cooperation is being sought to compile existing laws related to soil conservation and to draft a proposal for consideration by the Government. It would have a two-year duration, but no definition of needed investment has been made yet.

- La Palma: This is a stabilization of La Palma river in the Chalatenango province, which contributes to Cerrón Grande reservoir. It involves soil conservation of 250 hectares, reforestation of 500 hectares, protection of 3 kilometers of local roads, and conservation of 20,000 cubic meters of

material from gullies and ditches. No definition of needed investment has been made yet, but technical-financial assistance is being sought from IDB, AID or FAO. It would be a 5-6 year project.

- El Tránsito: It is a flood control project near the El Tránsito village close to the mouth of the San Miguel river. It involves soil conservation in 45 square kilometers, flood control for 23 square kilometers, conservation of 10,000 cubic meters of material from gullies and ditches, and protection of 1/2 kilometer of major roads. No investment has been determined and technical-financial assistance is being sought from FAO and IDB. It would be a 5-year project.

- Natural Resources Management Model:

Assistance is being sought from AID for this 2-year project. Using an as yet unspecified 200 hectare area, a natural resources management structural and administrative model is to be studied. It will give guidelines for comprehensive natural resources development with proper soil management techniques.

- Regional Projects:

ISREN has several regional soil conservation, reforestation, irrigation, reservoir, and wildlife projects. AID funds will be used for this purpose through the Job Generation Program.

iii) Critique

In the discussion that follows, the capabilities of the institutions are the observations of the Consultant, but most of the disabilities were recognized and stated by the staff members that were interviewed, mostly by its Executive Director.

- Capabilities:

Both the technical and administrative authorities of ISREN recognize the need for watershed management activities and show great interest. It is also the national institution which has the legal basis to undertake these activities and has the basic administrative substructure for that purpose. A Watershed and Management Division exists with about 30 percent of the budget of ISREN and about 12 percent of its staff. The causes for the natural resources situation in El Salvador are clearly stated and adequate solutions are sought. ISREN has also the capability to undertake projects funded jointly by GOES and by international institutions. Its executives are also aware of the disabilities and limitations of the institution, and will not accept the proposed ROCAP project if it involves only reforestation or soil conservation. ISREN is willing to work together with CEL in a project such as the one proposed by ROCAP. The Executive Director of ISREN is the President of the National Water Resources Committee and thus ISREN is part of the CRRH. It would be the institution that would decide the priorities in case the ROCAP project objectives are watershed management for natural resources development or for multipurpose water resources development.

- Disabilities:

ISREN has less relative weight in the public sector than other institutions such as CEL. It has a deficit in its installed capacity for watershed management and there is a tendency to associate watershed management activities of the type proposed by the ROCAP project with hydrometeorology and water resources, and to associate "watershed management" as included in its administrative substructure, with soil conservation and reforestation. Its major experiments in watershed management have been of the protective-defensive type related to soil conservation and reforestation. It needs to increase its capacity to reach the other institutions, such as CEL, which

are users of the service provided by ISREN. It also needs to abandon the subjective in favor of the objective quantitative approach, and lacks a long term plan for its institutional development in order to be able to meet the obligations imposed to it by law. The fact that it is not an autonomous institution but depends directly from a ministry, diminishes its administrative flexibility.

b) Executive Hydroelectric Commission for the Lempa River (CEL)

i) Profile

- Main Objectives and attributions:

- . Development, administration and utilization of El Salvador Hydraulic resources, particularly those from the Río Lempa and any other means of electric energy generation (Article 2 of CEL's constitution law);
- . Evaluate and develop oil reserves and the subsequent industrial and commercial activities;
- . Buy and sell crude oil needed by the country.

- Geographical Area of Competence:

All the country

- Administrative Structure and Dependence:

It is an autonomous institution. It has a Directive Council presided by the Minister of the Interior and formed by four Directors from the Ministry of Agriculture and Livestock, one from the Ministry of Public works and Socioeconomic Development, one from the Ministry of Planning, one from the Banking Institutions, one from the Agricultural and Industrial Associations, and one representing the CEL bond holders. It also has an Executive Director and a Deputy Executive Director.

- Main Executive and Address:

Ing. Francisco E. Grandino  
Executive Director, CEL  
P.O. Box 2669  
San Salvador, El Salvador

PH: 220855

TELEX: 20969; CABLE: CEL San Salvador

- Organizational Chart:

See Annex 2.2 .

- Staff and Funds (1980):

In 1980 CEL employed a monthly average of 1940 persons, contractors and subcontractors not included. CEL operated a special 1978-81 budget which showed by December 31st 1980 the following balance:

Income:           ¢ 481,509,969.71

Expenditure:   ¢ 454,896,340.39

It also operated two extraordinary budgets whose balance as of December 31st 1980 was as follows:

a) Seventh Energy Project

Income:   ¢ 121,961,270.79

Expenditure: 147,210,206.71

b) San Lorenzo Hydroproject

Income:   ¢ 230,775,660.81

Expenditure: 238,078,156.18

ii) Projects Related to Subject Matter:

See Annexes 4.1 to 4.5 for a description of the 5 de Noviembre, Cerrón Grande, San Lorenzo, El Tigre and Paso del Oso hydroprojects. The last two as modified by the Water Resources Master Plan.

iii) Critique

- Capabilities:

Being an autonomous institution, CEL has some degree of administrative flexibility. Its link to the Central Government is through the Ministry of Economy, but the decisions are taken by its Directive Council. It is a strong institution both technically and economically and has a relatively large weight in the public sector. It has some administrative substructure that could be used towards the purposes of the project. It would be the institution that would set forth the priorities in case the ROCAP project is geared towards watershed management for hydroelectric generation. CEL would be interested in a project such as the one proposed by ROCAP and most probably would appropriate funds for that purpose if the project is approved by its authorities. If CEL were to participate in the project, it most probably would be through its planning and studies Superintendence.

- Disabilities:

Watershed Management is not an activity that fits within the main responsibilities of CEL. Its importance is recognized and they would contribute to it, but their feeling is that another institution would do a better job at it. Its technical and administrative substructure is specifically for generating and selling energy and, although some of it could be used for the purposes of the project, a great effort would be needed to adequate it. At present, these activities would have to be attended by the Planning Superintendence, the Hydrology Section, and the Agrarian Superintendence, according to the officials interviewed. The Agrarian Superintendence was originally created to manage coffee plantations that became under CEL ownership when lands were acquired for certain projects. There is a certain tendency to equate watershed management to hydrology and reforestation. It seems that in the past CEL has participated in discussions as to when, where,

how, and by whom the reforestation activities should be done. It also appears that CEL has been approached in the past with an aim to convince them that they should engage in reforestation activities, but apparently their position has been that it is not within their responsibilities. Thus, a great effort or a new approach would be needed this time to move CEL into participating in a project such as the one proposed by ROCAP. It is believed that with an adequate approach, CEL might be convinced of participation, but it would be more difficult to convince them of being the institution in charge of the project.

c) Other Related Institutions and Groups in the Country

i) Ministry of Planning and Socioeconomic Development (10a. Avenida Sur y Calle México No.1505, San Salvador, El Salvador, PH: 229069):

The International Technical Cooperation Directorate is the office that has to approve all projects involving international participation. This office of the Ministry of Planning and Socioeconomic Development of El Salvador, holds the Secretariat of the Central American Technical Cooperation Committee (CIC), which is formed by the six Directors of international technical cooperation of the planning offices in the region. The CIC has been instrumental in the approval of regional projects such as the ESNACIFOR School at Siguatepeque, Honduras. They feel that the area of watershed management has not been covered adequately in Central America, and would be most interested in a project such as the one proposed by ROCAP, at a regional level. As far as El Salvador is concerned, they feel that a project such as this would have a high priority according to the country objectives. A large technical assistance component (experts) would probably not be received favorably, but an institutional development approach is appealing. As of January 1983, the Ministry of

Planning will have a Specialized Water Office as recommended by the Water Resources Master Plan of El Salvador, and they would be most interested in participating along with suggested institutions ISREN and CEL, in order to coordinate their activities.

ii) FAO - UNDP

With UNDP funds and FAO as executive agency, a project on conservation and comprehensive use of natural renewable resources in the northern watershed of Cerrón Grande reservoir is being executed. The work is done through three administrative -operative zones whose headquarters are in Chalatenango, La Palma and Nueva Concepción. Each zone has an Executive Zonal Delegate responsible for the work done in his area. It also has nine Rural Assistants, usually agronomists or agricultural graduates, and a home educator.

iii) Universities and Other Training Institutions:

This area is presently atomized in El Salvador due to the prevailing situation. There are some 27 private universities besides the National University, which is not functioning properly, due to the political situation.

2.1.2 GUATEMALA

a) National Forestry Institute (INAFOR)

i) Profile

- Main Objectives and Atributions:

- . Conservation and rational use of forestry resources;
- . Reforestation;
- . Inventory and evaluation of forest cover and lumber production;
- . Licenses for cutting of trees;
- . Ecosystematic, socioeconomic and forest inventory studies (through its Evaluation and Promotion Unit), as a basis

- 9 Professionals:
  - 5 Agronomists
  - 1 Forester
  - 2 Economists
  - 1 Lawyer
- 30 Technicians:
  - 9 Agronomists
  - 3 Foresters
  - 3 Botanists
  - 4 Teachers
  - 1 Public Relations
  - 10 High School Graduates
- 11 Administrative and Other:
  - 1 Accountant
  - 2 Secretaries
  - 8 Auxiliaries

Its organizational chart is given in Annex 2.5. The budget of this units is as follows: (1982)

Administration	Q 22,170
Ecology	81,653
Forest Inventories	139,844
Economy & Social Studies	<u>55,161</u>
TOTAL	Q 298,828

ii) Projects Related to Subject Matter

- Reforestation (see Map of Annex 3.7 )

PROJECT	STARTED	TOTAL HECTARES	Q. TOTAL COST	HECTARES TO 6/30/82
Cuilco Watershed	1979	29,676	13,354,200	912.43
Chixoy Watershed	1978	8,000	3,688,000	1,181.49
Suchiate Watershed	1976	3,628	860,245	1,053.15
Teocinte Watershed	1976	1,750	933,757	1,084.75
Xayá-Pixcayá Watersheds	1979	4,000	1,362,430	468.11
Amatitlán Watershed	1981	2,500	2,067,425	735.47
Aguacapa Watershed	1979	14,000	6,492,225	1,581.62
Río Grande Watershed	1979	7,643	3,439,350	1,653.23
Río Hato Watershed	Not yet	110	90,469	-
Small Water Supply Basins in Jutiapa	Not yet	978	1,033,000	-

SOURCE: INAFOR

More information about the reforestation project of the Chixoy Watershed is given in Annex 5.1.

- Integral Management of Momostenango Watershed

INAFOR has the idea to extend the Momostenango Project outside the municipal boundaries to cover the upper Río Negro basin, which is the critical sediment yield area for the Pueblo Viejo-Quixal hydroproject. They have made the following maps about this area (Scale 1:50,000):

- . Present Land Use
- . Potential Land Use
- . Land Gradients
- . Vegetal Life Zones

- . Runoff and Drainage Patterns
- . Potential Erosion Susceptibility
- . Forestry Vocational Areas and Priorities for Reforestation (in process).

The original Momostenango Project is described in Annex 5.4.

- Restoration of Amatitlán Lake:

This project drafted by an interdisciplinary and interinstitutional commission involves pollution control, recreation, water resources, soil resources, wildlife, water use, and health activities. The proposed total investment is about Q3.5 Million. More details are given in Annex 5.5.

- Natural Resources Conservation Program

This program aims to motivate local rural inhabitants towards adequate use and management of natural resources. It is being executed by INAFOR, CARE and Peace Corps. Additional details are given in Annex 5.6 .

- Fuelwood and Alternative Energy Resources

This is a Regional project involving ROCAP, CATIE and ICAITI at regional level and INAFOR at national level in Guatemala. Its main objective is to solve the energy problem of the rural inhabitants. There is a professional paid by INAFOR and an assistant paid by CATIE. The principal activities to date of this project in Guatemala have been a bibliographic compilation, basic research, observation and experimentation of species, monitoring of plantations, and promotional activities. Annex 5.11 gives a description of the project at the Regional level.

iii) Critique

- Capabilities:

INAFOR has the legal base to carry out a project such as the one proposed by ROCAP. It also has interest in it and has certain admi-

nistrative substructure. This includes an ecological approach to natural resources activities that is lacking in other institutions. It has some experience in watershed management related activities such as reforestation in several watersheds, including coordinated work with INDE in the Chixoy watershed, although this project is very limited in scope.

- Disabilities:

There is no natural resources institution in Guatemala such as ISREN in El Salvador, where watershed management activities could be located. Soil conservation activities are the responsibility of other institutions, as well as hydro-meteorologic coverage. The closest is perhaps INAFOR because of its ecological approach and ecosystematic investigations. By its nature however, INAFOR is heavily slanted towards reforestation, and some effort would be needed to develop an adequate substructure for watershed management. The budget allotted to the Evaluation and Promotion unit is scarce, as well as its human resources. The watershed reforestation activities of INAFOR respond more to requests of institutions or local authorities than to a comprehensive plan. Experiences in coordinated team work such as those related to the Lake Amatitlan project have not been very successful. Sometimes there is a different conception about watershed management problems between administrative and technical levels.

b) National Electrification Institute (INDE)

i) Profile

- Main Objectives and Attributions: Besides electric generation and distribution, according to its legal base (Congress Decree No.1287 of 5/27/59):

- Work towards the rational use of natural resources.
- Conservation of water resources in the country.

- Protection of watersheds water sources and riverbeds.
- Evaluate the hydroelectric capacity of the country.
- Geographical Area of Competence:

All the Country.

- Administrative Structure and Dependence:

INDE is a semi-autonomous Institution. Its link to the Central Government is through the Ministry of Communications. Its main authority is a Directive Council integrated by a President and five Directors. It has a General Manager and four Deputy Managers.

- Principal Executive and Address:

Eng. Rolando Yon Siu

6a. Avenida 2-73, Zona 4

Ciudad de Guatemala

Phone: 65-7-73

Telex: INDE 5324 GZ, Cable: INDE Guatemala

- Organizational Chart:

See Annex 2.6

- Staff and Funds:

The distribution of the 3161 employees of INDE is as follows (1981):

Category	Area					
	Financial	Administrative	Planning and Projects	Construction	Operation	Total
Professional	4	12	66	62	53	197
Technical	20	69	17	81	96	283
Administrative and Auxiliary	107	81	116	437	626	1367
Operators	7	21	27	129	698	882
Other	1	39	43	97	752	432
Total	139	222	269	806	1725	3161

Source: INDE

In 1980 the balance of INDE was as follows:

Income: Q85.13 Million

Expenditure: Q80.99 Million

This does not include the extraordinary budgets for the construction of Pueblo Viejo - Quixal and other Projects.

ii) Projects Related to Subject Matter

- Hydroelectric Projects:

See annexes 4.6 to 4.11 for a description of Pueblo Viejo - Quixal, Jocotalles, Los Tapezcoc, Palzajel, Serchil, and Xalala hydroelectric projects. All of them are in the Chixoy watershed.

- Reforestation Activities:

INDE has undertaken a reforestation program in the Chixoy river basin, upstream from the Pueblo Viejo - Quixal hydroelectric project, through its water-

shed Protection Unit. A description is included in Annex 5.2.

iii) Critique

- Capabilities

Being a semi-autonomous institution, INDE has some degree of administrative flexibility. It is a strong institution both technically and economically and has a relatively large weight in the Public Sector. It would have a strong voice to set forth the priorities in case the ROCAP project is oriented towards watershed management for hydroelectric generation. INDE is interested in watershed management studies and it has experience in such activities, since a comprehensive study for development of the Chixoy basin was made in 1980-81 with IDB financing and the cooperation of the Consulting Firm LAVALIN (See Annex 5.3). Its legal base allows INDE to undertake activities such as the one proposed by ROCAP. Limited watershed protection activities are being made in the Chixoy river basin in cooperation with INAFOR. For this purpose, it has a Watershed Protection Unit within the administrative unit of the Pueblo Viejo-Quixel project. With an adequate approach, it may be convinced to be the institution in charge of the project.

- Disabilities

Although interested in studies for watershed management, operational activities in this area do not interest INDE too strongly. It may undertake them, depending on how a project is structured, but up to now it has been an incidental activity such as the one now being carried out in the Chixoy river basin. Some effort would be needed to adequate its administrative substructure for this, since up to now only a small incidental unit is attached to the Pueblo Viejo-Quixel project.

c) Other Related Institutions and Groups in the Country

i) Renewable Natural Resources Directorate (DIRENARE) of the General Directorate of Agricultural Services (DIGESA) Guatemala City, Guatemala PH: Irrigation and Drainage 310121; Soil management program 315852):

DIRENARE and DIGESA, belong to the Public Agricultural Sector, as shown in the organizational chart of Annex 2.3. DIRENARE'S name notwithstanding, it focuses mainly on those activities related to Agriculture, such as irrigation and drainage, soils, water quality for agricultural purposes, etc. It has a Watershed Studies Unit, which recently participated in the natural resources evaluation within the "Rural Areas Integrated Studies" with AID funding. This study covered the provinces of Quezaltenango, Totonicapán, Sololá, San Marcos, and Huehuetenango. More information about this study can be found in Annex 5.7. This unit is presently engaged in studying the agricultural potential of the international river watersheds bordering with Mexico. DIRENARE also has a national soil conservation program that will require a Q20 million investment.

ii) Sectorial Unit of Agricultural, Livestock and Food Planning (USPADA) (Via 2, 3-34 B, Zona 4, Ciudad de Guatemala, Phone: 31156, 324255, 315595): This Unit is the link between the Public Agricultural Sector and the General Secretariat for Economic Planning SEGEPLAN (see Annex 2.3 ). Its main function is to coordinate the activities of the Public Agricultural Sector that are specified in the Agricultural Development Plan, with the National Development Plan of SEGEPLAN. Thus, it is a clearinghouse for projects of both INAFOR and DIRENARE. At present times its guidelines are the "National Plan of Security and Development" and the "Short Term Economic Policy" set forth by the Government of Guatemala. These guidelines include the 14 general national objectives enunciated on March 23, 1982, plus the following short term economic objectives:

- Diminish the balance of payments disequilibrium in the external sector.
- Correct the disequilibrium of public finances.

- Reactivate the productive sectors and levels of employment.
- Atenuate the Social unbalance, especially in the violence prone areas .
- Contribute to reactivate the Central American Common market.

USPADA is now backing two projects for which IDB financial assistance is being sought:

- Rural Integrated development in two Areas of the Western Highlands.
- Integrated Agricultural Forestry and Native Crafts Development of the Momostenang Municipality. This project is described in Annex 5.4.

iii) General Secretariat for Economic Planning (SEGEPLAN) (Edificio de Finanzas Nivel 11, Centro Cívico, Ciudad de Guatemala. Phone: 511601/19 511380, 511394): Two Departments of SEGEPLAN would be mainly concerned with a project such as the one proposed by ROCAP: the Department of Energy and the Department of International Technical Cooperation. The First one is the representative of Guatemala in the Central American Energy Program (PEICA), and tries to coordinate policies regarding energy matters in the country. However, as far as hydroelectric energy is concerned, it tries to help INDE, which has considerable more weight in these matters. The Department of International Technical Cooperation would be the one to recommend approval of the project, since it involves international aid. Officials in this Department are interested and feel that it would have a high priority according to the present Government guidelines. A problem could arise, however, since emphasis is being given to short term projects. If the emphasis of the proposed project is related to hydroelectric generation watersheds, the opinion of the Department of Energy will probably be asked and taken into account.

iv) University of San Carlos (Ciudad Universitaria Zona 12, Guatemala. Phone: 460611/13 460321/25):

It is the National University and the largest (about 40,000 students) and oldest in the country. Founded in 1676 is also one of the oldest of the Americas. Currently there is no specific Watershed Management program within the University. There are, however, several closely related areas. One of this is in the School of Agronomics where a curriculum has been proposed for Renewable Natural Resources Engineering. The Syllabus of the School of Biology includes topics related to natural resources (mostly Flora and Fauna) and ecology. In the school of Engineering there is a Graduate program (M.S. level) for Water Resources Engineering with emphasis on comprehensive planning. It is the only such graduate program in Central America and serves the six countries of the Region.

v) Rafael Landivar University ( Campus Vista Hermosa III, Zona 16, Guatemala. Phone: 692151, 692621, 692751):

It is the oldest and largest of the private universities. Some actions have been taken to create an Environmental Sciences Institute with three main activities: teaching, research, and services to the public. It is not fully developed yet.

### 2.1.3. Honduras:

a) Hondurean Corporation of Forest Development (CONDEFOR)

#### i) Profile

- Main Objectives and Attributions:
- Development and management of the forestry sector, both public and private.
- Protection and restoration of national forest resources
- Planning and financing wood product industries.
- Betterment of the living conditions of the rural population

that lives in the forested areas of the country.

- Geographical Area of Competence:

All the Country

- Administrative Structure and Dependence:

CONDEFOR is an autonomous institution linked directly to the highest level of decision in the Presidency of the Republic. Its main authority is the Board of Directors which is presided by the President of the Republic. Other members are the Ministers of Natural Resources, Economics and Commerce, Treasury and Public Credit, and Defense and Public Security, as well as the Secretary of the Superior Committee of Economic Planning (CONSUIPLANE). It has a General Manager. The place of CONDEFOR in the Public Sector is shown in Annex 2.7.

- Principal Executive and Address:

Prof. Rodrigo Castillo  
Apartado No. 1378, Tegucigalpa, Honduras  
Phone: 227050, 226652, 224346

- Organized Chart:

See Annex 2.8

- Staff and Funds:

It has about 3,000 employees, more than 70 percent of which are in the Forestry Department. Its total budget is in the order of 300 million Lempiras.

ii) Projects Related to Subject Matter

With IDB financing and FAO Cooperation, CONDEFOR is executing a 5 year reforestation project in Comayagua (Comayagua Plan) which started two years ago. The watershed of El Cajon hydroelectric project is in this area. Along with the Natural Resources Secretariat (SRN), INA, the Communications, Public Works and Transportation Secretariat, the Pan American Agricultural School, and the National Cadaster, CONDEFOR is participating in the AIT

financed Choluteca Watershed Management Project. It is also performing several reforestation activities in the upper Patuca River basin.

iii) Critique

- Capabilities:

By Law, COHDEFOR is the institution in charge of watershed management activities. It is a strong institution both in funds as in personnel, and is directly linked to the Presidency of the Republic. It has an adequate administrative substructure with a watershed management unit. It has some experience in watershed management activities, although these have had a strong reforestation slant. It is presently involved in an interinstitutional management effort related to the Choluteca project, and was responsible for the Los Laureles Watershed Management Project. This project included measurements and field experiments to assess the potential reservoir sedimentation and the impact of different land uses in the watershed ( sixty percent of Tegucigalpa water supply comes from Los Laureles reservoir)

- Disabilities

It has been subjected to criticism for lack of persistence in some watershed management activities that have been initiated and then abandoned or not cared for properly. Although it has had experience in watershed management activities, the brunt of its operations is the commercial exploitation of forests. The main objectives of the Watershed Management Unit have been social problems and land use, and small farmer agriculture and related deforestation.

b) National Enterprise for Electric Energy (ENEE)

i) Profile

-Main Objectives and Attributions: According to Decree No. 48 of the Military Junta of 2/20/57, its main objectives are:

- . To provide Electric Energy to the country.
- . Planning and execution of electric energy projects.
- . Operation and Administration of Public Energy projects.

- Geographical Area of Competence:

All the country

- Administrative Structure and Dependence:

Annex 2.7 shows its place in the Public Sector. It is an autonomous institution whose maximum authority is a Board of Directors presided by the Minister of Communications, Public works and Transportation. Other Directors are the Ministers of Natural Resources and Treasury and Public Credit, a representative of the Private Enterprise Council of Honduras, a representative of CONSUPLANE, and the President of the Central Bank of Honduras. It has a Manager and an Administrative Deputy Manager.

- Principal Executive and Address:  
Eng. German Aparicio  
P.O. BOX 99, Tegucigalpa, Honduras  
Phone: 22-2444  
Telex: 1128 HT

- Organizational Chart:

See Annex 2.9. In El Cajon Project, there is a Watershed Management Interinstitutional Working Group.

- Staff and Funds:

ENEE has about 3,000 employees, and its financial balance by December 31, 1980, was as follows:

Income: L. 98.7 Million                      Expenditure: L 71.7 Million

Additionally, ENEE invested in 1980 about L 152.8 million in several activities. About 64 percent of this investment was directly in hydroelectric projects.

ii) Projects Related to Subject Matter

El Cajon and El Nispero hydroelectric Projects are described briefly in Annexes 4.12 and 4.13. Other projects were described briefly in section 1.4.3.

iii) Critique

- Capabilities:

Being an autonomous institution, it has some administrative flexibility. It has some interest in watershed management activities and some administrative substructure for it. A project such as the one proposed by ROCAP would be of interest to ENEE, provided that it is done within the normal activities of the institution and would not surpass its present personnel and equipment. There is some interinstitutional experience in watershed activities through El Cajon working group. At technical engineering level, there are very definite ideas as to where and how watershed management activities are needed.

- Disabilities:

Although it is an autonomous institution, it is somewhat at a lower level than COHDEFOR since its link to the highest levels of authority is through a Ministry and not direct. It has no trained personnel in watershed management, and such activities are considered incidental because of a given project such as El Cajon, rather than within the main line of activities of the institution. The watershed management activities related to El Cajon are focused mainly to identifying tasks and assigning them to other institutions through the Interinstitutional Working Group. This project originally envisioned as of a larger magnitude, has been trimmed down because of lack of funds and following an IDB suggestion, included in the activities of the Plan Comayagua. Sometimes the points of view and understanding of watershed management problems related to hydroelectric projects, differs between the administrative and technical levels.

c) Other Related Institutions and Groups in the Country

i) Natural Resources Management Project:

This project, focused on the upper Choluteca River basin, aims to

strengthen the institutional capability of the Government to generate basic information for development of policies, plans, and programs for renewable natural resources, specially forests, soils and water. With AID and Government funding for L 43.9 million (68 and 32 percent, respectively), it is being implemented (after some time lost in organizational efforts) by a special unit of the Natural Resources Secretariat (SRN). Other institutions such as CONDEFOR, INA and the National Cadaster also participate. It is coordinated by an Executive Natural Resources Committee formed by the Minister of Natural Resources, the Secretary of CONSUPLANE, the Executive Director of INA, the General Manager of CONDEFOP, and the Ministry of Treasury and Public Credit as permanent guest. There are about 53 persons presently working in the project: 15 professionals, 13 technicians, 10 of supporting services, and 15 administrative. In the future there will be an increment, since only in technical assistance more than 236 man months will be used in 5 years. Activities have been initiated in the Aguas de La Cabecera sub-basin, and will be initiated shortly in the Sampire sub-basin. For middle 1983, another sub-basin will be initiated. For each basin they have as a minimum, the following persons: one Agronomist Engineer, One Dasonomist, and one promoter. The organizational chart of the project is included in Annex 2.10 . Annex 5.8 gives a summary of aims and goals of the project. The project has been plagued by organizational troubles, since responsibilities were assigned at first, but funds were not allotted to participating institutions. Thus, many rivalries and frowns existed at the beginning. It was also found that the data base was not realistic, and it has been necessary to make additional efforts to obtain this data base.

ii) Superior Committee of Economic Planning (CONSUPLANE):

As in El Salvador and Guatemala, its Department of International Technical Cooperation has a voice in approving all international projects.

They feel that a project such as the one proposed by ROCAP could reach a high priority among the priority groups they have defined. They are of the opinion that a project such as this, should be linked to local development and integrated into the production process of the country since the crux of the problem rests on the subsistence needs of the rural inhabitant. As far as the possible relationship of the project with PEICA, it is believed that this program is in serious organizational and monetary trouble. CONSUPLANE is the executive agency for the regional-local planning project of the Aguan Valley, with UNDP funding. This project is described in Annex 5.9.

iii) Hydrologic and Climatologic Services Department, General Directorate of Water Resources, Natural Resources Secretariat:

It operates 150 stations. There are about 12 other institutions that operate hydrometeorological stations, but most of them are being transferred to this Department: 30 from COHDEFOR, 38 from CONSUPLANE, 1 from SAPIAN, 14 from the AID Natural Resources Management Project. The idea of a project such as the one proposed by ROCAP is looked upon very favorably, but they foresee organizational problems since there is no single institution where it would fit and in the past the interinstitutional commissions have not worked.

iv) National Aqueduct and Sewer Autonomous Service (SANAA):

This Institution is in charge of water supply and sanitation for all Honduras. With IDB funding, it has recently concluded a "Master Plan for Tegucigalpa D.C." to provide water supply and sanitary as well as storm sewers for Tegucigalpa up to year 2010. It includes projects in the upper Choluteca river basin and is described in Annex 5.10.

v) National Forestry Sciences School (ESNACIFOR): (Siguatepeque Honduras):

This School was created as a Regional effort with the assistance

from FAO, to prepare Central American technical people in forest management and forest industry. It received funds from CONDEFOR and is trying to establish a third program in watershed management.

vi) National Autonomous University of Honduras (UNAH):

Through its Regional University Center for the Atlantic Coast (CURLA), it has a program in La Ceiba to prepare Forestry Engineers.

2.2 Regional Agencies

2.2.1. Permanent Secretariat for the Central American Economic Integration

General Treaty (SIECA):

a) Profile

i) Main Objectives and Attributions:

- Keep watch for the Correct application of the General Treaty of Economic Integration and other Commercial and Economic Integration Regional or bilateral treaties.

- Keep watch for the fulfillment of resolutions of the Central American Economic Council and the Executive Council created by the General Treaty, and perform the studies, tasks, and functions set forth by these councils.

ii) Geographical Area of Competence:

Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua.

iii) Administrative Structure and Dependence:

The Ministers of Integration from each of the five countries from the Central American Economic Council, which establishes policies. The Executive Council formed by one representative from each country, manages and applies such policies. SIECA keeps watch for the fulfillment of resolutions of both councils. It is divided into Departments and Sections.

iv) Principal Executive and Address:

Dr. Raul Sierra Franco  
Secretary General (elected by the countries for 3 year periods)  
4a. Avenida 10-25, Zona 14

Apartado Postal 1237  
Ciudad de Guatemala  
Phone: 682151/4  
Telex: "Integración SIECA"

v) Organization Chart:

See Annex 2.11. .

b) Projects and Associated Activities Related to Subject Matter:

i) Central American Multinational Watershed Study:

This study was made in 1973 with financial assistance from IDB. It included a diagnosis and an evaluation of the development possibilities in three multinational watersheds: Gulf of Honduras, between Guatemala and Honduras; Gulf of Fonseca between El Salvador, Honduras and Nicaragua; and San Juan River, between Nicaragua and Costa Rica. For each one of these it included natural resources, substructure, socioeconomic situation, agriculture and livestock, mining, industry, transportation and energy, actual conditions and trends, and development perspectives.

ii) Central American Energy Commission (COMENER):

It was created in 1975 by resolution of the 13th Meeting of the Ministers of Economy of Central America. Its main purpose was to coordinate the policies of energy development in the five countries, performing as a technical advisory council. Its Secretariat is SIECA. COMENER is formed by one representative from each country and its attributions are:

- Promote hydroelectric and geothermal studies to indentify suitable energy projects.
- Promote energy projects using the natural resources of the Region, and reducing the use of imported hydrocarbons.
- Promote the interconnection in Central America.
- Promote Petroleum natural gas, and coal exploration efforts.

- Study the creation of multinational enterprises of the Central American countries related to the petroleum industry, and the joint use of other energy resources.

It met once and, unfortunately, its second meeting scheduled for late 1979 has not yet taken place.

iii) Central American Energy Program (PEICA)

This program was initiated in 1976 with support from the UNDP. During a first phase, the principal activities that could be included to integrate a regional energy program were identified. A second phase was initiated in 1978 with OPEP funds through the UNDP. An ad-hoc committee with representatives from each country was created to coordinate its activities and a Regional Coordinator was appointed with UNDP funds. Among its activities was the elaboration of energy balances for each country. The balance for El Salvador is already published. The one for Honduras has been finished and is about to be published, but the balance for Guatemala was never undertaken because a consulting firm was supposed to be working on it, but the results were not what was needed.

The second phase ended in 1981 and now, a third phase is being promoted. This new phase will have four major components:

- . Energy planning; to consolidate a regional planning group, to evaluate the renewable energy resources in the Isthmus, to promote the rational use of energy in the six countries, and to back up the institutionalization of the energy sector in the six countries. Expected cost is about \$836,000.
- . Regional Electric Integration, with an estimated cost of \$931,000.
- . Integration of the hydrocarbons sector, with a \$862,000 cost.
- . Training. Estimated cost is \$ 1,213,000.

COMENER was to be the main Regional Organization for PEICA and thus SIECA is involved in its activities. PEICA received strong support from CEL in El Salvador. Some institutions in Honduras are skeptical and in

Guatemala, it has been coordinated by SEGEPIAN, but INDE has not been too enthusiastic in giving support to it.

At present it is idling because no financial source has been found yet for its third phase. There is no Regional Coordinator and some think it will not survive its organization and financial woes.

c) Critique:

SIECA has the basic administrative substructure, but it is limited in staff. These activities are carried on by its Department of Physical Integration which is understaffed. It lacks the financial resources to cover the technical human resources needs required by COMENER. These needs are actually being taken care of by one expert.

2.2.2 Regional Committee for Hydraulic Resources of the Central American Isthmus

a) Profile:

i) Main Objectives and Attributions:

The Regional Committee for Hydraulic Resources of the Central American Isthmus (Comité Regional de Recursos Hidráulicos), CRRH, is an organization created by the governments of Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panamá. CRRH, is a coordinating organization in activities related to meteorology, hydrology and hydraulic resources.

The Central Office is in Tegucigalpa, Honduras, and is administered by the Executive Secretary under the direction of a committee consisting of the presidents of the national water resources committee of the six countries.

The principal aims of the Committee are:

- To use the conservation and development of surface and ground-water resources as a mean to further the social development and the economic integration of the Central American Isthmus.
- To use the surface and ground-water resources integrated with the human requirements and with the other natural resources.
- To use the activities in meteorology, hydrology and evaluation of water resources, both surface and underground, as a means of unifying the professionals working in these disciplines in Central America.
- To orient the meteorologic and hydrologic investigations towards the solution of actual and future problems related to climate and the integral use of water resources in the Isthmus.
- To develop the hydrologic and meteorologic activities in the Central American Isthmus as to contribute to the worldwide advancement in these disciplines.
- To use the water resources (both surface and underground) in the Isthmus in a rational and integral manner so as to promote their conservation.

ii) Geographical Area of Competence:

The Central American Isthmus

iii) Administrative Structure and Dependence:

The Regional Committee is formed by the 6 National Committees of Hydraulic Resources, one for each country. Each National Committee is formed by the national institutions that deal with water related issues.

The principal national institutions are the ministries of agriculture or of natural resources, the meteorologic or hydrologic organizations, the

the institutions that manage electric energy, domestic water supply, irrigation, etc.

The projects and activities of the Committee are carried out by the institutions in each country.

iv) Principal Executive and Address:

Lic. Nabil Kawas  
Executive Secretary  
P.O. Box 718  
Tegucigalpa, D.C., Honduras  
PH: 323804

b) Projects and Associated Activities

Various international organizations have requested the collaboration of CRRH for their regular and special programs in the region. These include the "WORLD WEATHER WATCH" and the Hydrologic Operative Program, HOMS, of WMO, as well as the International Hydrologic Program of UNESCO. CRRH cooperates in the coordination and execution of these activities involving its member institutions.

The Committee is now giving high priority to the following projects of specific regional interest:

- i) RLA/80/003 "Regional Development and Application of Components of the Operative Hydrologic Sub-Program for Multiple Use" (HOMS) of WMO:

The objective of this project is the transfer of technology for the evaluation of the hydraulic resources among the countries of the region and HOMS centers in other parts of the world.

This project has a UNDP contribution of 344,000 dollars, and the participating countries provide an equal amount.

- ii) RLA/78/021 "Hydrologic Forecasting in Central America"

This project is to provide the basic methodology and necessary

instrumentation for a reliable modern system of prediction.

The project document is presently finished and will be submitted for approval by CRRH and to UNDP through the economic planning offices of the member countries.

The cost is estimated in 661,000 dollars as a contribution from UNDP, and 5,280,600 dollars from the six Governments.

iii) Short Courses and Other Related Activities

In 1979 approval was given to the national universities of the six countries and to CRRH for the course "Regional Itinerant Post-Graduate Course in Hydrology and Water Sciences," with assistance from UNESCO and ERIS. In 1980 the subject was "Quality of Basic Information for Hydraulic Projects," and was given in Tegucigalpa, Honduras and San José, Costa Rica. In 1981 it was given in Nicaragua and Panama and the theme was "Small Watersheds Development". For 1982 it is scheduled for El Salvador and for Dominican Republic, and for 1983 in Guatemala, Honduras, and Costa Rica.

CRRH has also collaborated with the ROCAP/IICA sponsored PIADIC project in organizing two seminars of 3 days duration in each of the participating countries. An important part of each seminar consisted in a description of the importance of the importance of and the use of solar radiation data in agricultural development.

Other important activities include the publication of 148 technical studies or reports for use by national and regional technicians over a period of 13 years.

During the progress of the UNDP-WMO sponsored regional PHCA, a climatic atlas (Atlas Climatológico del Istmo Centroamericano) was prepared jointly with PAIGH. The atlas contains various maps of the principal hydrometeorological parameters that have been studied in this area.

c) Critique

Since 1966 CRFH operates through the institutions that form the National Water Resources Committees in each country. The Secretariat performs an effective coordination and promotion role among and within the six countries, and between these and the international organizations. Regional projects require an active lobbying activity and this is one of the most important functions of the Secretary. Needless to say, the Secretariat is understaffed since it has only one professional and 3 administrative and support persons.

3. EXAMPLES OF POSSIBLE WATERSHEDS FOR PROJECT IMPLEMENTATION

3.1 General Statement

After consulting with the institutions discussed in sections 2.1. and 2.2., the Consultant reached the conclusion that it is premature at this stage to try to define watersheds for project implementation.

Some persons interviewed had clear in their minds which watershed should be chosen, but some did not. And then, except in Guatemala where the opinion was unanimous about the Chixoy watershed, there were conflicting opinions as to "which," "where," and "why."

Some persons did not want to express an opinion because they were afraid to compromise their institution so early in the game, and some did not do it because they would have liked first to have more information and perhaps to discuss it with other staff members.

It is believed then that this subject should be left for the early stages of the project itself, when responsible officials feel that they have solid bases to decide and are not based on abstract "blue prints." At any rate it is felt that this is a decision that the countries themselves

will have to take, and it may even be that a given country decides not to base the project upon activities to be implemented in any single watershed, but in several small pilot areas.

But since one basic premise of the proposed methodology is that of "learning by doing", it is attempted to define an envelope of the opinions received, in order to set forth examples of possible watersheds and the reasons for choosing them.

### 3.2. El Salvador

There are three possibilities, all related to Río Lerma:

#### 3.2.1. Watersheds to the North and North West of Cerron Grande reservoir:

These involve the Sumpul, Tamulasco, Azambio, Grande de Tilapa, Metayate, and Mojaflares rivers, with a combined area of some 1,200 square kilometers (see Annex 3.2 ). The Sumpul River watershed is partially in Honduras.

They are overgrazed lands mostly degraded or suffering an intensive degradation process, as can be seen in the following table:

Land Use	Approximate Percentage of Total
Degraded	44
Natural Pasture	33
Agriculture (annual)	14
Forest cover	9

Source: UNDP - FAO

The UNDP - FAO soil conservation project is in that zone, which seems to have priority because most of the sediment to the middle Lerma down to

5 de Noviembre dam seems to come from there. It contributes to the Cerron Grande reservoir, which is the main river regulation feature of the whole river.

There is a good data base for this area. A drawback is that this zone is in the Chalatenango area where serious problems of violence are now occurring.

3.2.2. Watersheds to the North of Río Lempa, between 5 de Noviembre dam and El Tigre damsite:

This is the area that has the highest sediment yield.

It involves the Mocal, Guarajambala, and Torola rivers, which have a combined area of 5,245 square kilometers. Most of the Mocal and Guarajambala areas and part of the Torola are in Honduras, and involve an area over which territorial disputes have been fought in the past.

Smaller critical areas would have to be defined for study if this problem is to be chosen.

The hydroelectric project El Tigre has a relatively small reservoir since the flow from Río Lempa is controlled by Cerron Grande and only the Mocal, Guarajambala and Torola waters would have to be regulated there. However, the Water Resources Masterplan has determined that flood damages downstream would occur from floods coming from these three rivers alone, and therefore has identified the need for flood control space in El Tigre. This scheme underlines the importance of sediment control in these three watersheds.

3.2.3. Area upstream from the Lempa - Desague Confluence:

One important portion of the higher Lempa watershed is regulated by the Güija lake. This is the portion that is mostly in Guatemala, and reaches Lempa below Güija through the Desagüe river. There is however, another river branch to the east: the Lempa proper, which flows from Honduras.

Most of this area to the north is forested, but some degradation exists to the southeast of Metapan.

CEL plans the Zapotillo dam just below the confluence of Lempa and Desagué rivers, and Paso del Oso downstream from it. Although both of them are not scheduled yet, the Water Resources Masterplan has proposed a multipurpose scheme between elevations 300 and 430 m.a.s.l. which involves irrigation and water supply for San Salvador. This scheme includes a single larger dam at Paso del Oso, whose active storage would have to be protected from sedimentation.

### 3.3. Guatemala

#### 3.3.1. Upper Chixoy Watershed

The Chixoy watershed down to Pueblo Viejo dam has an area of 5450 square kilometers. Downstream from Pueblo Viejo, INDE has studied the Xalalá project to feasibility stage. Upstream from Pueblo Viejo, prefeasibility studies have been made for 4 more projects. As can be seen in Table 14, seven out of the nine hydroelectric projects involving reservoir now being considered by the phase II of the national electrification plan, are in the Chixoy watershed.

No sediment problem has been envisioned for the Xalalá project, since most of it would be trapped by Pueblo Viejo and other upstream reservoirs, and the area between Pueblo Viejo and Xalalá presently has a very low sediment yield. For these, however, the problem is real as was already discussed in section 1.3.

All of the projects upstream from Pueblo Viejo are located in or downstream from the highest sediment yield rate area (about 1100 tons per square kilometer per year).

The area upstream from Pueblo Viejo shows an advanced degree of degradation and has been the subject of several studies. In 1974, Goodland and Pollard stated that "extensive and precipitous slopes and the protracted six-month dry

season, followed by relatively heavy rains, conspire to make erosion a serious potential hazard. Unchecked, erosion, will increase with environmentally disruptive activities, such as cutting, burning, cultivation, road and dwelling construction and the population increase in general. The life of the projected dam system can be cheaply and effectively extended by progressive watershed management."

Some reforestation activities are now under way carried out by INAFOR close to the Pueblo Viejo damsite, and by INDE in the Pueblo Viejo - Sacapulas reach. An integrated agriculture - forestry development project for the Momostenango Municipal area proposed by LAVALIN - INDE, is now being backed by USPADA. An enlarged version of this Momostenango project is being studied by INAFOR for the area upstream from Serchil (some 1400 square kilometers). These activities and studies are documented elsewhere in this report.

There is extensive information and a good base data for this area. It has some violence - related problems and this would be a drawback. However, it is within the areas that the Government has given high priority for immediate attention.

### 3.4. Honduras

#### 3.4.1. El Cajon Watershed

It has and approximate area of 8,300 square kilometers. It is much degraded by deforestation, shifting agriculture, and erosion. Poor watershed management is likely to negatively affect the useful life of the reservoir. A watershed management plan was drafted, submitted to IDB for financing, and a coordination working group formed, but later it was scaled - down and included in the COMDEFOR IDB funded 40,000 hectare forest management "Plan Comayagua," as a result of the recommendations of an IDB mission to Honduras.

#### 3.4.2 Middle Patuca Watershed:

INEE is considering the Piedras Amarillas and Portal del In-

fierno large hydroelectric developments in the middle Patuca reach, downstream from the Río Guayambre and Río Guayape confluence, for the nineties.

This has been a pristine area, but disturbing symptoms have been detected lately, such as steeper flood flow peaks and twelve meter rises in water levels in some streamgaging stations.

The upper portion of the watershed is deforested along the Guayambre river and there are agricultural and livestock SRN projects down the Guayape river. Downstream from their confluence, INA is promoting land settlements which are starting a shift agriculture pattern.

#### 3.4.3. Choluteca Upper Watershed:

This is a very degraded area due to population pressure (25% of the country's population). About 20,000 rural families have been forced by circumstances to farm on steep slopes increasing erosion and lowering productivity. Fuelwood cutting for Tegucigalpa has increased the deterioration of the area.

There are no hydroelectric projects in this area. However, the SANAA water supply masterplan considers some developments in the upper watershed. There is also a SRN multipurpose water resources development included in an agricultural development project for the Choluteca river.

The Choluteca watershed is the area that presently has the better data base in the country. The AID backed Natural Resources Management project is being executed in this area. This project aims to develop a law, policy, and institutional package for land use and natural resources, a land use classification system and practical activities within the area.

#### 4. PRINCIPAL CONSTRAINTS TO MANAGEMENT PLAN DEVELOPMENT AND SUBSEQUENT PROJECT IMPLEMENTATION

##### 4.1. Data Base

The data base available is in general well developed for the three

countries. Water resources data are managed through competent independent hydrometeorologic services or basic studies units within the electrification institutions. Excellent summaries have been compiled and published as part of large project studies within the areas that might be selected for the proposed project implementation, or as part of masterplan studies. An effective Regional data interchange and normalization has been developed as part of past UNDP - WMO Regional projects as well as present CRRH efforts.

Data related to other natural resources and other data related to management plans are not as well organized and, although some inventory efforts have been made, considerable more effort would be needed to organize them in a suitable manner. Soils and land use as well as forest cover are the data areas in better shape, although obsolescence exists in the last two due to the rather static nature of data updating and the very dynamic rate of resource degradation. Good reliable data on erosion rates is lacking for many areas. No regional system of interchange and coordination exists and although CRIES may serve this purpose, it is still incipient.

The local National Geographic Institutes are a source of valuable information graphic and otherwise. As part of a joint effort with PAIGH (Pan American Institute of Geography and History), useful researcher's guides have been published for all six countries. These guides are a valuable information source as to existing topographic and thematic maps, as well as atlases aerial photographs and other remote sensing images. Regional maps of the main hydrometeorological parameters have been published by PAIGH - CRRH.

No severe constraints for plan development are thus expected in the data area, except in erosion rates, and maybe in the aspect of Regional interchange. There are however, mechanisms such as CRRH, CRIES, and PAIGH that could be used.

For project implementation, specific data restrictions could arise depending upon the geographical areas that are chosen for the project, but this could

be expected anywhere in the world.

#### 4.2. Prior and Existing Efforts Undertaken in this Field with International Aid

The main efforts are summarized in Table 15. By this it is by no means implied that those efforts per - se are constraints. Each and every one of them are worthwhile efforts that have, are, and will provide beneficial results for the countries in which they are considered. Moreover, they would also provide useful information and sometimes support for a project such as the one being proposed. However, since in some way or another they refer to activities related to watershed management and since a trend was detected in certain sectors towards equating watershed management with reforestation or soil management alone, some caution is needed.

It should be made clear in the minds of all persons that will have a saying in the approval of the proposed project, how it will complement past and present efforts, in which ways it is different from them, how it will avoid situations that have caused other attempts to fail or to be very difficult to implement, and why after all it should be financed by institutions already supporting some of those efforts. These considerations, unless clarified, may become important constraints.

#### 4.3 Institutional Constraints

Under this heading, problems detected during visits in all three countries are discussed. Although no specific information was at hand, it is believed that at least most of them are also common to the other countries. These have been gathered in five groups, as follows:

##### 4.3.1 Political Backing

It is felt that the main constraints rests in the fact

TABLE 15

SUMMARY OF PRIOR AND EXISTING MAIN EFFORTS UNDERTAKEN IN THIS FIELD  
WITH INTERNATIONAL AID

Country	Project	Brief Description	International Agency	Status
El Salvador	Conservation and Integral use of Renewable Natural Resources in the Northern Cerron Grande Reservoir.	Mainly soil conservation activities related to Cerron Grande Project.	UNDP-FAO	In Progress
Guatemala	Development of the Chixoy River Basin.	A plan including irrigation, agricultural and livestock development, parks and reforestation.	IDB	Concluded
	Integral Agriculture, Forestry and Native Crafts in the Momostenango Municipal Area.	Mainly reforestation in a limited area of the upper Chixoy basin.	IDB	To be presented for the Bank's Consideration.
	Natural Resources Conservation Program	Reforestation, forest management and soil conservation in small areas in 11 provinces (mainly western highlands) as part of extension activities in small rural communities.	CARE-US Peace Corps	In Progress
Honduras	Natural Resources Management	Land use management in the Choluteca Watershed.	AID	In progress
	Plan Comayagua	Forest Management in the El Cajón Watershed	IDB	In progress
	Integrated Watershed Management in the Northwest	Soil conservation, and reforestation in the Sierra de Omoa, Lago de Yojoa, and Macuelizo areas. Methodologies for watershed management	FLD-U.S. Peace Corps	Concluded

Country	Project	Brief Description	International Agency	Status
Honduras	Watershed Experiments in Los Laureles	Experiments and pilot watershed management activities to assess the potential of reservoir sedimentation in Los Laureles.	U.S. Peace Corps	Concluded
	Integrated Rural Development Program of the West (Prodero) and of Santa Barbara	Integrated development, including reforestation with fuelwood and soil conservation in the Santa Rosa de Copán and Santa Barbara areas.	FIDA-IDB	In progress
	El Nispero	Reforestation of a national regional and local planning system. Río Aguan pilot area.	UNDP-DTCD	In progress
All Countries	Fuelwood and Alternative Energy Sources	Test alternative fast-growing species for use as fuel and more efficient energy use at homes and small industries.	ROCAP	In progress
	Central American Energy Program	Electric interconnection, energy planning, and training activities.	UNDP	Looking for additional financing

that there is little understanding at the political and high level decision-making echelons about the magnitude of the problem, and about the importance of an adequate watershed management in the country.

#### 4.3.2 Diagnosis

Most activities related to watershed management have originated from local or sectorial individual needs and not from a comprehensive view of the problem as part of a national development strategy. There really is no diagnosis of the situation on which to base priorities for watershed management.

#### 4.3.3 Approach

All agencies face severe financial limitations and the prognosis is for this situation to get worse. The fight for project fund raising is likely to be vicious and undoubtedly lost if past approaches are to be repeated, and if the capacity of the service institutions (ISREN, INAFOR, etc.) to reach the users of their services is not greatly improved. Project presentation has not been very objective in the past as benefits have not been clearly demonstrated in quantitative ways. Emphasis has been on the protectionist-subjective side instead of in the quantitative beneficial-objective components.

#### 4.3.4 Agency Limitations

There is really very limited or no experience in watershed management at the various institutions. It is very often confused with reforestation, soil conservation or hydrologic activities. There is a serious deficit in installed capacity, mainly human resources, to undertake serious water management efforts, and medium as well as long-range

planning for institutional development aiming to improve this situation is practically non-existent. Some forestry institutions are commercially oriented towards forest exploitation, and for the energy institutions, these activities generally are not within their functions and are viewed as marginal or are incidental. There is also lack of interinstitutional knowledge and coordination and in the cases when this has occurred, it has been painful, haphazard and oftentimes ending in failure, mostly because responsibilities are assigned but not funds to comply with them.

#### 4.3.5 Various

The watershed management "slang" often scares the more engineering oriented institutions such as electrification institutes due to lack of communication. There are no Regional channels of communication established for these activities among the Central American countries, such as the ones effectively established in the energy, economic and hydrologic sectors. The watersheds contributing to the major present hydroelectric projects are already in an advanced degree of degradation (and nevertheless, there is few good reliable information about erosion rates), increasing the cost of possible corrective plans and measures. Preventive measures are less expensive, but institutions are sometimes hesitant to get involved in expenditures for situations too far off in the future due to the high degree of uncertainty involved. Land tenure and the lack of government control of such variables in certain areas, as well as the subsistence problem of the poorest rural inhabitants that live in the more degraded or degradation prone areas are also of importance.

#### 4.4 Other Constraints

Under this heading, those problems mentioned in some countries, but which were not common to all, are discussed. For example, the lack of a water resources master plan as well as a failure to link watershed management problems to the development of the countries were mentioned in Honduras and Guatemala, but not in El Salvador. Problems related to violence in certain areas were mentioned in El Salvador and Guatemala, and problems related to international watersheds were important in El Salvador.

### 5. NEEDS AND OPPORTUNITIES FOR A REGIONAL PROJECT IN WATERSHED MANAGEMENT

#### 5.1 Needs

##### 5.1.1 General

The field work conducted gave a general, broad first view of the situation that was useful for outlining the proposed project activities. However, since now the situation and orientation of the proposed project is more defined than when the field activity was undertaken, a more detailed investigation is needed at the Project Document stage. Therefore, it was inevitable at the beginning, to sometimes ramble into unrelated areas detrimentally to the now defined more relevant ones.

Nevertheless, it was able to detect that the proposed project would be of interest in all countries and that in some such as El Salvador, a high priority would probably be given to it. This, of course, depends on the level of officials interviewed, but it is believed to be a valid conclusion. Of special significance is the reception offered to the idea of institutional development and to the concept of integrated management as

opposed to isolated reforestation or soil conservation activities.

It is also needed not to limit the scope of the project only to watersheds for electric generation. These could be part of the strategy to create interest in the higher levels of financial decision making, but the watersheds finally chosen for project implementation need to be defined by the countries themselves at a latter stage of the project.

The final stages of the project need to be implemented by the institutions that have such legal responsibility in each country, and should be institutionally developed for that purpose. However, they cannot do it by themselves and will need the cooperation of other institutions. Among these are the energy institutions, especially if watersheds for hydroelectric generation are to be chosen for project implementation.

#### 5.1.2 Specific

The following specific needs were defined:

- a) A complete diagnosis of the watershed management situation in Central America on a Regional basis. This will include the reasons why watershed management activities have not been overly successful to date.
- b) A methodology for project presentation that underlines the benefits in objective quantitative terms and that clearly identifies the beneficiaries. This should be stated thinking in who is going to read the project proposal, rather than who is writing it. Those issues of importance for the decision maker rather than for the project designer should be stressed.
- c) Broad orientation as to the meaning of and need for watershed management: at the decision making level, at the technical

level, and at the general public level.

d) Training of local personnel, both at professional and technician levels, for planning and implementation of watershed management projects.

e) Medium and long-term planning for institutional development in order to accommodate and effectively use the trained personnel.

f) Cohesion of isolated activities related to watershed management now taking place or to be initiated shortly.

g) Inclusion of required watershed management activities as part of the planning process of large hydroelectric and other development projects to avoid risks of jeopardizing large sum investments.

h) Effective information between national institutions within each country and on a regional basis.

i) Cooperation between countries for activities involving binational and/or multinational watersheds.

## 5.2 Opportunities

Based on the outlined situation for the three northernmost Central American countries and on the discussions with the other Consultant for the other three countries, it is believed that good opportunities exist for a Regional project in Watershed Management.

These opportunities are to contribute on a regional basis to the following:

- To have a complete diagnosis of the watershed management situation in the region, on which to base decisions and assign priorities. This would also allow to compare the benefits obtained under three scenarios:

. Priorities are assigned individually by each country.

- . Priorities are assigned on a regional basis with the help of regional mechanisms such as CRRH, SIECA, and the CCT.
- . Priorities are assigned first by each country individually, and then are adjusted accordingly when regional economic and energy priorities and needs are established.

- To develop a coordinated institutional development plan with short, medium and long-term goals. Although taking into account the different institutional situation that exists in each country, a regional approach would benefit from the economies of scale involved in the technical assistance needed to do it.

- To develop a cadre of trained personnel at all levels, capable of undertaking certain immediate activities in watershed management as well as training more persons for future needs. Economies of scale similar to those mentioned above would also be present in a regional project.

- To make a real contribution in practical aspects of watershed management by:

- . Working at the political -high decision levels to increase their awareness about the importance and need for watershed management.
- . Increasing the probabilities for approval of watershed management projects by providing an objective and pragmatic methodology of project presentation.

. Working at the international financial institutions level, to negotiate financial support for certain priority watershed management activities that may be identified during the early stages of the project (diagnosis). Also, to propose certain measures that would assure that watershed management is included in the financing of large development projects. This would be more effectively done on a regional basis and with the help of existing regional organizations, than country by country.

. Initiating the priority watershed management activities identified at the early stages of the project, to use them as tools for the evaluation ex-ante and ex-post of the institutional development effort. This would provide on a regional basis, an objective evaluation procedure. It would also give, at the end of the project, some real contributions in terms of field results.

- To develop or to strengthen a regional system for watershed management data exchange.

## 6. PROPOSED REGIONAL WATERSHED MANAGEMENT PROJECT

From the above discussion of needs and opportunities, as well as from discussions with the other Consultant and representatives from CATIE and CRRH, the following Regional Watershed Management Project guidelines are proposed:

### 6.1 Project Goal

To strengthen national institutions to better plan, manage, and utilize the natural resources of their respective countries.

### 6.2 Project Objectives

1. To create an adequate operational capability and substructure

of human resources within the national institutions with legal responsibility for watershed management in each country, so that they can undertake these activities in the future with little or no external assistance.

2. To create a regional system for providing immediate technical assistance between the countries for specific high priority or emergency watershed management activities.

3. To make a diagnosis of the watershed management situation in the region to facilitate the prioritization of watersheds, the elaboration of management plans to complement current efforts, and the selection of a minimum number of definite pilot projects.

4. To develop a methodology that will facilitate the obtention of funds necessary for watershed management efforts based on their socio-economic viability.

5. To suggest improvements in the legal and policy bases necessary to bring about a more rational utilization of watershed resource through more effective and comprehensive management by government institutions.

6. To define and initiate a minimum number of small pilot projects and elaborate financial proposals for further activities.

7. To create an appropriate mechanism for the collection and dissemination of watershed resources information pertinent to planning on national and regional level.

### 6.3. Strategy

Objective 4 aims to improve the probabilities for watershed management project funding but first, this project must be accepted by the countries. In order to attain high priority in a scarcity of funds situation, it is proposed that it be related to unquestionable project situations already receiv-

ing high priority attention from the governments and that in the proposal, a definite quantitative contribution to these situations be clearly stated. Such high priority project situations could relate to large hydroelectric projects, but not necessarily need to be limited to them if other project situations seem to receive more attention from a given government.

When watershed management related activities are already under way financed by international institutions, the ways in which the project will complement these activities should be clearly stated.

Additional field investigations during the Project Document elaboration phase is needed for this purpose.

#### 6.4. Project Organization

Two groups of institutions are defined for the project:

Those that will have an active role and those that will have a supporting participation.

##### 6.4.1. Principal Institutions

###### a) Regional

- The project will be managed by CATIE in Turrialba, Costa Rica, through the Wildlands and Watershed Management Program (PASC) within the Department of Renewable Natural Resources (DRNR). The project will provide for an increase in PASC staff for this purpose.

- The Regional Committee for Hydraulic Resources (CRRH) through its Executive Secretariat in Tegucigalpa, Honduras, will cooperate with CATIE for the approval of the project and signing of agreements by the countries, and through its member institutions in the implementation of the activities assigned to each one of them at the national level. The project will provide for an increase in CRRH staff for this purpose.

###### b) National

The project will be focused towards the following

for reforestation, forest management, and national park projects.

- Geographical Area of Competence:

All the country except Peten Province, which is covered by FTDEP.

- Administrative Structure and Dependence:

INAFOR belongs to the Public Agricultural Sector.

Its maximum authority is a Directive Council formed by the Ministries of Agriculture, Livestock and Nutrition, Economy, Finance, and Defense, as well as the Secretary of the National Planning Council. It has a General Manager and a Deputy Manager. The location of INAFOR within the public Agricultural Sector is shown in Annex 2.3 .

- Principal Executive and Address:

Agr. Eng. Guillermo Pacheco De León  
5a. Av. 12-15, Zona 9  
Edificio El Cortez  
Ciudad de Guatemala, Guatemala

PH: 317215 - 67221

- Organizational Chart:

See Annexes 2.4 and 2.5

- Staff and Funds:

INAFOR has managed several projects since 1976, whose combined total amount is in the order of Q35.5 million (Q1 = US\$ 1). Its Evaluation and Promotion Unit (ecosystematic, socioeconomic, and forest inventory studies) has a staff of 50 persons, as follows:

national institutions:

- DGF in Costa Rica
- ISREN in El Salvador
- INAFOR in Guatemala
- COHEFOR in Honduras
- JICVA in Nicaragua
- RENASE in Panamá

It is expected that by the end of the project, these institutions will be capable of undertaking the watershed management activities to better utilize the natural resources of the country, with little or no external assistance, as required by other national institutions.

#### 6.4.2. Supporting Institutions

Support will be asked as needed, from several regional and national institutions. Mostly this support will be given within the present capabilities of such institutions and occasionally, funds will be provided to facilitate this support as deemed by the Project Manager. These are:

##### a) Regional

- SIECA: to facilitate regional coordination with the energy and economic sector and to serve as communication channel with these sectors.

##### b) National

- Planning Offices
  - . OFIPLAN in Costa Rica
  - . MIPLAN in El Salvador
  - . SDEPLAN in Guatemala
  - . COUSUPLANE in Honduras
  - . MIPLAN in Nicaragua

.MIPPE in Panamá

These offices must approve the project and all related activities through their Departments of International Technical Cooperation, which also form the Regional Committee for Technical Cooperation (OCT).

- National Water Resources Committees, whose principal

Institutions are:

- . ICE in Costa Rica
- . ISREN in El Salvador
- . INSIVUMEH in Guatemala
- . Water Resources Division of SRN in Honduras
- . INE in Nicaragua
- . IRHE in Panamá

These institutions will provide all necessary water resources data and, in cooperation with other member institutions of the National Water Resources Committees, will cooperate in the diagnosis and will define priorities for watershed management. They are linked through CRRH.

- National Geographic Institutes:

- . IGN in Costa Rica
- . IGN "Pablo Guzmán," in El Salvador
- . IGN "Alfredo Obiols Gómez" in Guatemala
- . IGN in Honduras
- . IGN in Nicaragua
- . IGN "Tommy Guardia" in Panamá

These will provide all necessary topographic and thematic cartographic material, as well as aerial photos and other remote sensing images. They maintain regional communication through PAIGH and the bi-annual Central American Cartographic week.

- Other institutions related to natural resources and/or activities that may be related to the project:
  - . Instituto Tecnológico de Cartago in Costa Rica
  - . CEL in El Salvador
  - . USPADA, DIGESA, INDE, AND USAC-ERIS in Guatemala
  - . ESNACIFOR, CATASTRO, INA, and UNAH in Honduras
  - . MIDINRA, INETER, and UCA in Nicaragua
  - . University of Panama, in Panamá.

#### 6.5. Project Components

The Project will have the following components (also refer to Dulin's report):

##### 6.5.1. Diagnosis and Pilot Projects

a) A diagnosis of the watershed management situation in the region will be made. This diagnosis will include:

- Critical or potentially critical situations in watersheds where conflicting pressures for natural resources use are strong.
- Past and Current efforts to alleviate such situations, including the degree of success or failure attained and the reasons for such an outcome.
- Existing substructure to cope with such situations: institutions, laws, policies, water resources and natural resources master plans, human resources, government priorities, etc.

The diagnosis will provide a basis for the following activities:

- b) Drafting of Watershed Management Policies.
- c) Priorization of watersheds according to needs.
- d) Selection of a minimum number of definite pilot projects to implement management plans (could be to complement

current efforts). These will be defined, initiated with project funds in those components that are viable to do so, and documented for financial request for other larger components that could fit outside the scope of the project. They will refer to watersheds where high priority projects are being built or considered, or where high priority attention is being given by governments. Most probably would refer to hydroelectric development watersheds, but not necessarily so. This component will be the task of the national member institutions of CRPH, with assistance from the project Manager, the Land-Use specialist, and the Technical Assistant to CRPH.

#### 6.5.2. Institutional Development

The principal institutions in each country will be strengthened as to create an operational capability to undertake watershed management activities in the future with little or no external assistance. The approach of task assignment and performance objectives will be used for this purpose. This approach consists of the following steps (see figure 1):

a) Based on the watershed management activities diagnosis, on the watershed prioritization, and on the pilot project management plans to complement current efforts, an institutional diagnosis will be made of the principal national institutions.

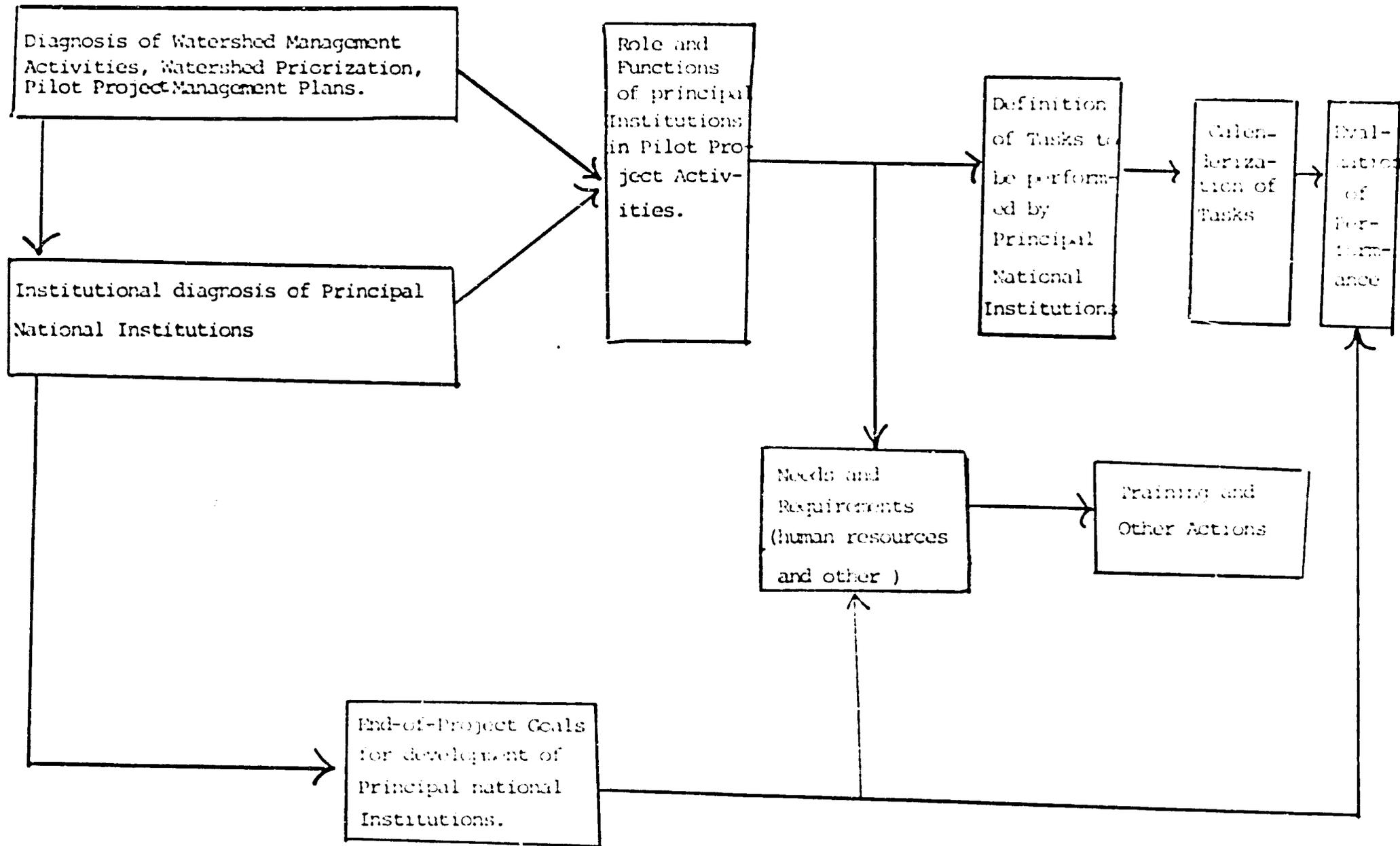
b) Based on the institutional diagnosis, the role and functions of the principal institutions in the pilot project activities will be determined.

c) The end-of-project goals for the development of principal institutions will also define the institutional needs in terms of human resources and otherwise.

e) With the definition of the role and functions of the principal national institutions, the tasks to be performed by them in the pilot project activities will be defined, as well as scheduling of such tasks.

FIGURE 1

INSTITUTIONAL DEVELOPMENT COMPONENT (SCHEMATIC)



f) Finally, the accomplishment of the project goals in terms of the institutional performance to meet the tasks will be evaluated. This will be complemented with curriculum development and instructional resources development for human resources training both outside the institutions and on the job training (see Dulin's report).

#### 6.5.3. Consciousness Raising in Decision Makers and Institutions

This component is directed at the administrative and the highest managerial level where development and policy decisions are made. The focus of the component will be to establish a channel of communication between these levels and the technical level, by improving the capacity of the latter to present projects with objective socio-economic arguments understandable to the former. Also to directly inform and continuously "advise" decision makers as to the importance of optimal watershed resources management. All project specialist will collaborate in order to prepare strategy on how best to implement this component in each country. The project manager will be in charge of this component. Strategy will probably involve one or a combination of the following sub-components:

- a) Development of a Pragmatic and objective methodology of project presentation, stressing the quantitative benefits in terms of natural resources' beneficial uses from which a large number of persons will benefit.
- b) Discussion with the principal international financial institutions, of an acceptable formula to include a water resources management component in the financing of large development projects (hydroelectric projects, water supply projects, etc.)
- c) Propaganda lobby concerning key issues ("arm-bending)
- d) National and regional congresses for the upper stratum personnel in each of the natural resource related organizations (including sectorial planning organizations).

e) Development and presentation of "informative modules" of multi-media form.

f) Informative "news and advise" letters

g) Public relations related field trips to priority watersheds, and natural resources related project areas (fuelwood, soil conservation, hydroelectric projects).

SIBCA will give the project support in providing lobby and "persuasion" through political channels which they have already established. In return project staff will offer collaboration on natural resources issues which confront SIBCA.

#### 6.5.4. Watershed Management and Natural Resource Information System

A regional information center will be supported by a network of national focal points or centers created at suitable national institutions such as the National Geographic Institutes, the Water Resources Institutions members of CRRH, or the principal national Institutions (see Dulin's report).

#### 6.5.5. Technical Assistance (see also Dulin's report)

The project will provide financing for the following technical assistance:

##### a) Technical Assistance Group for Watershed Management at CATIE

This group will increase the staff of PASC at CATIE to manage the project and provide technical high level professional consulting services to the national institutions for the duration of the project and while the local personnel cadre is being formed. This group is listed below:

- Watershed Management Specialist/Project Manager:

5 Years.

i) Will coordinate the entire project

ii) Will contribute to technical assistance

iii) Will define a pilot project management plan in collabora-

tion with other staff members (Land/Use Specialist, Natural Resources Planning and Policy Specialist, and Institutional Development Specialist).

iv) Will design and conduct short courses

v) Will design needed investigation projects.

vi) Will develop a Methodology for demonstrating the economic viability of watershed management projects in the region (in collaboration with other staff members and local counterparts).

vii) Will participate with the Specialist at CRESI and local counterpart personnel, in the prioritization of watersheds and elaboration of management plans to complement current efforts.

- Land Use Specialist: Middle of first year to middle of fifth year (4 years)

- Natural Resources Planning and Policy Specialist: years 2,3, and 4 (3 years)

- Soil Conservation/Land Reclamation Specialist: years 3,4, and 5 (3 years)

- Socio-Economist: years 3 and 4 (2 years)

- Natural Resources Information Specialist: years 2,3, and 4 (3 years)

- Instructional Resources Specialist: years 2 to 5 (4 years)

- Institutional Development Specialist: years 2 to 5 (4 years).

Ph. D. or Master's level with Latin American experience in the organization of natural resources public institutions. Spanish Fluency. Administrative and training experience. Good human relations abilities.

i) Will coordinate the institutional diagnosis.

ii) Will assist the Project Manager in the definition of

a pilot project management plan.

- iii) Will determine the role and functions of the principal national institutions in the pilot project activities.
- iv) Will define end of project objectives and goals for the principal institutional development.
- v) Will assess the principal institutional needs and requirements to meet such goals.
- vi) Will participate in the definition of the tasks to be performed by the principal national institutions (with other specialists of the Group).
- vii) Will evaluate the degree of principal institutional development reached at the end of the project, and the capability of these to continue watershed management activities by themselves.

**b) Technical Assistant to CREE:**

Watershed Management, Natural Resources Planning, or Water Resources Specialist: middle of first year to middle of fifth year (4 years). Ph. D. or Master's level with Latin American (preferably Central American) experience in national and regional project structuration, coordination, and implementation. Spanish Fluency:

- i) Will Coordinate CREE project activities with those of the group at CATIE.
- ii) Will coordinate the diagnosis on watershed management situation, and will participate with the Project Manager and local counterpart personnel, in the prioritization of watersheds and elaboration of management plans to complement current efforts.

- iii) Will coordinate the activities of the national member institutions of CRRH, with those required by the project.
- iv) Will contribute with technical assistance consulting to CRRH member institutions in activities related with the project.
- v) Will assist the Executive Secretary of CRRH in lobbying for government approval and financing of national and/or regional activities of member institutions, derived from the project.

c) Country Residents

These six specialists, one for each country, will reside in each of the principal national institutions. They will be of Master's level in Watershed Management or Natural Resources Planning with Latin American experience (preferably Central American) in watershed management or natural resources development. Administrative experience is desirable. They should be fluent in Spanish.

- i) Will coordinate local activities with regional activities
- ii) Will serve as links between local counterpart staff and the CATIE and CRRH group.
- iii) Will participate in all project activities at national level
- iv) Will conduct short courses, seminars, and congresses in natural resources administration at national level.

d) Short Term Consultants

Funds will be provided for short term consultants, as needed.



ACTIVITY	Year 1	Year 2	Year 3	Year 4	Year 5
-Evaluation					
-Curriculum development					
-Instructional res.dev.					
-Formal and on the job training					
Component: Decision Makers and Institutions Consciousness Raising					
-Preparation of Strategy					
-Development of methodology for project presentation					
-Discussion with financial Institutions					
-Develop info. modules					
-Preparation of Newsletter					
-Field trips, seminars, congresses					
Component: Watershed Mgmt. and Natural Res. Information System					
-Assess info.mgmt.needs in each country and designate counter- part					
-Establish CRIS, and other systems					
-Consolidate Available info. and put into system					
-Seminars, short courses					
-Consolidate and disseminate needed publications					
Component: Technical Assistance					

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ANNEX 1  
PRINCIPAL CONTACTS

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COSTA RICA	Meteorological Institute	Eladio Zarate	CRPH Representative		22-56-16		
	Ministry of Energy	Gloria Villa	PEICA Representative	Apartado 4752, San José, Costa Rica	33-19-55		
	ICE	Teófilo de la Torre	President	Apartado 10032 San José, Costa Rica	32-72-25		
	ICE	Eugenio Odio	Electrification Sub-Committee Rep.	Apartado 10032 San José, Costa Rica	32-72-25		
	ICE	Edgar Robles	CRPH Rep.	" "	"		
	OFIPLAN	José M. Blanco	PEICA Rep.				
EL SALVADOR	AID	Roberto Figueroa (*)	Assist. Proj. Office, Forestry, Nat. Res. Cons.	American Embassy/El Salvador APO Miami 34023	23-61-64 23-94-73 26-71-00		
	AID	Darell McIntyre	Project Officer Small-Scale Irrigation Training	" "	"		
	ISREN	Francisco Serrano (*)	Executive Director CRPH Rep.	Soyabango, El Matasano, San Salvador, El Salvador	27-04-90		

COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
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	ISREN	Roberto Denis (*)	Watershed & Soils Expert	" "	"		
	ISREN/PLA'DARH	Hernán Romero Chavarría	Hydrologist	17 Calle Poniente 223 San Salvador, El Salv.	27-09-78		
	ISREN/PLA'DARH	Luis Eduardo Hernández Trigueros(*)	National Director	" "	21-90-54		
	ISREN/PLA'DARH	Fernando Troyano Lobatón (*)	UN Director	P.O. Box 114 San Salvador, El Salv.			
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	CEL	Noel Espinosa Chavarría (*)	Supervisor of Planning and Studies-PEICA Represent.	" "	" "		
	CEL	Erick Casaniquela	COMENER Rep.	Condominio Los Héroes 3er. Nivel Boulevard Los Héroes San Salvador, El Salv.	26-71-33		

COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
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	CEL	Alberto Chicquillo	Engineer	Edificio CEL-Centro de Gobierno Boulevard Los Héroes San Salvador, E.S.	22-08-55		
	MIPLAN	Ernesto Jaimes(*)	Executive Director of Intl. Cooperation	10a. Avenida Sur y Calle México No.1505 San Salvador, E.S.	22-90-69		
	FAO-UNDP Tamulasco River Watershed Project	Humberto Tasaico(*)	Project Manager	7a. Calle Poniente y 81 Avenida Norte No. 505 San Salvador, E.S.	23-66-11		
	Private Consultant	Joaquín Guevara Morán	Agronomist				
	Private Consultant	Carlos Montenegro	Hydrologist				
	Private Consultant (ACERO, S.A.)	Bené Nuñez	Engineer				
GUATEMALA	INAFOR	José Guillermo Pacheco De León	General Manager	5a. Avenida 12-15, 3.º Edificio El Cortez Guatemala, Guatemala	31-72-15 67- 2-21		
	INAFOR	Jorge Pineda(*)	Deputy Manager	" "	"		

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GUATEMALA	INAFOR	Ernesto Matheu(*)	Head Planning Unit	5a. Avenida 12-15, Z.9 Edificio El Cortez Guatemala, Guatemala	31-72-15 67- 2-21		
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	INAFOR	Otoniel Granados(*)	Head Ecology Dept.	" "	"		
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	INDE	Orlandino Arteaga Toledo (*)	Master Plan Coordinator	" "	"	"	"
	INDE	Arnulfo Padilla de León	Watershed Protection Unit Coordinator - Proyecto Chixoy	Edificio Torrecafé 7o. Nivel Guatemala	31-52-43		
	INSIVUMEH	Claudio Urrutia	Director CRPH Rep.	7a. Avenida 14-57, Z.13 Guatemala, Guatemala	32-47-41 32-47-22 31-49-67		

COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
GUATEMALA	DIGESA	Carlos De León Prera (*)	Head Irrigation & Drainage Div.	7a. Avenida 3-67, Zona 13 Guatemala, Guatemala	31-02-01		
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	SEGEPLAN	Julieta de Morales (*)	Ing. Coop. Dept.	" "	"		
	SEGEPLAN	Luis Paz (*)	Head, Energy Dept. PEICA Rep.	" "	"		
	USPADA	Félix Keller	General Coord.	Vía 2, 3-34 B, Z. 4 Guatemala, Guatemala	31-11-56 32-42-55 31-55-95		
	USPADA	César Reyes (*)	Project Coord.	" "	"		
	SIECA	Raúl Sierra Franco	Secretary General	4a. Avenida 10-25, Z. 14 Apartado Postal 1237 Guatemala, Guatemala	68-21-51/5		INTEGRA CION SIECA
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	SIECA	Julio Obiols G. (*)	Deputy Direc- tor, Physic' Int. Dept.	" "	"		"

COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
GUATEMALA	UNDP	César Michele(*)	National Rep. for Guatemala.	5a. Avenida 20-25, Z. 10, Edificio Plaza Marítima Guatemala, Guatemala	68-18-58 68-18-60 68-19-50 68-29-03		
	USAC	Eduardo Meyer	Rector	Ciudad Universitaria Zona 12 Guatemala, Guatemala	46-06-11/3 46-03-21/5		
	USAC	César Fernández	Dean, Engineering School	" "	" "		
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	AID	John Warren(*)	Officer in Charge of Natural Res.	" "	" "		
	AID	Peter Deinken(*)	Officer Environment & Tech. Of.	" "	" "		

COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
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COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
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	ENEE	Mauricio Móssi	Planning Electrifica- tion Sub-Com- mittee Rep.	" "	"		
	SRN	Miguel Lardizábal	Secretary CRRH Rep.				
	SRN/NRMP	Carlos Rivas(*)	National Director Nat. Res. Mngmt. Prog.				
	SRN/NRMP	Francisco Lupiac (*)	Technical Field Director				
	SRN/NRMP	Ricardo Fárez (*)	Cabeceras Sub-Basin Coord.				
	SRN/NRMP	Eduardo Canales (*)	Samble Sub-Basin Coord.				
	SRN	Roberto Dímas Alonzo(*)	Head Hydro- met. Services Rep.				
	SRN	María Luisa Pardo(*)	Eng. Hydro- met Services				
	SRN	Sigfrido Sandoval	PEICA Rep.				

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	CONSUPLANE	Rafael Ochoa(*)	PEICA Rep.	" "	22-22-61		
	CONSUPLANE	Oscar Rivas Najar	"	" "	"		
	CONSUPLANE	José M. Palacios	"	" "	22-22-62		
	CONSUPLANE	Olga Fuentes	"	" "	22-70-01		
	CONSUPLANE	Ernesto Crespo	Aguan Project Coordinator	Apartado Postal No.881 Tegucigalpa, Honduras			
	Catastro Nacional	José Fco. Abarca (*)	Head Water Res.	Apartado Postal 1655 Tegucigalpa, Honduras			
	Escuela Agr. Pan. (Zamorano)	Nelson Agudelo(*)	Head Forestry Sector	Apartado Postal 93 Tegucigalpa, Honduras			
	SANAA	Tomás Lozano	General Manager	1a. Avenida y 13 Calle Comayaguela, D.C. Honduras			
	SECOPT	Miguel A. Matute(*)	Head Studies and Projects Dept.				
	METROPLAN C/DC	Armando Mendoza(*)	Head Constr. Permit Sect.				
	CRPH	Nabil Kawas (*)	Executive Secretary	P.O. Box 718 Tegucigalpa, Honduras	32-38-04	CORREH	

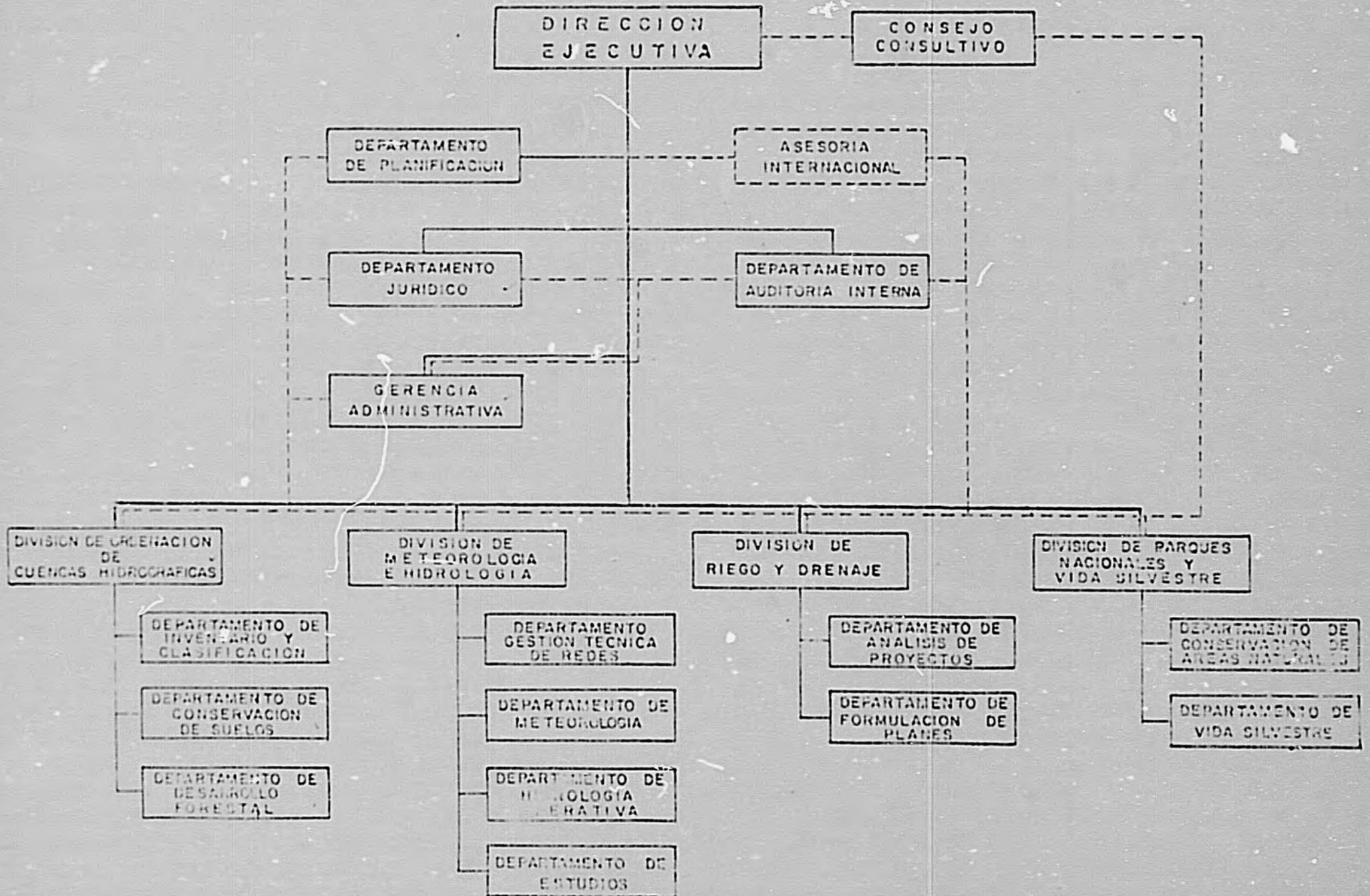
COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
NICARAGUA	INE	Emilio Papacholi	Minister, INE President COMENER Rep.	Apartado Postal 55 Managua, Nicaragua	26-6-39 26-6-40		
	INE	Fernando Cuevas	Energy Mgr. PEICA Rep.	" "	26-6-80 26-6-39		
	INE	Pedro J. Ruiz	PEICA Rep.	" "	26-6-80 26-6-39		
PANAMA	IRHE	Rafael de Gracia	Engineer Director	Apartado Postal 5285 Panama 5, Panama	25-87-67		
	IRHF	Ovigildo Herrera	Engineer Sub-Dir. CRRH Rep.	" "	27-31-37		
	IRHE	Alcides Salas	Watershed Management Dept.	" "	25-63-67		
	IRHE	Claudia Candayedo (*)	Head Hydro- met. Dept. CRRH Rep.	" "	62-15-84		
	IRHE	Carlos Colón Bermúdez	PEICA Rep.	" "	62-62-22 Ext. 273		
	IRHE	José A. Gómez Pérez	PEICA Rep.	" "	62-28-27		
	MIPPE	Lyudmila Velásquez	Director Tech. Intl. Coop.	Apartado Postal 2694 Panamá 3, Panamá Vía España, Edif. Prosperidad, 3r.nivel	69-31-58 69-14-61		

COUNTRY	INSTITUTION	NAME	TITLE	ADDRESS	TELEPHONE	CABLE	TELEX
PANAMA	MIPPE	Carlos Sánchez (*)	Health & Energy Sector Div.	Apartado Postal 2694 Panamá 3, Panamá Vía España, Edificio Prosperidad, 3er Nivel	69-31-58 60-14-61		
	RENARE	Irving Díaz	Director	Apartado 2016, RENARE Paraíso, Panamá 5, Panamá	32-43-77		
	RENARE	Gerardo Cáceres (*)	Head Water Department	" "	32-49-96		
	CANAL COMMISSION	Frank Lee	Head Engr. Div.	APO Miami 34011			
	CANAL COMMISSION	A. Wong (*)	Engr.	" "			
	CANAL COMMISSION	J. Corelli (*)	"	" "			
ECUADOR	OLADE	Alvaro Umaña		Casilla 6413 Quito, Ecuador	459-783		
MEXICO	CEPAL	Ricardo Arosamena		Avenida Presidente Masarik 29 México D.F., México	545-0086		
	CEPAL	Roberto Jovel		" "	"		
	CEPAL	Alfonso Silva		" "	"		

\* OFFICIALS INTERVIEWED OR CONTACTED.

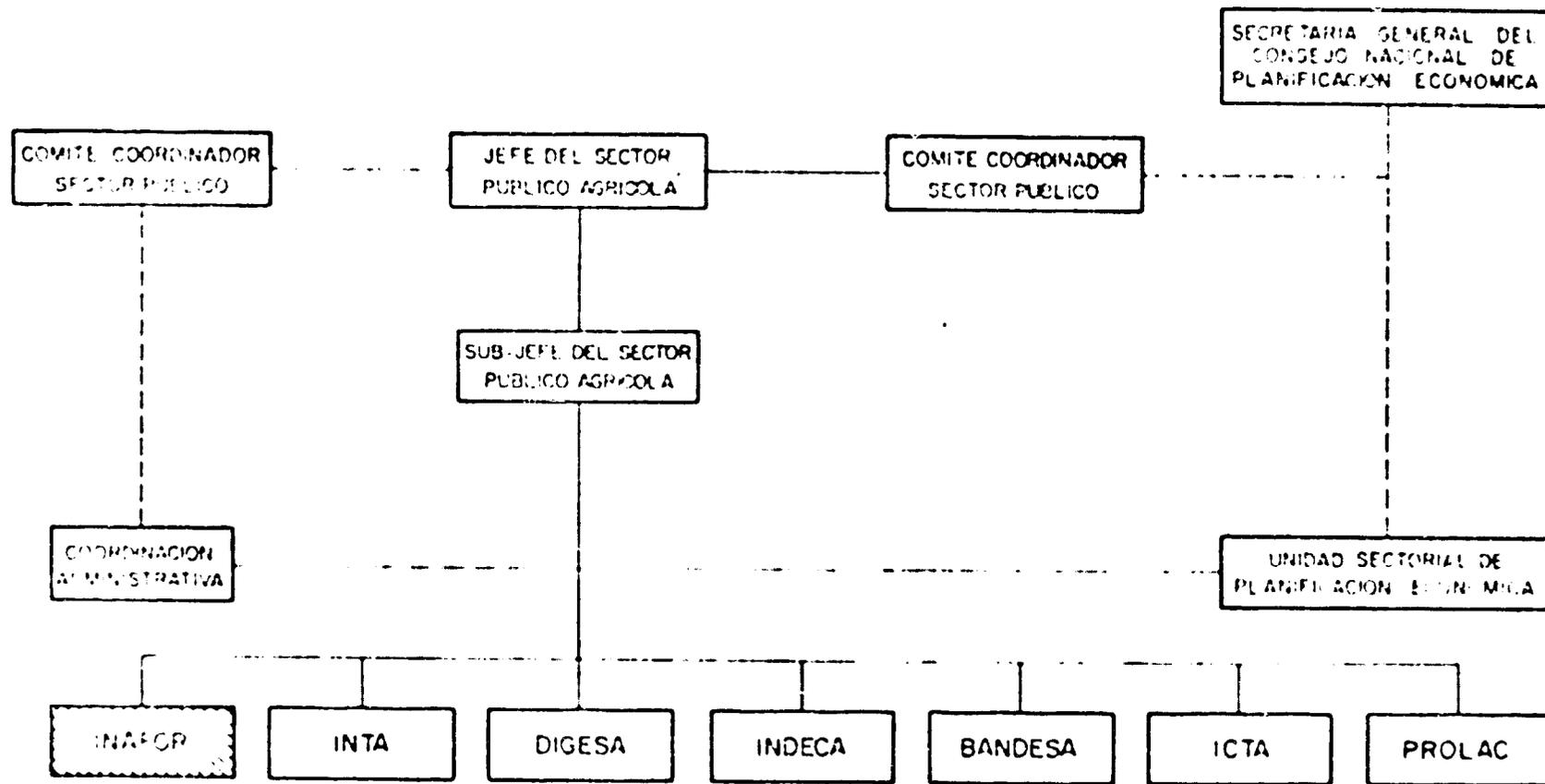
ANNEX 2.1  
 ORGANIZATIONAL CHART OF ISREN

ESTRUCTURA ORGANIZATIVA DEL INSTITUTO SALVADOREÑO DE RECURSOS NATURALES (ISREN)

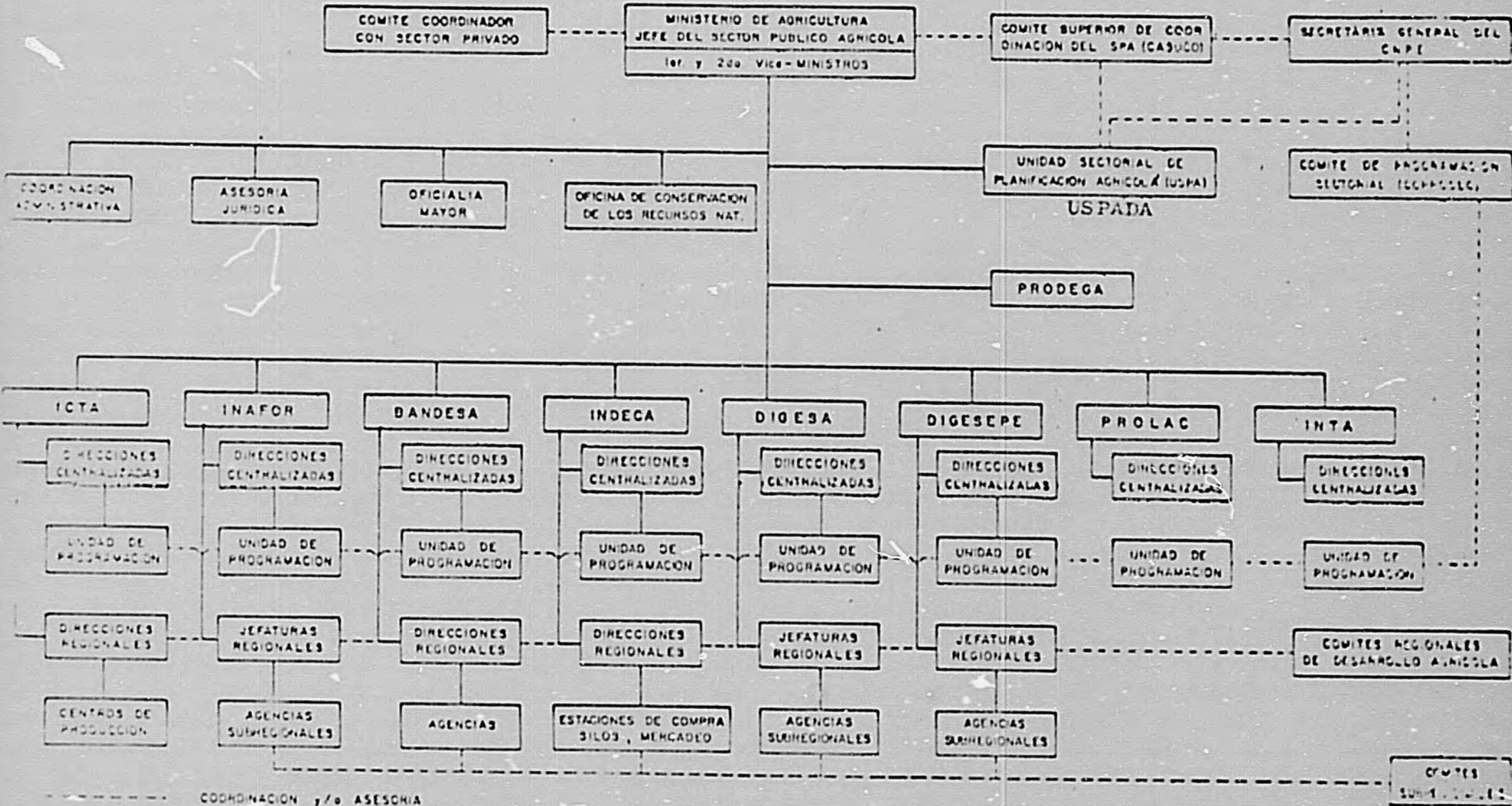




# LOCALIZACION DEL INAFOR EN EL SECTOR PUBLICO AGRICOLA



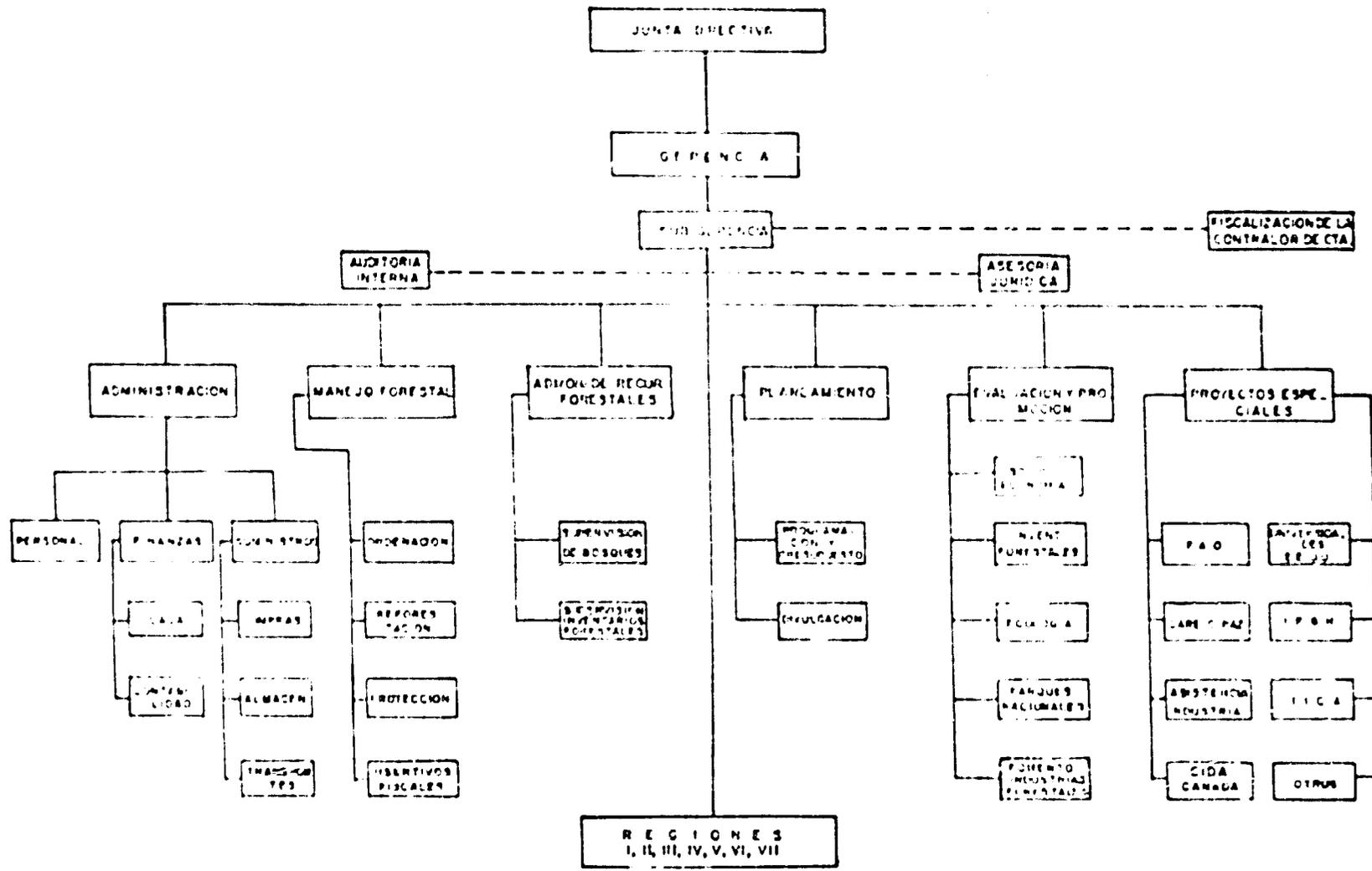
ANNEX 2.3  
PUBLIC AGRICULTURAL SECTOR (Guatemala)  
ORGANIGRAMA DEL SECTOR PUBLICO AGRICOLA



ANNEX 2.4

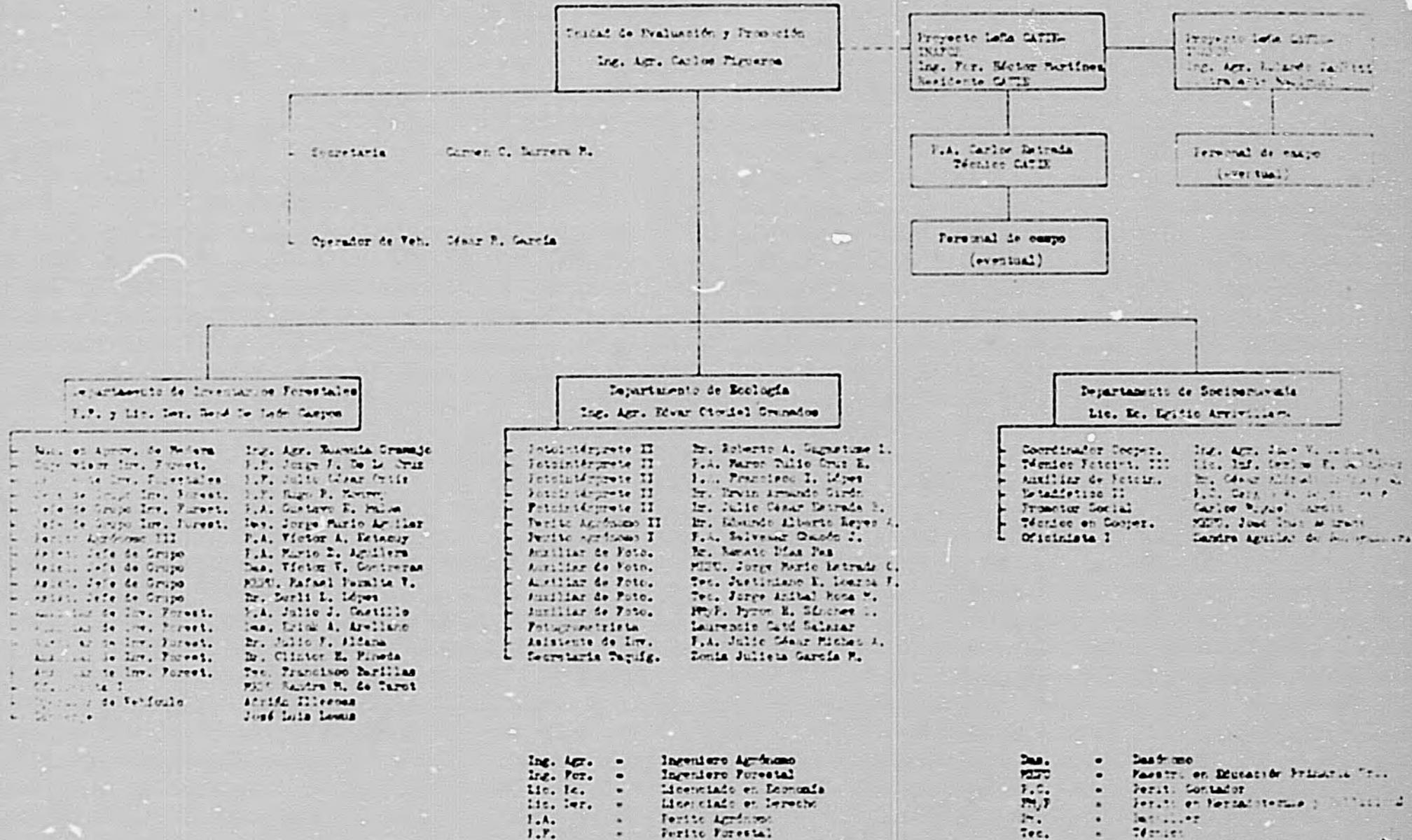
I N A F O R

SECTOR PUBLICO AGRICOLA

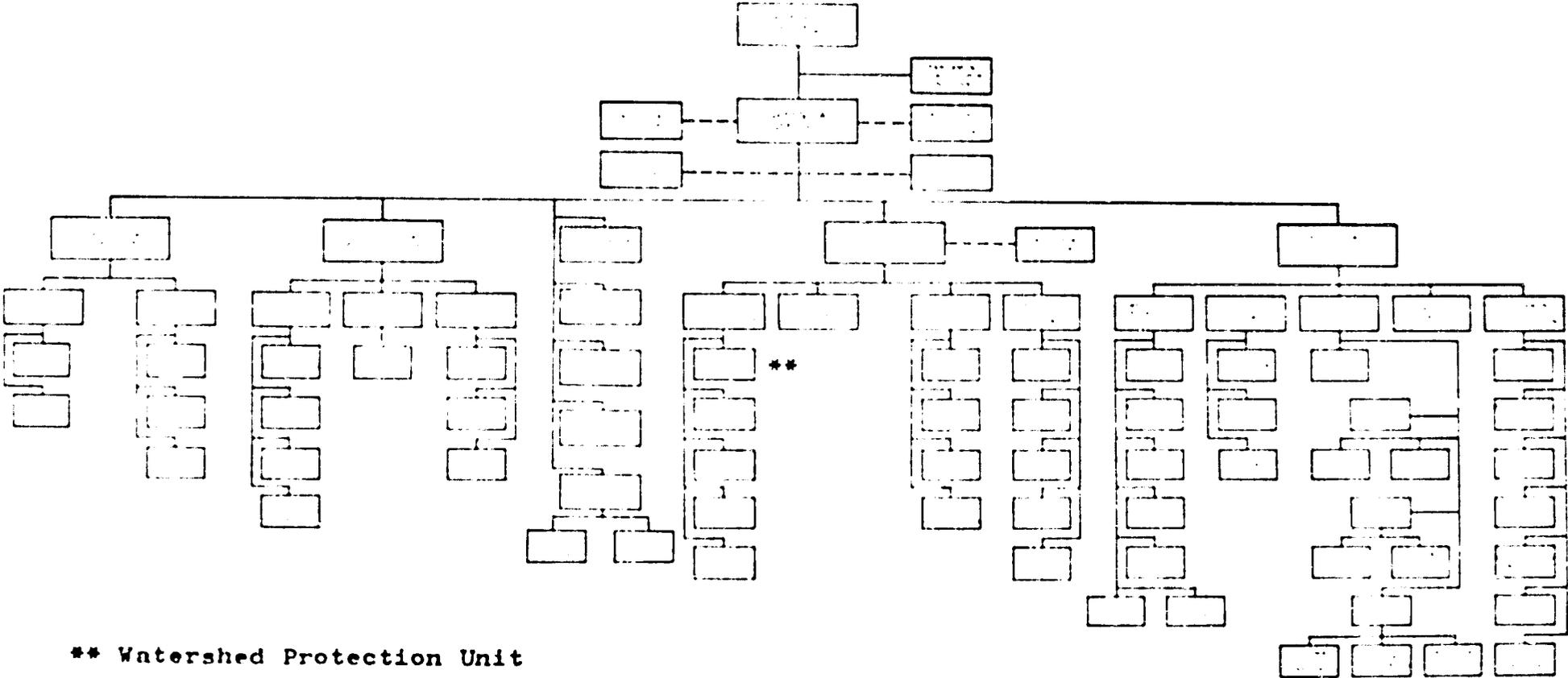


ANNEX 2.5

ORGANIGRAMA DE LA UNIDAD DE EVALUACION Y PROMOCION



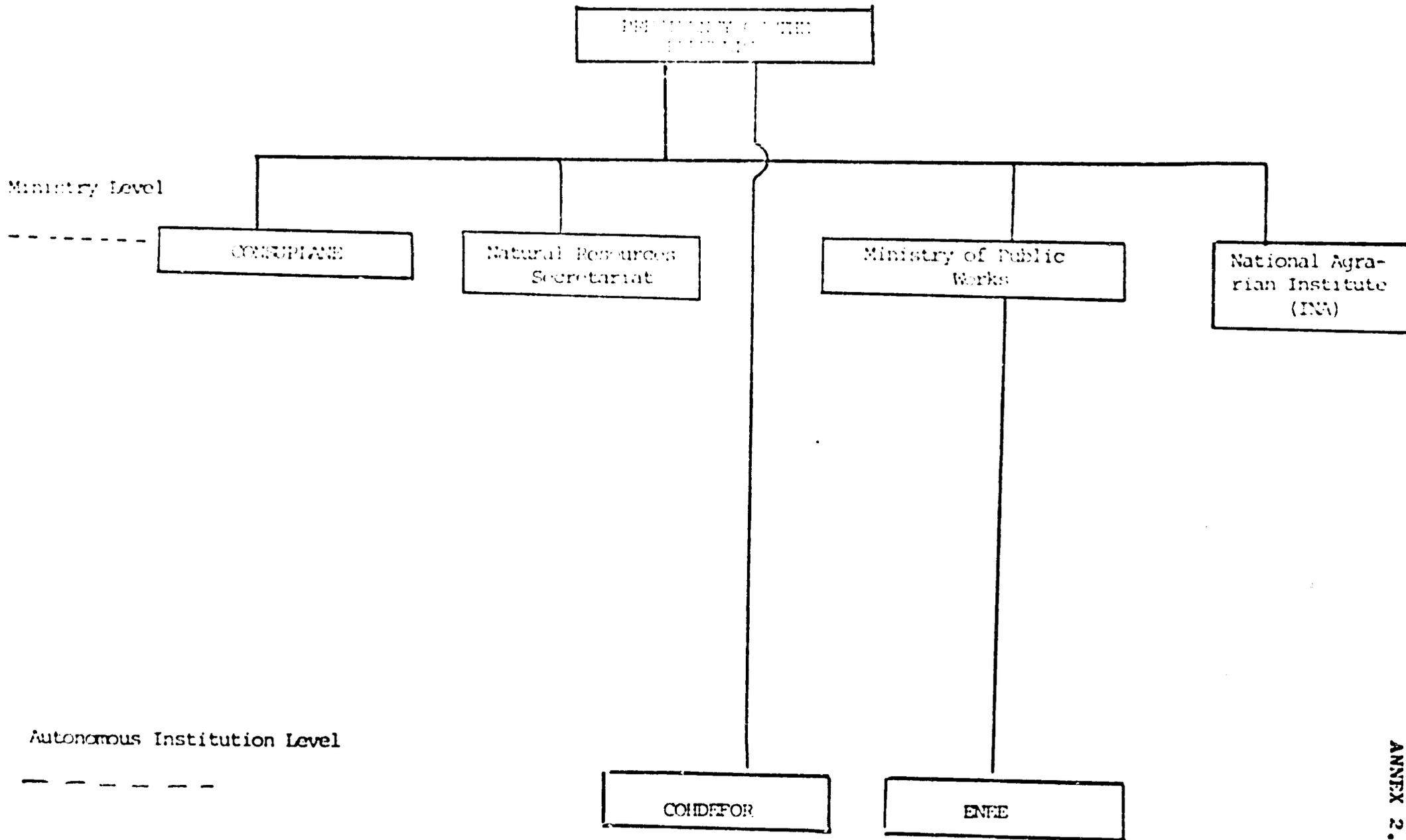
# ORGANIGRAMA DEL INSTITUTO NACIONAL DE ELECTRIFICACION (INDE) 1979



\*\* Watershed Protection Unit

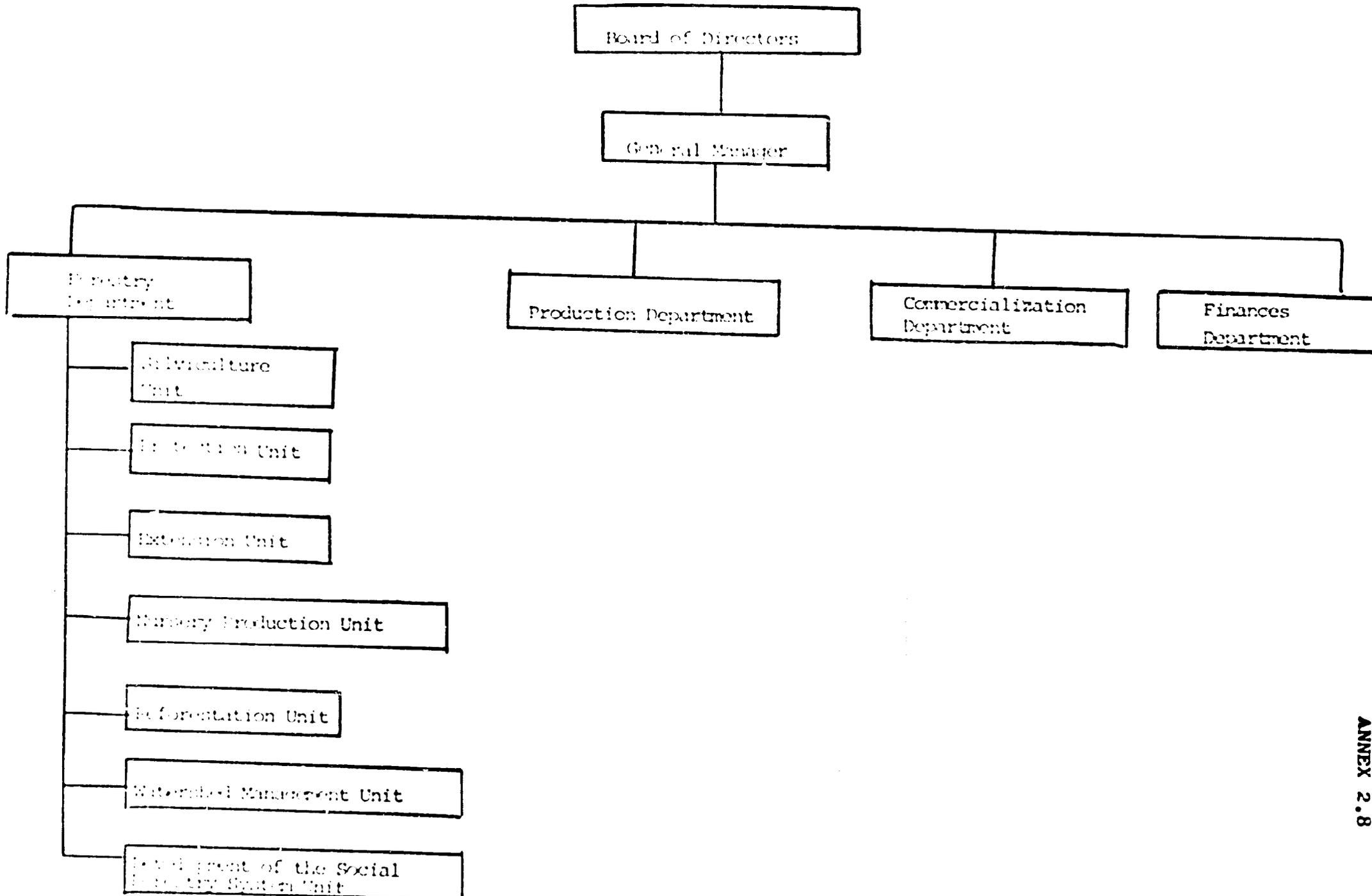
ANNEX 2.7

PLACE OF SELECTED INSTITUTIONS IN THE PUBLIC SECTOR (HONDURAS)



SOURCE: CONSUPLANE

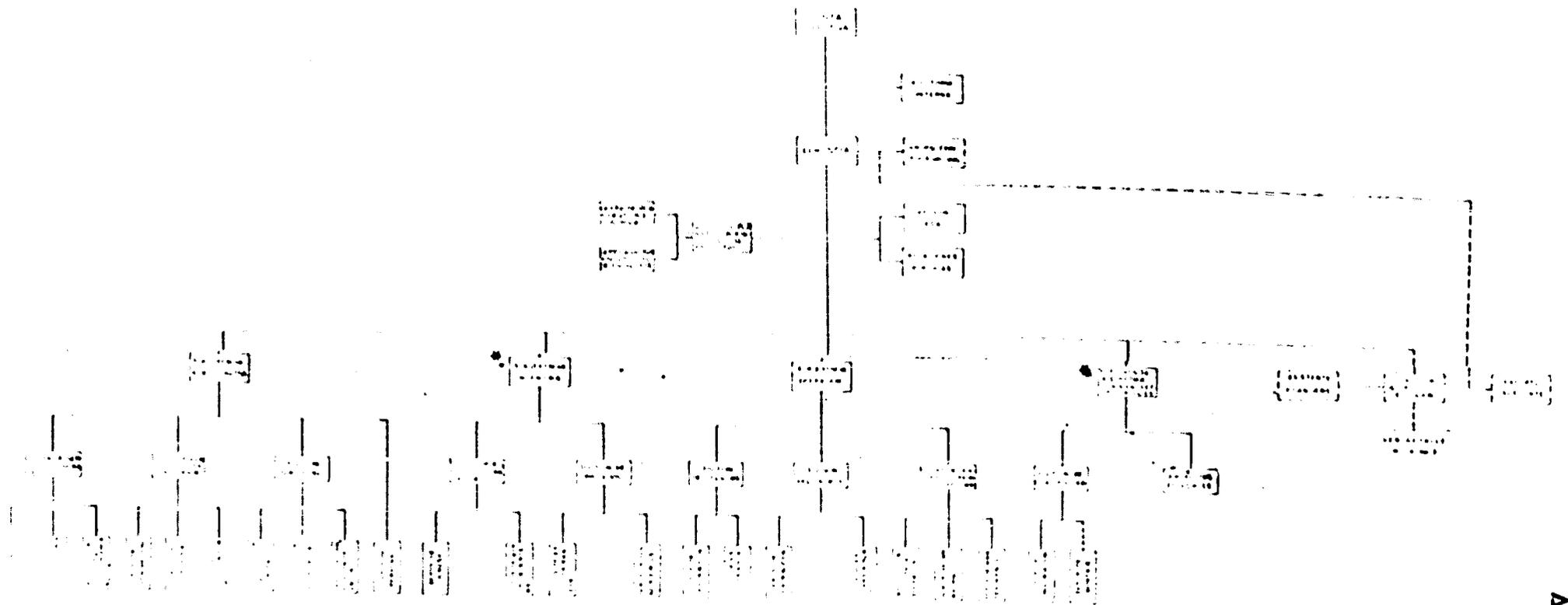
ORGANIZATIONAL CHART OF COMEFOR (SCHEMATIC)



# ANNEX 2.9

## ORGANIGRAMA

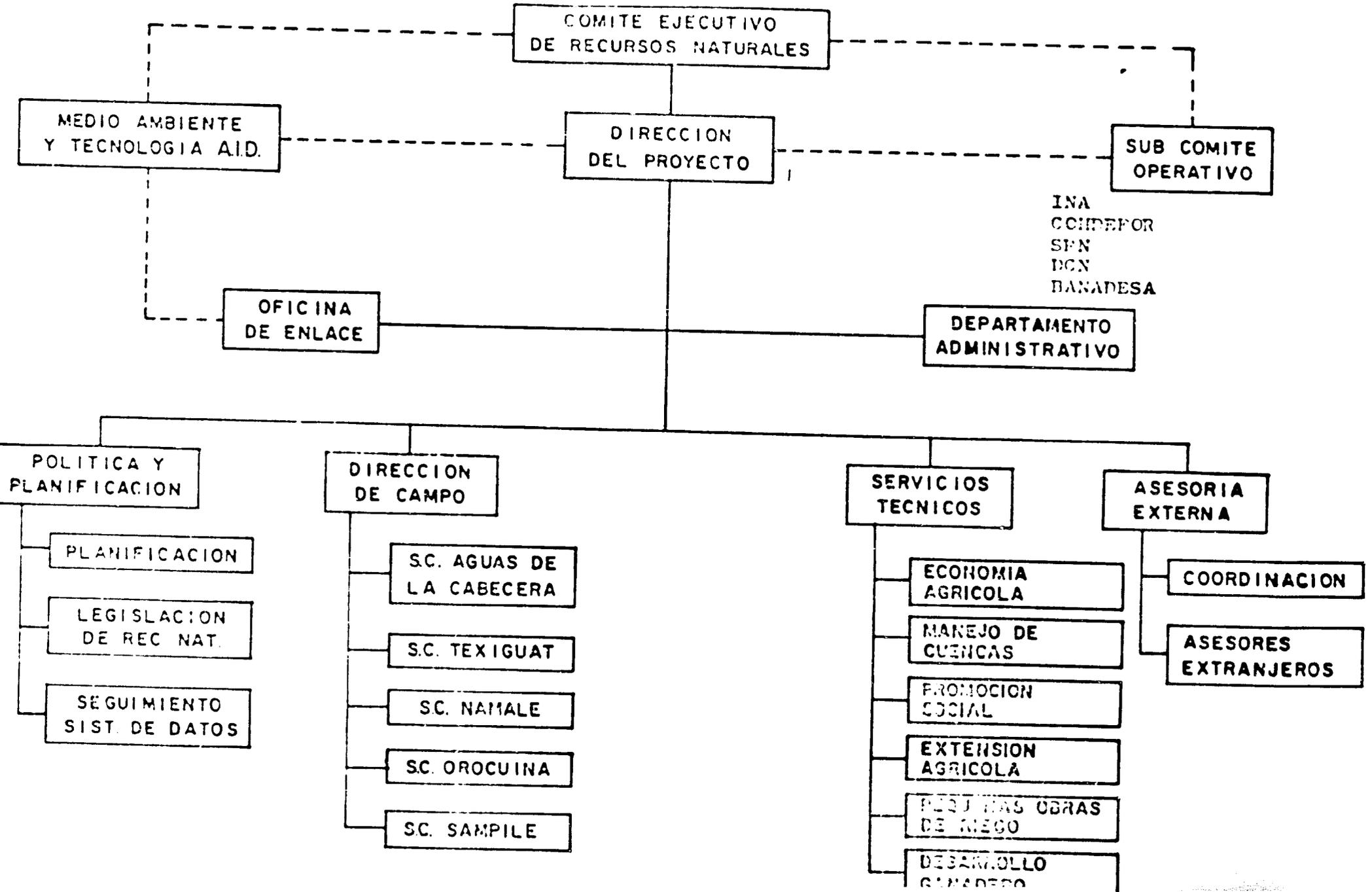
EMPRESA NACIONAL DE ENERGIA ELECTRICA



• Now joined in Civil Engineering

BEST AVAILABLE DOCUMENT

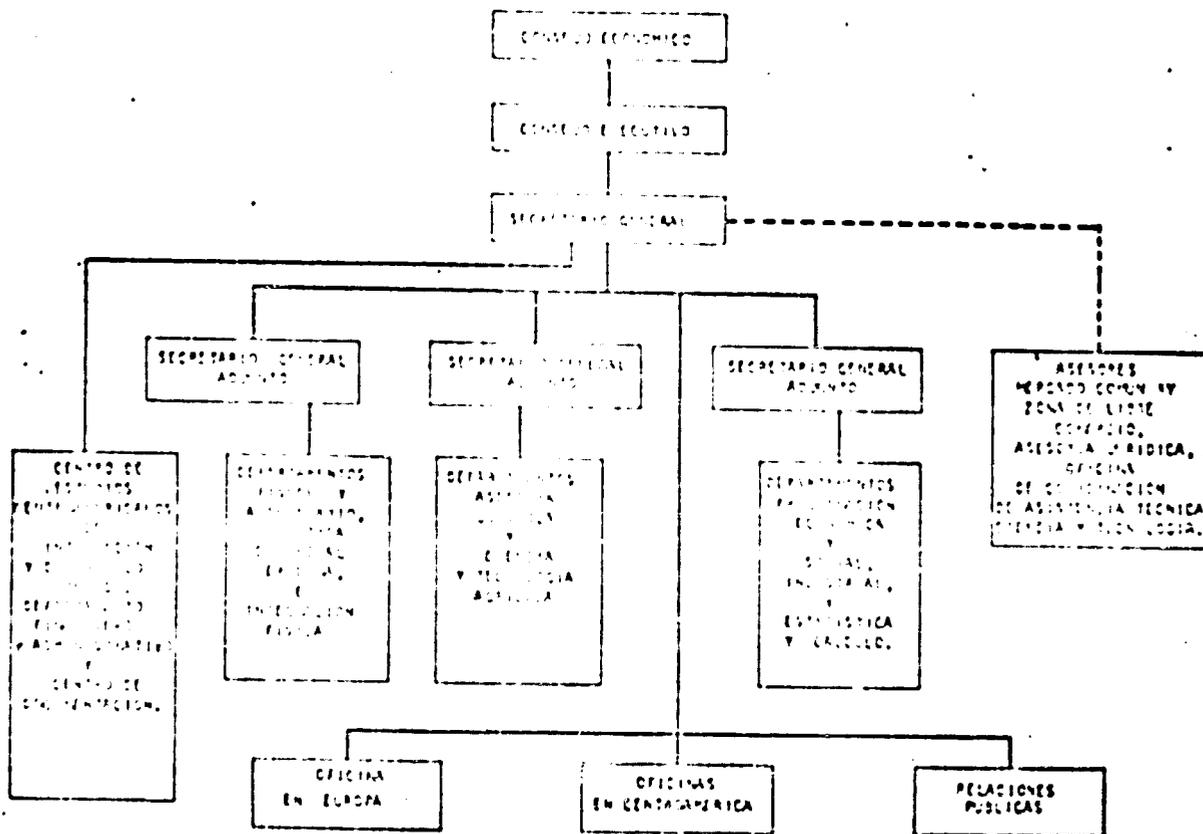
ANNEX 2.10  
**ORGANIGRAMA**  
**PROYECTO DE MANEJO DE RECURSOS NATURALES**



ANNEX 2.11

ORGANIZATIONAL CHART OF SIECA

A-8 ORGANIZATIONAL CHART



A-8 ORGANIZATIONAL CHART (FORM 0)



ANNEX 3.1

FOREST COVER OF EL SALVADOR



BOQUES DE CONIFERAS



BOQUES PLANTADOS EN ZONA ALTA



BOQUES SALVADOS

MINISTERIO DE AGRICULTURA Y GANADERIA  
 DIRECCION GENERAL DE RECURSOS NATURALES RENOVABLES

DEPT. DE INVESTIGACIONES HIDROLOGICAS

INSTITUTO NACIONAL DE AGUAS Y RECURSOS

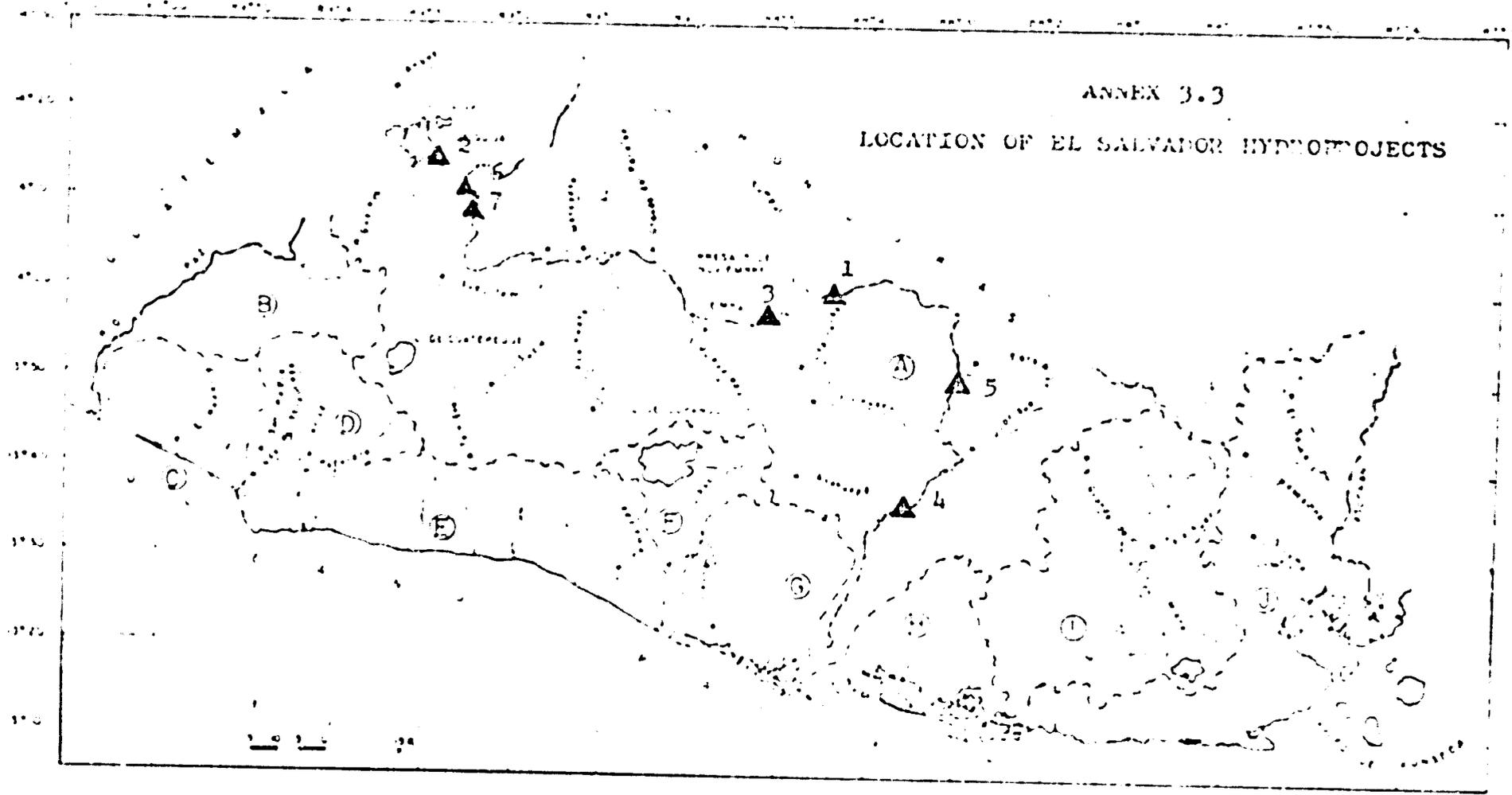
MAPA DE EL SALVADOR

Mostrando areas en donde existen zonas de  
 Bosques Naturales y Plantados.



ANNEX 3.3

LOCATION OF EL SALVADOR HYDROPROJECTS

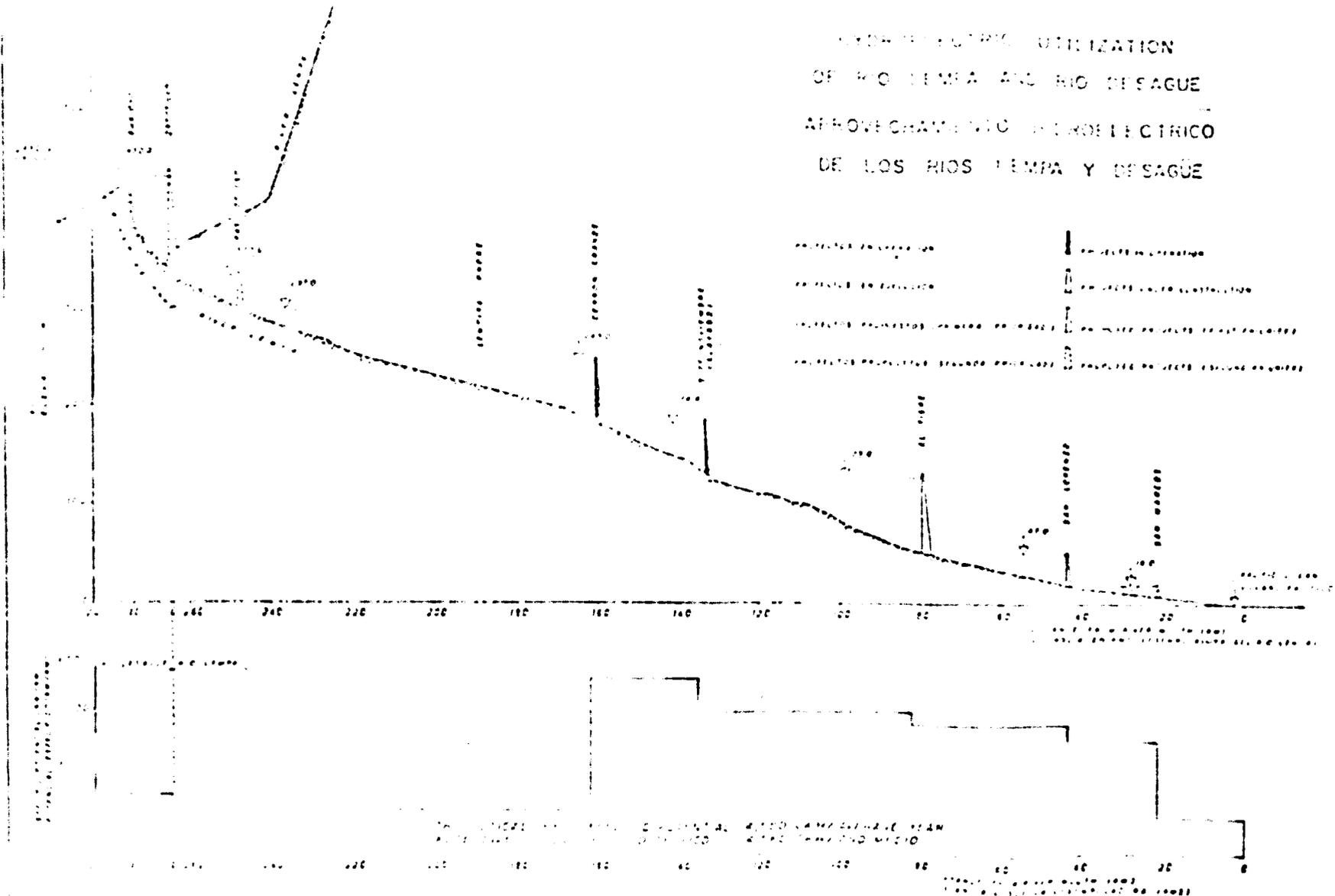


- - - - - LIMITE DE CUENCA  
 ●●●●● CIUDADES PRINCIPALES  
 (A) NOMENCLATURA DE LAS PRINCIPALES CUENCAS HIDROGRAFICAS

INSTITUTO NACIONAL DE INVESTIGACIONES CIENTÍFICAS  
 DEPARTAMENTO DE INVESTIGACIONES HIDROLÓGICAS  
 MAPA DE EL SALVADOR  
 Mostrando los principales sitios hidrográficos

ANNEX 3.4

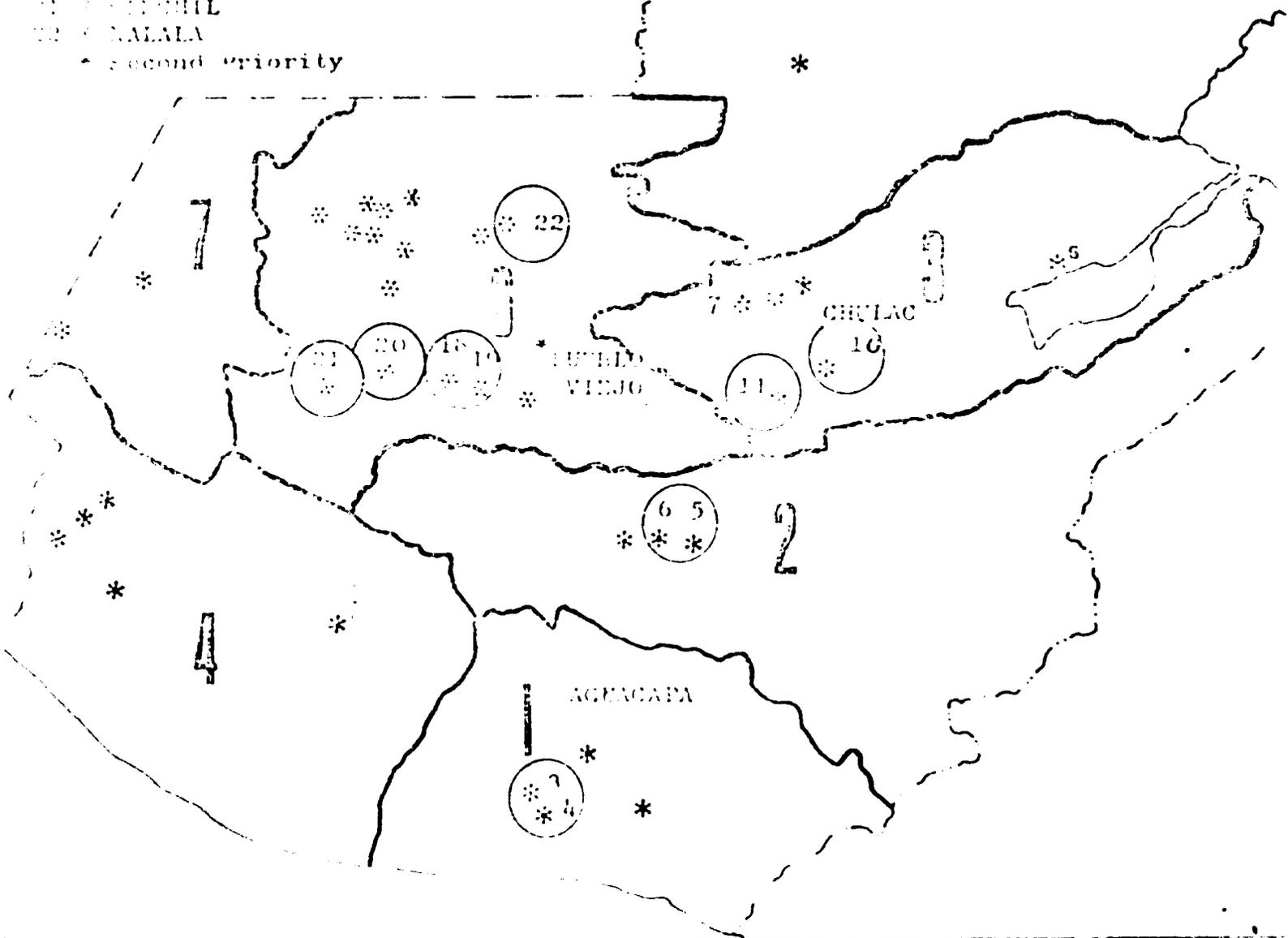
HYDRO-ELECTRIC UTILIZATION  
 OF RÍO TEMPA AND RÍO DESAGUE  
 APROVECHAMIENTO HIDROELECTRICO  
 DE LOS RIOS TEMPA Y DESAGUE



Source: "El Salvador Water Resources Master Plan Supporting Studies"  
 TAHAL Consulting Engrs. LTD. FLANDERSH

ANNEX 3.5  
LOCATION OF GUATEMALA HYDROPROJECTS

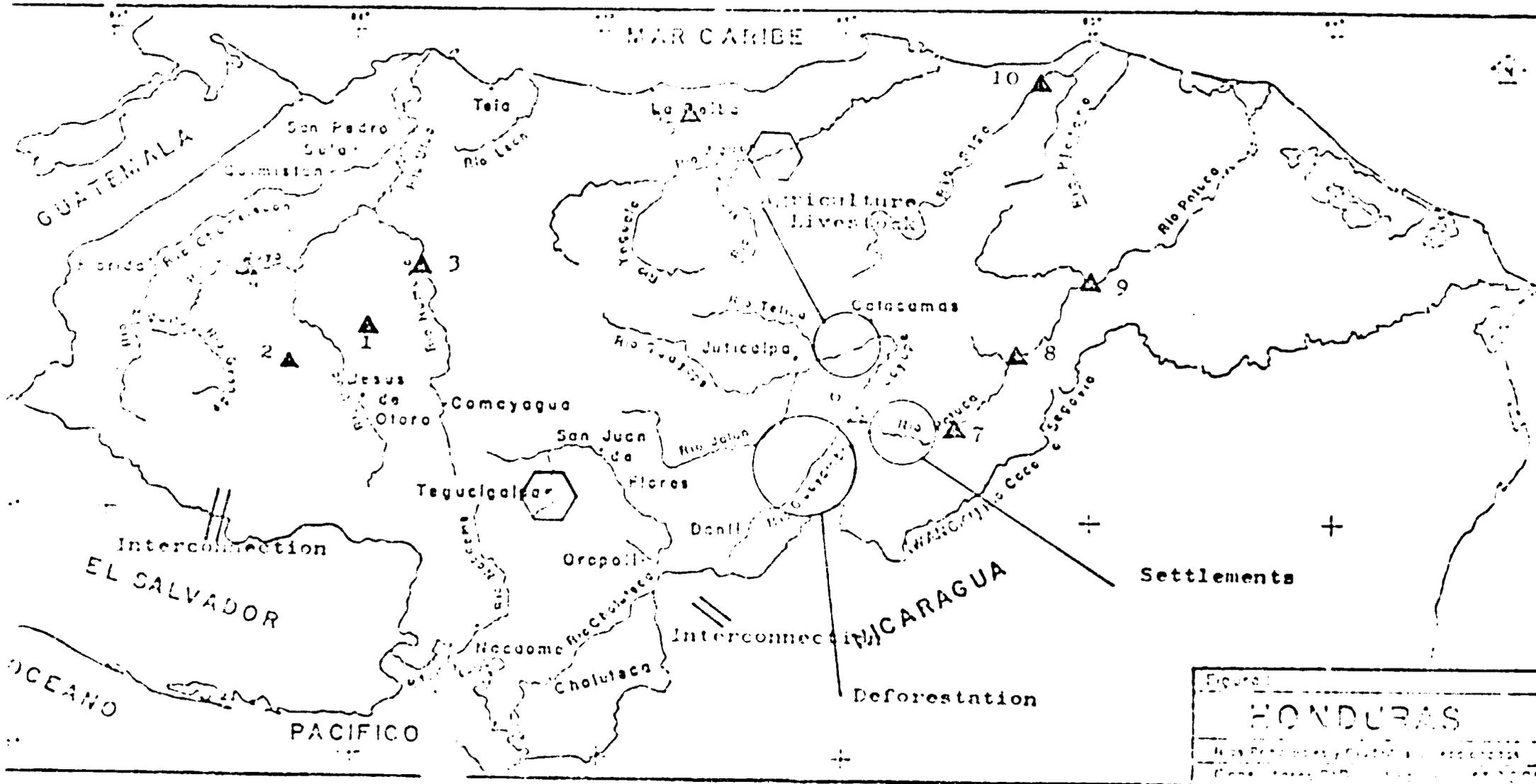
- 3 \* SINALAPA
- 4 \* PUERTA VISTA
- 5 \* EL GUAYABO
- 6 \* EL CISELITE
- 7 \* UJIAN
- 10 \* LA PINTA
- 11 \* GUAYTON
- 12 \* JUCA SALES
- 13 \* LOS ANEZCOS
- 14 \* ALMAMEL
- 15 \* SINCIL
- 16 \* CHULAC
- 17 \* MALALA
- \* Second priority



ANNEX 3.6

LOCATION OF HONDURAS HYDROPROJECTS

- 10 -



 Demand Centers

- |                    |                        |
|--------------------|------------------------|
| 1. Yojoa-Rio Lindo | 6. Piedras Amarillas   |
| 2. El Nispero      | 7. Portal del Infierno |
| 3. El Cajon        | 8. Cuyamel o Valencia  |
| 4. Narengito       | 9. Nampu               |
| 5. Congrejal       | 10. Sico               |



## HYDROELECTRIC PROJECT PROFILE

NO. 4.1

COUNTRY: EL SALVADOR

- NAME: 5 DE NOVIEMBRE
  - TYPE: Single Purposes
  - PLAN: Lempa River development. Ultimate goal: to install 1403 MW (excluding Guajoyo); see Annex 3.4; generate 4316 Gwh/year; 94% utilization coeff.
  - PROGRAM: National Electrification
- 
- AGENCY(IES): CIL
  - COMPLETION DATE: June 21, 1954. Started with 30 MW. In 1976 increased to 82 MW.
  - LOCALIZATION: Middle Lempa, downstream from the Sumpul River Confluence About 135 km from river mouth.
  - WATERSHED: Middle Lempa
  - RIVER(S): Lempa
  - PURPOSE(S): Hydroelectricity
  - OBJECTIVE(S): Generate 82 MW. Planned expansion to 201 MW and 701 Gwh/year by 1986.
  - GENERAL LAYOUT: Dam with gated spillway. Underground power house with five generating units. Head provided by dam.
  - REGULATION: Originally provided by Guija and its own reservoir presently provided by Cerrón Grande.
  - RESERVOIR CAPACITY:  $250 \times 10^6 \text{ m}^3$  OPERATIONAL ELEVATION: 178.4 m  
Now reduced to  $60 \times 10^6 \text{ m}^3$  by sedimentation MAXIMUM ELEVATION:
  - TYPE OF DAM: LENGTH: HEIGHT:
  - FLOODED AREA:

- SPILLWAY CAPACITY:
- INSTALLED CAPACITY: 82 MW
- HEAD:
- TUNNEL LENGTH:
- CANAL LENGTH:
- FLOOD PROTECTION:
- PUMP CAPACITY:
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS:
- INFORMATION SOURCES: CIL brochures. El Salvador Water Resources Master Plan Studies.
- COST: \$55.6 million (1954). About \$22.2 million at 2.50 exchange rate. World Bank loan and CIL bonds. Planned expansion cost: \$99.8 million (1978). About \$28.5 million at 3.5 exchange rate.
- OBSERVATIONS:

Designed by Harza Eng. Co.

## HYDROELECTRIC PROJECT PROFILE

NO. 4.2

COUNTRY: EL SALVADOR

- NAME: CERRON GRANDE
- TYPE: Single Purpose (CEL). Proposed Multiple Purpose (WRMP).
- PLAN: Lempa River development. See 4.1. See Annex 3.4 (CEL)  
Lower Lempa Flood Control (WRMP).
- PROGRAM: National Electrification. Water Resources Master Plan.  
(WRMP)
- AGENCY (IES): CEL
- COMPLETION DATE: 1976 (67.5 MW). February 15, 1977 (135 MW).
- LOCALIZATION: Upstream from 5 de Noviembre, between the Chalatenango  
and Cabañas Provinces, some 160 km from river mouth and  
35 km from San Salvador.
- WATERSHED: Middle Lempa
- RIVER(S): Lempa
- PURPOSE(S): Hydroelectricity and protection of 5 de Noviembre against  
sediments (CEL). Flood control (WRMP).
- OBJECTIVE(S): Generate 135 MW. Planned expansion to 202.5 MW by  
1989 and to 270 MW and 539 Gwh/year later on.
- GENERAL LAYOUT: Dam with gated concrete spillway (4 gates). Powerhouse  
at foot of dam, connected by penstock. Presently two  
generating units. Planned for four units (67.5 MW each).
- REGULATION: Main feature in Lempa
- RESERVOIR CAPACITY:  $2180 \times 10^6 \text{ m}^3$  OPERATIONAL ELEVATION: 243 m MAXIMUM 250m  
ELEVATION:
- TYPE OF DAM: Gravity Earth and Rockfill with impervious nucleus. LENGTH: 800 m HEIGHT: 70 m
- FLOODED AREA: 135 square kilometers

- SPILLWAY CAPACITY: 6500 m<sup>3</sup>/s
- INSTALLED CAPACITY: 135 M
- HEAD: -
- TUNNEL LENGTH:
- CANAL LENGTH:
- FLOOD PROTECTION: WFP has proposed to use 1430 x 10<sup>6.3</sup> for flood control of lower Jampa.
- PUMP CAPACITY
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS:
- INFORMATION SOURCES: CIL WFP Studies
- COST: 250 x 10<sup>6</sup> (1977). About \$100 x 10<sup>6</sup> at 2.5 rate. Loans by IDB and World Bank. CIL Bonds.
- OBSERVATIONS: Designed by Harza Eng. Co.

INTAKE CAPACITY:

ENERGY:

PLANT FACTOR:

58 M (HE elevation - normal T.F. elevation)

WFP has proposed to use 1430 x 10<sup>6.3</sup> for flood control of lower Jampa.

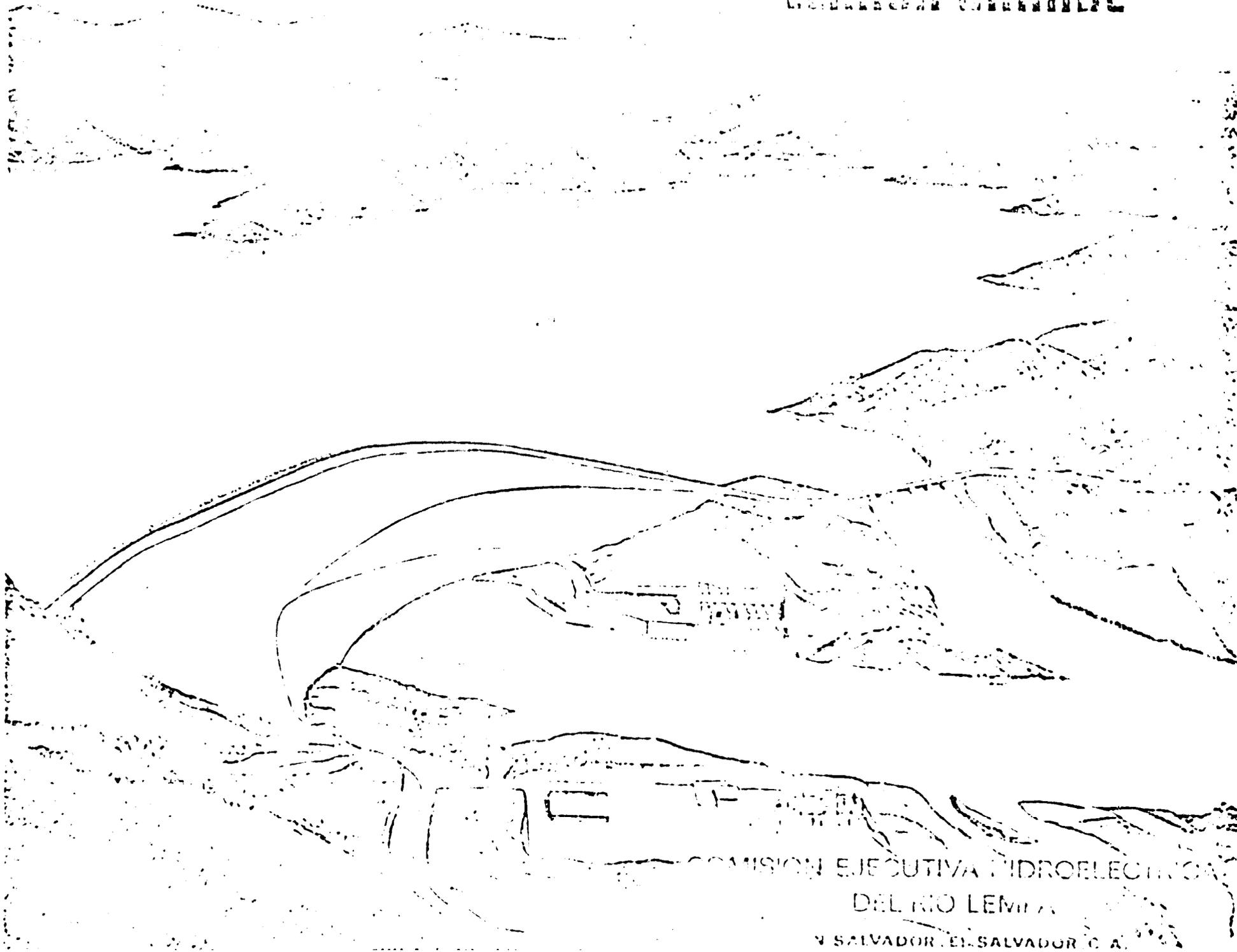
CIL WFP Studies

250 x 10<sup>6</sup> (1977). About \$100 x 10<sup>6</sup> at 2.5 rate. Loans by IDB and World Bank. CIL Bonds.

Designed by Harza Eng. Co.

COMISION EJECUTIVA HIDROELECTRICA

DEL RIO LEMITA



COMISION EJECUTIVA HIDROELECTRICA

DEL RIO LEMITA

EL SALVADOR, EL SALVADOR, C. A.

## HYDROELECTRIC PROJECT PROFILE

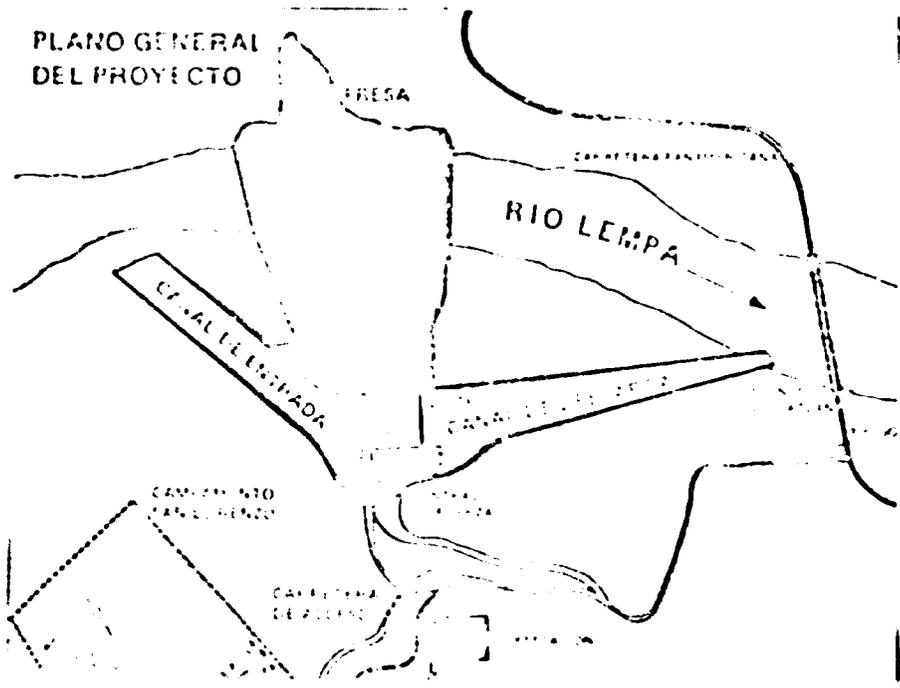
NO. 4.3

COUNTRY: EL SALVADOR

- NAME: SAN LORENZO
- TYPE: Single Purpose (CEL)
- PLAN: Lempa River Development. See 4.1. See Annex 3.4
- PROGRAM: National Electrification
- AGENCY (IES): CEL
- COMPLETION DATE: Under construction. Planned for 1982.
- LOCALIZATION: Lower Lempa, between Usulután and San Vicente, about 50 km from river mouth and about 1 km upstream from Panamerican Highway Cuscatlán Bridge.
- WATERSHED: Lower Lempa
- RIVER(S): Lempa
- PURPOSE(S): Hydroelectricity
- OBJECTIVE(S): Generate 180 MW
- GENERAL LAYOUT: Dam with concrete spillway (8 gates 12.2 m wide and 16 m height). Spillway and powerhouse on right-hand side. Two 90 MW Kaplan generating units.
- REGULATION: Provided by Guija, Cerrón Grande and 5 de Noviembre.
- RESERVOIR CAPACITY:  $393 \times 10^6 \text{ m}^3$       OPERATIONAL ELEVATION: 47M      MAXIMUM 49M  
ELEVATION:
- TYPE OF DAM: Rockfill      LENGTH: 650 M      HEIGHT: 47M  
above foundation
- FLOODED AREA: 35 square kilometers

- SPILLWAY CAPACITY: 13,000 m<sup>3</sup>/S
- INSTALLED CAPACITY: 180 MW
- HEAD: 32 m (max. grosshead)
- TUNNEL LENGTH: 92 m
- CANAL LENGTH:
- FLOOD PROTECTION:
- PUMP CAPACITY
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS:
- INFORMATION SOURCES: CEL
- CCST: \$500.3x10<sup>6</sup> (1979). About \$200.12x10<sup>6</sup> at 2.5 rate. Financing by IDB, Suppliers and CEL.
- OBSERVATIONS:

PLANO GENERAL  
DEL PROYECTO



## HYDROELECTRIC PROJECT PROFILE

NO. 4.4

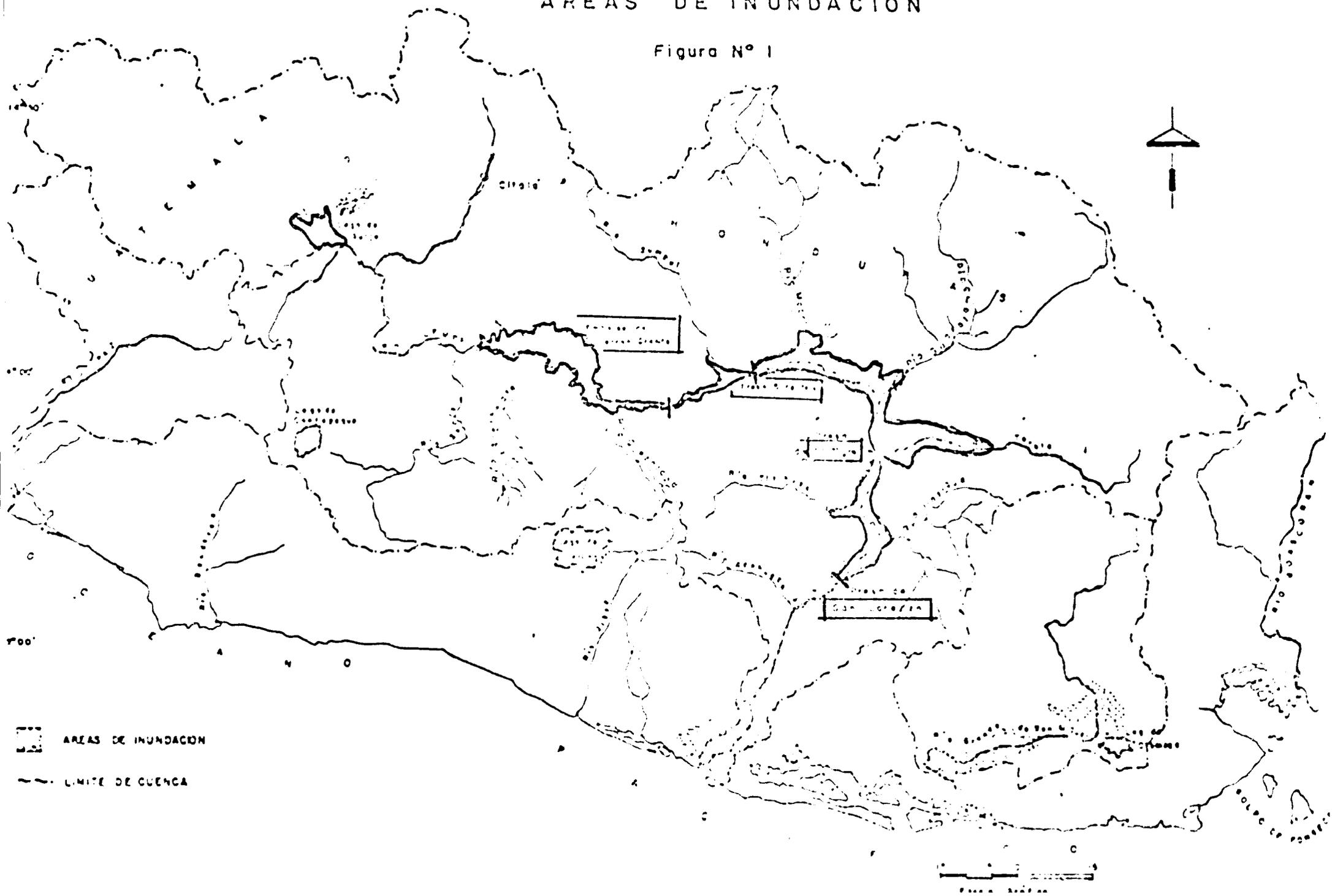
COUNTRY: EL SALVADOR

- NAME: EL TIGRE
- TYPE: Single Purpose (CEL). Proposed multi-purpose (WRMP).
- PLAN: Lempa River development. See 4.1 (CEL). See Annex 3.4. Lower Lempa flood control. (WRMP).
- PROGRAM: National Electrification (CEL). Water Resources Master Plan (WRMP).
- AGENCY (IES): CEL.
- COMPLETION DATE: 1992 (270 MW) 1995 (405 MW).
- LOCALIZATION: Between 5 de Noviembre and San Lorenzo, some 80 km. from river mouth. Below Torola River confluence.
- WATERSHED: Lower Lempa
- RIVER(S): Lempa
- PURPOSE(S): Hydroelectricity (CEL). Flood control to lower Lempa areas. Protection mainly from Mocal, Guaranbala and Torola Floods.
- OBJECTIVE(S): Generate 540 MW and 1557 Gwh/year upon completion.
- GENERAL LAYOUT:
- REGULATION:
- RESERVOIR CAPACITY:  $1500 \times 10^6 \text{ m}^3$  OPERATIONAL ELEVATION: 125' MAXIMUM ELEVATION:
- TYPE OF DAM: LENGTH: HEIGHT:
- FLOODED AREA:



# AREAS DE INUNDACION

Figura N° 1



## HYDROELECTRIC PROJECT PROFILE

NO. 4.5

COUNTRY: EL SALVADOR

- NAME: PASO DEL OSO - ZAPOTILLO
- TYPE: Single Purpose (CEL). Proposed multi-purpose (WRMP).
- PLAN: Lempa River development. See 4.1 (CEL). See Annex 3.4. Development of Lempa reach between elevations 300 and 430 m (WRMP).
- PROGRAM: National Electrification (CEL). Water Resources Master Plan (WRMP).
- AGENCY (IES): CEL
- COMPLETION DATE: Not yet scheduled.
- LOCALIZATION: Upper Lempa, below Lempa and Desague rivers, some 245-260 km. upstream from river mouth.
- WATERSHED: Upper Lempa.
- RIVER(S): Lempa. Sucio.
- PURPOSE(S): Hydroelectricity, irrigation, domestic water supply.
- OBJECTIVE(S): Generate 40 MW and 142 Gwh/year at Paso del Oso; and 120 MW and 405 Gwh/year at Zapotillo (CEL). Irrigate 30,000 Ha. including the Aticooyo irrigation district diversion of some 2m<sup>3</sup>/s for San Salvador Water Supply from Sucio River (WRMP).
- GENERAL LAYOUT:
  
- REGULATION:
- RESERVOIR CAPACITY: OPERATIONAL ELEVATION:
 

Paso del Oso (CEL):	330 m	MAXIMUM Paso del
Zapotillo (CEL):	430 m	Oso
Paso del Oso (WRMP):	430 m	ELEVATION: (WRMP)
		435m
- TYPE OF DAM: LENGTH:
 

	HEIGHT:
--	---------
- FLOODED AREA:

- SPILLWAY CAPACITY:
- INSTALLED CAPACITY:
- HEAD:
- TUNNEL LENGTH:
- CANAL LENGTH:
- FLOOD PROTECTION:
- PUMP CAPACITY
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS: Irrigation and water supply.
- INFORMATION SOURCES: WRMP Studies.
- COST: Paso del Oso (CEL):  $\text{¢}175.2 \times 10^6$  (1978). About \$70.08  $\times 10^6$  at 2.5 rate.
- OBSERVATIONS: Zapotillo (CEL):  $\text{¢}433.9 \times 10^6$  (1978). About \$173.56  $\times 10^6$  at 2.5 rate.  
WRMP Scheme substitutes both Paso del Oso (40 MW) and Zapotillo (120 MW) CEL Projects by a single enlarged project at Paso del Oso.

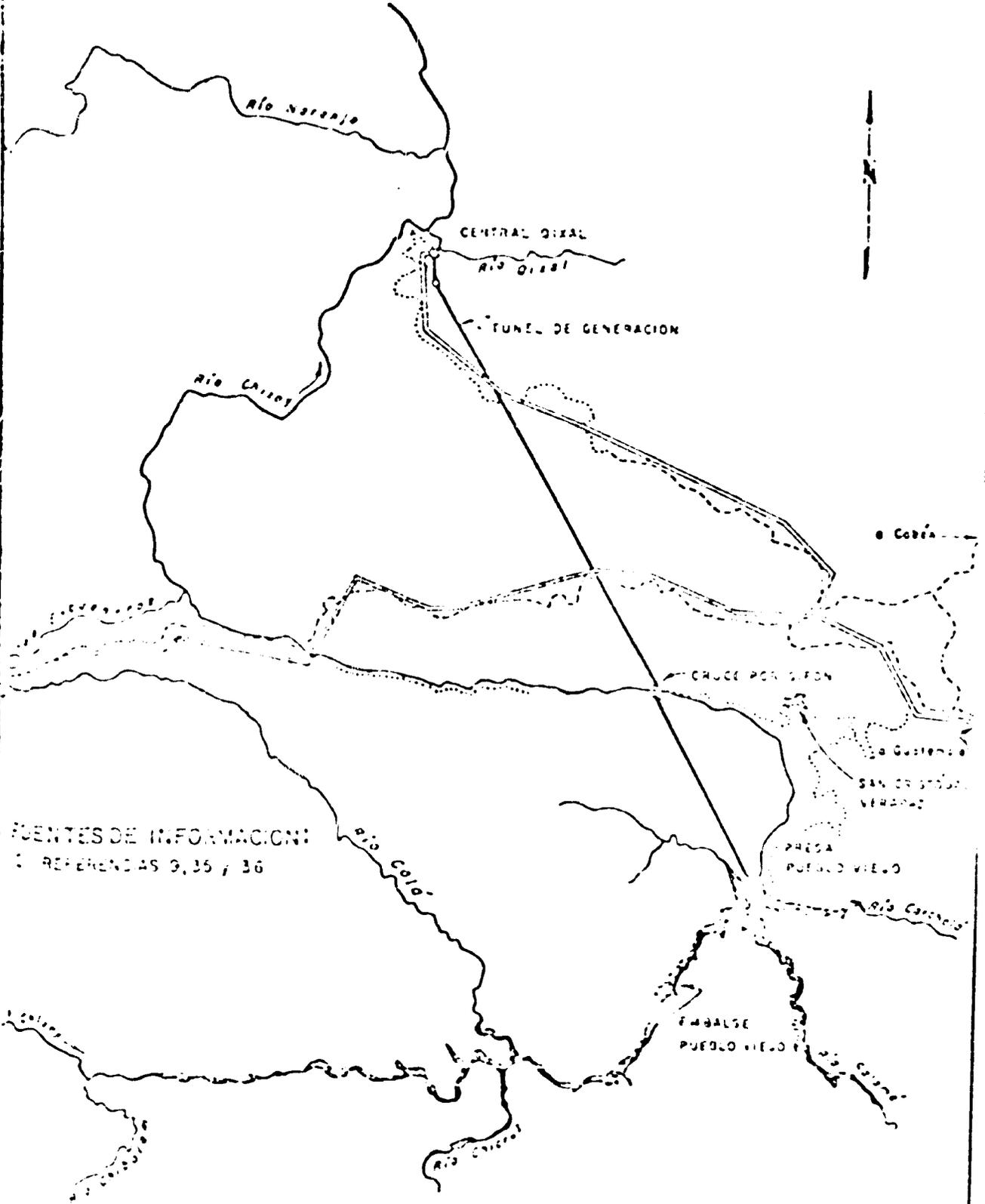
## HYDROELECTRIC PROJECT PROFILE

NO. 4.6

COUNTRY: GUATEMALA

- NAME: FUEBLO VIEJO - QUIXAL
  - TYPE: Single purpose (INDE)
  - PLAN: Development of upper and Middle Chixoy River Basin
- 
- PROGRAM: National Electrification (INDE)
  - AGENCY (IES): INDE
  - COMPLETION DATE: April 1983 (tests). May 1983.
  - LOCALIZATION: North-Central Guatemala, in the Quiché, Baja Verapaz, and Alta Verapaz Provinces, near San Cristóbal, and Cobán. Some 75-100 Km from Guatemala City.
  - WATERSHED: Middle Chixoy
  - RIVER(S): Chixoy, Quixal, Catarata Pampur.
  - PURPOSE(S): Hydroelectricity
  - OBJECTIVE(S): Generate 1710 Gwh/year. Externalities in construction materials, professional services skilled and unskilled labor, and real state demands. Provide work for 4,000 families during construction.
  - GENERAL LAYOUT: Dam with ungated spillway. Tunner diversion down to Quixal River. Power house at Quixal. Introduction of Pampur water to penstock. 5 Pelton generating units. Siphon. Surge tank.
  - REGULATION: Annual 99%
  - RESERVOIR CAPACITY: 460x10<sup>6</sup>m<sup>3</sup>      OPERATIONAL ELEVATION: 799.9m      MAXIMUM 811.2m ELEVATION:
  - TYPE OF DAM: Rockfill      LENGTH: 250m      HEIGHT: 110m
  - FLOODED AREA: 13.4 square kilometers





FUENTES DE INFORMACION:  
 REFERENCIAS 9, 35 y 36

- SIGNOS CONVENCIONALES**
- CARRETERA EN OBRA
  - - - - CARRETERA A SER CONSTRUIDA
  - CENTRAL HIDROELECTRICA
  - SITIO DE PRESA
  - CHAMBERA DE RESERVOIRIO
  - - - - LINEA DE TRANSMISION A SER CONSTRUIDA
  - SUBESTACION
  - TUNEL DE GENERACION

**TABLA 2.C.12**  
**ESQUEMA DE OBRAS PROYECTO**  
**PUEBLO VIEJO**

0 2 4 6 8 KM  
 ESCALA 1:50,000

## HYDROELECTRIC PROJECT PROFILE

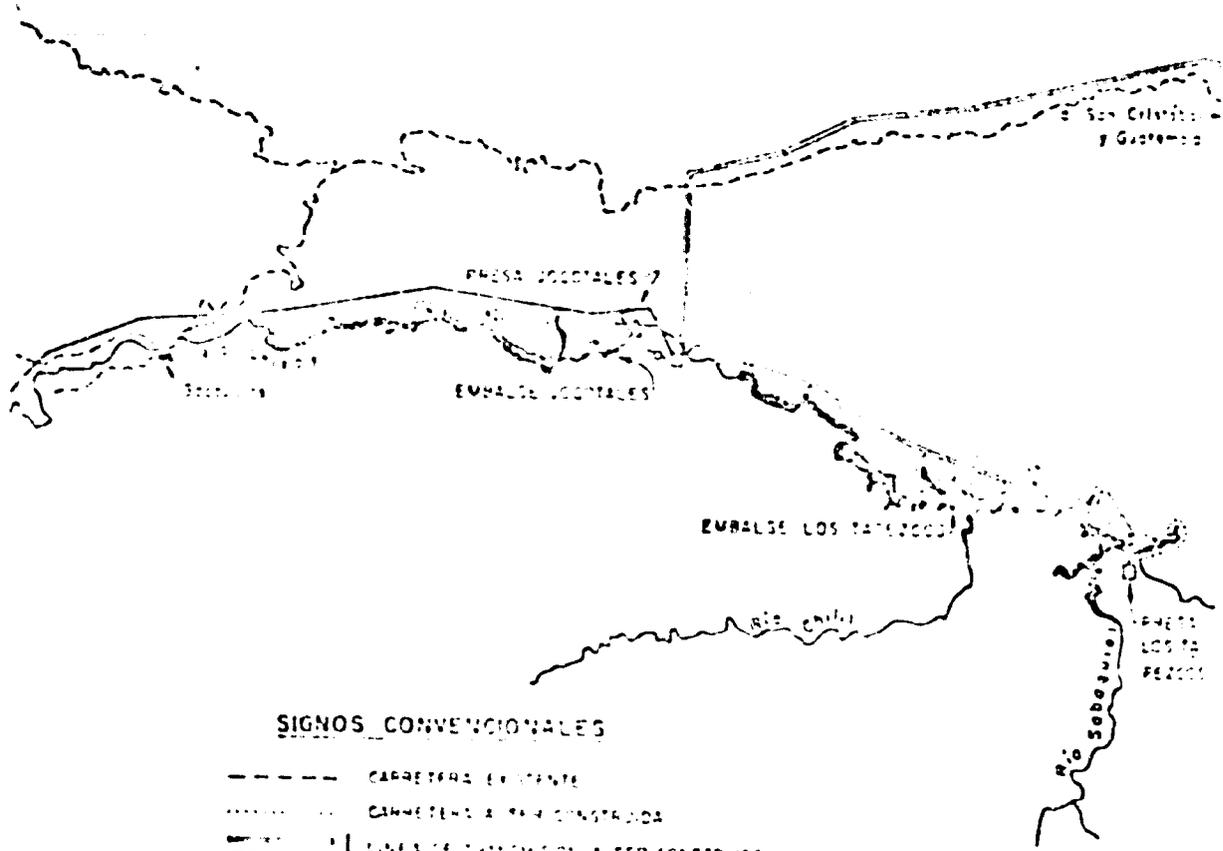
NO. 4.7

COUNTRY: GUATEMALA

- NAME: JOCOTALES
- TYPE: Single purpose.
- PLAN: Development of Upper and Middle Chixoy River Basin. Electricity Master Plan Phase II.
- PROGRAM: National Electrification
- AGENCY (IES): INDE
- COMPLETION DATE: Not yet scheduled
- LOCALIZATION: Northern Guatemala, Quiché Province, East of Sacapulas
- WATERSHED: Middle Chixoy
- RIVER(S): Chixoy
- PURPOSE(S): Hydroelectricity
- OBJECTIVE(S): Generate 80 MW (64 MW and 164 Gwh/year as revised by Master Plan).
- GENERAL LAYOUT: Dam, gated spillway, intake, penstock, surge tank, powerhouse, access roads.
- REGULATION: Annual 96%
- RESERVOIR CAPACITY:  $42.5 \times 10^6 m^3$  OPERATIONAL ELEVATION: 1104.5m MAXIMUM ELEVATION: 1127m
- TYPE OF DAM: Earth and Rockfill LENGTH: 270 m HEIGHT: 87 m
- FLOODED AREA: 1.57 km<sup>2</sup>

- SPILLWAY CAPACITY: 5180 m<sup>3</sup>/s
  - INSTALLED CAPACITY: 60 MW
  - HEAD: 106 m
  - TUNNEL LENGTH: 1.83 Km
  - CANAL LENGTH:
  - FLOOD PROTECTION:
  - PUMP CAPACITY
  - DRAINAGE WORKS:
  - NAVIGATION WORKS:
  - OTHER WORKS: 15 Km access roads
  - INFORMATION SOURCES: INDE pre-feasibility studies and Masterplan Studies.
  - COST: Q41.4 × 10<sup>6</sup> (1973) 1Q = 1 US\$
  - OBSERVATIONS: Studies made by LAM Consortium
- INTAKE CAPACITY: 88.8 m<sup>3</sup>/s  
 ENERGY: 202.2 GWh/yr  
 PLANT FACTOR: 0.24

TABLAS 2.C.13 y 2.C.14  
 ESQUEMA DE OBRAS: PROYECTOS JOCOTALES Y LOS TAPEZCOS

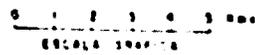


**SIGNOS CONVENCIONALES**

- CARRETERA EXISTENTE
- ..... CARRETERA A SER CONSTRUIDA
- — — LINEA DE TRANSMISION A SER CONSTRUIDA
- CENTRAL HIDROELECTRICA
- ▬ STIO DE ENTE
- CHIMENEA DE EQUILIBRIO

**FUENTES DE INFORMACION:**

REFERENCIAS 9, 35 y 36



## HYDROELECTRIC PROJECT PROFILE

- NO. 4.8 COUNTRY: GUATEMALA
- NAME: LOS TAPEZCOS
  - TYPE: Single Purpose.
  - PLAN: Development of Upper and Middle Chixoy River Basin. Electricity Master Plan Phase II.
  - PROGRAM: National Electrification.
  - AGENCY (IES): INDE
  - COMPLETION DATE: Not yet scheduled.
  - LOCALIZATION: 111 Km upstream from confluence of Chixoy and Quixol rivers, between Pueblo Viejo and Jecotales.
  - WATERSHED: Middle Chixoy
  - RIVER(S): Chixoy
  - PURPOSE(S): Hydroelectricity
  - OBJECTIVE(S): Generate 200 MW (63 MW and 162 Gwh/year as revised by Master Plan).
  - GENERAL LAYOUT: Dam, gated spillway, intake, generation tunnel, powerhouse, access roads.
  - REGULATION: Annual 90%
  - RESERVOIR CAPACITY:  $86.5 \times 10^6 m^3$  OPERATIONAL ELEVATION: 963M MAXIMUM OPERATIONAL ELEVATION: 983M
  - TYPE OF DAM: Earth and Rockfill LENGTH: 210M HEIGHT: 81M
  - FLOODED AREA: 3.1 Km<sup>2</sup>

- SPILLWAY CAPACITY: 3780 m<sup>3</sup>/s
- INSTALLED CAPACITY: 200 MW
- HEAD: 60 M
- TUNNEL LENGTH: 85 M
- CANAL LENGTH:
- FLOOD PROTECTION:
- PUMP CAPACITY
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS: 27 Km access roads
- INFORMATION SOURCES: INDE pre-feasibility studies and Master Plan Studies.
- COST: Q 49.3 X 10<sup>6</sup> (1973). 1Q = 1\$
- OBSERVATIONS: Studies made by LAMI Consortium

INTAKE CAPACITY:

ENERGY: 145.2 GWh/yr PLANT FACTOR: 0.075

## HYDROELECTRIC PROJECT PROFILE

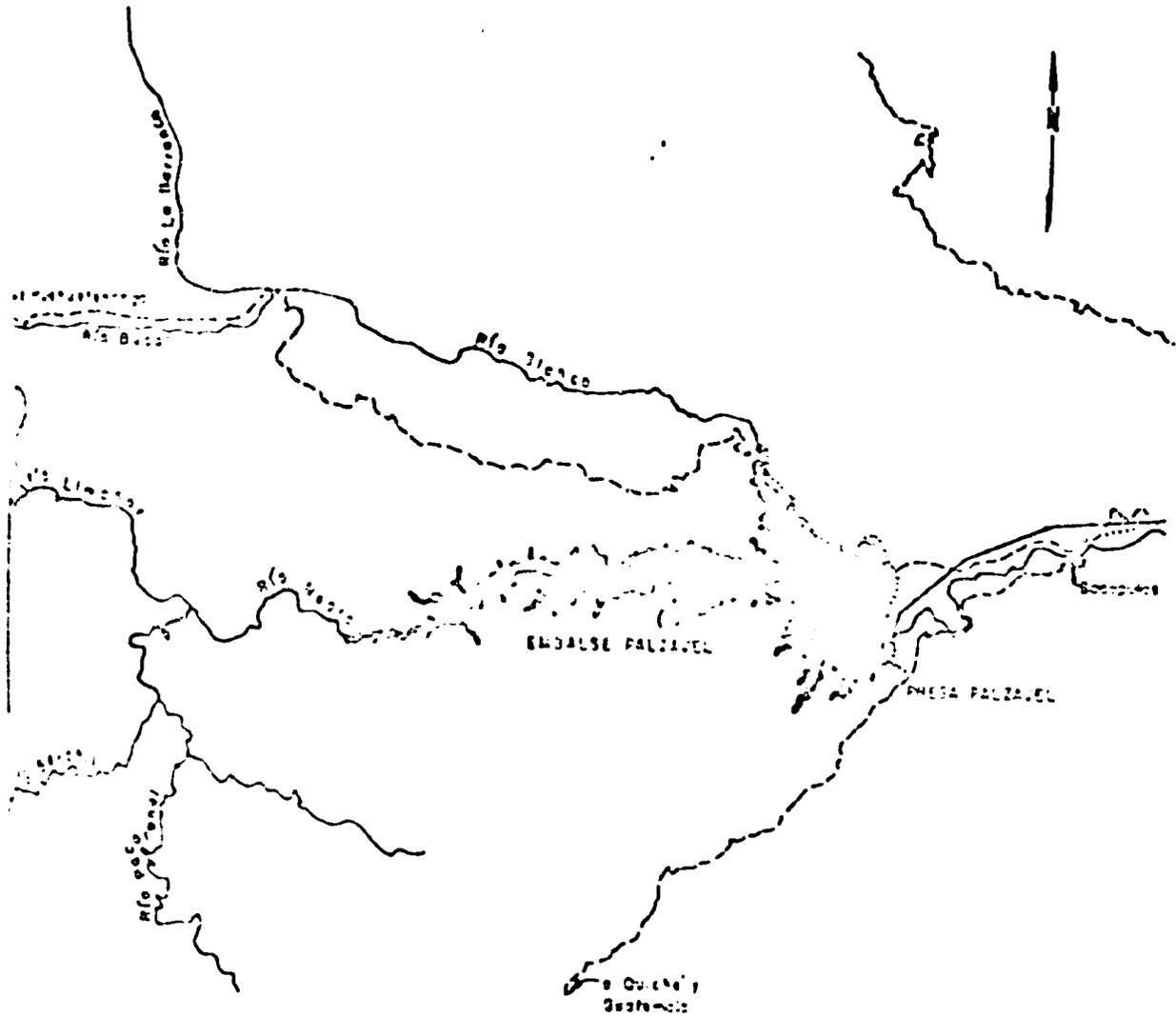
NO. 4.2

COUNTRY: GUATEMALA

- NAME: PALZAJUL
- TYPE: Single Purpose
- PLAN: Development of Upper and Middle Chixoy River Basin. Electricity Master Plan Phase II.
- PROGRAM: National Electrification
- AGENCY (IES): INDE
- COMPLETION DATE: Not yet Scheduled
- LOCATION: Upstream from Los Tapezeos, west of Sacapulas, below the Río Negro and Río Blanco confluence.
- WATERSHED: Upper Chixoy
- RIVER(S): Chixoy, Blanco, Negro
- PURPOSE(S): Hydroelectricity
- OBJECTIVE(S): Generate 40 MW (35 MW and 92 GWh/year as revised by Master Plan).
- GENERAL LAYOUT: Dam, gated spillway, intake, penstock, generation tunnel, powerhouse, access roads.
- REGULATION: Annual 90%
- RESERVOIR CAPACITY:  $364.2 \times 10^6 \text{ m}^3$  OPERATIONAL ELEVATION: 1246M MAXIMUM 1277.3M ELEVATION:
- TYPE OF DAM: Earth and Rockfill LENGTH: 240M. HEIGHT: 77M.
- FLOODED AREA:  $11.5 \text{ km}^2$



TABLA 2.C.15  
ESQUEMA DE OBRAS: PROYECTO PALZAJEL



SIGNOS CONVENCIONALES

- CARRETERA EXISTENTE
- ..... CARRETERA A SER COMPLETADA
- LINEA DE TRANSMISION A SER COMPLETADA
- CENTRAL HIDROELECTRICA
- ▭ SITIO DE INSTA
- PUEBLACION

0 1 2 3 4 5 Km  
ESCALA GRAFICA

FUENTES DE INFORMACION:  
REFERENCIAS 9, 35 y 36

## HYDROELECTRIC PROJECT PROFILE

NO. 4.10

COUNTRY: GUATEMALA

- NAME: SERCHIL
- TYPE: Single Purpose (INDE). Multipurpose (Guatemala City Water Supply Master Plan - PLAMABAG).
- PLAN: Electricity Master Plan and Electricity Master Plan Phase II (INDE). PLAMABAG (Guatemala City).
- PROGRAM: National Electrification (INDE). PLAMABAG
- AGENCY (IES): INDE
- COMPLETION DATE: Not Yet Scheduled
- LOCALIZATION: Upstream from Palzajel, below the confluence of Paracanat and Serchil Rivers.
- WATERSHED: Upper Chixoy
- RIVER(S): Negro (Chixoy), Paracanat, and Serchil
- PURPOSE(S): Hydroelectricity (INDE). Water Supply (PLAMABAG).
- OBJECTIVE(S): Generate 37 MW, 187 GWh/year of firm energy and 325 GWh/year of total energy (81 MW and 210 GWh/year as revised by Master Plan II). Provide up to 3 M<sup>3</sup>/s of water supply to Guatemala City (PLAMABAG).
- GENERAL LAYOUT: Dam, powerhouse, gated tunnel, spillway, tunnels.
- REGULATION: Annual 56%
- RESERVOIR CAPACITY: 98x10<sup>6</sup>M<sup>3</sup>      OPERATIONAL ELEVATION: 1575 M      MAXIMUM 1579.2M ELEVATION:
- TYPE OF DAM: Rockfill      LENGTH: 360M      HEIGHT: 114.5M
- FLOODED AREA: 4.8 Km.<sup>2</sup>

- SPILLWAY CAPACITY: 2500 M<sup>3</sup>/5
- INSTALLED CAPACITY: 37 MW
- HEAD: 240.3 M (net)
- TUNNEL LENGTH: 790 M
- CANAL LENGTH:
- FLOOD PROTECTION:
- PUMP CAPACITY
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS:
- INFORMATION SOURCES: INDE pre-investment studies. PLAMABAG final report.
- COST: 2 143 x 10<sup>6</sup> (1977). 1Q = 1\$
- OBSERVATIONS: INDE Studies made by LSF Consortium. PLAMABAG (TAMAL) has studied both a Concrete and Rock-fill dam alternatives of 136.35 and 140M height respectively. It would be the phase IV of one of the studied water supply schemes to Guatemala City. This scheme would include ground water, and surface water from the upper Motagua river for a combined total regulated flow of 7.5 M<sup>3</sup>/s at stage IV. Conflict with INDE is envisioned, so it has low priority.

INTAKE CAPACITY:

ENERGY: 187 GWh/yr. PLANT FACTOR: 0.85  
(firm)



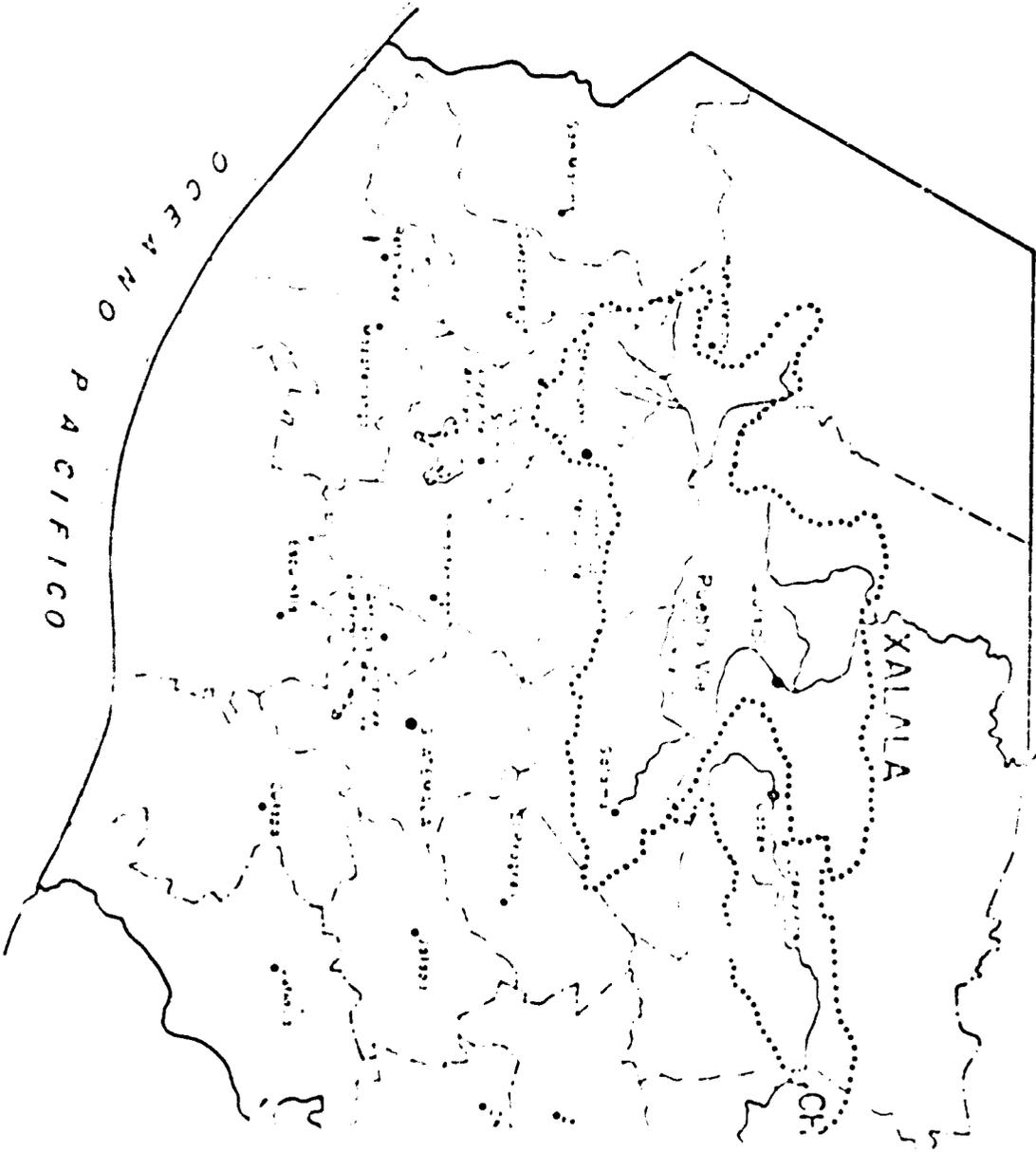
## HYDROELECTRIC PROJECT PROFILE

- NO. 4.11 COUNTRY: GUATEMALA
- NAME: XALALA
  - TYPE: Single Purpose
  - PLAN: Electricity Master Plan Phase II
  - PROGRAM: National Electrification
  - AGENCY(IES): INDE
  - COMPLETION DATE: Not Yet Scheduled
  - LOCALIZATION: Between the Quiché and Alta Verapaz provinces in a remote and sparsely-populated area about 50 km. north of Cobán. Downstream from Pueblo Viejo.
  - WATERSHED: Lower Chixoy
  - RIVER(S): Chixoy, Azul
  - PURPOSE(S): Hydroelectricity
  - OBJECTIVE(S): Generate 330 MW, 677 GWh/yr. of firm energy and 1474 GWh/yr. of total energy (360 MW and 1468 GWh/yr. as revised by Master Plan Phase II).
  - GENERAL LAYOUT: Dam, transbasin diversion from Río Azul, gated spillway, tunnel, powerhouse.
  - REGULATION: Annual 98%
  - RESERVOIR CAPACITY:  $430 \times 10^6 \text{ m}^3$  OPERATIONAL ELEVATION: 290M MAXIMUM ELEVATION: 290M.
  - TYPE OF DAM: Rockfill LENGTH: 280 M HEIGHT: 97M
  - FLOODED AREA:  $31.8 \text{ km}^2$

- SPILLWAY CAPACITY: 553013/5
- INSTALLED CAPACITY: 330MW
- HEAD: 72.2. (net)
- TUNNEL LENGTH: 2580 M.
- CANAL LENGTH:
- FLOOD PROTECTION:
- PIPE CAPACITY
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS:
- INFORMATION SOURCES: INDE KALALA feasibility study.
- COST: Q 380 x 10<sup>6</sup> (1980). 1Q = 1\$
- OBSERVATIONS: Studies made by ISF Consortium

INTAKE CAPACITY: 54013/5

ENERGY: 677x10<sup>6</sup> GWh/yr. (firm) PLANT FACTOR: 0.85



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Topografía  
de  
Xalapa

## HYDROELECTRIC PROJECT PROFILE

- NO. 4.12 COUNTRY: HONDURAS
- NAME: EL CAJON
  - TYPE: Single Purpose
  - PLAN:
- 
- PROGRAM: National Electrification
  - AGENCY (IES): ENEE
  - COMPLETION DATE: 1986
  - LOCALIZATION: 3 Km. downstream from the Humuya and Sulaco rivers, about 30 Km. east of the Río Lindo project.
  - WATERSHED: Comayagua River Basin, eastern branch of Río Ulua.
  - RIVER(S): Humuya
  - PURPOSE(S): Hydropower, flood control (incidental)
  - OBJECTIVE(S): Generate 296 MW and 1695 GWh/yr. save  $155 \times 10^6$  each year in oil imports (1978). Contribute to flood control in the Sula Valley by controlling the Humuya River.
  - GENERAL LAYOUT: Dam, underground powerhouse, Spillway, bottom outlets
- 
- REGULATION:
  - RESERVOIR CAPACITY: OPERATIONAL ELEVATION: 285M MAXIMUM ELEVATION:
  - TYPE OF DAM: Arch Dam LENGTH: HEIGHT: 225
  - FLOODED AREA: 94 Km.<sup>2</sup>

- SPILLWAY CAPACITY: 17,100 M<sup>3</sup>/5 plus INTAKE CAPACITY:  
5,250 M<sup>3</sup>/5 by bottom outlets
- INSTALLED CAPACITY: 296 MW ENERGY: 1,695 GWh/yr. PLANT FACTOR:
- HEAD: 158 M(net)
- TUNNEL LENGTH:
- CANAL LENGTH:
- FLOOD PROTECTION:
- PUMP CAPACITY
- DRAINAGE WORKS:
- NAVIGATION WORKS:
- OTHER WORKS:
- INFORMATION SOURCES: ENEC brochures
- COST: L 1032 X 10<sup>6</sup> (1978). About \$516 X 10<sup>6</sup>.  
Financing by World Bank, IDB, Central American Bank, IDA, OPEP, CIDA, Suppliers, U.K., Private Banks and Government of Honduras.
- OBSERVATIONS:

Design made by Motor Columbus.

## HYDROELECTRIC PROJECT PROFILE

NO. 4.13

COUNTRY: HONDURAS

- NAME: EL NISPERO
- TYPE: Single Purpose
- PLAN:
- PROGRAM: National Electrification
- AGENCY(IES): ENEE
- COMPLETION DATE: 1982
- LOCALIZATION: Near El Nispero, about 25 Km. South of Santa Bárbara, in Santa Bárbara Province.
- WATERSHED: Río Otoro Watershed, western branch of Río Ulua.
- RIVER(S): Palaja
- PURPOSE(S): Hydropower
- OBJECTIVE(S): Generate 22.5 MW for peak demands.
- GENERAL LAYOUT: Dam, concrete spillway, channel, tunnel, powerhouse, Francis turbine.
- REGULATION: Run of River
- RESERVOIR CAPACITY:                      OPERATIONAL ELEVATION:                      MAXIMUM ELEVATION:
- TYPE OF DAM: Earth dam                      LENGTH:                      HEIGHT:
- FLOODED AREA: 0.33 Km.<sup>2</sup>



## GENERAL PROJECT PROFILE

NO. 5.1

COUNTRY: Guatemala

NAME: CHIVON WATERSHED REFORESTATION

- LEVEL:            Idea     Pre-Project     Project     Operational
- TYPE:            Single Purpose
- PLAN:            National Forest Development
- PROGRAM:        Pueblo Viejo Hydropower Project
- SOLICITUDE:     INDEF.
- EXECUTIVE AGENCY (IES):    INAFOR
- FINANCING:       0797,353 (1978-82)  
                     405,338 (for 1982)  
                     7,850,680 (beyond 1982)  
                     (10 = US\$) Financed by INAFOR
- DURATION:        4 years (from 1982)
- LOCALIZATION:    Near Pueblo Viejo Dam (see 4.6)
- OBJECTIVE(S):    Reforestation
- GOAL(S):         1136 Has. up to 1981  
                     500 Has. for 1982  
                     9164 beyond 1982.
- STRATEGY (IES):    Planned to enlarge it to upstream watershed's
- METHODOLOGY (IES):    To use 4,071 local persons
- IMPORTANCE:      High priority within INAFOR.
- INFORMATION SOURCES:    INAFOR, Ecology Section



Total de plantas en los viveros: 1,167,327  
 Número de Ha reforestadas: 977,35

No	MUNICIPIO	VIVERO
1	Sacubillas	Chicoyá
2		El Estero
3	Uspantán	Uspantán
4		Fuente Nueva
5		Jocutú 2
6		Sacubillas
7	Cubulco	Cubulco
8	Ratón	Ratón
9	San Miguel Chiquí	San Miguel Chiquí

**SÍMBOLOGÍA**

- Límite Departamental
- Límite Cuicma Chicoy Río
- Carretera Principal
- - - Carretera Secundaria
- Cabecera Departamental
- Áreas Reforestadas
- ▣ Viveros

- ⊙ INDE
- ▣ INAFOR

INSTITUTO NACIONAL DE ELECTRICIDAD Y ENERGÍA  
 GUATEMALA

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COORDINACIÓN TÉCNICA DE CUENCAS

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LOCALIZACIÓN DE VIVEROS  
 PARA LA REFORESTACIÓN  
 DE LA CUENCA DEL CHICOY

GENERAL PROJECT PROFILE

NO. 5.2

COUNTRY: GUATEMALA

NAME: CHIXOY WATERSHED REFORESTATION

- LEVEL: Idea  Pre-Project  Project  Operational
- TYPE: Single Purpose
- PLAN: Chixoy River Watershed Management Plan
- PROGRAM: Pueblo Viejo Hydropower Project
- SOLICITUDE: World Bank
- EXECUTIVE AGENCY (IES): INDE
- FINANCING: Q389,800 (1980)  
595,100 (1981)  
599,200 (1982)  
Financed by INDE
- DURATION: 20 years (started 1979)
- LOCALIZATION: Sacapulas, Uspantán, Cubulco, Rabinal,  
San Miguel Chicaj
- OBJECTIVE(S): Reforestation
- GOAL(S): 100,000 Has.  
977,36 reforested to date
- STRATEGY (IES): Promotion, education, awareness, motivation, forest-fire prevention in local communities.
- METHODOLOGY (IES): Tree nurseries located in several places in the middle Chixoy reach. Reforestation in spring areas.
- IMPORTANCE:
- INFORMATION SOURCES: Report by INDE's Watershed Protection Unit

GENERAL PROJECT PROFILE

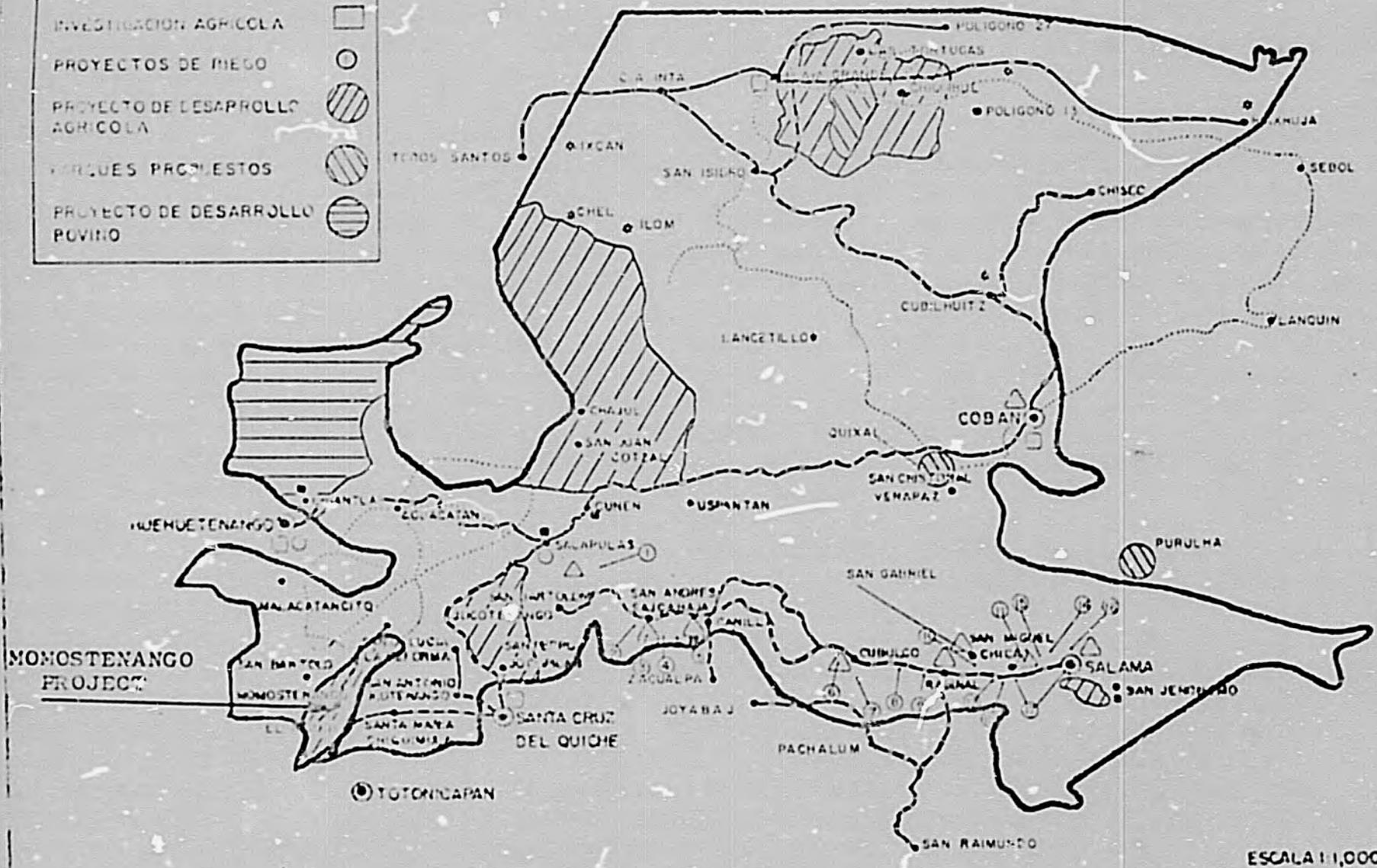
NO. 5.3

COUNTRY: GUATEMALA

NAME: CHIXOY RIVER WATERSHED DEVELOPMENT PLAN

- LEVEL: Idea  Pre-Project  Project  Operational
- TYPE: Multidisciplinary
- PLAN:
- PROGRAM:
- SOLICITUDE: SIGUEPLAN
- EXECUTIVE AGENCY (IES): INDE-LAVALIN
- FINANCING: IDB
- DEPARTICN:
- LOCALIZATION: Complete Chixoy Watershed
- OBJECTIVE(S): Socio-cultural, agriculture, forestry, parks, native crafts, tourism, transportation, mines, archaeology.
- GOAL(S): To develop an integrated development plan for the watershed.
- STRATEGY (IES): Urban planning, agricultural research, irrigation, agricultural development, national park, reforestation, and livestock development projects.
- METHODOLOGY (IES): A first phase to identify projects. Second phase to study selected projects to feasibility level.
- IMPORTANCE:
- INFORMATION SOURCES: LAVALIN Final Report

- PROYECTO DE PLANIFICACION URBANA
- INVESTIGACION AGRICOLA
- PROYECTOS DE RIEGO
- PROYECTO DE DESARROLLO AGRICOLA
- PARQUES PROYECTADOS
- PROYECTO DE DESARROLLO PUVINO



ESCALA 1:1,000,000

INSTITUTO NACIONAL DE ELECTRIFICACION  
I. N. D. E.  
LAMARRE VALOIS INTERNATIONAL LIMITEE  
LAVALIN

MAPA No  
3

ESTUDIO DE DESARROLLO DE LA CUENCA DEL RIO CHIXOY  
LOCALIZACION DE PROYECTOS

## GENERAL PROJECT PROFILE

NO. 5.4

COUNTRY: GUATEMALA

NAME: INTEGRAL AGRICULTURE, FORESTRY AND NATIVE CRAFTS DEVELOPMENT  
IN MOMOSTENANGO MUNICIPAL AREA

- LEVEL: Idea  Pre-Project  Project  Operational
- TYPE: Multidisciplinary
- PLAN: Chixoy River Watershed Development Plan
- PROGRAM:
- SOLICITUDE: USPADA
- EXECUTIVE AGENCY (IES):
- FINANCING: IDB
- DURATION: Two 5-year phases
- LOCALIZATION: Momostenango Municipality
- OBJECTIVE(S): Raise level of income of local population; demonstrate practical ways to decrease erosion and Chixoy sediment transport; establish a model for development and erosion decrease projects in the Chixoy Watershed.
- GOAL(S): Reforestation of 5500 Has. Direct aid to 5000 families.
- STRATEGY (IES): Dry-season agriculture, mini-irrigation, forestry and native crafts programs.
- METHODOLOGY (IES): Two years to promote change in agricultural practices, 3 years for 40% of dry-season agriculture and forestry programs, 80% of mini-irrigation and almost all native crafts program. Second five-year period to be defined.
- IMPORTANCE: High Priority
- INFORMATION SOURCES: LAVALIN Final Report. USPADA

## GENERAL PROJECT PROFILE

NO. 5.5

COUNTRY: GUATEMALA

NAME: RESTORATION OF AMATITLAN LAKE

- LEVEL: Idea  Pre-Project  Project  Operational
- TYPE: Multidisciplinary
- PLAN: Multidisciplinary Interinstitutional Commission (MIC)
- PROGRAM:
- SOLICITUDE: MIC
- EXECUTIVE AGENCY(IES): More than 12. INCLUDES INAFOR
- FINANCING: Local funds from the several institutions.  
Total Cost: Q3,484,500  
1 Q = 1 US\$
- DURATION: 2 months to 5 years to continuous activities.
- LOCALIZATION: Amatitlán Lake Watershed
- OBJECTIVE(S): Contribute to solve the lake problems and to maintain continuous attention towards the lake.
- GOAL(S): For INAFOR: Reforestation of 450 Has. Drafting of guidelines for soil management.
- STRATEGY(IES): Creation of a lake authority. Creation of a scientific commission. Implementation of the 24-project package.
- METHODOLOGY(IES): Projects in the following areas: pollution, recreation, water budget, soil resources, wildlife, water use, health, various.
- IMPORTANCE:
- INFORMATION SOURCES: Final Report of the Technical Commission.

GENERAL PROJECT PROFILE

NO. 5.6

COUNTRY: GUATEMALA

NAME: FORESTRY MOTIVATION 1982

- LEVEL: Idea  Pre-Project  Project  Operational

- TYPE: Single Purpose

- PLAN:

- PROGRAM: INAFOR/CARE/U.S. Peace Corps Natural Resource Conservation Program

- SOLICITUDE:

- EXECUTIVE AGENCY(IES): INAFOR/U.S. Peace Corps

- FINANCING: INAFOR/CARE

- DURATION: Indefinite

- LOCALIZATION: Several communities in Huehuetenango, Quiché, Quezaltenango, San Marcos, Totonicapán, Santa Rosa, Jutiapa, Jalapa, Sololá, Baja Verapaz, Chimaltenango.

- OBJECTIVE(S): Change of attitude of farmers in highlands towards use and management of natural resources.

- GOAL(S): For 1982: 850,000 m<sup>2</sup> of terraces, 105 km. of infiltration ditches, 330,000 m<sup>2</sup> of contours, 130,000 m<sup>2</sup> of forest management, 170,000 m<sup>2</sup> of pasture management, and several other activities.

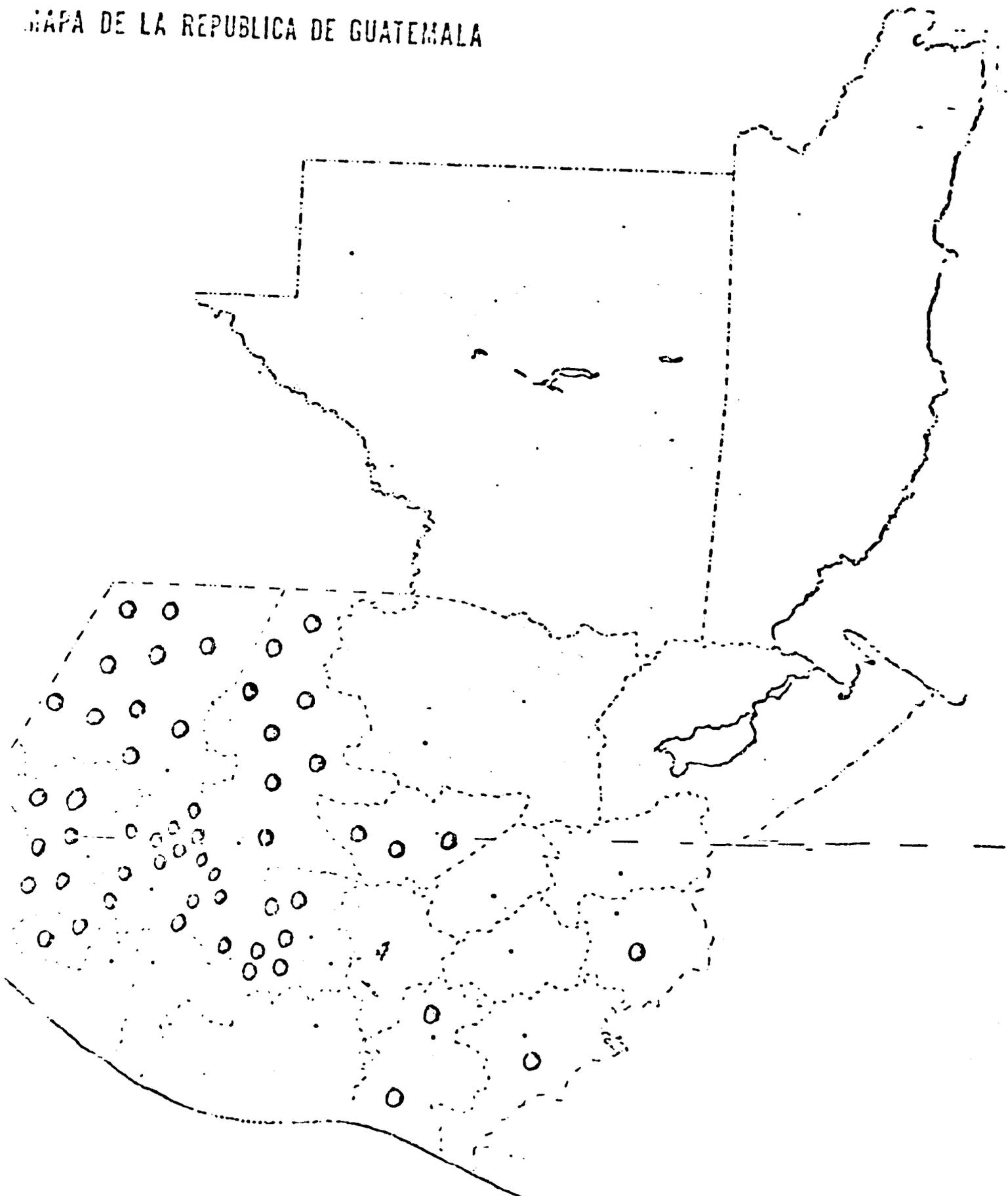
- STRATEGY (IES): Program operations organized as part of extension services of INAFOR. Seeks direct participation of local authorities and small farmers.

- METHODOLOGY (IES): Permanent mutual aid activities for about 150,000 persons in 75 rural communities. Emphasis on local INAFOR extension workers and community groups.

- IMPORTANCE:

- INFORMATION SOURCES: INAFOR Report

MAPA DE LA REPUBLICA DE GUATEMALA



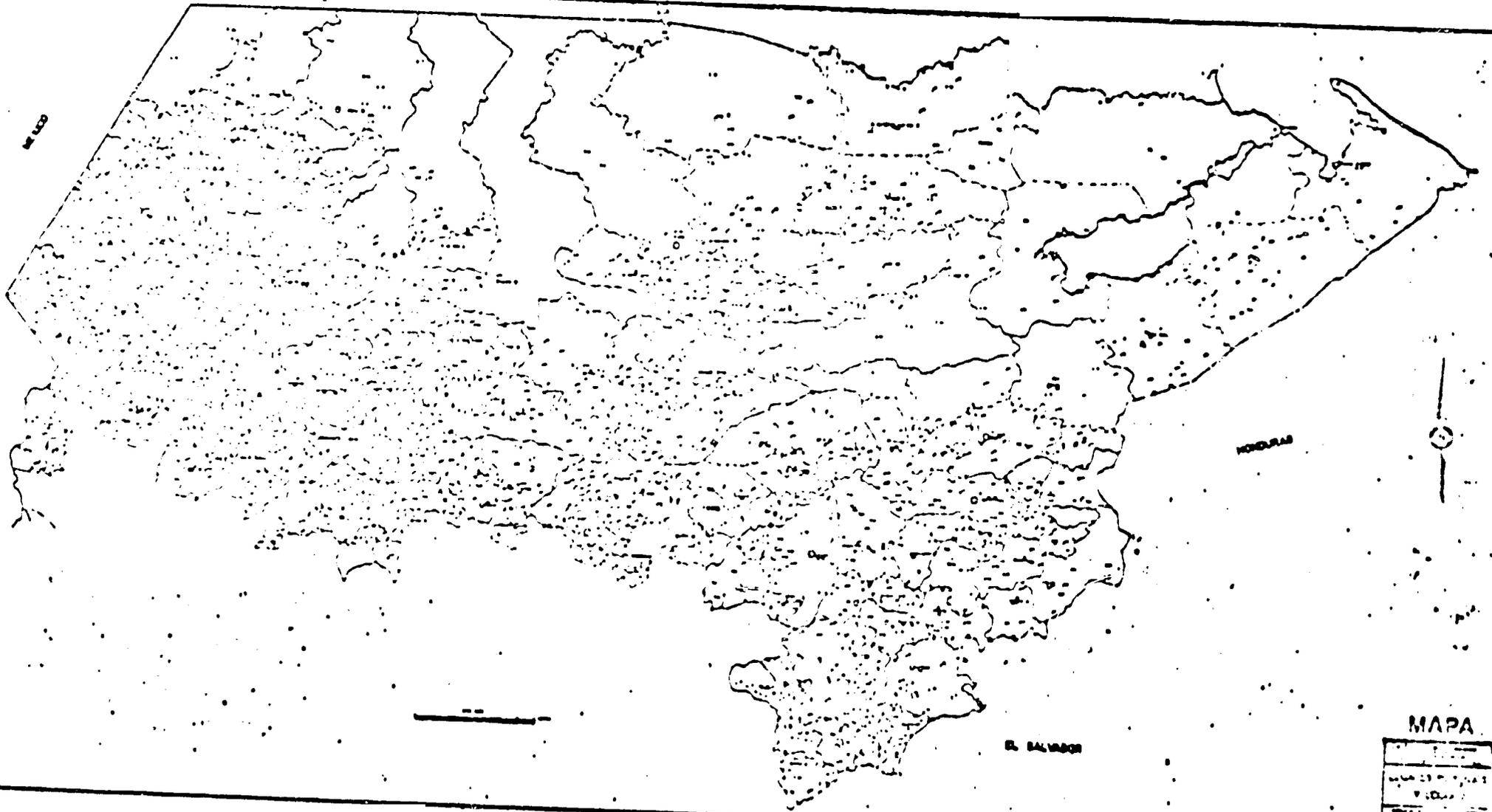
## GENERAL PROJECT PROFILE

NO. 5.7

COUNTRY: GUATEMALA

NAME: RURAL INTEGRATED AREAS STUDY (RIAR)

- LEVEL:            Idea     Pre-Project     Finished  
Project     Operational
- TYPE:            Multidisciplinary
- PLAN:
- PROGRAM:
- SOLICITUDE:            SEGEPLAN
- EXECUTIVE AGENCY (IES):    DIGESA, INFOM
- FINANCING:            AID
- DURATION:
- LOCALIZATION:            209 municipalities in Huehuetenango, Sololá, Totonicapán, Quiché, Alta y Baja Verapaz, Jalapa, Escuintla, Chiquimula, Izabal, El Progreso, Quetzaltenango, San Marcos, Jutiapa, Guatemala and Chimaltenango.
- OBJECTIVE(S):            Implement a methodology for systematic planning at municipality level.
- GOAL(S):            Identification of investment areas, identification of deficits in basic services.
- STRATEGY (IES):            Population analysis, design of a systematic planning methodology, integration of an information center.
- METHODOLOGY (IES):            Emphasis on information useful to identify investments in infrastructure and services.
- IMPORTANCE:
- INFORMATION SOURCES:            RIAR Final Report



M. LEO

HONDURAS

G. SALVADOR



MAPA 1.


## GENERAL PROJECT PROFILE

NO. 5.8

COUNTRY: HONDURAS

NAME: NATURAL RESOURCES MANAGEMENT

- LEVEL:            Idea     Pre-Project     Project     Operational
- TYPE:                            multidisciplinary
- PLAN:
- PROGRAM:
- SOLICITUDE:                    Government of Honduras
- EXECUTIVE AGENCY (IES):        SRN, INA, COHDEFOR, PCN, BANADESA
- FINANCING:                    AID (L 29.9 million), and Government of Honduras  
(L 14 million)  
2 L = 1 US\$
- DURATION:                      5 years (1981-1985)
- LOCALIZATION:                 Choluteca Watershed
- OBJECTIVE(S):                 To strengthen institutional mechanisms, through  
which the Government of Honduras manages the  
country's natural resources.
- GOAL(S):                        Improvement of income to 7,000 local farmers, re-  
forestation of 13,000 Has., improved cultivation  
practices in 5,000 Has. of pasture and 18,000  
Has. of corn, natural resources policies and an insti-  
tutional framework.
- STRATEGY (IES):                Law and Policy package, institutional strengthening,  
development of a land-use classification system and  
betterment of the watershed.
- METHODOLOGY (IES):            Natural resources policy, planning and data collection.  
Watershed management in 5 sub-basins.
- IMPORTANCE:                    High in natural resources area
- INFORMATION SOURCES:         AID Project Paper. PMFN- SRN Direction

THE NATURAL RESOURCES MANAGEMENT PROJECT



Figure 1.1 THE FIVE SELECTED SUBWATERSHEDS OF THE CHOLUTECA WATERSHED

## GENERAL PROJECT PROFILE

NO. 5.9

COUNTRY: HONDURAS

NAME: NATIONAL SYSTEM FOR REGIONAL-LOCAL  
PLANNING AND APPLICATION TO THE AGUAN REGION

- LEVEL: Idea  Pre-Project  Project  Operational
- TYPE: Multidisciplinary
- PLAN:
- PROGRAM: Rural Integrated Development (RRI)
- SOLICITUDE: CONSUPLAN
- EXECUTIVE AGENCY (IES): CONSUPLAN
- FINANCING: UNDP/ONCD \$808,000.  
Local \$1,462,000
- DURATION: 2 years (1982-83)
- LOCALIZATION: Aguan River Valley (1580 km<sup>2</sup>)
- OBJECTIVE(S): Define a planning methodology, implementation of a pilot project in the Aguan Region, training of local personnel.
- GOAL(S): Methodology for regional development plans, pilot plan, training of 10 technicians.
- STRATEGY (IES): Direct technical assistance; institutional development.
- METHODOLOGY (IES): Regional planning, agricultural economy, regional economic water resources, social development, cartography.
- IMPORTANCE: High within CONSUPLAN
- INFORMATION SOURCES: UNDP Project Paper

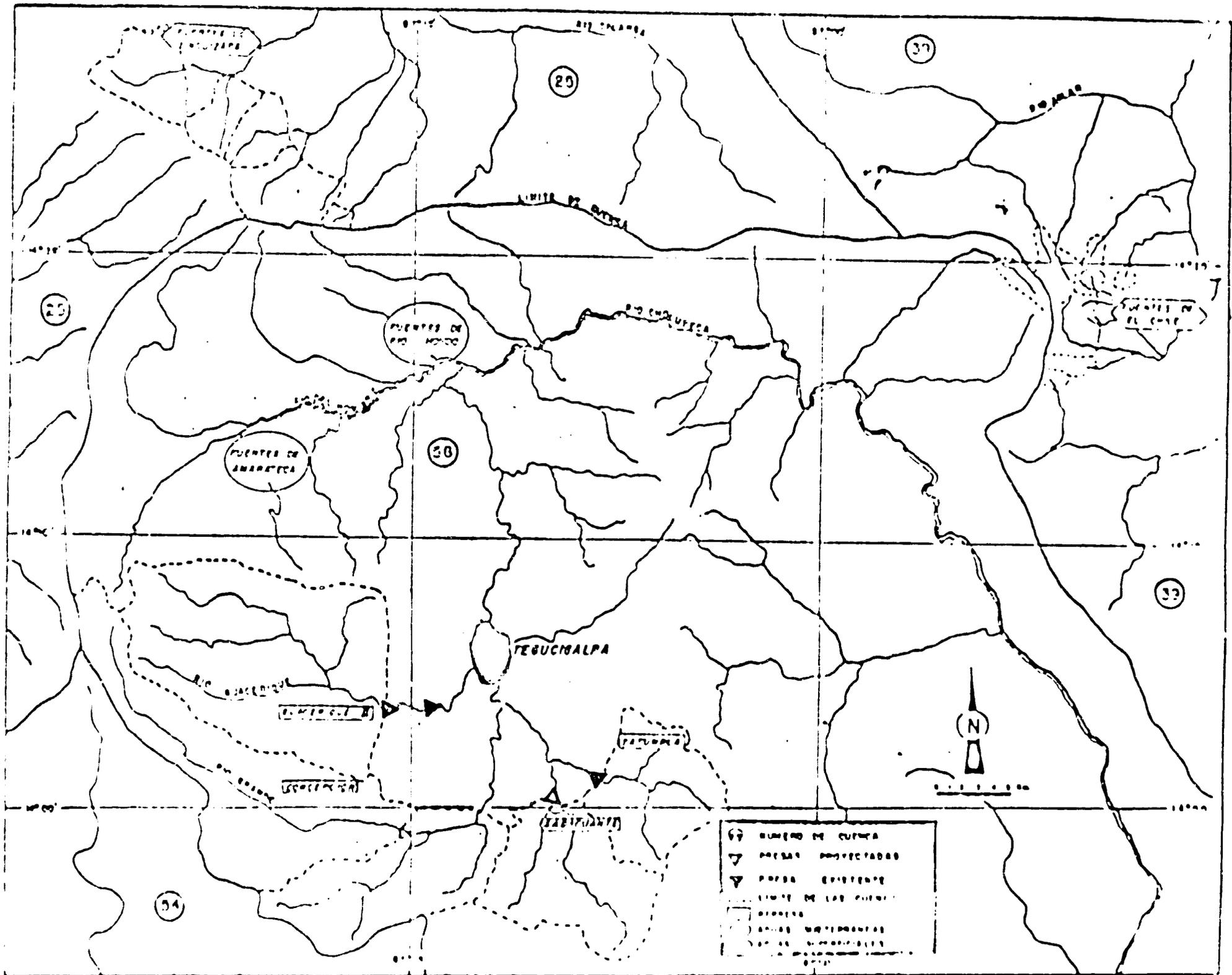
## GENERAL PROJECT PROFILE

NO. 5.10

COUNTRY: HONDURAS

NAME: TITUICIGALPA WATER SUPPLY MASTER PLAN

- LEVEL:            Idea     Pre-Project     Project     Operational
- TYPE:                            Water Supply and Sanitation
- PLAN:
- PROGRAM:
- SOLICITUDE:                    SANAA
- EXECUTIVE AGENCY (IES):        SANAA
- FINANCING:                      IDB
- DURATION:                      Short, medium and long-term (up to year 2010)
- LOCALIZATION:                 Upper Choluteca Watershed and vicinity
- OBJECTIVE(S):                 Plan for solution of water supply domestic and storm sewer problems for Titucigalpa up to year 2010.
- GOAL(S):                        Sequence of projects.
- STRATEGY (IES):                In the Choluteca River Watershed, 4 dam sites were identified (Cerro Unión, Guaymilla, Sabayante, Taburbla), and 2 ground water areas (Maratón, Río Pando) (one of the dams is 114 m high (Cerro Unión).
- METHODOLOGY (IES):            Diagnosis, study of alternatives, basic projects, ground water.
- IMPORTANCE:
- INFORMATION SOURCES:         SANAA Report to VIII AIDIS Congress (Panama, August 1982)



- |     |                      |
|-----|----------------------|
| 69  | NUMERO DE CURVA      |
| ▽   | PORES PROYECTADOS    |
| ▽   | PORES EXISTENTE      |
| --- | LINEA DE LAS FUENTES |
| --- | BOVEDAS              |
| --- | ANILLOS INTERMEDIOS  |
| --- | SEÑALES ALTERNATIVAS |

GENERAL PROJECT PROFILE

NO. 5.11

COUNTRY: REGIONAL

NAME: FUELWOOD & ALTERNATIVE ENERGY SOURCES

- LEVEL: Idea  Pre-Project  Project  Operational
- TYPE: Multidisciplinary
- PLAN:
- PROGRAM:
- SOLICITUDE: ROCAP
- EXECUTIVE AGENCY(IES): CATIE, ICAITI
- FINANCING: AID \$7.5 million
- DURATION: 6 years
- LOCALIZATION: Central America and Panama
- OBJECTIVE(S): To improve the welfare and the productivity of low income groups and increase the supply of low cost energy for rural and urban poor.
- GOAL(S): Test and provide new energy-efficient technologies for use in rural areas, and test alternate species and patterns of production of fast-growing and shrubs.
- STRATEGY(IES): Work through national coordinating agencies with small farmers, community teachers and national and forestry or agricultural research institutions. Work through national energy and technology institutes, private manufacturers and home owners.
- METHODOLOGY(IES): Fuelwood vs. Alternate Energy Sources, Small Industry vs. Home Fuelwood Use, Research vs. Application and Dissemination.
- IMPORTANCE: High Priority by COMENR
- INFORMATION SOURCES: ROCAP Project Paper