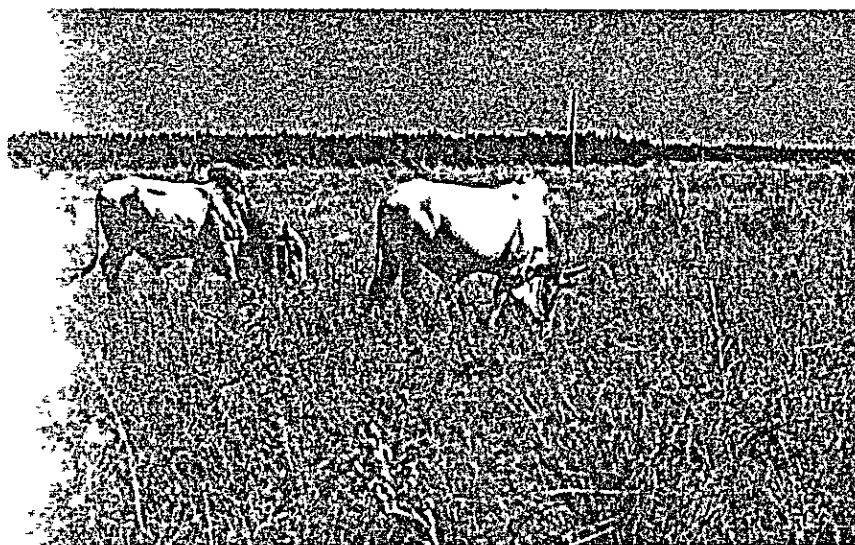


# THE REPUBLIC OF COLOMBIA




## FEASIBILITY STUDY ON

# AGRICULTURAL DEVELOPMENT PROJECT SUMMARY AND RECOMMENDATIONS



JUNE, 1984

JAPAN INTERNATIONAL COOPERATION AGENCY  
(JICA)

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**THE REPUBLIC OF COLOMBIA**

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**FEASIBILITY STUDY ON**

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**THE PAMPLONITA RIVER BASIN**

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**AGRICULTURAL DEVELOPMENT PROJECT**

---

**SUMMARY AND RECOMMENDATIONS**

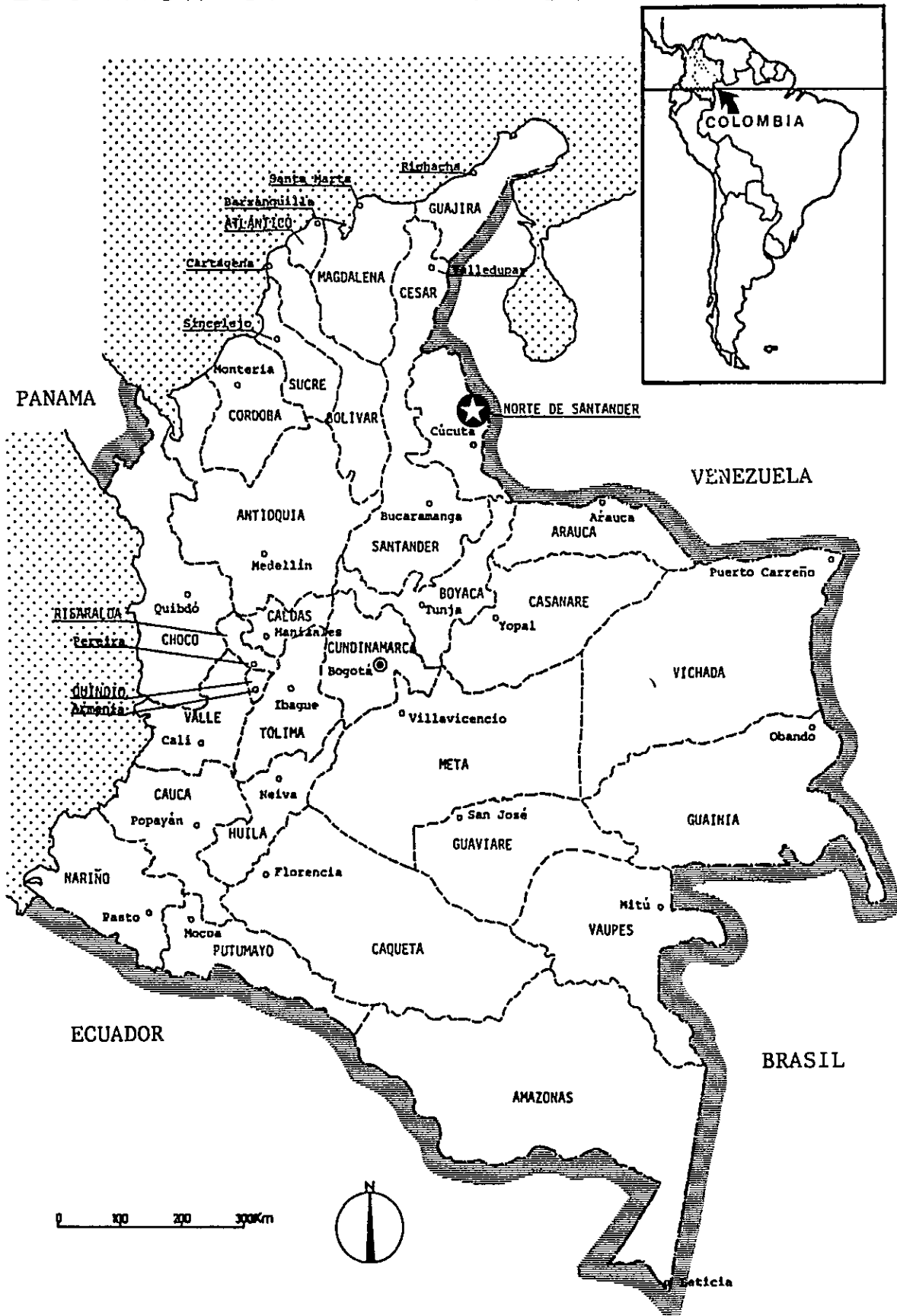
**JUNE, 1984**

**JAPAN INTERNATIONAL COOPERATION AGENCY  
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# LOCATION OF THE PROJECT







**Farmer's house in the Study Area.**  
 計画地区内農家（洪水対策用立床）



**The Pamplonita River nearby Agua Clara**  
 計画地区内 Pamplonita 川（ Agua Clara 附近）



**Distant View of the Study Area.**  
 計画地区遠望



**The Guaramito River in the Study Area.**  
 計画地区内 Guaramito 川（左側コロンビア国、右側ベネズエラ国）







Soil Survey.  
土壤調查



New Gauging Station at Puerto Santander.  
新設測水所 ( Puerto Santander )



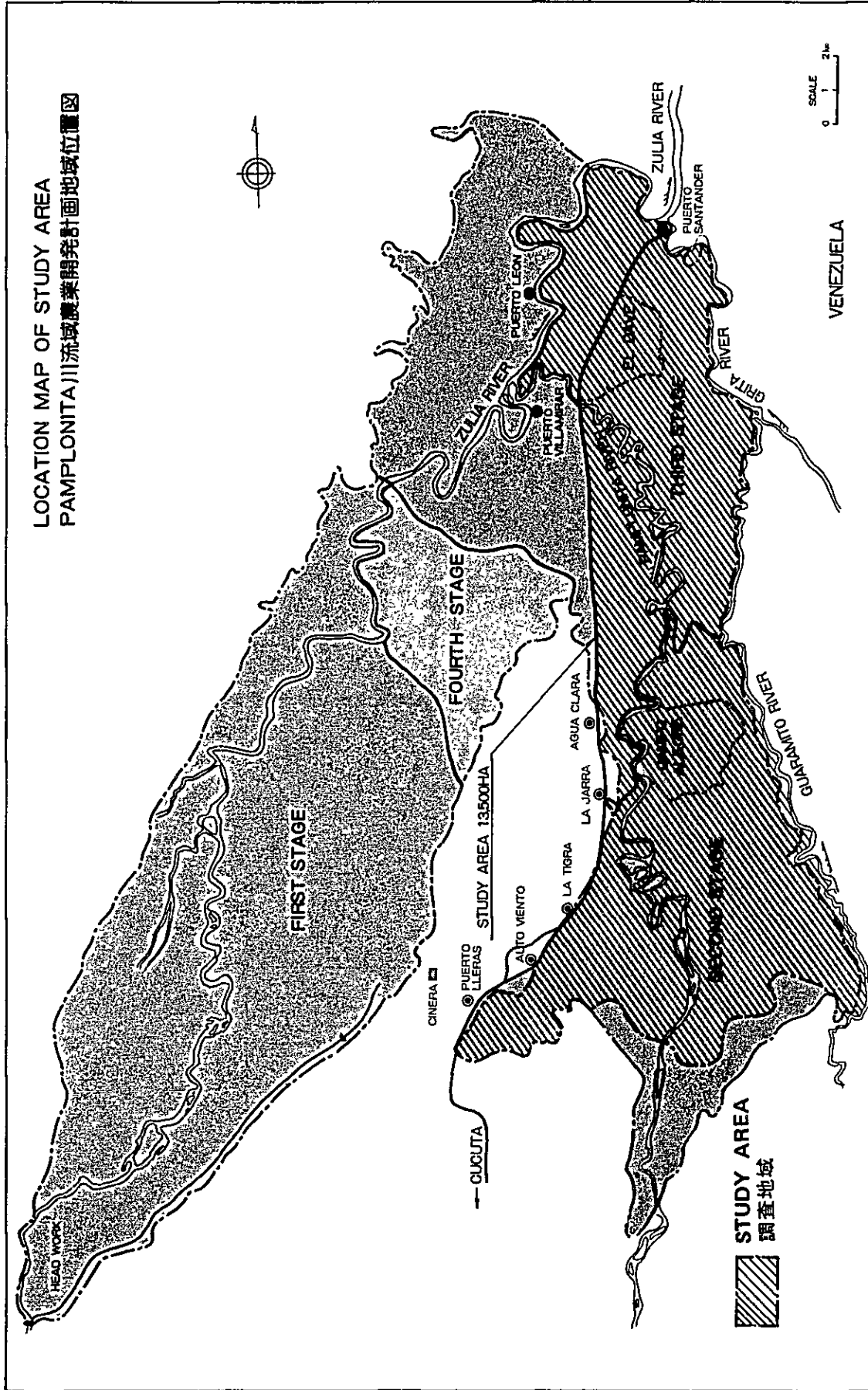
Cacao Beans (Drying in the sun).  
カカオ豆栽培農家 ( 天日乾燥 )



Public Market in Cucuta city.  
Cucuta 市市場



LOCATION MAP OF STUDY AREA  
 PAMPLONITA川流域農業開發計画地域位置図



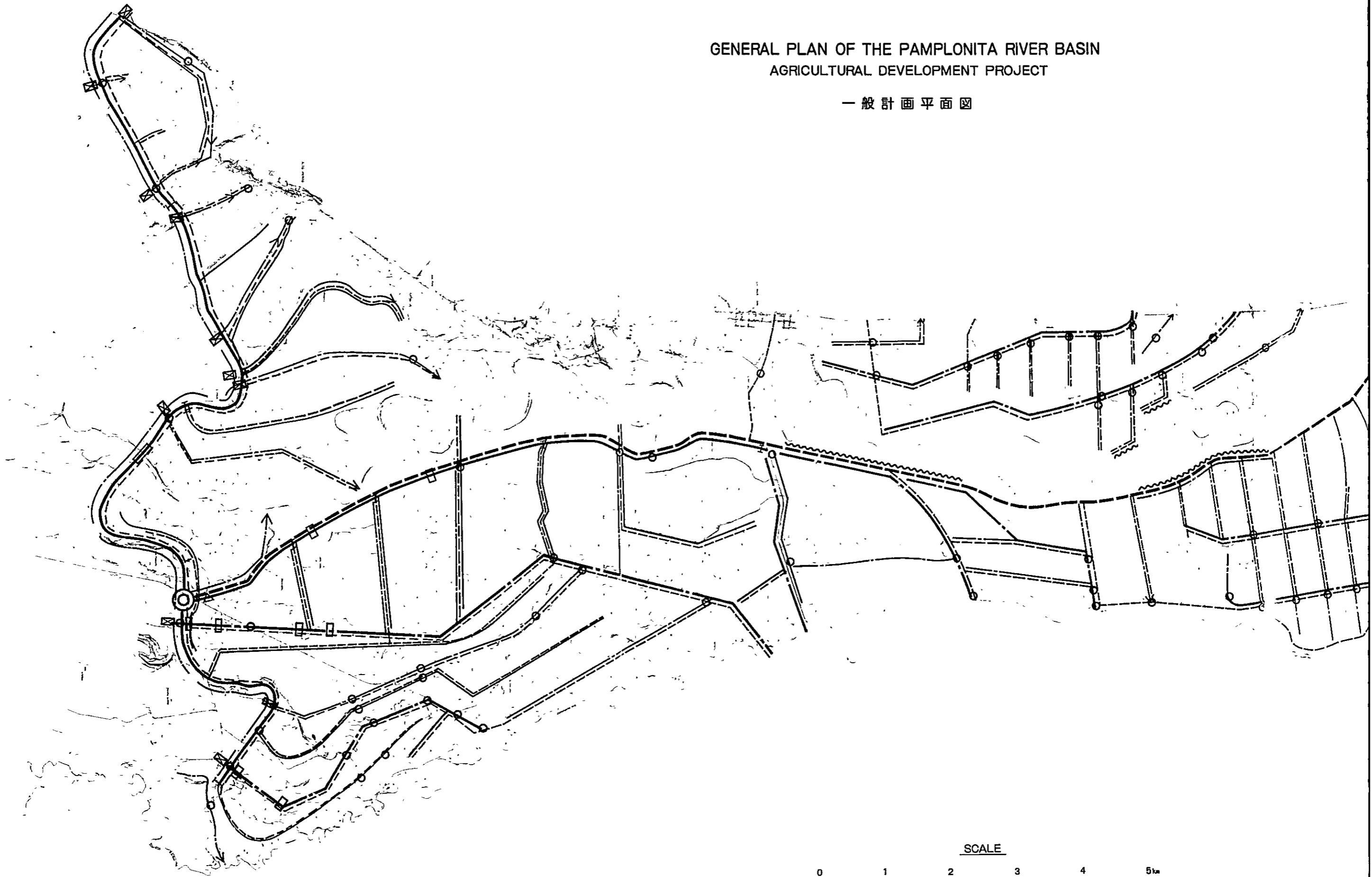
STUDY AREA  
 調査地域

SCALE  
 0 1 2 km

VENEZUELA

GENERAL PLAN OF THE PAMPLONITA RIVER BASIN  
AGRICULTURAL DEVELOPMENT PROJECT

一般計画平面図

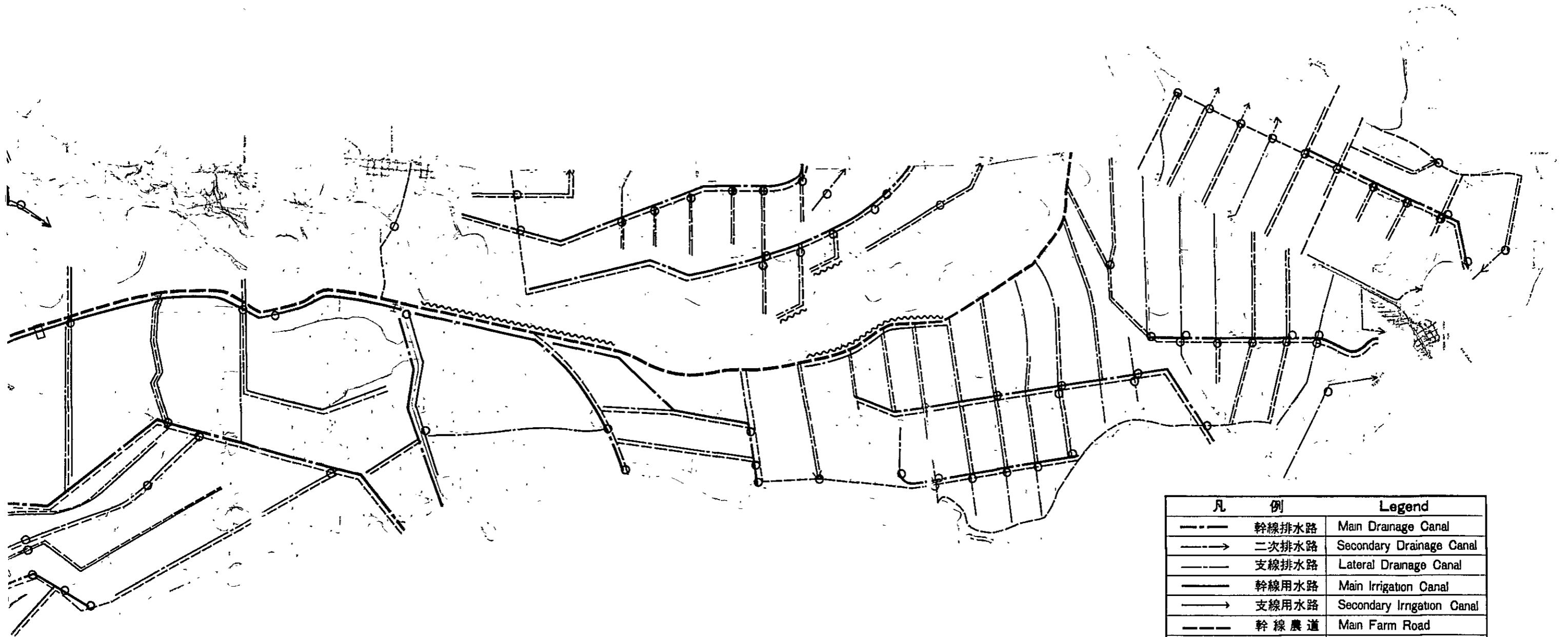
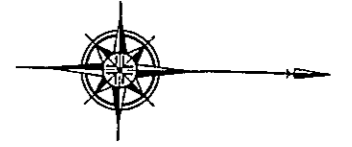


SCALE



GENERAL PLAN OF THE PAMPLONITA RIVER BASIN  
 AGRICULTURAL DEVELOPMENT PROJECT

一般計画平面図



凡 例	Legend
--- (thick dashed line)	幹線排水路 Main Drainage Canal
--- (medium dashed line)	二次排水路 Secondary Drainage Canal
--- (thin dashed line)	支線排水路 Lateral Drainage Canal
--- (thick solid line)	幹線用水路 Main Irrigation Canal
--- (medium solid line)	支線用水路 Secondary Irrigation Canal
--- (thick dashed line)	幹線農道 Main Farm Road
--- (thin dashed line)	支線農道 Secondary Farm Road
--- (rectangle with horizontal lines)	サイフォン Siphon
⊙	分水工 Diversion Work
△	急流工 Shute
□	落差工 Drop
--- (T-shape)	チェックゲート Check Gate
○	橋梁 Bridge
~~~~~	溢水部 Overflow Zone
⊠	暗渠 Cross Culvert

SCALE





## SUMMARY OF THE PROJECT

For formulation of the project, three Plans with defferent development levels were studied.

Of these, Plan III is recommended to be the most optimum plan for the project.

The outline of Plan III is given below:

### I. Development Plan

1. Objective Area : 13,500 ha
2. Drainage Area : 13,500 ha
3. Drainage Method : Gravitational Drainage
4. Irrigation Area : 4,300 ha
5. Irrigation Method : Border Irrigation
6. Type of Crops : Pasture (Beef Cattle Raising), Maize, Sorghum, Cacao and Cassava
7. Facility Plan
  - i) Drainage Canal : Length 606 km in total  
Main Canal,  
Secondary Canal,  
Lateral Canal and  
Tertiary Canal
  - ii) Irrigation Canal : Length 286 km in total  
Driving Canal,  
Main Canal,  
Secondary Canal and  
Tertiary Canal
  - iii) Related Structures : 619 Places in total  
Diversion works,  
chute,  
Drop, Siphon and  
others
  - iv) Road : Length 689 km in total  
Main Road including  
improvement of ex-  
isting road (6 km),  
Secondary Road and  
Terciary Road
  - v) Bridge : 97 places in total  
Bridge crossing over  
the Pamplonita River : 1 place

Farm Road Bridge	96 places
8. Implementation Period :	5 years
9. Project Life :	50 years

## II. Project Cost, Benefit and Evaluation

	Million Col \$	(Million US \$)
1. Construction Cost (excluding price escalation)	2,079	(26.0)
Foreign Portion	1,366	(17.1)
Local Portion	713	( 8.9)
2. Total Construction Cost (including price escalation)	3,098	(38.7)
Foreign Portion	1,786	(22.3)
Local Portion	1,311	(16.4)
3. Economic Construction Cost (Construction Cost - Adminis- tration Cost)	2,043	(25.5)
4. Annual Operation and Mainte- nance Cost (Including Administration Cost)	37	(0.46)
5. Economic Annual Operation and Maintenance Cost (Excluding Administration Cost)	32	(0.4)
6. Annual Benefit of the Project	352	(4.4)
7. Economic Internal Rate of Return	13.4%	



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## 1. Introduction

1.1 This is the summary report of the Feasibility Study on The Pamplonita River Basin Agricultural Development Project. The report of the feasibility study consists of SUMMARY AND RECOMMENDATIONS, MAIN REPORT, DRAWINGS and APPENDIXES as shown below:

I	BACKGROUND
II	METEOROLOGY AND HYDROLOGY
III	DRAINAGE
IV	IRRIGATION
V	SOIL, LAND CLASSIFICATION, GROUNDWATER AND WATER QUALITY
VI	AGRICULTURE
VII	COST ESTIMATE
VIII	PROJECT EVALUATION

1.2 High priority is placed on housing, education, agriculture and livestock in the economic development policy of The Republic of Colombia (hereafter referred to as The Republic). The objectives for development of agriculture and livestock have been increased in production and attainment of sound rural economy through efficient utilization of available water and land resources. Agriculture and livestock are also recognized as one of the most important production sectors in the National Economic Development Plan (1983-1986) (DNP 1983).

The area of approximately 35,000ha in the downstream catchment area of the Pamplonita, the Zulia and the Grita River were identified for the Norte de Santander Project consisting of 4 stages where an immigration project was implemented by INCORA in the early 1960s. A land improvement project was also executed in the area of the first stage (Zulia Project), the second and a part of the third stage.

HIMAT which is responsible for land improvement in The Republic since reorganization of the Government structures, determined to undertake a feasibility study in part of the area in the second and the third stage of the Norte de Santander Project which remain to be developed.

1.3 For this purpose the Government of The Republic requested to the Government of Japan for technical cooperation to undertake this feasibility study.

In response to the above request, the Government of Japan despatched the mission to The Republic in January, 1983. After site reconnaissance and discussions with the Government officials concerned of The Republic, the mission determined the policy of the feasibility study and exchanged the agreed Scope of Work.

1.4 Objectives of this feasibility study are:

- a. To propose solution to drainage problems,
- b. To propose irrigation and the land improvement plans including land reclamation, and
- c. To evaluate technical and economic aspects of the proposed development plans.

2. Brief Description of the Study Area and Problems

2.1 The study area covers about 13,500ha located in the catchment area of the downstream part of the Pamplonita River in the north eastern part of the Norte de Santander Department. The central village of the study area is Agua Clara which is approximately 40km to the north from Cucuta.

2.2 There are two rainy seasons (in the months from April to May and from September to December ) and the rest of the year corresponds to the dry seasons.

The average annual rainfall is about 2,500mm and the average air temperature is about 27°C in the study area.

Monthly average air temperature and rainfall is shown in the following table with the study area represented by the meteorological station at Santa Isabel.

Month	1	2	3	4	5	6	7	8	9	10	11	12	Year
Average Monthly Air temperature °C '69-'83	26.2	26.2	26.7	26.9	27.4	27.3	27.2	27.3	27.3	27.2	26.8	26.2	26.9
Average Monthly Rainfall mm	116.3	126.0	169.8	292.7	229.4	125.9	130.4	174.7	253.2	300.4	331.3	240.3	2490.4

2.3 Major rivers in the study area are the Pamplonita, the Zulia and the Grita. Hydrological dimensions are summarized in the following table.

Name	Catchment Area	Length	Average Discharge	Drough Discharge	Flood Discharge
Pamplonita	km <sup>2</sup> 2,060	km 170	m <sup>3</sup> /s 22	m <sup>3</sup> /s 3	m <sup>3</sup> /s 300 - at Agua Clara
Zulia	5,360	193	114	28	500 - at Puerto Leon
Grita	1,500	-	-		

The river system in the study area is shown in Fig. 1.

2.4 Topography in the study area consists of alluvial plain in the northern and the central areas and river terraces in the southern part.

The soil series distributing in the study area are classified into three groups shown in Fig. 2.

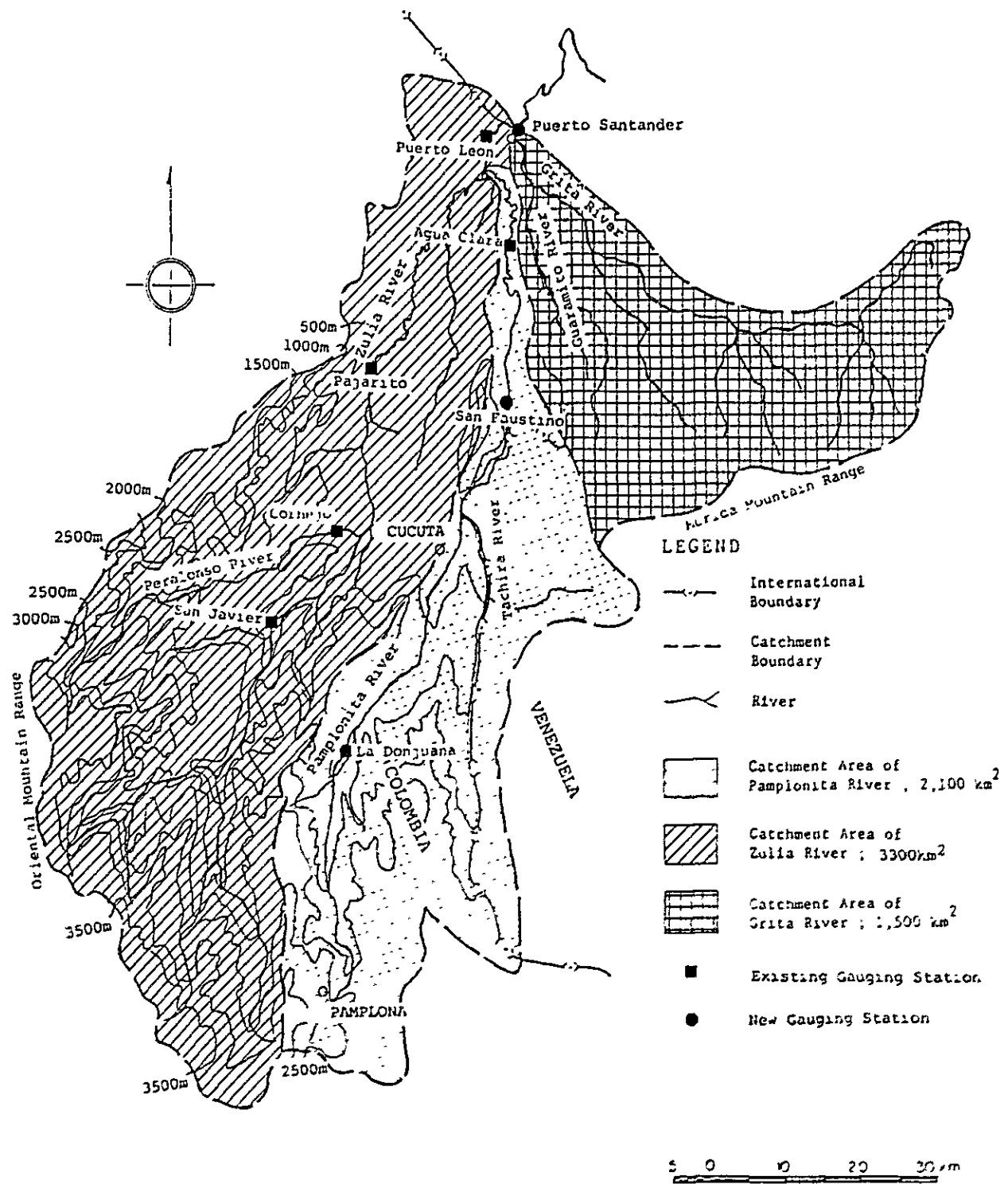
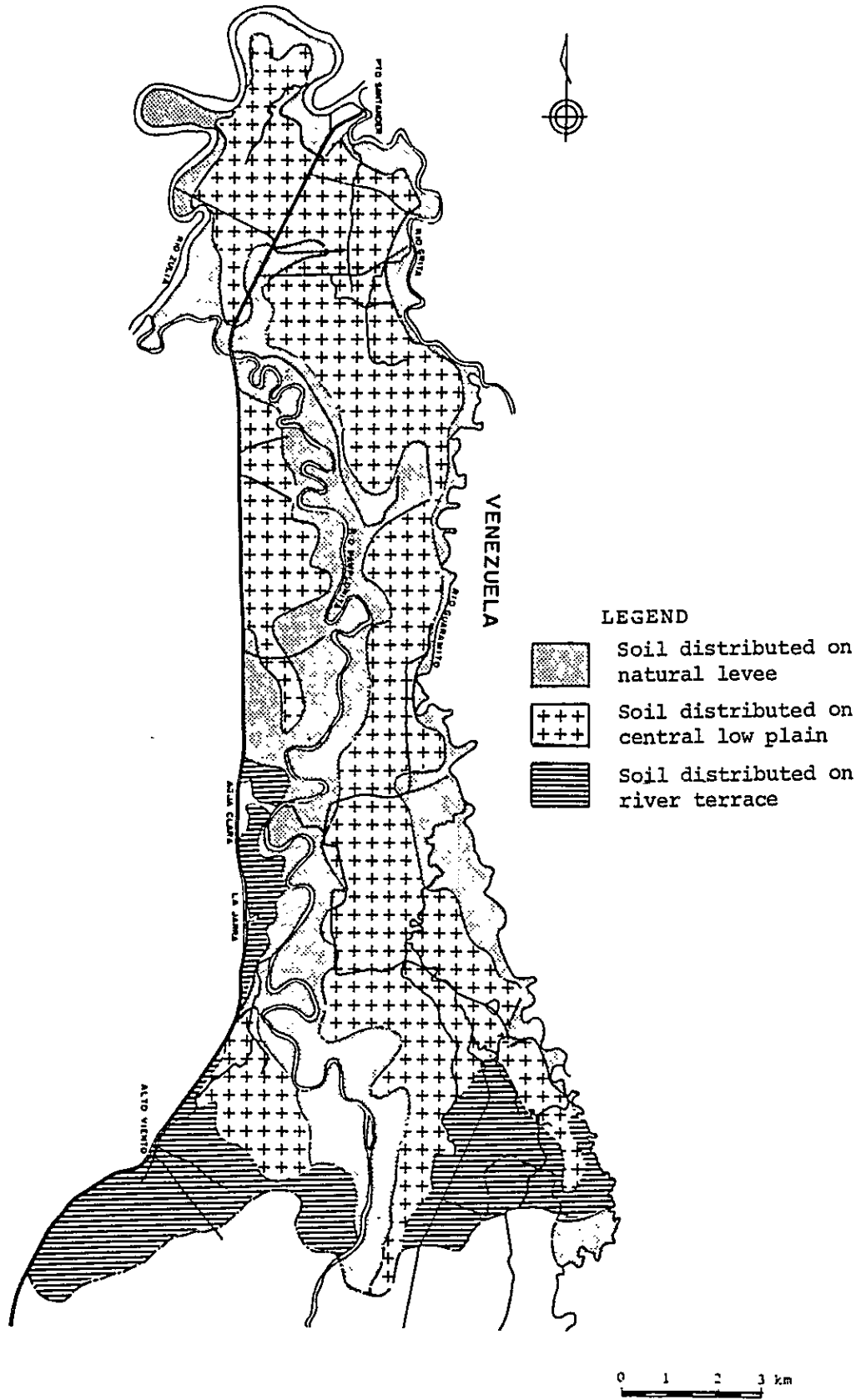


Fig.1 Map of Catchment Areas and Gauging Stations  
S-3



**Fig.2 Soil Distribution Map**

Distribution of Soil Series	Area	Productivity
On the natural river levee	(ha) (%) 3,880 28.7	Generally high
On the central low plain	6,870 50.9	Low due to poor drainage
On the river terrace	2,030 15.1	Fair to low

Note: The rest of the area (720ha, 5.3%) is settlement area and rivers.

- 2.5 The existing land use is shown in the table below. The 95% of agricultural land is used for pasture of beef cattle raising. The cultivated land is used mainly for cultivation of cacao. Other crops like cassava, maize and cashew nut are cultivated only in a limited area.

(ha)

Cultivated Land	Agricultural Land			Sub-total	Non Agricultural Land			Sub-total	Total
	Pasture		Total		Forest	Urban Area	Road and River		
	Artificial	Natural							
510	2,890	6,740	9,630	10,140	2,640	270	450	3,360	13,500
% (5.0) 3.8	% (28.5) 21.4	% (66.5) 49.9	% (95.0) 71.3	% (100.0) 75.1	% 19.6	% 2.0	% 3.3	% 24.9	% 100.0

- 2.6 Total number of households in the study area is 320. Distribution of land ownership of households is summarized in the table below. The average size of landholding is 32ha.

Land Size	Less than 5 ha	5-25 ha	25-45ha	45-65ha	More than 65 ha	Total
Number of households	2	100	153	37	28	320

- 2.7 Infrastructure in the study area is insufficient, especially farm road density is very low. The study area receives much influence from the Venezuelan economy since the area borders Venezuela.
- 2.8 The area has a moderate ground surface gradient and is surrounded by heavily meandering river courses. In addition, the density of drainage canals is extremely low, which results in long periods of

land inundation from rainwater and river flooding. The inundation caused by rainfall lasts 5 days to all the year round and the flooding from river overflow lasts 7 days at maximum.

The groundwater level rises 0.3 - 1.0m from the ground surface during the rainy season which produces chronic poor drainage problems in the area.

Daily rainfall in the magnitude of 100mm occurs every year and poor drainage problems are brought on over the area of approximately 10,000ha. In the poor drainage area, about 2,700ha is the area with an inundation over 30cm depth and 10 days' duration.

Flooded area caused by the Zulia and the Pamplonita River in different return periods is shown in the table below:

Return Period	2 years	5 years	10 years
Flooded Area (ha)	1,050	4,300	6,560

The area with poor drainage distribute wider in the northern area than in the southern area (Fig. 3).

There are some drainage canals at Campo Alegre and El Dave, but these canals function unsatisfactorily due to poor maintenance.

Major agricultural products in the area are beef cattle and cacao. The average unit yield of these crops are:

Beef cattle	0.14 t/ha (52 t/ha of pasture)
Cacao	0.52 t/ha

The above yields are 42% and 67% each of the unit yield in the farms well drained area.

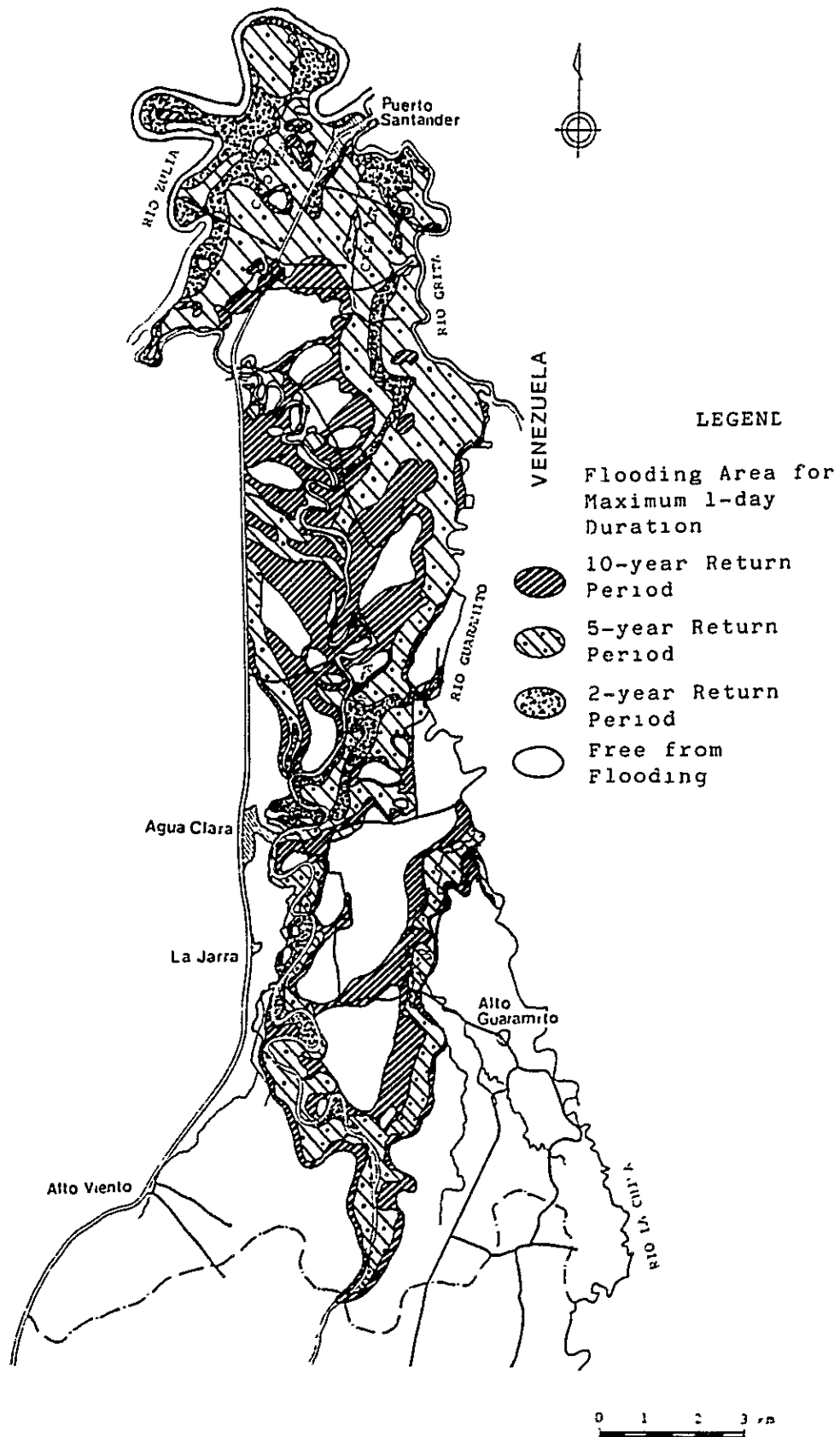
- 2.9 The study area is classified into four zones based on topography, drainage conditions, land ownership and land use.

These factors have a large influence on the drainage plan and the production plan, therefore the above zone classification is also used as basis of the development plan. Characteristics of each zone are summarized in the table below.

Demarcation of the zone classification is shown in Fig. 4.

- 2.10 The project area is located along the national border with Venezuela. The market in Venezuelan territory is not taken into account of the project formulation due to the significant recession since February 1983.





**Fig.3 Present Flooding Map**

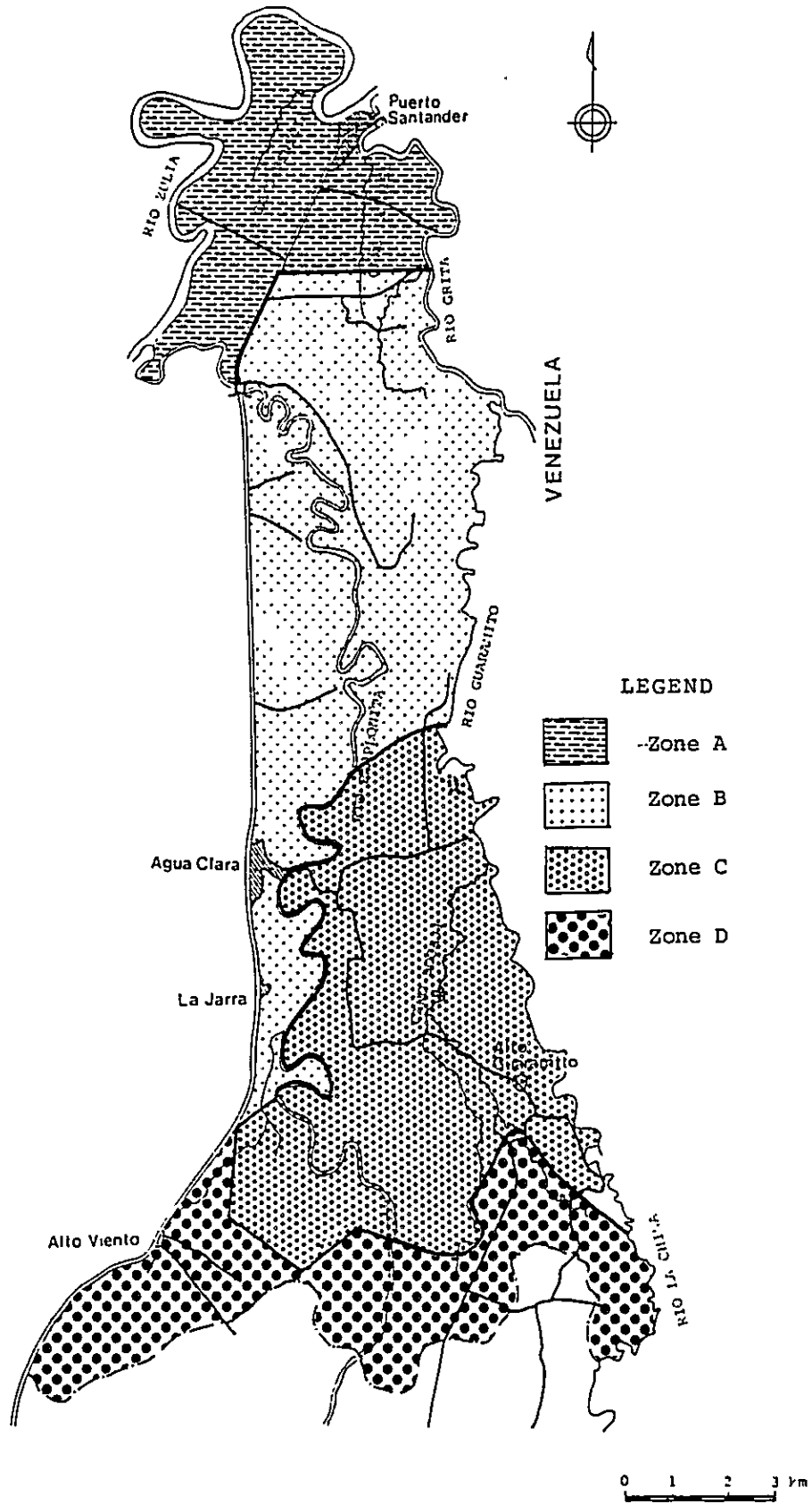


Fig.4 Zone Classification Map

### Zone Characteristics

Zone	Acreage (ha)	Agricultural Land (ha)	Number of Farm (house)	Acreage per Farm (ha/house)	Topography (Elevation) Average Slope	Soil Texture (Productivity)	Drainage and Flood Condition			Principal Land Ownership	Principal Land Use
							Flood Day <sup>3/</sup> and Flooding Area	4/ Flooding Area (ha)	5/ Annual Average to Groundwater Level (m)		
A	1,930	C: 10 P: 1,510 O: 0 T: 1,520	I: 34 P: 4 T: 38	40	Alluvial plain (47 to 55 m) 1.5%	Low plain soil Medium to fine (Moderate to high)	3 days 1,570 ha	44	60 to 110	INCORA's parceleros	Pasture
B	4,750	C: 40 P: 3,130 O: 90 T: 3,260	I: 42 P: 60 T: 102	32	Alluvial plain (51 to 75 m) 2%	Low plain soil Medium to fine (Moderate to high)	3 days 1,760 ha	25	60 to 140	Particu-lars	Pasture
C	4,860	C: 30 P: 3,450 O: 260 T: 3,740	I: 123 P: 14 T: 137	27	Alluvial plain (63 to 81 m) 2%	Low plain soil Medium to fine (Moderate to high)	1 day 880 ha	14	90 to 200	INCORA's Parceleros	Pasture Partially Cacao
D	1,960	C: 10 P: 1,540 O: 70 T: 1,620	I: 3 P: 40 T: 43	38	River terrace (75 to 100 m) 7%	Terrace soil Coarse (Moderate to low)	1 day 90 ha	0	170 to 310	Particu-lars	Pasture
Total	13,500	C: 90 P: 0,630 O: 420 T: 10,140	I: 202 P: 118 T: 320	32	(47 to 100 m) 2%		4,300 ha				

Notes: 1/ Cultivated Land

P: Pastures

O: Orchard

T: Total

2/ I: INCORA's Parceleros

P: Particulars

T: Total

3/ Consecutive flood days and area by flood of 5 years return period

4/ Topographic slope < 1/500, Ponding depth 30 cm and period more than 10 days

5/ Below the ground surface

### 3. Comparison of Development Levels

3.1 Objectives of this project are to attain sound productivity of agriculture and household economy and to raise living standards of farmers through:

- a. Improvement of drainage conditions, and
- b. Optimum utilization of irrigation water.

For this purpose the project consists of

- a. Drainage Improvement Plan,
- b. Irrigation Plan, and
- c. Improvement of Related Social Infrastructures.

Introducing any drastic change into the existing farming pattern would require a large capital investment, large number of labours and a long implementation period. Therefore, the basis of the project focuses on existing beef cattle raising.

For this purpose the analyses are made of the following three different development levels:

#### Development Plan I

On the basis of existing beef cattle raising, the drainage conditions will be improved to the same level as lands where pasture is managed in a favourable conditions in the area at present. By the improvement of drainage conditions, the productivity of beef cattle raising will be increased.

#### Development Plan II

By extension of better pasture, beef cattle raising productivity will be increased above that of development Plan I. Drainage conditions will be improved to the level of cacao and cassava extension under the appropriate crops' condition.

#### Development Plan III

On the basis of development Plan II, the cropping area of field crops will be extended by introduction of irrigation.

Proposed development plans for each development level are summarized in the following table.

3.2 Economic evaluations of the three proposed plans are summarized in the table below:

Alternative Cost Item	Plan I	Plan II	Plan III
Project Cost	Col\$ 2.26 Bil.	Col\$ 2.67 Bil.	Col\$ 3.48 Bil.
Project Benefit	Col\$ 5.88 Bil.	Col\$10.54 Bil.	Col\$15.95 Bil.
EIRR	7.1%	11.1%	13.4%

Evaluation of financial aspects of the project are summarized below:

The Plan I :

Produces insufficient incremental benefit for farmers to repay the construction cost.

The Plan II :

Produces sufficient incremental benefit for farmers to repay for construction cost. However, there is some limitation in variety of crops and potential production in this case.

The Plan III :

Produces abundant products with a variety of crops. The potential to adapt to future requirements will be high.

It is, therefore, proposed to select Plan III as the optimum development plan for the project.

3.3 In Plan III, however, the cropping area of some crops with which some farmers are not familiar needs to be extended. For this reason, it is indispensable to support these farmers with technical extension services and agricultural credits.

## Comparison of Development Plans

Development Plan	Land Improvement Plan			Production Plan				Remarks
	Land Improvement	Level of Improvement	Land Improvement Condition	Beef Cattle	Cacao	Cultivated Crops	Others	
Plan I Improvement of agricultural productivity based on the existing beef cattle business pattern	Improvement of drainage system	Level of good drainage site in study area	Groundwater level from ground surface; more than 0.8 m. Submergence; once every 2 years. Ponding; no exist. Design rainfall; 2 years return period. Drainage capacity; for peak discharge.	Improvement of pasture existing (Braquaria) Plowing once in 5 years. Being exhaustive of vaccination. Amplification of fattening of beef cattle.	Extension of Zones B, C (1,000 ha).	Extension in cultivable land (320 ha). Remaining of existing maize (40 ha).	Remaining of existing cashew nuts.	Consequences of backwater by the Zulia River
	Improvement of farm road							
Plan II Amplification of cacao and cassava on the appropriate drainage condition and introduction of superior pasture	Improvement of drainage	Improvement of drainage condition for cacao, cassava and superior pasture	Groundwater level from ground surface; more than 1.0 m. Submergence less than once in the 5 years by river flood and rainfall. Design rainfall; 5 years <sup>2/</sup> return period. Drainage capacity for peak discharge.	Improvement of pasture by superior species (tropical Kudzu & Angleton). Plowing once in the 5 years and fertilization. Being exhaustive of vaccination. Extension of fattening of beef cattle.	Extension in proposed area of approx. 2,000 ha.	Extension of cassava in proposed area (640 ha). Remaining of existing maize.	Same to Plan I.	Consequences of backwater by the Zulia River
	Improvement of farm roads							
Plan III Intensification of farming by introduction of irrigation	Improvement of drainage	Same to Plan II	Same to Plan II.	Zones A, B; Same to Plan II.	Same to Plan II.	Zones A, B; Extension of cassava in proposed area (260 ha)	Introduction of papaya and pineapple in Zone D.	Consequences of backwater by the Zulia River.
	Irrigation	Same to level of arrangement in Zulia District.	Drought discharge; once in the 5 years.	Zones C, D; Establishment of rotated grazing by irrigation Rotation of pasture and cultivated crops.		Planning two crops a year of maize and sorghum (2,660 ha) and watermelon (100 ha) Doing rotation with pasture.		

1/ Irrigation zones; Zones C, D only therefore development level of Zones A, B will be same as Plan II

2/ 5 years return period is used for projects of Zulia, Sibunday, Lebrija, Tolima, etc.

#### 4. Contents of the Project

The contents of the Development Plan III recommended for the project are summarized as below.

4.1 The proposed land use and cropping plan is summarized in the following table:

(Unit : ha)

Plan Zone	Present Condition	Plan III	Land re- clamation	Right of way
A 38 farms	Pasture 1,510 Cassava 10	Pasture 1,220 Cassava 80 Cacao 260	120	80
	Sub-total 1,520	Sub-total 1,560		
B 102 farms	Pasture 3,130 Cassava 30 Maize 10 Cacao 90	Pasture 2,610 Cassava 200 Maize 10 Cacao 720	460	180
	Sub-total 3,260	Sub-total 3,540		
C 137 farms	Pasture 3,450 Cassava 10 Maize 20 Cacao 260	Pasture (I) 880 Maize & Sorghum (I) 1,760 Cacao 960	260	400
	Sub-total 3,740	Sub-total 3,600		
D 43 farms	Pasture 1,540 Maize 10 Cashew nut 70	Pasture (I) 500 Maize & Sorghum (I) 900 Watermelon (I) 100 Papaya (I) (Pineapple) 100	60	80
	Sub-total 1,620	Sub-total 1,600		
Total 320 farms	Pasture 9,630 Cassava 50 Maize 40 Cacao 350 Cashew nut 70	Pasture 3,830 Pasture (I) 1,380 Cassava 280 Maize 10 Maize (I) 2,660 Sorghum (I) (2,660)* Cacao 1,940 Watermelon (I) 100 Papaya (I) (Pineapple) 100	900	740
	Total 10,140	Total 10,300		

(I) : Irrigation

\* : Double cropping

4.2 A comparison is made between present production and the proposed production as shown below.

Crop	Comparison	Cropping Area (ha)	Unit Yield (t/ha)	Production (t)	Farm Gate Price (10 <sup>3</sup> COL\$/kg)	Gross Production (10 <sup>3</sup> COL\$)	Unit Production (COL\$/ha)	Net Production (10 <sup>3</sup> COL\$)
Beef Cattle (Pasture)	Present	9,630	0.14 <sup>1)</sup>	1,335	90	121,968	6,300 <sup>1)</sup>	60,984
	Proposed	3,830	0.31	1,172	90	105,478	12,358	58,147
Beef Cattle (Irrigated pasture)	Present	-	-	-	-	-	-	-
	Proposed	1,380	0.60	829	90	73,099	15,662	52,205
Cassava	Present	50	6.00	300	15	4,500	10,180	3,991
	Proposed	280	15.00	4,200	10	42,000	54,350	26,702
Maize	Present	40	2.00	80	17	1,360	10,160	953
	Proposed	10	3.00	30	17	510	27,150	238
Maize (Irrigated)	Present	-	-	-	-	-	-	-
	Proposed	2,660	4.00	10,640	17	180,880	32,300	94,962
Sorghum (Irrigated)	Present	-	-	-	-	-	-	-
	Proposed	(2,660) <sup>3)</sup>	4.00	10,640	15	159,600	30,700	77,938
Cacao	Present	350	0.52	182	125	22,750	26,000	13,650
	Proposed	1,940	0.90	1,746	125	218,250	48,600	123,966
Watermelon (Irrigated)	Present	-	-	-	-	-	-	-
	Proposed	100	15.00	1,500	10	15,000	91,250	5,075
Papaya (Pineapple) (Irrigated)	Present	-	-	-	-	-	-	-
	Proposed	100	17.50	1,750	10	17,500	83,856	9,114
Total	Present	10,140 <sup>4)</sup>		2,337 <sup>4)</sup>		154,198 <sup>4)</sup>		80,719 <sup>4)</sup>
	Proposed	10,300		32,500		813,117		449,307

Note: 1) The overall average

2) Estimated market price is same as the regional average price since large amount of product is expected.

3) ( ) = Double cropping

4) Including cashew nut



4.3 There are some drainage canals in a limited area, however, they are extremely insufficient to drain rainfall and river flooding.

The design rainfall return period for the drainage plan is proposed as 5 years with necessary adjustment to be made to accommodate flood overflow in the magnitude of 5 year return period.

Drainage method is to be gravitational drainage.

The 1,750ha of present flooded areas will be reduced by the provision of above drainage canals.

Proposed drainage facilities are summarized in the table below:

Facility Dimension	Main Canal	Secondary Canal	Lateral Canal	Tertiary Canal	Interception Canal
L: m Canal Q: m <sup>3</sup> /s	50,550 44-6.1	38,950 29-0.48	84,150 12-0.52	418,000 1.5-3.0 (standard)	14,650 8.6-0.04
I: (earth canal)	1/310- 1/1,310	1/160- 1/1,310	Approx. 1/700	Approx. 1/700	1/500- 1/2,000
Drops(Place)	7	49	13	-	-
Culvert (Place)	2	7	150	160	-

4.4 Irrigation facilities are provided for 4,300ha of Zone C and D in the southern part of the project area.

The design drought return period is 5 year.

Border irrigation is proposed and the water requirements are estimated to be  $6.0 \text{ m}^3/\text{s}$  which is within the limit of water source of  $7.5 \text{ m}^3/\text{s}$  at the diversion of the Canal Zulia planned by HIMAT.

Proposed irrigation facilities are summarized as below.

Facility	Driving Canal	Main Canal	Secondary Canal	Tertiary Canal
Canal L: (earth Q: canal) I:	6,400m $6.0 \text{ m}^3/\text{s}$ 1/2000	26,700m $5.9-1.5 \text{ m}^3/\text{s}$ 1/1000- 1/2000	50,350m $0.06-5.7 \text{ m}^3/\text{s}$ 1/1000	203,349m $0.02 \text{ m}^3/\text{s}$ 1/1000
Siphon	L: (A) D	180m $\phi 2,000\text{mm}$ Floresta R.	-	-
	L: (B) D	320m $\phi 2,000\text{mm}$ Concepcion R.	-	-
	(C)	-	L = 250m $\phi 1,900\text{mm}$ Pamplonita R.	-
Diversion		1 place		
Chute		1 place		
Drop		2 places		
Wasteway		1 place		
Check Gate		7 places		
Intake			20 places	
Culvert	1 place		196 places	

- 4.5 Existing road density in the project area is extremely low especially in the area on the right bank of the Pamplonita River.

In the project it is proposed to construct a main road along the higher ground surface than the surround area on the right bank of the Pamplonita River making fully use of the alignment of existing farm road.

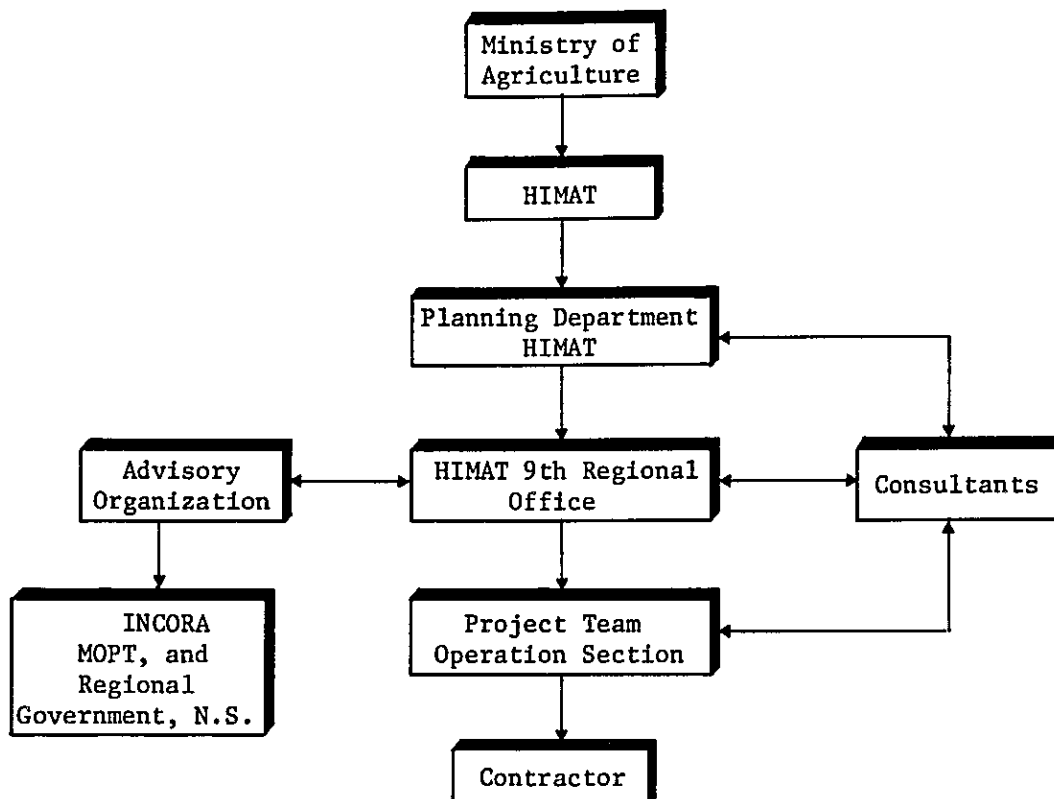
Construction of one bridge (100m in length) is proposed to connect the areas on the right bank of the Pamplonita River with the existing national road at Agua Clara.

Proposed roads and bridge are summarized as below:

Dimension	Facility	Main Road		Secondary Road	Tertiary Road	Bridge Crossing Pamplonita River	Farm Road Bridge
		New construction	Improvement				
Length	m	14,500	6,250	250,000	418,000	100	-
Width	m	6.0	6.0	4.0	3.0	6.0	4.0 or 6.0
Road Density	m/ha	3.6		18.5	31.0	-	-
Nos. of Places		-	-	-	-	1	96

## 5. Project Implementation and Evaluation

- 5.1 Construction period is to be 5 years including the period of preparatory work.
- 5.2 HIMAT is to be the executing agency of construction for the project and the proposed organization chart is illustrated below.



The project term is to be organized in the existing Conservation Section in the 9th Regional office, HIMAT. No new project office is to be established.

5.3 After commencement of the project, HIMAT is to keep close cooperation with INCORA and ICA to provide farmers with progressive technical extension services and training.

5.4 Construction cost is estimated to be COL\$ 2,079,970,000 consisting of COL\$ 1,366,450,000 of foreign portion and COL\$ 713,520,000 of local portion as shown in the table below.

Unit 10<sup>3</sup>COL\$  
(10<sup>3</sup>US\$)

Item	Foreign Portion	Local Portion	Total
1. Preparatory Work		14,852 (186)	14,852 (186)
2. Civil Works	886,355 (11,080)	566,671 (7,083)	1,453,026 (18,163)
3. Procurement of O/M Machinery	91,768 (1,147)		91,768 (1,147)
4. Buildings		6,000 ( 75)	6,000 ( 75)
5. Administration		33,480 (418)	33,480 (418)
6. Engineering Services	264,112 (3,301)	27,650 (346)	291,762 (3,647)
Sub Total	1,242,235 (15,528)	648,653 (8,108)	1,890,888 (23,636)
7. Physical Contingency	124,223 (1,553)	64,865 (811)	189,088 (2,364)
Total	1,366,458 (17,081)	713,518 (8,919)	2,079,976 (26,000)

Note: Exchange Rate 1 US\$ = 80 COL\$

The total construction cost including price escalation is estimated to be COL\$ 3,098,520,000 consisting of COL\$ 1,786,900,000 of foreign portion and COL\$ 1,311, 620,000 of local portion.

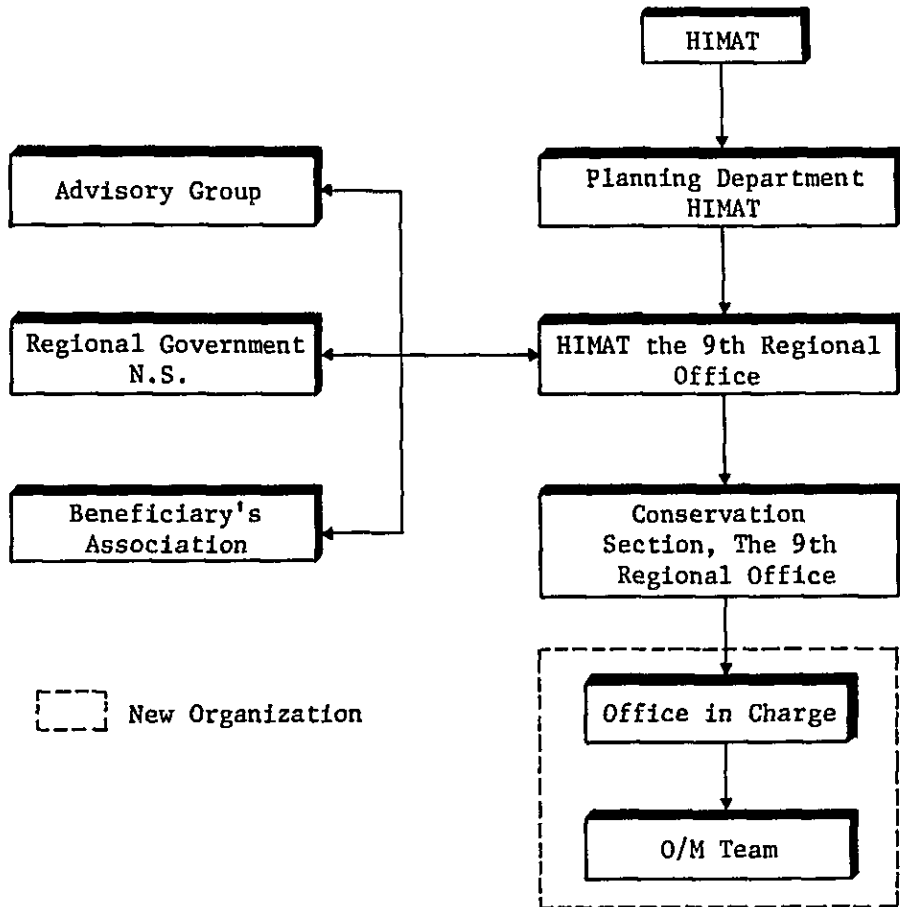
Percentage of the foreign and the local portions are 58% and 42%, respectively.

The disbursement schedule is proposed as shown in the table below.

Annual Disbursement Schedule [ Plan III ] Unit: 101 CoIs

Description	Investment Cost		1st Year		2nd Year		3rd Year		4th Year		5th Year	
	F/C	L/C	1985/1986		1986/1987		1987/1988		1988/1989		1989/1990	
			F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
I. Preparatory Work		14,852		14,852								
II. Irrigation												
1. Driving Canal	33,185	53,823		26,548		43,058		6,637		10,765		
2. Main Canal	44,584	40,770		8,917		8,154		17,834		16,308		16,308
3. Secondary Canal	20,202	25,361						20,202		25,361		
4. Tertiary Canal	44,000	12,800						22,000		6,400		6,400
III. Drainage												
1. Main Canal	217,996	70,905		38,849		12,840		110,955		35,070		22,995
2. Secondary Canal	50,956	59,918						22,930		26,963		26,963
3. Tertiary Canal	226,800	87,488						45,360		17,498		43,744
4. Lateral Canal	93,313	52,686						18,663		10,537		26,343
5. Interception Canal	8,610	2,435						8,610		2,435		
IV. Road												
1. Main Road	18,415	64,588						14,732		51,670		
V. Bridge	72,674	82,942						43,605		49,765		16,588
VI. Land Reclamation	55,620	12,955						33,372		7,773		16,686
Sub-Total (I - VI)	886,355	581,523		98,094		109,707		364,900		260,545		322,233
VII. O/H Equipment	91,768											45,884
VIII. Supporting Service		6,000										3,000
IX. Administration Cost		33,480		6,696		6,696						6,696
X. Engineering Service	264,112	27,650		2,000		3,660		65,239		9,390		6,300
Sub-Total (I - X)	1,242,235	648,653		114,588		120,063		430,139		276,631		312,223
XI. Physical Contingency (10%)	124,223	64,865										
Sub-Total (I - XI)	1,366,458	713,518		124,223		124,066		430,139		276,631		312,223
XII. Price Escalation	420,446	598,102		45,747		132,069		473,153		304,294		197,146
Grand Total	1,786,904	1,311,620		160,010		256,135		903,292		580,925		509,369
	58 %	42 %		100 %								

5.5 Operation and maintenance services are required for the irrigation and drainage canals, roads and other facilities. The operation and maintenance of the 9th Regional Office of HIMAT and other organization are shown below.



For this project, one sub-section is to be established under the conservation section of the 9th Region Office of HIMAT.

5.6 Annual operation and maintenance cost is estimated to be:

Item	Cost COL\$ Million/year
Operation of Machinery	29.14
Repair Works of Facilities	2.91
Administration Cost	5.45
Total	37.51

5.7 The project life is 50 years including 18 months preparatory period and 42 months construction period.

Economic construction cost is estimated to be COL\$ 2,043.15 million excluding the administration cost.

Annual benefit of the project at matured stage is estimated to be COL\$ 352.44 million.

Economic internal rate of return (EIRR) of the project is estimated to be 13.4% which exceeds the 12% of capital opportunity cost in The Republic.

5.8 Sensitivity analyses are made in respect to construction cost, gross production value and production cost. It is found that economic returns of the project are influenced by these factors in the order of magnitude, construction cost, gross production value, and production cost as follows:

Factors of sensitivity analyses	EIRR
(a) 10% increase in construction cost	12.3%
(b) 10% decrease in gross production value	11.0%
(c) 10% increase in production cost	12.4%

5.9 According to the results of financial analyses, it is concluded that the project will produce sufficient benefit for farmers under average farming condition to permit their repayment of the construction cost.

The capital investment condition are: 8% interest rate with 8% annual inflation for the foreign portion and 20% interest with 20% inflation for the local portion. Repayment condition for farmers is 20% interest rate within a term of 15 years after 5 years grace period.

## 6. Conclusion

As the result of feasibility study, it is concluded that the Plan III is justified in economical, financial, technical and social aspects.



## 7. Recommendations

### 7.1 Earlier Implementation of The Project

Considering economic and social effects of the project not only for the project area but also the nation, it is recommended that implementation of the project should be made immediately. The project involves many aspects, the close coordination among the related public institutions should be made.

### 7.2 Construction

- a. For land acquisition of the right-of-way, prudent negotiation should be made with land owners in advance.
- b. Construction should be started on irrigation/drainage facilities since earlier commencement of production.
- c. Farmers who can not cultivate their farms due to construction should have priority to be employed as construction labourers.
- d. Soil and topographic surveys should be made before designing of the major structures.

### 7.3 Project Management and Operation & Maintenance

- a. The successful results from the project largely depend on the management, operation and maintenance of the project facilities. For this purpose HIMAT has to play a leading role in coordinating related public institutions and establishment of the management organization.
- b. Operation and Maintenance  
Main and secondary irrigation/drainage canals are to be maintained by HIMAT, however, tertiary irrigation canals are to be maintained by benefiting farmers.

### 7.4 Extension Services

- a. For successful extension of new crops with which farmers are not familiar, intensive technical extension services are indispensable. For this purpose HIMAT has to maintain close coordination with ICA and INCORA.
- b. For the project implementation, credit will be required for production cost. HIMAT has to make the necessary arrangements with Caja Agraria and F.F.A.P. to meet the farmer credit requirements.

### 7.5 Continuation of Hydro-meteorological Observation

Hydro-meteorological observation undertaken in the project area and its vicinity should be continued in the future since these data will provide important information for the project and other similar projects.



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