CATIE

CENTRO AGRONOMICO TROPICAL DE INVESTITACION Y ENSEÑANZA

SOIL SCIENCE IN GUATEMALA

CLASSIFICATION, FERTILITY AND CONSERVATION

Compiled by:

H. P. Newton

P. C. Duisberg

Preliminary document for discussion prepared for the "Reunión Técnica Regional sobre Fertilidad y Análogos de Suelos", in San Salvador, El Salvador, March 13-18, 1978.

For review and completion by the Guatemalan soil scientists.

Turrialba, Costa Rica

1978

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I. INTRODUCTION

This is one of six reports on the state of soils work in the countries of the Central American Isthmus. A similar outline and pattern is presented in each, in order to make the country reports as comparable as possible. Reports are based on interviews by members of the "Soil Analog Project" plus published information and reports available. However, no claim to completeness or full accuracy can be made. In Costa Rica the report was prepared with some participation by national soil scientists. In other countries time did not permit even this. It is hoped that these imperfect reports will serve as a basis for discussion during the first regional soils meeting at San Salvador, el Salvador from March 13-18, 1978, and that soils scientists from the different countries present will improve and complete the documents for their countries. The Costa Rica Report is the best but still should be thoroughly revised and improved by national and other soils men.

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* Preliminary document for discussion prepared for the "Reunión Técnica Regional sobre Fertilidad y Análogos de Suelos" in San Salvador, El Salvador from March 13-18, 1978.

** Ph.D.s. Soil Scientists (Consulting), Soil Analog Subproject, CATIE.

If all countries produce quality documents they can be used as a basis for a comprehensive document on the state of soils work in Central America and a realistic assessment of the weaknesses and needs for strengthening the field.

The field of soil science in Central America cannot serve as a basis for improving soil analogs unless it can be strengthened in every country. The analogs which have been possible through the soil analog subproject of CATIE/ROCAP for the Pacific area of Nicaragua, Honduras and El Salvador represent only a first step in supporting national development plans and agriculture by determining similarities between soils within and between countries. If basic knowledge and soils agencies can be constantly improved, the quality of analogs will also improve. The potential economic and social savings of identifying soils requiring very similar management, fertilization and conservation is enormous.

II. CONCLUSIONS AND SUGGESTIONS FOR THE FIELDS OF CLASSIFICATION, FERTILITY AND CONSERVATION

A. Soil Classification

The situation in soils in Guatemala is complicated and confusing. The country was covered by a soil survey almost two decades ago which has become out-dated but apparently those interested in soils have not been able to make this clear enough to obtain funding to train anyone in the new taxonomy and to initiate a national survey using it. On the other hand three agencies, DIGESA, IGN and INAFOR are engaged in making practical agrological maps based on the land capability classes of the U.S. Soil Conservation Service. To a certain extent efforts are being duplicated and no group alone seems to have sufficient trained personnel, logistic support or financial resources. In addition ICTA is doing some more detailed soil survey at the level of local areas and farms which is apparently not connected with the modern classification.

The most basic need in the field of soils in Guatemala is for a modern soil survey with it being semi-detailed, at least in the agricultural areas.

B. Soil Fertility

The ingredients for success in Guatemala seem available. ICTA is now doing all the soil fertility work and if this capability could be properly coordinated with soil classification the possibilities for both more effective agricultural research and agricultural planning might be enhanced. In the field of soil fertility, ICTA seems to have a dynamic

program in fertility trials, and a dependable laboratory to serve its program. There seems to be a need for a certain amount of research on soil problems which is lacking, but might be within the capabilities of the leadership of the ICTA laboratory. In this study there was only time to make superficial observations which should be explored more deeply.

C. Soil Conservation

Guatemala is losing great quantities of soil through erosion and the few working in the field are woefully insufficient in number and in specialization. The country does have some innovative programs related to reforestation, land use and sociological incentives. There is a need for training many soil conservation specialists for these types of programs

The Petén is a particularly troublesome problem. Obviously, it needs soils specialists and conservationists, but they would have to be supported and be part of practical overall policies which would give them some chance of arresting the rapid destruction of forest and land. It might be practical to develop soil conservationists within INAFOR and a cooperative relationship for their use within the FYDEP area.

III. SUMMARY TABLE OF SOILS AGENCIES

Table 1 only includes a suggested format. It is suggested that the Guatemalan soils scientists list the institutions and obtain the required information.

III. SUMMARY OF SOILS INST

TABLE I

ENTITY	Major Soil Emphasis	1977-1978 Budget Dollars	STAFF	STAFF		Offices
			Professional	Sub-Professional	Clerical	
Soils Department - ICTA						
Estudios y Proyectos - DIGESA						
Departamento de Geografía - IGN						
Sección de Ecología - INAFOR						
Programa de Cultivos _ ICTA						
INTA						
ANACAFE						
FYDEP						

TUTIONS IN GUATEMALA

Library (books, documents & maps)	Access to		Equipment		Other Collaborators (Major)	Mobility and transport	Outputs	Principal Users of Information
	Laboratory	Greenhouse	On hand	Ordered				

IV. EARLY PERIOD OF SOIL SCIENCE

A. Soil Classification

It appears that the first soil survey of any consequence is the country-wide survey done by Simmons in the fifties. Lic. Wyld, now with the ICTA soils group, was one of the assistants in part of the survey. For this time, this survey was adequate and the most advanced in Central America.

In the 1960's, the Instituto Geográfico Nacional made a soil survey of much of the Pacific Coastal area as part of an AID financed Cadastral project. Since the area had not been classified by the 7th approximation (now New Taxonomy), the project used Simmon's work as a reference and developed a rapid practical method for classifying the soils. An attempt was made to arrive at a land capability. The writers are vague about the actual facts concerning this work and they should be clarified by the Guatemalan soil scientists who revise this draft. Our feeling is that this work was an advance but needs to be revised for the present needs of the area. The series of Simmon's were used as a base and while constituting an important advance at the time include broad associations of series and are in need of extensive revision as well as modernization and reclassification into the new taxonomy.

As in other Central American Countries, there exists a map (1966) on a 1:1'000,000 scale and a report by Dr. C. V. Plath, "Uso Potencial de la Tierra" (FAO, Rome, 1964). This work no doubt used Simmons soils map extensively as well as scanning of aerial photography.

In the 70's the Geography Department of the IGN, the Basic Studies Department of DIGESA and the Ecology Section of INAFOR have been engaged in making practical agrological maps on 1:50,000 topographic maps. The methods are quite similar and adapted from the Land Capability Classification of the U.S. Soil Conservation Service. The degree of skill and access to aerial photography varies in the three cases. In some cases the same map sheets have been covered and in the one case observed did not coincide too well. Unification or very close coordination between the working teams should be considered.

B. Soil Fertility Work

The soils laboratory which today belongs to ICTA was set up in 1964 by the North Carolina State University Soil Fertility Evaluation and Improvement Program, which was headed by Dr. J. Walker. At first the laboratory tested only P and K levels in soil samples, but later extended its range to the complete fertility analysis and special problem analysis. The next step was to enlist and train University of San Carlos agronomy students in the development of greenhouse techniques, using potted plants for fertility correlation studies. Students also were trained to set up fertilizer field experiments and to conduct demonstrations for farmers.

At one time the project also used 21 Peace Corps Volunteers, each of which supervised a minimum of 5 fertilizer field experiments. These were spread throughout the most densely populated agricultural regions of the country. Crops used were grains and vegetable crops, mostly tomatoes, potatoes and cucumbers.

As a result of these studies summaries for crops and areas of Guatemala were prepared, and general fertilizer recommendations for use by the extension agents and agricultural credit agencies were published.

This project was superseded in 1973 when the Rockefeller Foundation recommended the establishment of ICTA, and helped in financing the new entity at a high level of funding. The present period under ICTA is discussed in a later section.

C. Soil Conservation

No information on early efforts was available for inclusion in this document. This history should be filled in by Guatemalan Soil Scientists. The present period is covered in the sections on DIGESA and INAFOR.

V. PRESENT SOILS ENTITIES AND LABORATORIES

A. Instituto de Ciencias y Tecnología Agrícola - ICTA

1. General

ICTA is an autonomous organization formed in 1973 with the help of advisors from the Rockefeller Foundation. It is nominally linked with the Ministry of Agriculture and the Minister of Agriculture is the President of ICTA's Board of Directors. The General Manager of ICTA has as his advisors the Director of DIGESA, the Manager of BANDESA, the Manager of INDECA and the President of INTA.

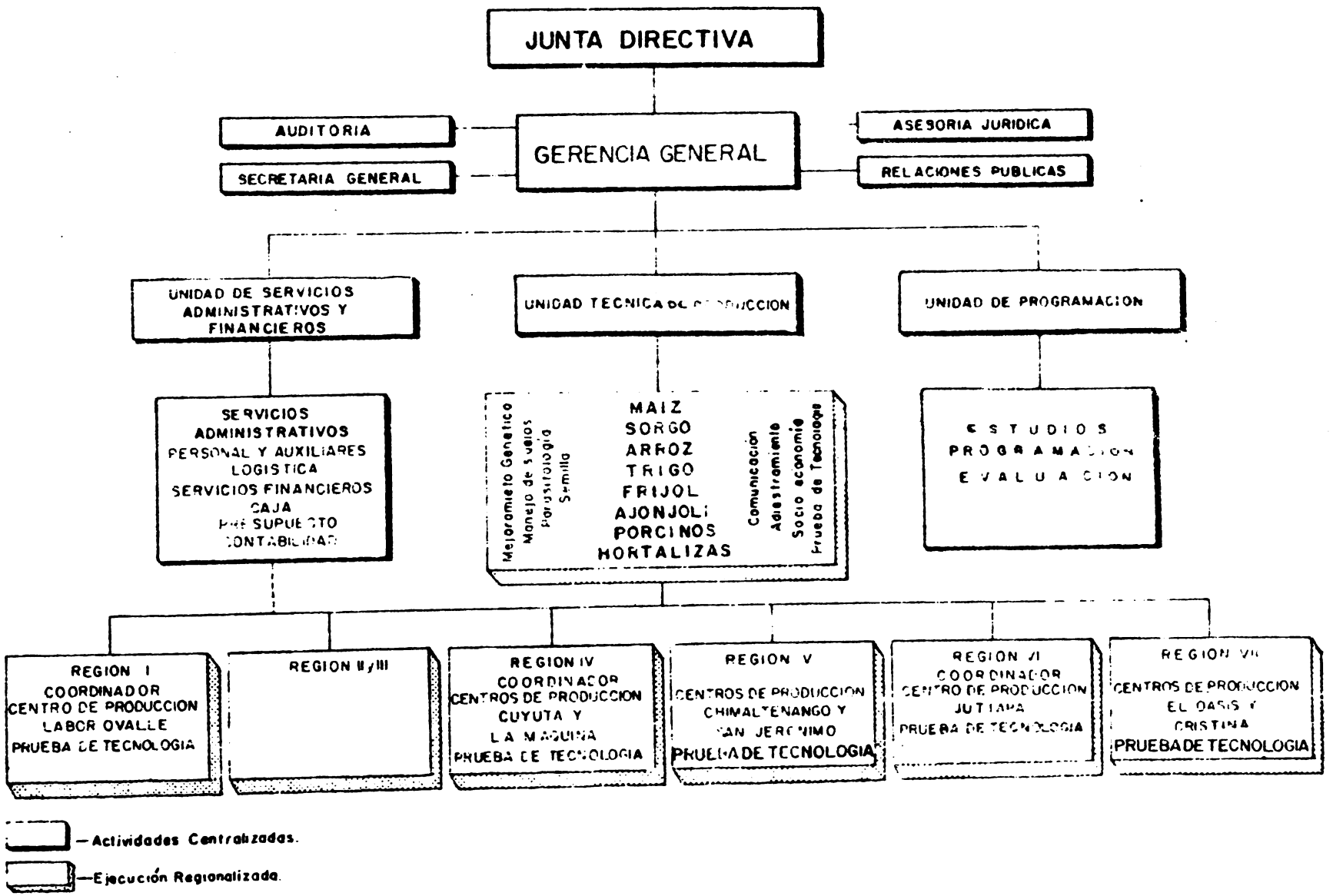
ICTA is charged with the investigation and application of agricultural sciences and technology to increase agricultural production, promote the use of the best technological methods in agriculture and to participate in regional rural development.

ICTA is an attempt at a new approach toward getting research results applied and is organized along action lines of programs on crops animals of major interest to the small farmer. The major programs are corn, beans, rice, sorghum, wheat, sesame, vegetable and hogs. As can be seen from the attached diagram (Fig. 1), the soils department has only a secondary and supporting role.

Soil fertility work like determining kinds and rates of fertilizers to be used seems to be done mostly by the crop programs. Soil samples from the experimental sites are analyzed in the soils laboratory. Results of fertilizer experiments with the various crops published show no profile or series identification. However, analytical results like pH, P, K, Na, Mg are often given. The extent of work (1975) with various crops can be seen from attached Table 1.

DIAGRAMA III

ORGANIGRAMA ICTA



2. Organization

The organization of ICTA and its position in the Public Agricultural Sector can be seen from the attached two Figures 1 and 2.

3. Department of Soils, ICTA

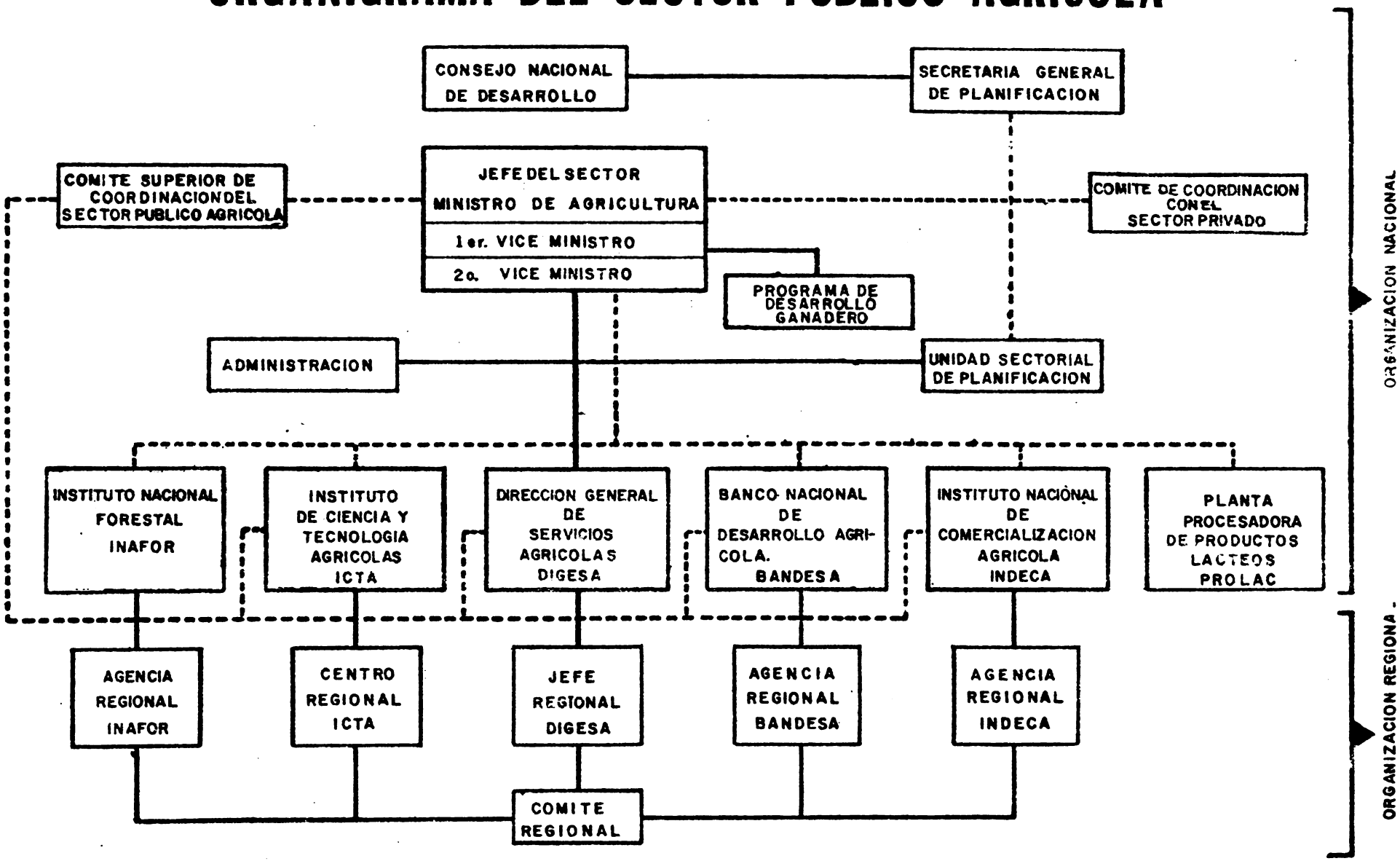
Dr. E. Escamilla, the present head, assumed jurisdiction recently from Dr. Urrutia who had had to double as head of the soils and sorghum program. The soils department, including the soil laboratory, consists of a total of 22 employees of which 6 are senior professionals, 4 junior professionals, 6 sub-professionals, 4 helpers and 2 secretaries. Of these 11 work in the soils laboratory, which has 4 professionals, and 2 sub-professionals. There are three vehicles within the department, and it is hoped that three more will be added. The budget for last year was about $110,000 and it is planned to increase this to $270,000 for next year (1978).

The soils laboratory seems to continue to function quite efficiently. They are now doing about 12,000 soils samples annually for farmers on a service basis and about 1,500 soils samples for experimental work of ICTA. They expect to do 2,000 foliar analyses per year in the future (they did 5,000 samples in 1976). Roughly 300 more soils samples were done each year in connection with special problems. For ICTA samples their analyses include texture, organic matter, total N, C. E. C., Ca, Mg, K, Na, pH, total exchangeable bases, Fe, Cu, Mn and Zn.

At present all analyses are entered in a masterlog for future use. In this way approximately 200,000 soil samples from former service

FIGURA 2

ORGANIGRAMA DEL SECTOR PUBLICO AGRICOLA



samples have been filed. There are also about 1,500 analyses from ICTA experimental samples in file, and about 7,000 foliar analyses. This represents a considerable amount of information. Some of the soils analyses data have been used to prepare soil fertility maps and reports like:

1. Evaluación preliminar de suelos de Guatemala, en cuanto a su acidez y alcalinidad, por R. E. Miyares J. (Tesis), Facultad de Agronomía, Universidad de San Carlos, Guatemala, Febrero 1977.
2. Evaluación preliminar del contenido de fósforo y potasio disponibles en los suelos de Guatemala, por Julio César Brolo Luna, (Tesis), Facultad de Agronomía, Universidad de San Carlos. 1976.

No information on field experiments with fertilizers was obtained for this report, other than the "Informe Anual" published by ICTA. This should be done by the Guatemalan soils men revising the document. The annual report indicates that work at ICTA is now being carried out by the different crop teams with the soils department playing only a supporting role, mostly in the form of analysis of soil samples from the different experimental plots. Three hundred and thirty four trials are reported in Table I for 1975 alone.

The soils department has some plans for doing more soil classification and mapppng in the future. They are already promoting greater attention by ICTA agronomists in collecting representative soil samples for their field trials. No laboratory analyses can be better than the sample from which it is run. In addition, Dr. Escamilla is interested in expanding greatly the number of soil profiles taken at the sites of field trials and

TABLE I

Resumen del Trabajo Efectuado en los tres Proyectos de Prueba de Tecnología, 1975

ORIENTE

	Ensayos de Finca	Parcela de Prueba	
Maíz			
Variedades	12	20	
Nitrógeno	12		
Densidad	7		
Control de Malezas	3		
Fecha de siembra	4		
Control de insectos-follaje	3		
Control de insectos-suelo	7		
Sub-Total.....	48	20	
Frijol			
Variedades	7	8	
Nitrógeno	6		
Densidad	6		
Control de Malezas	3		
Fecha de siembra	3		
Control de insectos - suelo	6		
Arroz en Suelos Chicaj	2	3	
Soya	-	15	
Cowpea	-	2	
Sorgo	-	1	
Sub-Totales.....	33	29	
TOTALES.....	81	49	130

Cont....

Table 1. Cont.

ALTIPLANO

	Ensayos de Finca	Parcela de Prueba	
Maíz	34	20	
Trigo	17	25	
Papa	3	10	
Totales.....	54	65	119

COSTA DEL PACIFICO

Prácticas Agronómicas	94	--	
Maíz		96	
Cowpea		24	
Arroz		48	
Ajonjolí		48	
Soya	--	24	
Totales.....	94	240	334

has hopes of obtaining a mechanical auger to facilitate this. Some three hundred field trials per year could contribute markedly to soil classification and revision and improvement of the Simmon' reconnaissance level survey of 1959. This survey considered more than adequate in its time considering the problem of accessibility, limited and small scale aerial photo coverage, inadequate laboratory analyses and that it predated the new taxonomy is now outdated. In addition, many of the 130 soil series seem more correctly to be associations with many boundary discrepancies even at that level. In 1976, Baccheciamp mapped about 30 different series out of five original series from the Simmon's survey.

The soils department of ICTA would need personnel trained in the new taxonomy and ICTA might only be interested in doing a thorough job of classification on the agricultural soils on which it has interest in crops rather than the entire region. Nevertheless, a cooperative attitude by ICTA could be an important factor in convincing policy makers that the cost of a modern semi-detailed survey could be lowered to an acceptable level by cooperation of existing agencies. It appears that presently ICTA does not fully see the potential of its soils department in providing a much more scientific base for its various crop programs.

B. Dirección General de Servicios Agrícolas - DIGESA

1. Division of Natural Resources

This Division is said to have four divisions, there was insufficient time to learn enough about the agency but it is hoped the Guatemalan soils scientists will complete this section. The departments are:

a. Soils
b. Water resources (fish and marine)
c. Hydraulic resources (irrigation)
d. Studies and projects

2. Estudios y Proyectos - DIGESA

The department was organized in 1970 and is under the direction of Ing. Agr. Marco A. Curley. The department has been under considerable pressure to produce documents for planning. As a result the department has divided the country into seven regions, which they will study consecutively.

Region 1, which is the altiplano occidental (the mountain chains toward the Mexican border) has been studied and thereport was published in late 1977. The title of the report is "Diagnóstico de región No. 1 con fines de desarrollo agrícola. This report consists of two volumes, the first of which gives an inventory of resources including socio-economic data. Vol. II includes analyses and maps and covers climate, waters, soils, vegetation, wildlife and fish, and roads.

There is a series of maps (about 26 for region 1) called "Agrológico del uso potencial". A similar set of maps has been prepared by INAFOR for the same region to determine reforestation priorities. Therefore, Estudios y Proyectos did not determine the potential of areas with a slope of 45% or more but left this to INAFOR.

In the classification for potential use 8 classes based on the U.S. Soil Conservation Classes have been used. The main characteristics used to separate them are slope differences although the Simmon's series were also considered. It appears that considerable savings could have

been effected by studying this area in an integrated way with INAFOR.

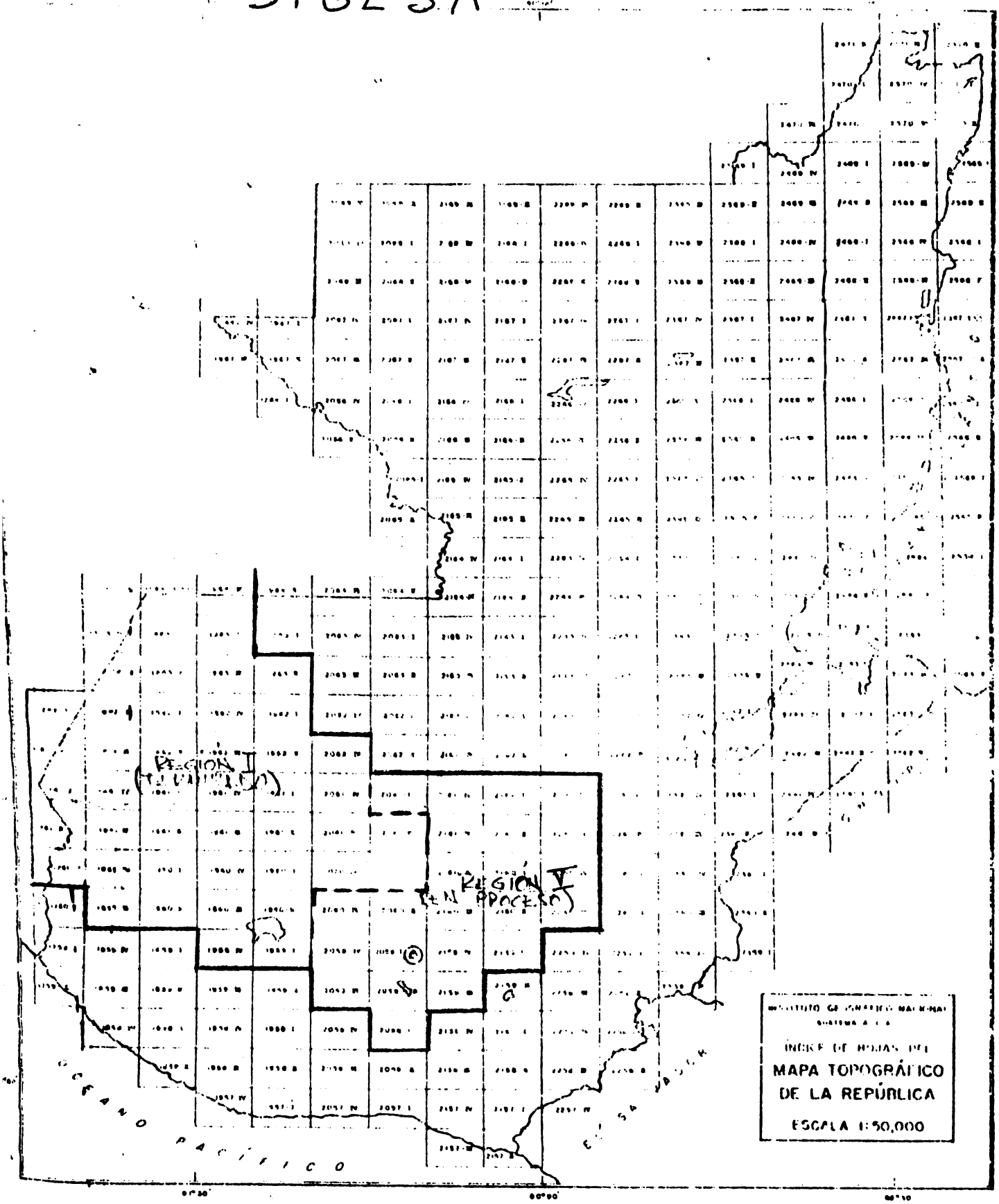
Region I was studied first because the altiplano occidental is very densely populated, has many minifundi and heavy political pressure exists for development projects.

The delineations of the eight classes are superimposed on 1:50,000 topo maps and field checking was said to be approximately at 2 kilometer intervals along roads. However, the points we observed located on a few maps had a rough average of about 10 each. Each unit is also marked for internal drainage, depth and susceptibility to erosion. Field work is handicapped by lack of vehicles and a small staff of three graduate persons none of whom is trained in the new soil classification taxonomy.

Field work was done by use of 1:50,000 topographic maps and the use of 1954 vintage aerial photographs (1:60,000?). However, no photo-interpretation was done with stereoscopes due to lack of skilled people in this field. It would appear that at least the most recent larger scale photographs should have been used and the IGN and INAFOR provided training in photo-interpretation.

Progress in completing maps seems rather rapid. In cases where DIGESA and IGN have duplicated the same quadrange it is feasible to compare one against the other. DIGESA maps can be no better than the topographic contours. IGN could spot errors in topography by photo-interpretation. There appears to be an effort to delineate and pinpoint areas with erosion problems through these maps. In the one case inspected there was considerable difference between the two maps.

DIGESA



¡MAPAS DE 1:50,000
CAPACIDAD DE USO
DIGESA

The report unfortunately has only a set of Xerox maps of report size. The originals are on 1:50,000 sheets which have been colored in according to classes identified. Only one original set exists which is in the offices of Estudios y Proyectos.

DIGESA is now working in region V, i.e. the area around Guatemala City. Map 1 shows exactly the area covered by Regions I and V.

Estudios y Proyectos is organized into 2 divisions: "Area de Desarrollo de Especialidades Técnicas" under Ing. Agr. Jorge M. del Valle, which includes the laboratory described below, and "Area de Clima y Flora" under Ing. Agr. Marco Antonio Aguilar. DIGESA's capability in soils has been hurt by the death of Ing. Agr. Francisco Mazariegos, its most experienced soils scientist.

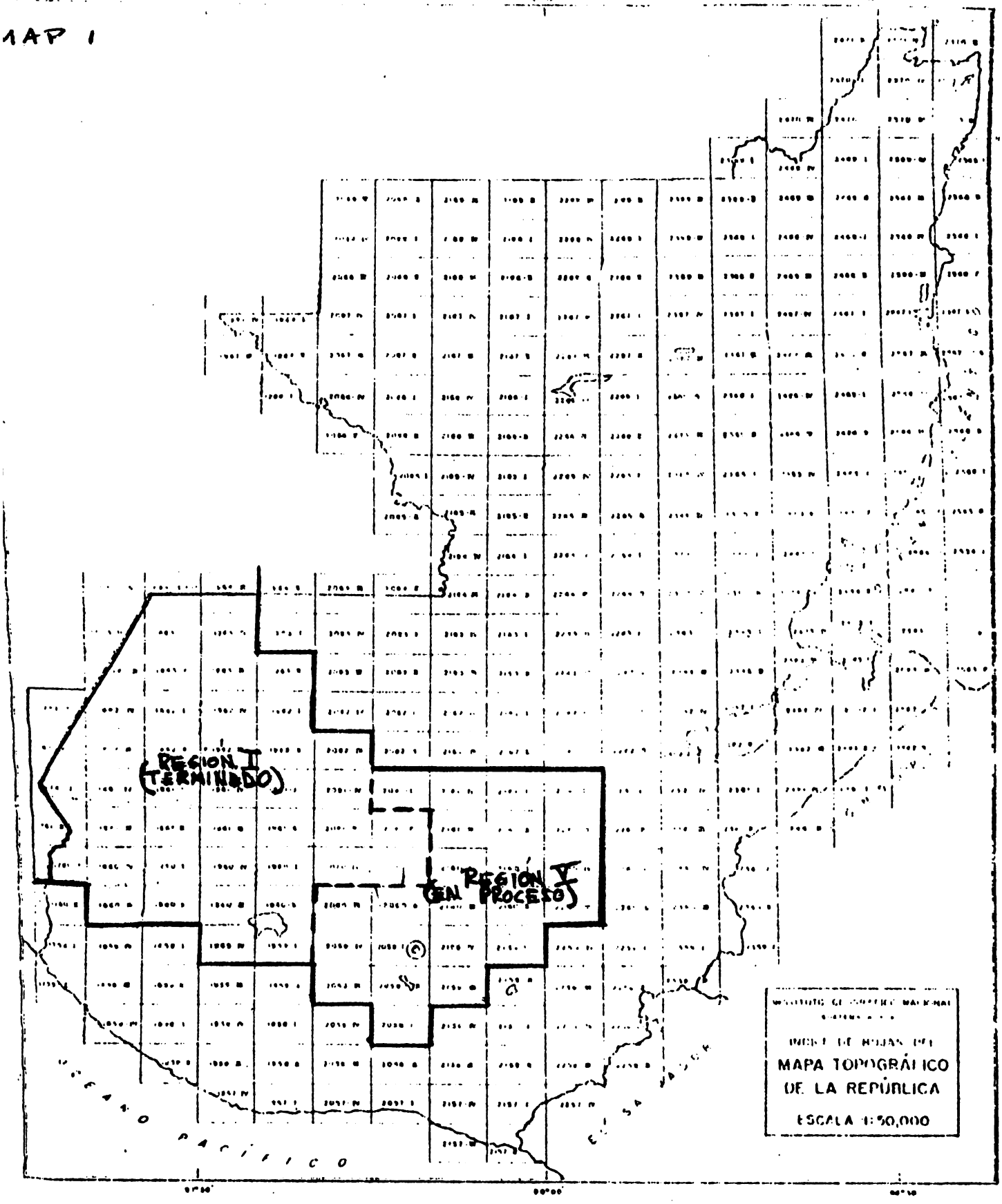
3. Laboratory - DIGESA

This laboratory is especially designed to help in the planning and operation of irrigation projects of the Water Resources Division as well as the work of the other divisions of ICTA.

The laboratory is available for research, classification of soils and waters. Its pricipal task is the physical and chemical analyses of soils to determine their suitability for irrigation, the classification of water for irrigation, fish culture, the determination of sediment in suspension in natural waters. It seems to have plenty of space and sufficient equipment. The laboratory head is Ing. Agr. Carlos Fernández assisted by 9 sub-professionals.

The present output of the laboratory each year is reported to be:

MAP 1


REGION I
(TERMINADO)
REGION V
(EN PROCESO)
INDICE DE HOJAS DEL
MAPA TOPOGRÁFICO
DE LA REPÚBLICA
ESCALA 1:50,000
O C E A N O P A C I F I C O

1. soils samples: about 13,000 (physical and chemical)
2. water: 3,300 samples for chemical analysis.
3. water: 2,000 samples analysed for suspended material.

There are analyses for about 80,000 samples field.

The laboratory believes it could increase its production to 30,000 samples if required. However, it would need an additional budget for reagents.

The following are routine determinations:

a. Soils: pH, texture, humidity, organic matter, bulk density, color (dry and moist), hygroscopic coefficient, moisture equivalent (1/3 atmosphere), carbonates (qualitative), cations (Ca^{++}, Mg^{++}, Na^{+}, H^{+}), exchange capacity.

b. Water: Electric conductivity pH, dissolved solids, cations (Ca^{++}, Mg^{++}, Na^{+}, K^{+}), anions ($CO_3^{=}$, HCO_3^{-}, Cl^{-}, $SO_4^{=}$).

c. Sediments in suspension.

d. If requested, water quality for fish ponds is also determined.

Special analyses, if needed, are:

Salinity in soils by the use of saturated paste and moisture retention curves.

Laboratory results are filed by a numerical and alphabetical system.

Major pieces of equipment found in the laboratory are:

- Spectrometer, vacuum pump, vacuum bell, large centrifuge, pressure plate (15 atm.) and pressure cooker (2 atm.) apparatus.

There is no greenhouse space available.

The budget for the laboratory is included in that of the Department of Studies and Projects. The possibilities of consolidation of the ICTA and DIGESA laboratories should be explored from the standpoint of possible savings for both agencies. Both laboratories are close to each other and are said to cooperate rather closely.

4. División de Recursos Hidráulicos - DIGESA

A somewhat dated list of irrigation projects in Guatemala is attached. This list shows about 20,000 ha under irrigation operational and an additional 35,000 ha projected (Table 2). The division may also operate some stream flow stations.

5. División de Suelos - DIGESA

As of April 1976 DIGESA included this very small division. No information was available at this writing whether it is still active and this can be checked by those revising this draft. The division is mainly concerned with soil conservation, in which it carries out small specific projects. The largest project undertaken by that time covered 1,600 ha. Most of the Division's activity seems to be the supervision of heavy machinery, the work of land levelling and the construction of soil conservation structures.

While obviously some of DIGESA's efforts, both through projects and maps, are directed towards delineating and solving soil conservation problems, the effort seems miniscale in relation to the overall problem existing. The Division of Soils also cooperates with the Division of

TABLE 2

MI[illegible]STERIO DE AGRICULTURA
DI[illegible]ON DE RECURSOS HIDRAULICOS

INFORMACION GENERAL DE LAS UNIDADES DE RIEGO
AÑO DE 1974

D[illegible] Y [illegible]
S[illegible] DE [illegible] Y ESTADISTICA

UNIDADES	EN CONSTRUCCION	EN LIQUIDACION	EN OPERACION TRANSITORIA	EN OPERACION	LOCALIZACION	PROYECTADA [illegible]	PROYECTADA [illegible]	PROYECTADA [illegible]	EN OPERACION [illegible]	EN OPERACION [illegible]	EN OPERACION [illegible]	FUENTES DE AGUA	ALTURA S[illegible] NIVEL DEL MAR	PRECIPITACION MEDIA A[illegible]	PRINCIPALES CULTIVOS	FECHA DE INAUGURACION	FECHA DE [illegible]	COSTO DE RIEGO POR [illegible]	TAMAÑO [illegible]
DISTRITO No. 1								226[illegible]			1748								
[illegible] MITA				O	JUTIAPA *	1000		1000	850		850	R[illegible] [illegible]	4[illegible]	10[illegible]4 5	[illegible]	[illegible]	[illegible]	[illegible]	0 [illegible]
ATESCATEMPA	⊙ *	◎ *		O	JUTIAPA	150	150	300	128		128	[illegible] MIAS RIO ATESCATEMPA	6700	[illegible]	[illegible] TABACO	FEBRERO [illegible]	MAYO [illegible]	[illegible]	0 23
EL TEMPISQUE	◎ *	◎ *		O	JUTIAPA	457	60	517	389		386	RIO [illegible]	5510	1283 0	MAIZ, TOMATE [illegible]	[illegible]	[illegible]	[illegible]	0 2
LAGUNA DEL HOYO				O	JALAPA		450	450		392	382	RIOS [illegible] LAGUNA DEL [illegible]	5610	1000 0	[illegible] TOMATE [illegible]	[illegible]	[illegible]	[illegible] 78	0 2[illegible]
DISTRITO No. 2								7773			3008								
LA FRAGUA				O	ZACAPA	2600		2600	2210		2210	RIO GRANDE ZACAPA	1900	710 9	TOMATE, [illegible] MAIZ [illegible]	FEBRERO [illegible]	[illegible]	34 [illegible]	0 4[illegible]
LLANO DE PIEDRA	O	O			ZACAPA		1700	1700				*	2700	710 9		MAYO 1974			
EL GUAYABAL	O	O			ZACAPA		1500	1500				*	2[illegible]5	710 9		MAYO 1974			
CABAÑAS				O	ZACAPA	900	500	1400	775	425	1200	RIO MOTAGUA	214 0	710 9	MAIZ, TABACO TOMATE	[illegible]	[illegible]	3463	0 42
[illegible]			O	O	ZACAPA	423		423	360		360	RIO ZAPOTE	[illegible]	[illegible]	[illegible]	ENERO [illegible]	[illegible]	34[illegible]	[illegible]
LA PALMA				O	ZACAPA	150		150	128		124	RIO LA LIMA QUEBRADA EL OTE	[illegible]	[illegible]	[illegible]		[illegible]	3463	[illegible]
DISTRITO No. 3								2830			2405								
[illegible]				O	EL PROGRESO	895		895	760		760	RIO MOTAGUA	274 0	[illegible]	[illegible]	[illegible]	[illegible]	55 5[illegible]	0 50
SAN JERONIMO				O	SALAMA B.V.	1200		1200	1020		1020	RIO SALAMA	993 0	[illegible]	TOMATE, [illegible] MAIZ, CAÑA	[illegible]	[illegible]	55 [illegible]	[illegible]
SAN CRISTOBAL				O	EL PROGRESO		250	250		212	212	RIO MOTAGUA	250 0	5[illegible]	MAIZ, TABACO [illegible]	[illegible]	[illegible]	55 5[illegible]	[illegible]
EL PROGRESO				O	EL PROGRESO		150	150		128	128	RIO GUASTATOYA	517 0	4[illegible]	TOMATE, TABACO MAIZ	[illegible]	[illegible]	55 56	0 50
SANTA ISABEL				O	EL PROGRESO	[illegible]	105	105		90	90	RIO LOS PLATANOS	550 0	600 0	MAIZ, TOMATE, [illegible]	MARZO [illegible]	[illegible]	55 53	1 00
PALO AMONTONADO				O	EL PROGRESO		60	60		50	50	RIO MOTAGUA	280 0	600 0	TOMATE, TABACO [illegible]	SEPTIEMBRE [illegible]	[illegible]	55 5[illegible]	0 20
LAS CANOAS				O	GUATEMALA	65		65	55		55	RIO LOS OCOTES	1340 0	[illegible]	[illegible]	OCTUBRE [illegible]	[illegible]	55 56	[illegible]
RINCON DE LA PAJA				O	GUATEMALA		30	30		26	26	RIO [illegible]	1440 0	[illegible]	[illegible]	[illegible]	ENERO [illegible]	5516	0 20
SANTA [illegible]				O	SACATEPEQUEZ		45	45		38	38	RIO BARRANCA HONDA	1370 0	1300 0	HORTALIZAS, MAIZ	[illegible]	ENERO [illegible]	55 56	0 50
[illegible] RAMIREZ				O	GUATEMALA	30		30	26		26	RIO SAN LUCAS	1457 0	1007 0	HORTALIZAS	MARZO [illegible]	[illegible]	55 56	0 20
DISTRITO No. 4								4000			1850								
CATARINA			O	O	SAN MARCOS	1500		1500	1285		1285	RIO CABUZ	233 0	4000 0	[illegible], MAIZ		ENERO [illegible]	31 69	0 17
[illegible]				O	SAN MARCOS	700		700	595		595	RIO PETACALAPA	170 0	4500 0	MAIZ, [illegible]	JUNIO 1974	NOVIEMBRE 1974	31 69	1 00
LA BLANCA	O				SAN MARCOS	1800		1800				RIO NARANJO	8 0	1400 0					
DISTRITO No. 5								400											
[illegible]	O	O			EL QUICHE	400		400				RIO [illegible]	1215 0	900 0					
								34485			19670								

[illegible]ACIONES
* AREA DE BOMBEO

Water Resources in the preparation of irrigation projects. Formerly it seems to have done some soil fertility trials. However, this function rests entirely with ICTA since 1973 and its soils department.

Ing. Teófilo Alvarez is in charge.

C. Instituto Geográfico Nacional (IGN) (Soils portion of work)

1. General

The IGN had a fairly large group in natural resources and soils under Dr. Luis Ferrete during the late 60's and early 70's as part of the cadastral project in the Pacific area. In soils they developed rather rapid and practical methods of technical classification based on the land classes of the U.S. Soil Conservation Service. Photo-mosaics were available for delineation although this should be checked.

In the early 70's Ferrete joined INAFOR and organized the Ecology Section and further developed the methodology but results were delineated on 1:50,000 topographic maps. When DIGESA entered the field it adopted a methodology for recording its agrologic classes quite similar to Ferrete's soil classes.

At one time it appeared that the IGN would become theprincipal agency in Guatemala in natural resources and its high point was the late 60's when it was carrying out the cadastral project with natural resources components. Since then it has been losing natural resources staff and departments. The most recent were the incorporation of the Departments of Geology and that of Water Resources into INSEVUMEH about 1975. The Department of Geography will undoubtedly remain since it should have an important

function in making Atlas' and other geographic products. However, its soils section may have trouble in the future justifying its inclusion in a geographic institute which does not have the other specialties for integrated geographic studies.

2. Department of Geography

The department is headed by Ing. J. Castro who is the only graduate agronomist in this department. For some time the department has depended on upper level agriculture students to assist part time.

By the end of 1977, the department had prepared 62 sheets at 1:50,000 of an agrologic map quite similar to those being prepared by DIGESA and also based on the U.S. Soil Conservation Service Land Capability System. The maps are hand colored blue print type maps and could easily be made available to users without coloring. IGN apparently has no plans to go to the expense of publishing these as colored maps.

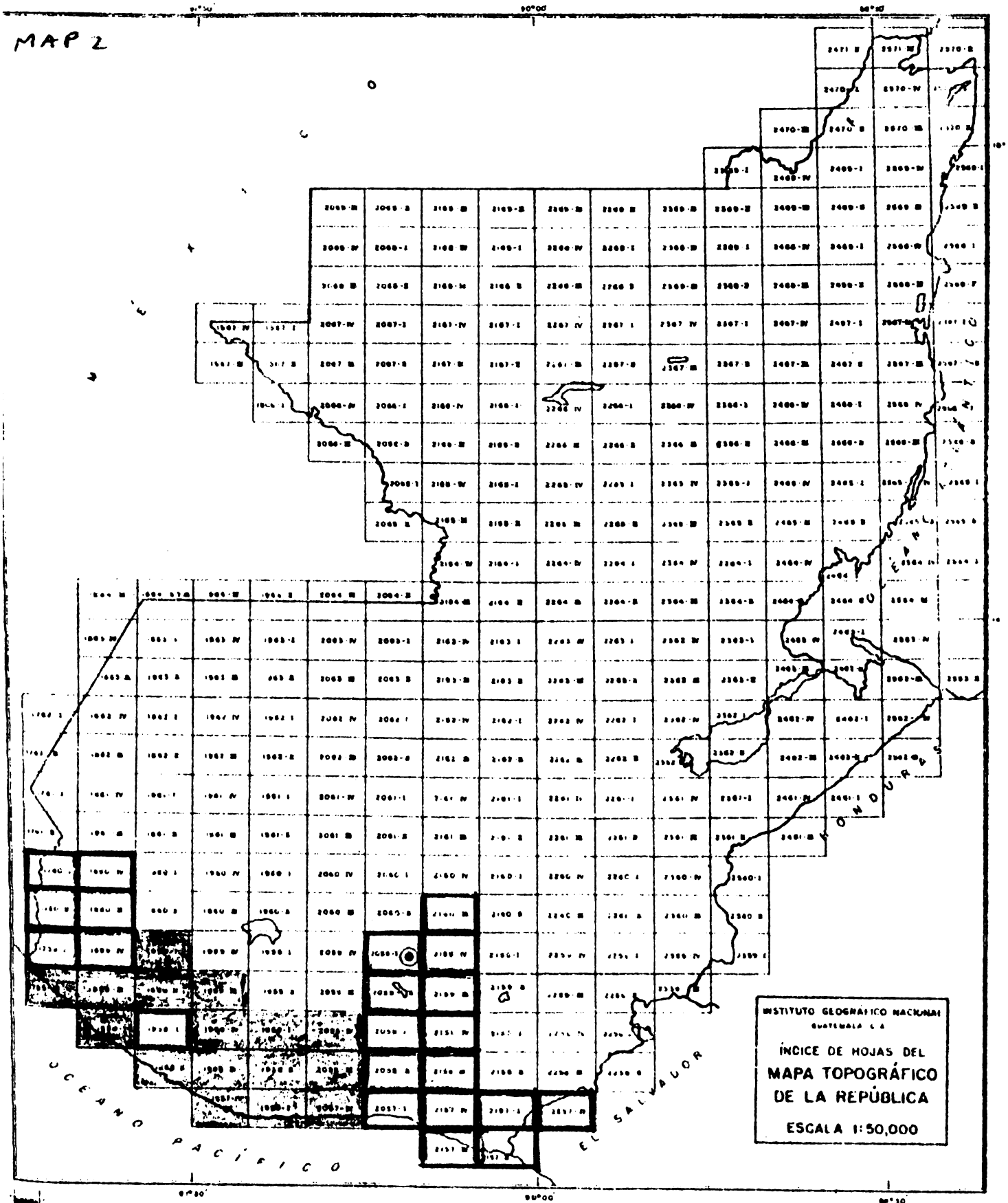
However, the department also has produced 38 sheets at 1:50,000 of actual land use and 16 sheets of these have been published as color printed maps. Single copies of the others are available in the department as colored blue prints. The areas covered are shown in maps 2 and 3.

The maps of IGN cover a larger area than those prepared by DIGESA and INAFOR and some quadrangles have been covered by all three.

Probably the IGN maps are more exact than DIGESA as they photo-interpreted recent aerial photographs. However, it appears that DIGESA has done more field checking. It appears that DIGESA as part of the Ministry of Agriculture and by publishing regional studies of interest to

USO DEL SUELO

MAP 2

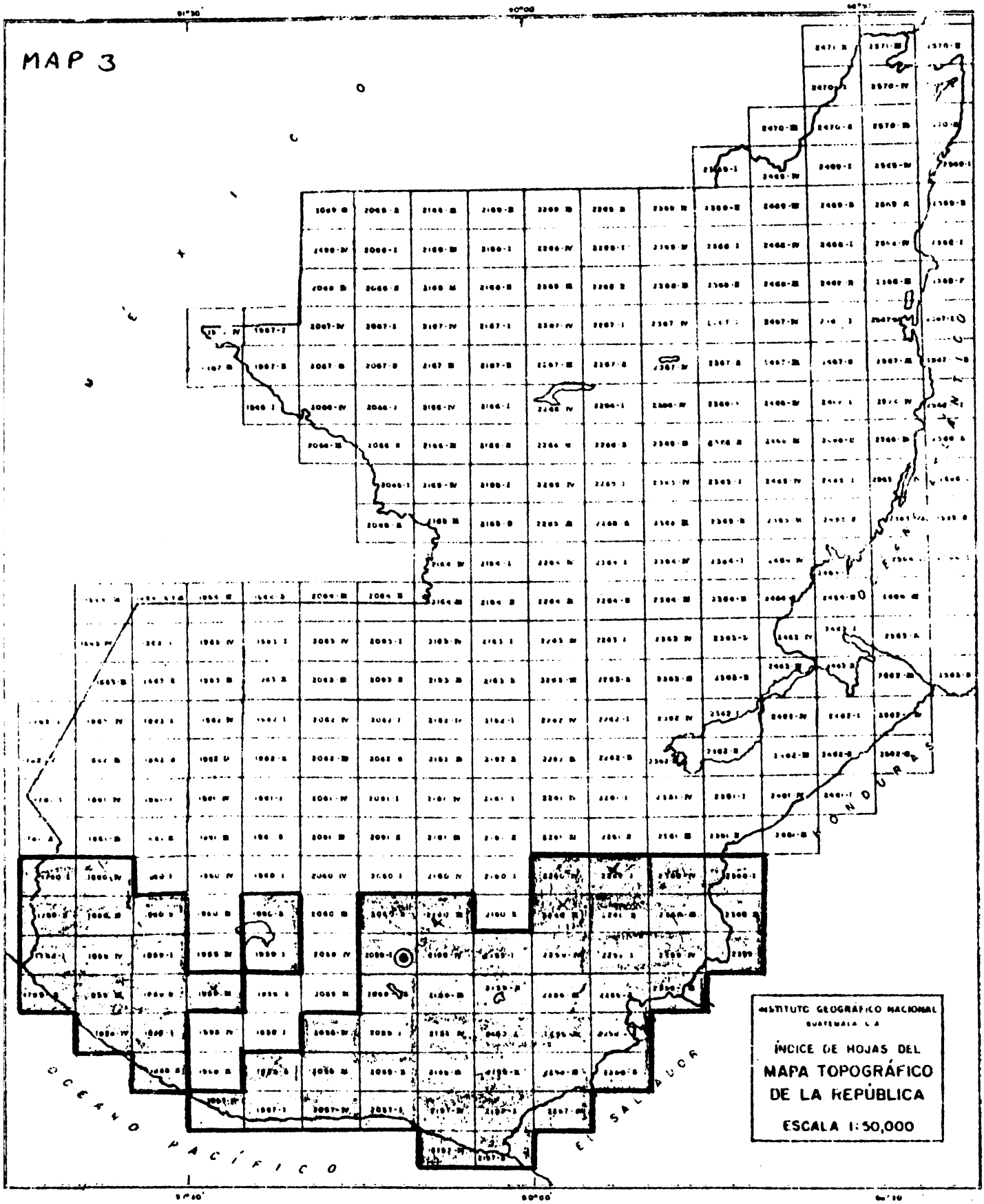


IMPRESAS A COLOR

COPIAS HELIOGRAFICAS COLOREADAS

CLASES AGROLOGICAS IGN

MAP 3



COPIAS HELIOGRAFICAS COLOREADAS.

the National Planning agency has greater opportunities for having its work applied and used. To an extent the INAFOR maps concentrate on the steeper areas which are or ought to be in trees. Nevertheless, the question arises as to whether these three efforts ought to be consolidated or at least coordinated to share methodology and experience in the national interest.

We did not determine the areas covered by the three offices. However, Dr. L. Ferrate, who initiated some of these programs, made the estimate below. Comparing his estimate with the index map prepared by IGN, it seems that IGN ~~has~~ done considerable additional work rather recently:

IGN:	13,000 sq. km.	
INAFOR:	14,000 sq. km.	1:50,000 maps
IGN-INAFOR:	± 7,000 sq. km.	
DIGESA:	5,000 sq. km.	1:20,000 to 1:10,000 maps
DIGESA:	± 13,000 sq. km.	1:50,000 maps

D. Instituto Nacional Forestal (INAFOR)

1. General

INAFOR is the organization charged with all forestry problems in Guatemala, except that it has no responsibility in the Petén area. It is mainly concentrating on the pine forested mountain areas, as there the problem of deforestation is most urgent. It has little interest in the humid tropical forests, probably because sustained yield management of these forests is still a pretty unsolved problem everywhere.

INAFOR started in 1974, when the "Departamento de Investigaciones Forestales" and the "Departamento de Manejo Forestal" of the Ministry of Agriculture were combined in an autonomous institute.

The institute started with 270 employees and a $2,000,000 budget, which has increased to 300 employees and a budget of over $3,000,000. Nevertheless, with deforestation and soil erosion massive problems INAFORE has an extremely difficult task.

2. Sección de Ecología

The section of ecology in the Unit of Program and Promotion has worked on a set of maps, which combine soils information, slopes, and actual and potential land use. These classify the land in four groups:

Class I: 1at priority land for reforestation: 32% slope or more, with gullies.

Class II: 2nd priority land for reforestation: gully and sheet erosion.

Class III: 3rd priority land for reforestation: noticeably sheet erosion.

Class IV: Land which either is in forest or has no erosion problems.

These maps were scheduled to be published with a publication entitled: "Ecosistemático del Altiplano de Guatemala", INAFOR. The procedure followed in preparing the maps according to the ecology section was as follows:

1) Check the 1:50,000 topographic sheets for slope.

2) Check the 1:50,000 topographic sheets for erosion hazard.

3) Class soils according to Simmon's survey.

4) Check actual land use using maps and aerial photographs (1:30,000, 1973).

5) Check results in the field (as the photos were several years old).

6) Prepare a potential land use map with the use of the U.S. Soil Conservation Service.

   Customary mapping symbols are: soil series (from Simmon's) soil type, slope percentage, erosion class, drainage, and the eight capability classes of the U.S. Soil Conservation Service.

7) Make a priority map from the overlays as indicated above giving the four priority classes for reforestation.

The work was done on 1:50,000 sheets, but the final map will be at 1:100,000. Soil samples taken in field were analysed by the ICTA soils laboratory. Nine persons have been working in this project since 1973. So far about 14,000 km^2 are completed. Next area to be covered will be the Oriente Region (toward el Salvador).

According to the ecology section, a new life zone map for Guatemala is being prepared by Dr. Holdridge. The system used by the ecology section was originally devised and the group trained by Dr. Luis Ferrate.

Dr. Ferrate, now head of the "Reconstruction Committee" (earthquake reconstruction, presumably with the Oficina de la Presidencia) calls those maps "landscape" maps. He feels that mapping and programming without the proper socio-economic action will be insufficient. Also, as part of reconstruction efforts he has organized local committees on the village level in most parts of the country, which hopefully can continue as action committees for further development.

Since deforestation of the mountain areas is one of the gravest problems in Guatemala, INAFOR proposed a law, which would permit a reduction of taxes up to 50% for landowners who reforest their properties with the approval of INAFOR. This law was recently enacted. As a result there are at least two private companies in existence who help landowners to reforest their properties. If this program proves successful, it will affect greatly the future of INAFOR and the problem of deforestation. In this case the institute, most likely, will have to increase its work force.

Another program of INAFOR inspired by FAO resulted in a disaster as a result of a lack of communications with the supposed beneficiaries. The idea was for small farmers to combine agriculture with conservation practices and reforestation. INAFOR was to provide technical assistance so that the campesinos could form cooperatives, manage their wood lots on a sustained yield basis, and participate in small local forest industries. Unfortunately vested interests told the campesinos this program was a government scheme to exploit their forest lands. Farmer resistence did not permit it to be carried out.

INAFOR has a program with the Peace Corps, under which volunteers try to promote conservation practices in the villages. They publish a monthly report about these activities.

There is also a fellowship program financed by CIDA (Canadian International Development Agency) for graduate studies in forestry and for "peritos forestales". There is no training facility in Guatemala for "peritos forestales", but neighboring Honduras and Mexico have such schools.

E. Fomento y Desarrollo Económico de Petén (FYDEP)

This organization is responsible for the large but sparsely settled Petén, where it replaces regular government departments.

The Petén is about 36,000 sq. km., its elevation quite low (from about 300 m in the South to sea level in the North), its surface cover savannas and humid forests.

The northern half (about the size of El Salvador) is in reserve but is being invaded by spontaneous immigration from Mexico. This problem probably is controllable. The southern half has been opened up more and more by FYDEP's road program and is being followed by a wave of spontaneous settlers causing great deforestation. The situation apparently is out of control. The population has increased from 15,000 to 150,000 in twenty-five years. This population might not be considered high for an area almost couble that of the country of El Salvador, except that the ecology of the region is extremely fragile. A FAO forester who made the pre-feasibility study which led to opening the area in the 1960's returned in 1975 and wrote that one third had been highly damaged, possibly irreversibly with little economic or social gain.

According to his 1965 FAO study, the Petén consists of 80% forest, 14% savannah and low bush, 6% rivers, lakes and swamps. The 23,400 sq. km. of forest then contain a potential of 21 million running feet of lumber including one million of mahogany and several million of cedar.

Reportedly soils in the Petén are very shallow, and subject to erosion, especially once the natural cover is removed. FYDEP does not have any soils men, even though it has a responsibility for a number of colonies, for land survey and titling and has an enormous problem of uncontrolled

spontaneous settlement. It hopes to get an agronomist but finds its lower salaty schedule and the hardship reputation of the Petén a barrier for obtaining technical staff. INAFOR and FYDEP have no effective working relationships, in fact, one of FYDEP's complaints is that INAFOR receives money from the exploitation of forest products from the Petén.

F. University of San Carlos

he agricultural college presently has 1,600 students enrolled. Their last graduating class was 30 Agronomy Engineers. Their present freshman class is 600. Thus, even counting on a high drop-out rate in the first year they will have an enormous increase in students which the University seems ill prepared to handle. Actual laboratory work by students will have to be reduced drastically, run in several sections and lecture teaching and laboratory teaching will be separated. The course for Agronomy Engineer takes a minimum of 11 Semesters for 5 1/2 years. Majors are Plant Science, Animal Science, Agr. Economics, and Agr. Engineering. There is no soils major. Courses in soils are "Edafología I and II", and "Fertilizers". There appears to be one full time professor in soils and some more part-time.

The University and the soils laboratory have suffered very severely from the earthquake. Some equipment like the muffle furnace was ruined, other was damaged, many windows broken. There is a teaching laboratory for regular chemistry courses for agriculture students, and a soils laboratory, which serves also as teaching laboratory, and for students projects. Even at best, they seem very inadequate. Most of

their equipment was once donated through a Rockefeller Foundation grant. Most of it is now in rather poor condition, if not outright damaged. The flame photometer does not function and apparently is not repaired for long periods of time. There is no place to dry and prepare soil samples. So it has to be done inside the laboratory on the laboratory floor.

Plans are ready for repairing the building, reorganizing and enlarging the laboratory. The plans call for a soils laboratory, an agricultural chemical laboratory, a general chemistry laboratory and an organic chemistry laboratory along with a centrally located office for the laboratory supervisor. However, until now these plans are just architect's drawings and it is not clear when the laboratory and the buildings will be renovated.

There are several more universities in Guatemala, although much smaller than the University of San Carlos, one of these the Universidad del Valle, which is private, reportedly will offer a soils major in the future.

G. Asociación Nacional del Café (ANACAFE)

The association consists of about 2,700 large and medium sized coffee growers, who produce about 85% of Guatemala's coffee crop, along with about 30,000 small growers (defined as generally producing less than 50 qq. per year).

Coffee covers roughly 350,000 manzanas and annual production is over a 3 million bags (1 qq an 100 each).

The association maintains a technical service which includes a department of "broca" control, processing and quality control, pests and diseases, an experimental station, a department of field stations, which has 13 regional offices and one training school, and a department of soils and fertilizers, which has a fertility section and a laboratory section.

The laboratory is located in what seems to be a former residence. In view of this, the room and office space is somewhat oddly arranged. However, the laboratory appears very well equipped and efficiently run. They work strictly as a service to the association. Investment in equipment supposedly is about $100,000 which seems fairly high.

The laboratory analyses about 3,000 soils samples from growers each year, but could easily increase capacity to 10,000. Presently they analyse about 60 foliar samples each month. Routine analysis includes: Cation exchange capacity, organic matter, total N, pH, P and K. They intend to add in the future routine analysis also for S and B. Routine foliar analysis includes Ca, Mg, K, P, Mn, Zn, Cu, Fe, and total N. Personnel consists of 4 professionals, 4 sub-professionals, and 4 additional people.

The department of soils and fertilization consists of sections on soils and nutrition, experimental analyses, analyses and services, and field. The annual budget is about $70,000 for the department,

H. Instituto Nacional de Transformación Agraria (INTA)

INTA was founded in November 1962. It supervises (as of 1974) 22 colonies covering somewhat over 2,000 km^2 or about 2% of the country. Prior to any settlement, INTA prepares maps of potential land use. Some of the soil series identified in this are identical with those of Simmon's survey, others are new names. Actually, INTA does not do any of this work themselves but depends on INAFOR, IGN and ICTA with all soils analysis being done by the ICTA soils laboraty.

VI. RELATION OF SOILS TO OTHER NATURAL RESOURCES AGENCIES.

A. Natural Resources

The organigram, Fig. 3, shows the approximate picture of the various organizations, including ICTA, in the natural resources field in Guatemala.

Most of these agencies are described under V because they contain soils components and other natural resources components. The only major natural resources agency not included is INSIVUMEH, it is covered in this section but should be amplified by the Guatemalan technicians. The soils part of IGN is included under V and the major topographic part in this part.

B. Instituto Nacional de Sismología, Vulcanología e Hidrología (INSIVUMEH)

This institute was formed after the earthquake in 1976. It seems to be a partial approach toward a Natural Resources Institute.

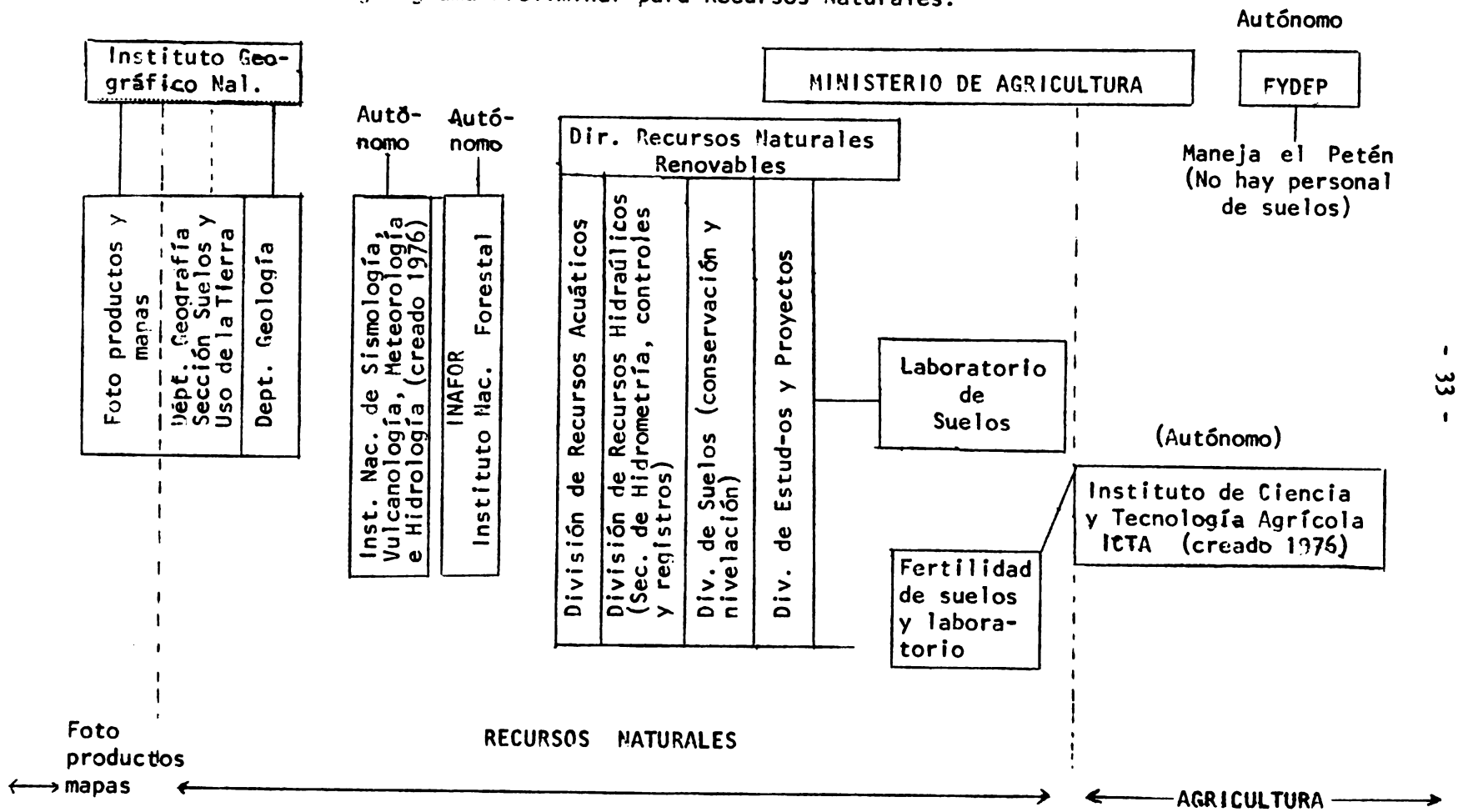
One of the components is the former meteorological institute. This and the hydrology group received support from the Proyecto Hydrometeorológico Centroamericano of the WHO.

At the conclusion of the WHO project in 1977 the network in meteorology had increased greatly. Map No. 6 shows the location of meteorological stations. As of 1976 there were 18 stations type A (complete stations) for each 6,000 km^2 However, this average does not indicate the distribution. Most existing stations are like the population in the highlands area. There were almost none North of the 16°N, i.e. the Petén area. There were 61 type B stations (temperature and

Figura No. 3.

G U A T E M A L A

Organigrama Preliminar para Recursos Naturales.



NOTA: Se debe ampliar y corregir este diagrama.

precipitation) and 380 type C stations (precipitation only). The stations were operated by the Observatorio Nacional, the Instituto Nacional de Electricidad and the IGN but have now been combined under INSIVUMEH.

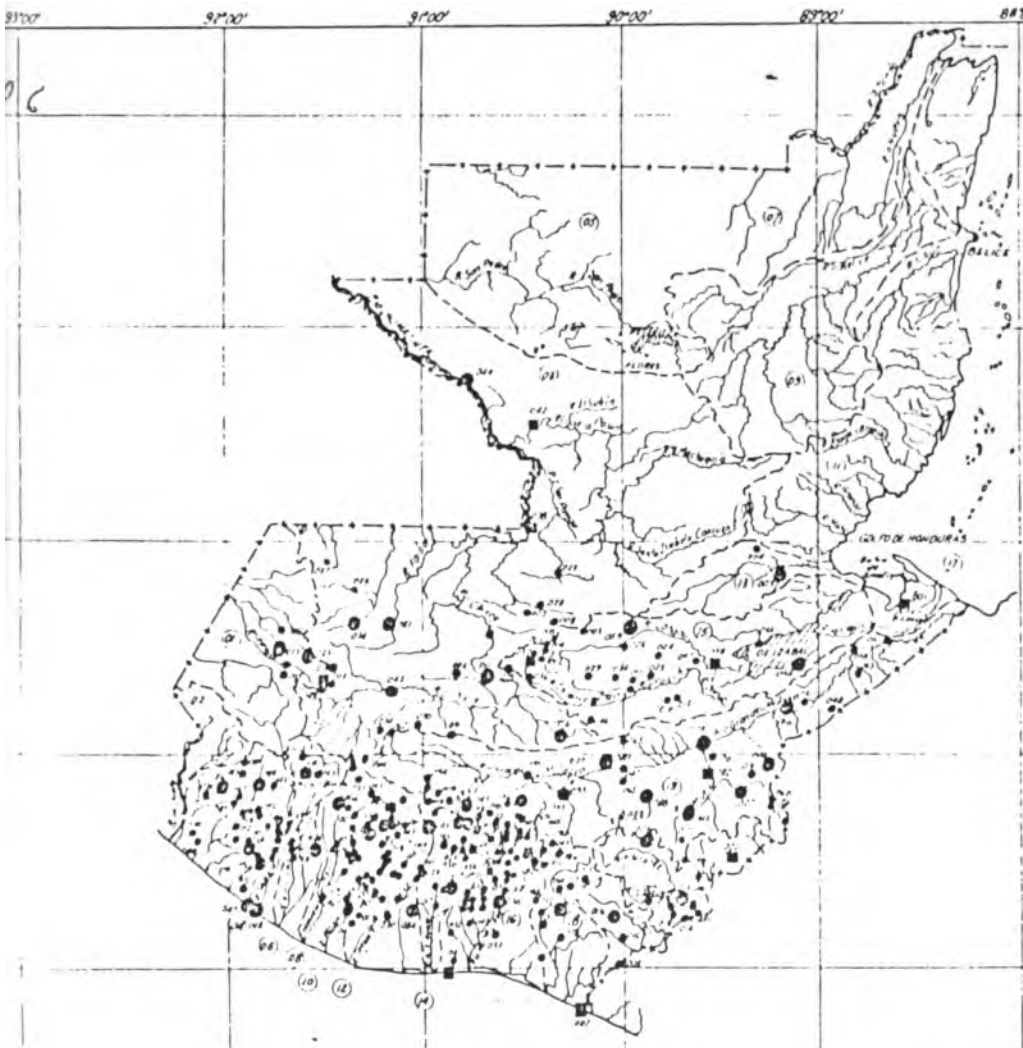
There is a considerable amount of climatic data available from the IGN, including "Datos Meteorológicos Mensuales hasta 1959"; "1960-1969", "Datos Pluviográficos Diarios y Horarios de 1926/71"; and "Evaluación de Sequías en la República de Guatemala".

An ecological map for Guatemala scale 1:1'000,000 by L. R. Holdridge, is considered outdated and has been re-mapped. There is also a publication by George H. Hargreaves "Irrigation Requirements and Precipitation Deficits for Guatemala", Utah State University, Logan, Utah, 1975.

C. Instituto Geográfico Nacional

1. General

The Institute consists of these departments: "Catastro, fotogrametría, cálculo, capacitación, geología, cartografía, geodésico, geografía, geofísica". Formerly it also had a department of Hydrography. This was transferred some time ago to the newly formed "Instituto de Sismología, Vulcanología, Meteorología e Hidrología" (INSIVUMEH). The geology department also has apparently been transferred and this and the actual present composition of IGN can be checked by those revising this draft.



Notas

1- La ubicación de estaciones es aproximada

2- Límites no oficiales.

3- No se indican los números en las zonas de gran densidad de estaciones

NACIONES UNIDAS - PROGRAMA PARA EL DESARROLLO
ORGANIZACION METEOROLOGICA MUNDIAL
GOBIERNOS DE COSTA RICA, EL SALVADOR, GUATEMALA, HONDURAS, NICARAGUA Y PANAMA

Proyecto de Ampliación y Mejoramiento de los Servicios Hidrometeorológicos e Hidrológicos en el Istmo Centroamericano

GUATEMALA

RED DE ESTACIONES METEOROLOGICAS

■ Climatológica principal ● Climatológica ordinaria ● Pluviométr...

Dibujó: Jorge A Perez R	Verificó:	Aprobó: Ing. Eduardo B...
Julio de 1973	Escala:	

Air Photography and Imagry

The IGN has the aerial photography located on maps in the office. The following notes were taken:

1954	1:60,000	Guatemala
1956	1:30,000	Jutiapa area
1957	1:30,000	Quetzaltenango area
1958	1:30,000	Escuintla area
1959	1:30,000	Quetzaltenango area
1960	1:60,000	USAF - Chiquimula area
1960	1:20,000	Quetzaltenango area
1961	1:20,000	Puerto Barrios area
1962	1:40,000	South Coast and Jutiapa area
1964	1:50,000	Guatemala
1965	1:17,000	Infrared, all the coast
1965	1:30,000	Coast
1967	1:30,000	Coast
1970	1:30,000	Coast
1962	1:40,000	Petén
1965	1:30,000	Port of Petén
1963-64	1:40,000	Lago de Izabal
1972	1:30,000	INAFOR-Forested central area
1974	1:30,000	Coastal area covered by Catastro Inmobiliario
1975	U-2	Post earthquake photography
1975	1:12,000	Falla geológica y ciudad de Guatemala
1975-76	1:20,000	Costa oriental y no oriental

In addition, the Sky Lab color photography is available at IGN for the Atlantic Area as of February 1974 and the Pacific coast as of September 1973. The rest of the country including the Petén has been taken but negatives may still be in the USA.

U-2 photography was taken February 3 and February 8 after the earthquake and was useful in determining landslides, road and river blockages, etc. At present, it provides the only recent coverage for some areas but its value is limited by its small scale and because it is not suited for stereoscopic analysis.

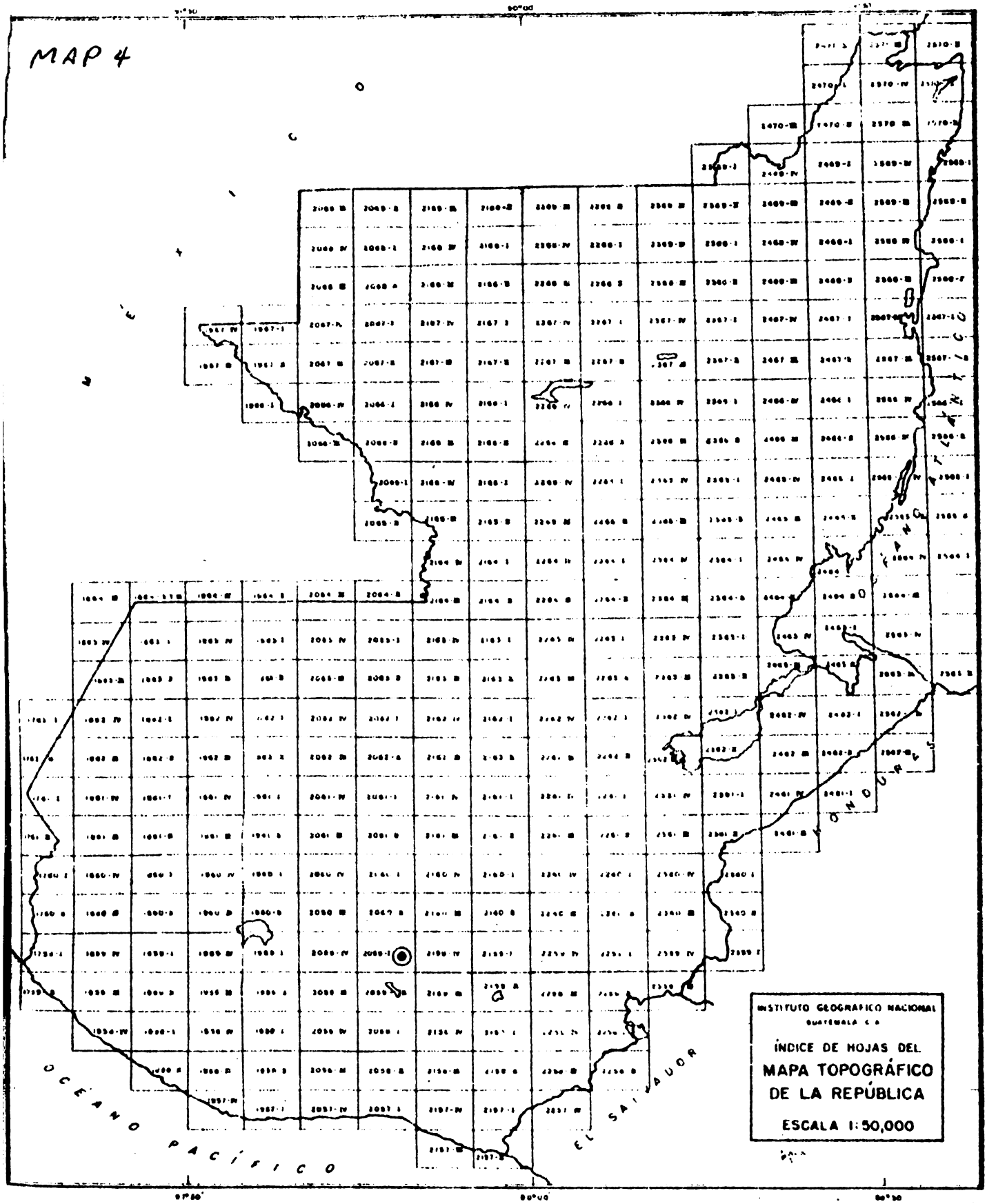
The IGN has the country covered by LANDSAT images taken between 1972 and 76 and make into a mosaic. This is being used in a forest type identification project.

It would appear from the listing of air photography that there is a lack of coordination. This means that some areas are duplicated when previous photography would probably suffice for a given project. At the same time, other areas have not been reflown in 25 years.

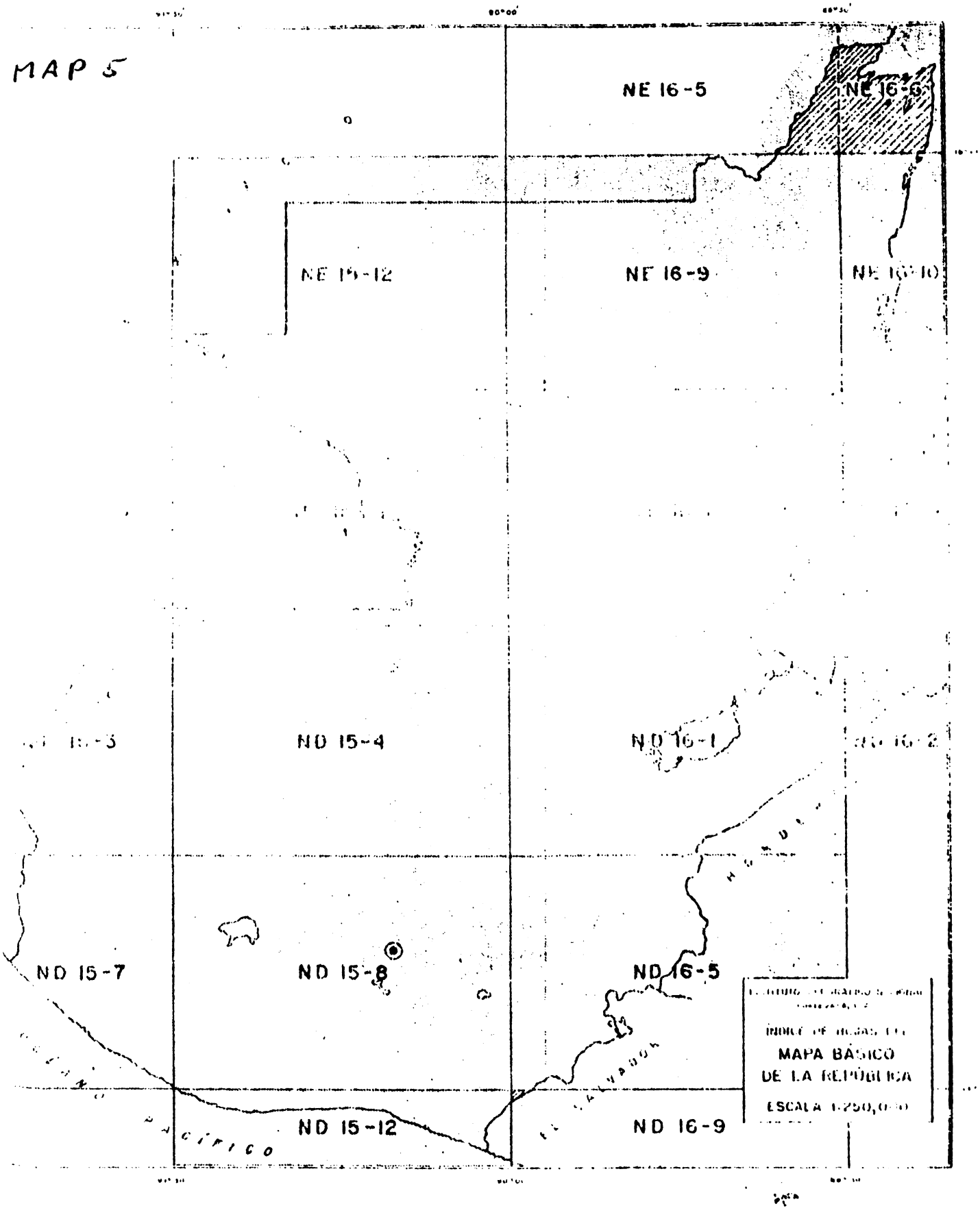
Topographyc Mapping

Considerable progress has now been made toward mapping the Petén. This was the last part of Guatemala without topographic maps although it did have photomosaics.

Attached indexes for 1:50:000 (Map 4) and 1:25,000 (Map 5) topographic maps which are available from IGN show coverage for almost the whole country.


MAP 4
INSTITUTO GEOGRAFICO NACIONAL
GUATEMALA C. A.
ÍNDICE DE HOJAS DEL
MAPA TOPOGRÁFICO
DE LA REPÚBLICA
ESCALA 1:50,000
OCEANO PACIFICO
EL SALVADOR
HONDURAS

MAP 5



ESTAS FRACCIONES SE ENCUENTRAN IMPRESAS INDEPENDIENTEMENTE EN LA HOJA NE 16-5

VII. REFERENCES AND MAPS

A. Bibliografías Agrícolas de América Central - Guatemala, Documentación e Información Agrícola No. 39, IICA/CIDIA, Turrialba, Costa Rica, 1975: Partes de interés en trabajos de suelos.

B. Indice de Mapas de América Latina, y el Caribe existentes en el IICA/CIDIA, Turrialba, 1975.

Mapas de Guatemala.