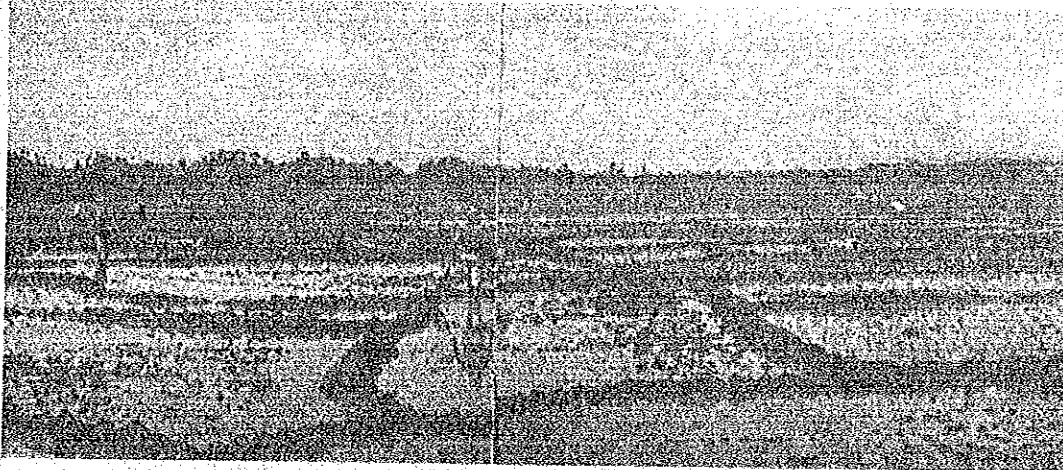
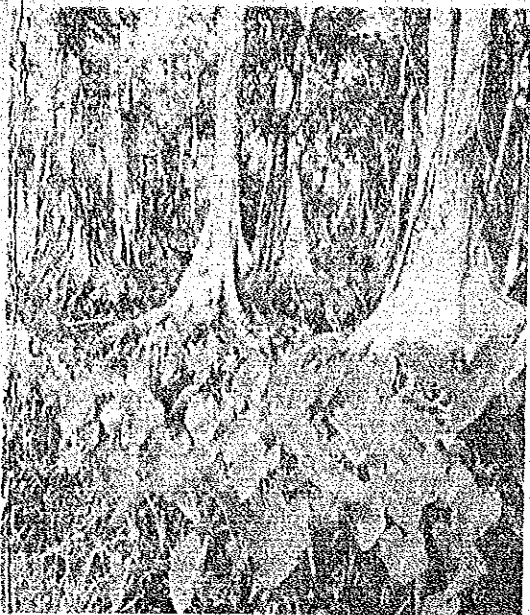


MINISTRY OF AGRICULTURE


**FEASIBILITY STUDY
ON
THE AGUACATE-GUAYABO
AGRICULTURAL DEVELOPMENT PROJECT**

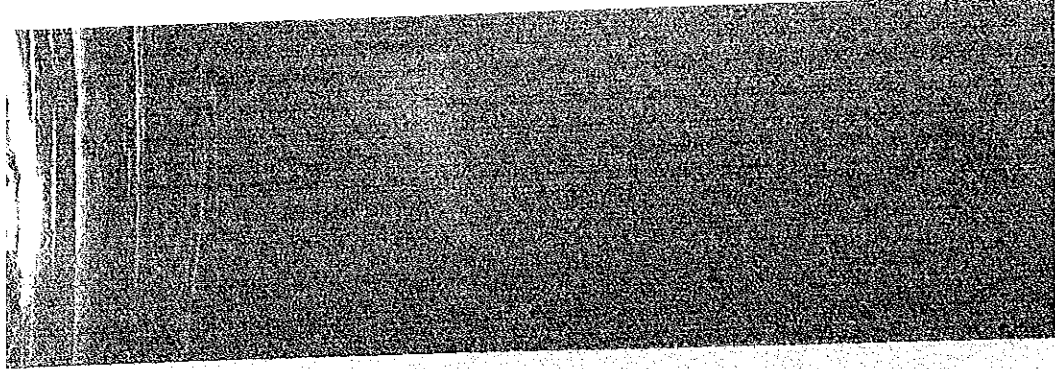
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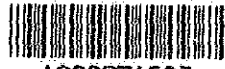
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**FEASIBILITY STUDY
ON
THE AGUACATE-GUAYABO
AGRICULTURAL DEVELOPMENT PROJECT**

FINAL REPORT

**VOLUME 2
ANNEX**

AUGUST 1986

**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)**

国際協力事業団	
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I. THE STUDY AREA

ANNEX A: BACKGROUND TO THE PROJECT

1. National Economic Background

TABLE A.1.1 POPULATION OF THE DOMINICAN REPUBLIC

Year	Total	Urban (%)	Rural (%)
<u>Census</u>			
1920	894,665	148,894 (16.6)	745,771 (83.4)
1935	1,479,417	266,565 (18.0)	1,212,852 (82.0)
1950	2,135,872	508,408 (23.8)	1,627,464 (76.2)
1960	3,047,070	922,090 (30.3)	2,124,980 (69.7)
1970	4,009,458	1,593,299 (39.7)	2,416,159 (60.3)
1981	5,647,977	2,935,860 (52.0)	2,712,117 (48.0)
<u>Growth Rate (% p.a.)</u>			
1920-1935	3.41	3.96	3.30
1935-1950	2.48	4.40	1.98
1950-1960	3.62	6.13	2.70
1960-1970	2.78	5.62	1.29
1970-1981	3.16	5.71	1.06

Source: 6th National Census for Population and Living

TABLE A.1.2 LABOUR FORCE AND EMPLOYMENT

Sector	No.	%
<u>A. Population Economically Active</u>	<u>1,784,157</u>	<u>100</u>
<u>Agriculture & Livestock</u>	<u>420,463</u>	<u>23.6</u>
<u>Non-agricultural Activities</u>	<u>942,066</u>	<u>52.8</u>
Mining and Quarrying	4,743	0.3
Manufacturing	224,437	12.6
Construction	80,850	4.5
Electricity, Gas and Water	13,891	0.8
Transport and Communications	40,470	2.3
Commerce	192,181	10.8
Banking, Insurance, etc.	22,369	1.2
Services	363,125	20.3
<u>Non-specified Activities</u>	<u>421,628</u>	<u>23.6</u>
Total Labour Force	1,915,388 ^{1/}	
Population	5,647,977	
Economically Active		33.9%
<u>B. Employment and Unemployment</u>		
Employed	1,563,994	81.7
Unemployed	351,394	18.3

^{1/} includes 131,231 of people who look for job opportunity for the first time.

Source: República Dominicana en Cifras 1985 VOL. XII

TABLE A.1.3 GROSS DOMESTIC PRODUCT

Sector	RD\$ Million at 1970 Constant Price					Growth Rate (% p.a.)				
	1976	1979	1980	1981*	1982*	1976/79	1979/80	1980/81	1981/82	1982/83
<u>Primary Sectors</u>	570.0	608.3	608.8	644.3	617.6	2.2	0.1	5.8	-4.1	9.1
Agriculture	429.2	461.7	484.2	510.8	532.6	2.5	4.9	5.5	4.3	3.1
Mining	140.8	146.6	124.6	133.5	85.0	0	-15.0	7.1	-36.2	46.6
<u>Secondary Sectors</u>	610.6	688.4	727.8	741.0	761.4	4.1	5.7	1.8	2.8	5.0
Manufacture	457.4	504.8	530.2	544.5	572.6	3.3	5.0	2.7	5.2	1.7
Construction	153.2	183.6	197.6	196.5	188.8	6.2	7.6	-0.6	-3.9	14.8
<u>Tertiary Sectors</u>	1,256.3	1,441.5	1,567.3	1,634.5	1,691.8	4.7	89.7	4.3	3.5	1.7
Commerce	414.0	451.5	473.6	494.9	520.2	2.9	4.9	4.5	5.1	0.5
Transport	166.7	195.8	199.6	210.1	222.2	5.5	1.9	5.3	5.8	0.3
Communications	24.1	28.5	30.9	32.6	34.8	5.7	8.4	5.5	6.7	5.1
Electricity	30.9	43.7	49.0	53.4	48.4	12.2	12.1	9.0	-9.4	4.3
Finance	58.2	67.9	70.4	73.2	76.5	5.3	3.7	4.0	4.5	3.9
Housing & Real Estate	156.8	186.0	198.1	198.8	197.0	5.9	6.5	0.4	-0.9	5.0
Government	189.9	233.6	280.3	300.1	311.9	7.1	20.0	7.1	3.9	2.3
Other Services	215.8	234.5	265.4	271.4	280.9	2.8	13.2	2.3	3.5	0.5
Total	2,422.9	2,738.2	2,903.9	3,019.8	3,070.9	3.9	6.1	4.0	1.7	4.0

* Preliminary Figure

** Estimated Figure

Source: Banco Central de la República Dominicana, Boletín Mensual, January 1985

TABLE A.1.4 DISTRIBUTION OF GROSS DOMESTIC PRODUCT BY SECTOR

Sector	1976	1979	1980	1981	1982	1983
<u>Primary Sectors</u>	23.3	22.2	20.9	21.2	20.1	21.1
Agriculture	17.6	16.8	16.6	16.8	17.2	17.2
Mining	5.8	5.4	4.3	4.4	2.8	3.9
<u>Secondary Sectors</u>	25.0	25.1	25.1	24.6	24.8	25.0
Manufacture	18.7	18.4	18.3	18.0	18.6	18.2
Construction	6.3	6.7	6.8	6.6	6.1	6.8
<u>Tertiary Sectors</u>	51.4	52.7	54.0	54.2	55.1	53.9
Commerce	16.9	16.5	16.3	16.4	16.9	16.4
Transport	6.8	7.2	6.9	7.0	7.2	7.0
Communications	1.0	1.0	1.1	1.1	1.1	1.1
Electricity	1.3	1.6	1.7	1.8	1.6	1.6
Finance	2.4	2.5	2.4	2.4	2.5	2.5
Housing & Real Estate	6.4	6.8	6.8	6.6	6.4	6.5
Government	7.8	8.5	9.7	9.9	10.2	10.0
Other Services	8.8	8.6	9.1	9.0	9.1	8.8
Total	100	100	100	100	100	100

Source: Banco Central de la República Dominicana, Boletín Mensual, January 1985

TABLE A.1.5 BALANCE OF PAYMENT

RD\$ Million, Current Price

	1979	1980	1981	1982	1983
I. Current Account					
1. Export (Goods & Services)	868.6	961.9	1,188.0	767.7	785.2
2. Imports (Goods & Services)	1,137.5	1,519.7	1,451.7	1,257.3	1,282.2
Commercial Balance (a)=(1-2)	-268.9	-557.8	-263.7	-489.6	-497
Net Factor Services Income (b)	-268.2	-299.8	-335.2	-157.3	-139.1
Net Transfer (c)	205.8	187.8	193.0	205.0	215.0
Current Account Balance (a)+(b)+(c)	-331.3	-669.8	-405.9	-441.9	-421.1
II. Capital Account					
1. Long Term Capital	143.2	330.4	151.0	263.8	457.8
2. Short Term Capital	251.9	239.6	168.5	53.4	-236.7
3. Foreign Investment	17.1	92.7	79.7	-1.4	48.2
Capital Flow (Net) (a)=(1+2+3)	412.2	662.7	399.2	315.8	269.3
Errors & Omissions (b)	-73.2	28.6	42.0	0.4	22.8
Change in International Reserves (c)	-7.7	-21.5	-35.3	125.7	129.0
Capital Account Balance (a)+(b)+(c)	331.3	669.8	405.9	441.9	421.1

Source: Banco Central de la Republica Dominicana, Boletin Mensual,
January 1985

TABLE A.1.6 MERCHANDISE EXPORTS

Value: RD\$ Thousand Current Price

	1980 (%)	1981 (%)	1982 (%)	1983 (%)	1984 (%)
<u>Principal Exports</u>					
Sugar	807,125 (83.9)	1,019,985 (85.9)	623,570 (81.2)	665,166 (84.7)	705,173 (80.9)
Coffee	290,196 (30.2)	517,247 (43.5)	265,514 (34.6)	263,562 (33.6)	275,475 (31.6)
Cacao	51,813 (5.4)	62,243 (5.2)	90,612 (11.8)	76,288 (9.7)	95,074 (10.9)
Tobacco	51,071 (5.3)	44,785 (3.8)	52,913 (6.9)	55,518 (7.1)	70,064 (8.0)
Bauxite	34,794 (3.6)	65,615 (5.5)	21,433 (2.8)	21,816 (2.8)	24,228 (2.8)
Ferronickel	18,513 (1.9)	15,727 (1.3)	5,250 (0.7)	- (-)	- (-)
Dore *	101,253 (10.5)	110,542 (9.3)	24,210 (3.2)	83,471 (10.6)	108,5223 (12.4)
Others	259,485 (27.0)	207,830 (17.5)	163,638 (21.3)	164,511 (21.0)	131,810 (15.1)
	154,732 (16.1)	168,036 (14.1)	144,174 (18.0)	120,010 (15.3)	166,492 (19.1)
Total	961,857 (100)	1,188,021 (100)	767,744 (100)	785,176 (100)	871,665 (100)

Source: Banco Central de la República Dominicana, Boletín Mensual, January 1985

TABLE A.1.7 EXPORTATION AND IMPORTATION BY COUNTRY 1981-1983

In Thousand of RD\$

Country	1981			1982			1983					
	Exp.	(%)	Imp.	(%)	Exp.	(%)	Imp.	(%)	Exp.	(%)	Imp.	(%)
U.S.A.	731,345	(61.6)	583,713	(40.3)	385,406	(26.6)	469,867	(37.4)	503,643	(64.1)	441,475	(34.5)
Venezuela	71,373	(6.6)	256,450	(17.7)	19,279	(1.3)	221,045	(17.6)	3,689	(0.5)	271,547	(21.2)
Canada	14,980	(1.3)	37,107	(2.6)	7,764	(0.5)	32,466	(2.6)	34,397	(4.4)	29,684	(2.3)
Brazil	6,164	(0.5)	21,612	(1.5)	-	(-)	14,994	(1.2)	-	(-)	20,131	(1.6)
Mexico	-	(-)	123,969	(8.5)	-	(-)	170,659	(13.6)	1,634	(0.2)	140,994	(11.0)
Puerto Rico	54,054	(4.5)	27,758	(1.9)	44,013	(3.0)	21,363	(1.7)	32,434	(4.1)	24,640	(1.9)
Netherland	26,944	(2.3)	12,927	(0.9)	21,510	(1.5)	10,732	(0.9)	31,386	(4.0)	10,145	(0.8)
Great Britain	12,644	(1.1)	17,918	(1.2)	947	(0.1)	14,388	(1.1)	3,148	(0.4)	12,619	(1.0)
Switzerland	102,973	(8.7)	7,494	(0.5)	89,920	(6.2)	4,348	(0.3)	48,318	(6.2)	4,424	(0.3)
Spain	43,254	(3.6)	21,233	(1.5)	11,106	(0.8)	46,540	(3.7)	16,765	(2.1)	43,886	(3.4)
Japan	15,135	(1.3)	82,397	(5.7)	5,983	(0.4)	64,596	(5.1)	6,973	(0.9)	55,032	(4.3)
Others	109,155	(9.2)	257,591	(17.8)	181,816	(12.5)	184,819	(14.7)	102,789	(13.1)	224,443	(17.5)
Total	1,188,021	(100)	1,450,169	(100)	767,744	(100)	1,255,817	(100)	785,176	(100)	1,279,020	(100)

Source: Banco Central de la República Dominicana, Boletín Mensual, January 1985'

TABLE A.1.8 AGRICULTURAL PRODUCTION (CURRENT PRICE)

(In Million of RD\$)

Group	1978 (%)	1979 (%)	1980 (%)	1981 ^{1/} (%)	1982 ^{2/} (%)
1. Cereales	102.7 (14.6)	115.2 (15.1)	121.3 (11.4)	132.2 (12.3)	179.8 (16.0)
2. Industrial Exportable Crops	334.8 (47.7)	368.4 (48.2)	557.9 (52.3)	592.7 (55.3)	526.1 (48.6)
3. Oleaginous Crops	16.8 (2.4)	11.4 (1.5)	14.0 (1.3)	12.5 (1.2)	13.7 (1.3)
4. Textiles	2.2 (0.3)	2.8 (0.4)	4.1 (0.4)	4.5 (0.4)	4.9 (0.5)
5. Leguminous Crops	41.3 (5.9)	49.7 (6.5)	63.4 (5.9)	63.3 (5.9)	70.8 (6.5)
6. Tubers, Bulbs	53.0 (7.5)	54.8 (7.2)	92.1 (8.6)	68.4 (6.4)	80.0 (7.4)
7. Fruits	59.4 (8.5)	65.4 (8.6)	73.6 (6.9)	77.9 (7.3)	74.8 (6.9)
8. Vegetables	63.6 (9.1)	45.5 (6.0)	60.6 (5.7)	61.3 (5.7)	59.8 (5.5)
9. Others	28.5 (4.1)	51.1 (6.7)	79.1 (7.4)	58.1 (5.4)	72.1 (6.7)
Total	702.3 (100)	764.2 (100)	1,066.1 (100)	1,070.9 (100)	1,082.0 (100)

^{1/} Farm-gate price

^{2/} Preliminary figure

Source: Banco Central de la República Dominicana, Boletín Mensual, January 1985

TABLE A.1.9 PRINCIPAL AGRICULTURAL PRODUCTION (1982-1984)

Unit: ton

Crops	1982	1983	1984	Growth Rate (%)	
				1982/83	1983/84
Sugarcane	11,805,000	11,520,000	10,271,000	(2.4)	(10.8)
Coffee	126,984	136,054	144,218	7.1	6.0
Cacao	34,921	32,896	34,541	(5.8)	5.0
Tobacco	34,184	33,569	27,907	(1.8)	(16.9)
Rice (in husk)	446,913	500,543	507,377	12.0	1.4
Habichuela (red)	22,439	44,085	47,032	96.5	6.7
Cassava	69,461	93,855	118,957	35.1	26.7
Yautia	16,834	26,884	27,806	59.7	3.4
Tomate (industrial use)	86,793	124,349	98,817	43.3	(20.5)
Plantain a)	26,480	27,804	42,604	5.0	53.2
Banana b)	214,702	136,980	184,188	(36.2)	34.5
Sorghum	16,639	39,050	43,476	134.7	11.3
Peanut	34,162	33,480	38,748	(2.0)	15.7

a) In thousand

b) In bunch

Source: Resultados Agropecuarios 1984, SEA

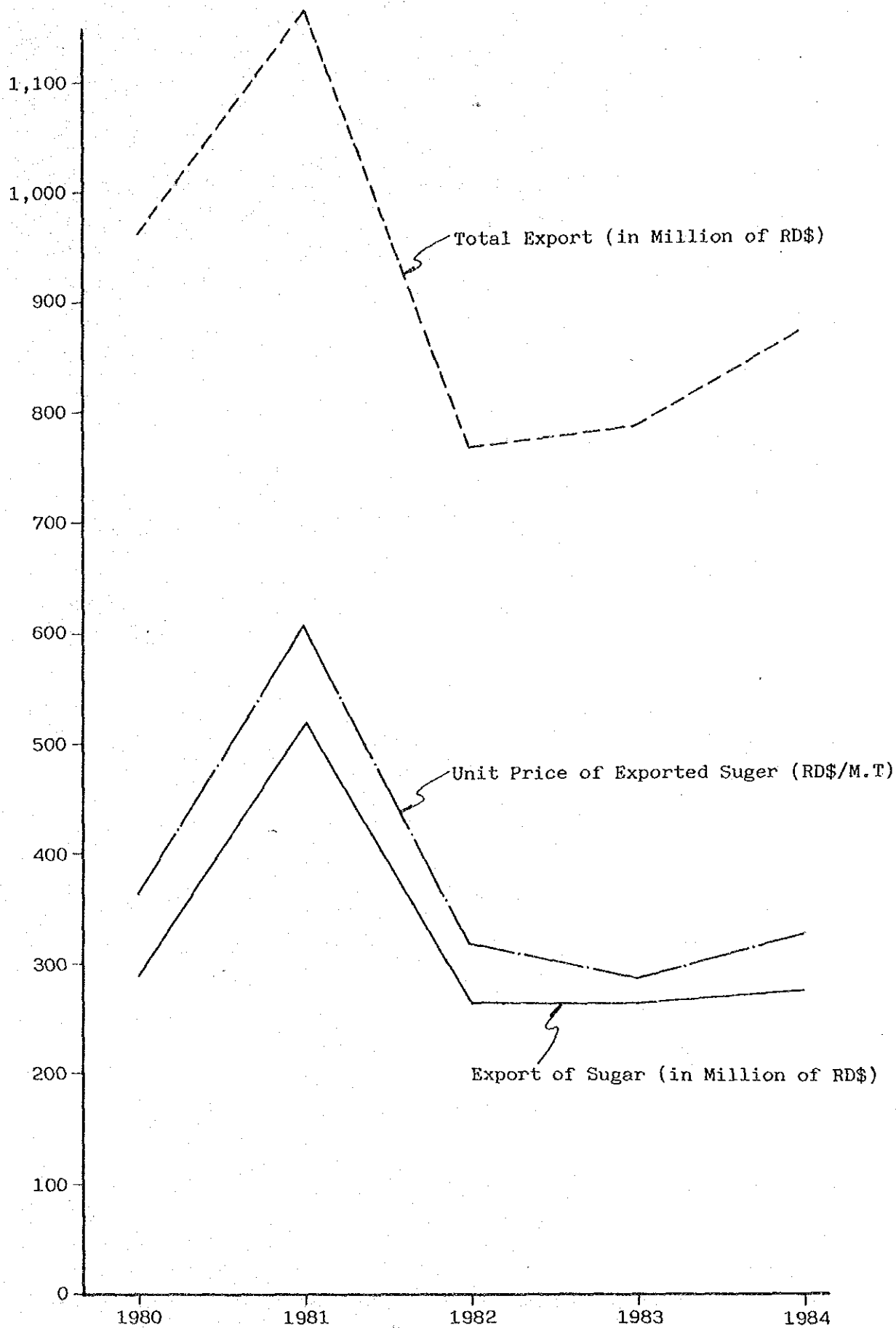


FIG. A.1.1 COMMODITIES AND SUGAR EXPORTS AND PRICE OF SUGAR IN THE INTERNATIONAL MARKET

2. Production and Consumption of Rice

TABLE A.2.1 BANK'S LOAN FORMULATION BY CROPS

Crops	1982		1983	
	Value (RD\$)	(%)	Value (RD\$)	(%)
A. Grains				
Rice	67,749,785	(62.4)	64,570,171	(54.9)
Corn	770,450	(0.7)	952,145	(0.8)
Sorghum	2,708,018	(2.5)	3,602,397	(3.1)
Sub-total	71,228,253	(65.6)	69,124,713	(58.8)
B. Small Fruits				
Plantain	1,846,963	(1.7)	2,775,997	(2.4)
Yautia	360,095	(0.3)	483,816	(0.4)
Cassava	735,013	(0.7)	1,260,515	(1.1)
Potato	862,887	(0.8)	618,356	(0.5)
Others	475,498	(0.4)	472,305	(0.4)
Sub-total	4,280,459	(3.9)	5,610,989	(4.8)
C. Exports				
Coffee	14,264,483	(13.1)	20,404,210	(17.3)
Cacao	1,974,970	(1.8)	4,706,131	(4.0)
Tobacco	4,346,109	(4.0)	5,374,256	(4.6)
Industrial				
Tomato	2,233,253	(2.1)	984,777	(0.8)
Others	957,984	(0.9)	833,095	(0.7)
Sub-total	23,776,799	(21.9)	32,302,469	(27.5)
D. Other Crops				
Kidney Bean	4,494,932	(4.1)	5,966,749	(5.1)
Onion	1,932,718	(1.8)	1,356,523	(1.2)
Garlic	1,026,297	(0.9)	612,209	(0.5)
Miscellaneous	1,771,753	(1.6)	2,684,950	(2.3)
Sub-total	19,225,700	(8.5)	10,620,431	(9.0)
Grand Total	108,511,211	(100)	117,620,602	(100)

Source: Banco Agrícola de la República Dominicana, Boletín Estadístico Año, 1983

3. Cibao Oriental Development Plan

3.1 Development Strategies by Sector

3.1.1 Global Level

- Transform farmlands into the core for activating the sub-regional economy by executing of actions and projects.
- Increase the production of export-oriented products such as, coffee, cacao, yautia, and tobacco by rendering technical assistance to farmers and renovating plantations already exhausted.
- Increase the value added for local products of the sub-region by promoting agro-industry.
- Promote to substitute imported products by producing these crops and developing agro-industry.
- Increase the exports earning by means of expanding mineral production, specially, gold, silver and marble.
- Accelerate and expand tourism development for the purpose of making more use of the natural resources existing in the sub-region.

3.1.2 Agricultural Sector

- Improve cropping techniques for domestic consumption products, such as rice, maize, cassava, bean, plantain, avocado, and vegetables.
- Improve cropping techniques for exports, such as coffee, banana, and yautia.
- Improve cropping techniques for processing crops, such as sorghum, ginger, tobacco, african palm, cacao, coconut, citrus, pineapple, mango, etc.
- Improve the productivity of crops with intensive program for technical assistance in fertilization of total farmland.

- Improve in-farm road network within the agrarian reform project areas.
- Expand credit services to farmers together with the enhancement of storage facilities for agricultural products.
- Reinforce the organization of SEA by means of expanding technical assistance services and increasing extension service staff.
- Reinforce the organization of IAD by means of expanding Regional Office and increasing technical staff stationed in the Office.

3.1.3 Water Resources

- Construct water regulation dams in some of principal rivers, like Chacuey, Alto Yuna, Nagua, Boba, Maguaca, and Payabo.
- Conserve various river basin, like Yuna (Hatillo) and Boba.
- Recuperate soils and irrigation in the Bajo Yuna.
- Rehabilitate and expand farmland in Cotui.
- Improve the irrigation system in areas under influence of the Rincon Dam.
- Construct irrigation canal network of the Boba River.

3.2 Proposed Investment Projects for the Yuna Delta Zone

Agriculture

- Rice production in the Yuna Delta (Limon del Yuna)
- Yautia production at Cristal in Northern Limon del Yuna
- Grapefruit production at Cristal in Limon del Yuna

Animal Husbandary

- Project for the production of pasture in inundating lands at Villa Riva

Forestry

- Project for reforestation of mangrove at the Yuna Delta

Mining

- Project for mining development on peat soils deposit in Samana
- Water supply to the principal villages and IAD's agrarian reform project area in Limon del Yuna and El Aguacate

Transport Infrastructures

- Construction of rural roads within the establishment of total transport network
- Study on railways system between Santo Domingo and Sanchez

Water Resources

- Soils and irrigation recuperation project in Lower Yuna River
- Payabo Dam Project

Education

- Alphabetization project for adults in rural areas

Public Health and Housing

- Public health centers improvement and equipment provision project
- Integrated project for the construction of living quarters and public health center by promoting self-construction by organized rural groups in Limon del Yuna and El Aguacate

ANNEX B: METEOROLOGY AND HYDROLOGY

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ANNEX B: METEOROLOGY AND HYDROLOGY

1. General

The study area is located in the lower basin of the Yuna River with elevation ranging from 0 to 10 m, and covered in a rainy zone within the Dominican Republic, where the mean annual rainfall varies from approximately 2,000 to 2,200 mm. The Yuna River is the second river in terms of scale in the country with catchment area of 5,660 km².

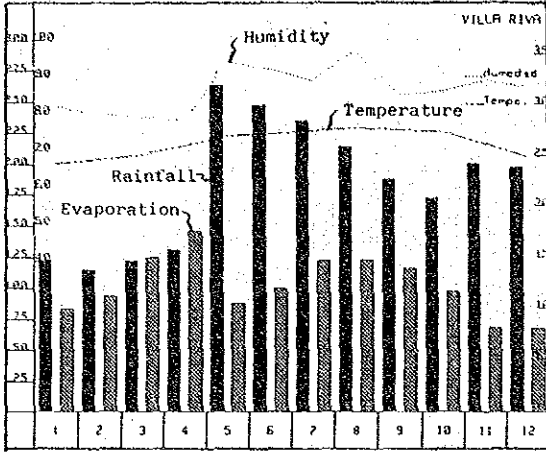
The greater portion of the study area is covered by plains characterized by poor drainage.

Generally, wettest period is in May and during November to December and driest period falls in February and March.

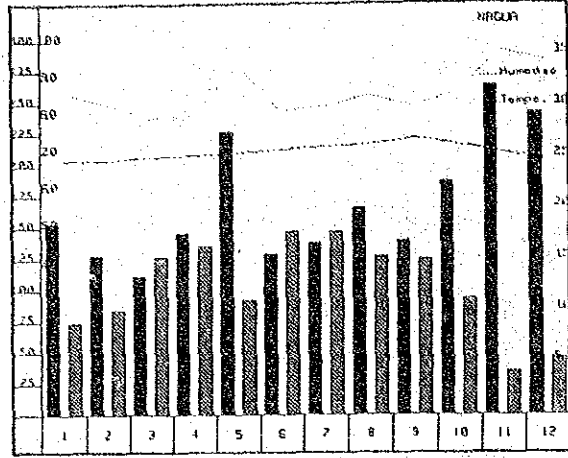
The mean temperature is 26.2°C; maximum temperature is observed during August - September and minimum in January.

In Fig. B.1.1, the climatological characteristics of the study area are shown.

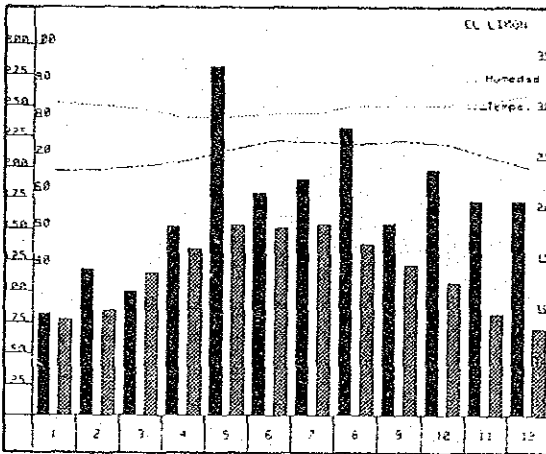
VILLA RIVA STATION



NAGUA STATION



BARRAQUITO STATION



SANCHEZ STATION

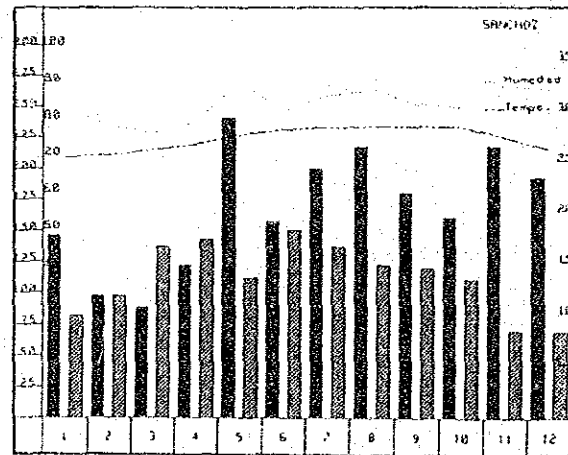


FIG. B.1.1 CLIMATOLOGICAL CHARACTERISTICS

2. Observating Stations

2.1 Climatological Stations

The existing climatological observing stations related to the study area are located at Sanchez, Villa Riva, Nagua and Barraquito and observe mainly rainfall.

In the course of the Phase I field works, rainfall observation stations installed at El Aguacate and at the confluence of the Guayabo River and the Yuna River, so as to obtain were installed.

The features of the existing and new stations are described below.

2.1.1 Existing Station

The Existing climatological stations related to the study area is shown in Table B.2.1.

TABLE B.2.1 CLIMATOLOGICAL STATIONS

Station	Distance (km)	Responsible Organization	Record Year	Available Data			
				DR	EP	HU	WD
Sanchez	0	Meteorological Agency	1939 -	o			o
Nagua	13	"	1943 -	o			o
Villa Riva	5	"	1939 -	o			o
Barraquito	7	INDRHI	1975 -	o	o	o	o

DR: Daily rainfall

EP: Evaporation

HU: Humidity

WD: Wind Direction

2.1.2 New Stations

The climatological station has been installed at the El Aguacate residential area, central part of the study area, and a pluviometer at the confluence of the Yuna River and the Guayabo River. It is expected that more reliable data will be obtained from these stations.

(1) El Aguacate Climatological Station

Commencement of the observation: September 1986

Observations realized : Hourly Rainfall
Evaporation
Temperature (Max. Min.)
Relative Humidity
Radiation
Wind Direction and Velocity

(2) Guayabo Pluvial Station

Commencement of the observation: September 1986

Observation realized : Hourly Rainfall

2.2 Hydrological Stations

The flow of the Yuna River is observed at many stations installed within its catchment area and the discharge of the River at any specific site is estimated after processing data collected from these stations. The stations connected with the study area are found at Villa Riva and at El Limon.

2.2.1 Existing Gauging Station with the Catchment Area of the Yuna River

The stations installed in the catchment area of the Yuna River are as shown in Fig. B.2.1; of these stations, one station installed at El Limon in 1969 is included within the study area. This station continues water level observation from the year of 1969, automatic water level observation from 1981 and monthly flow observation by means of current meter.

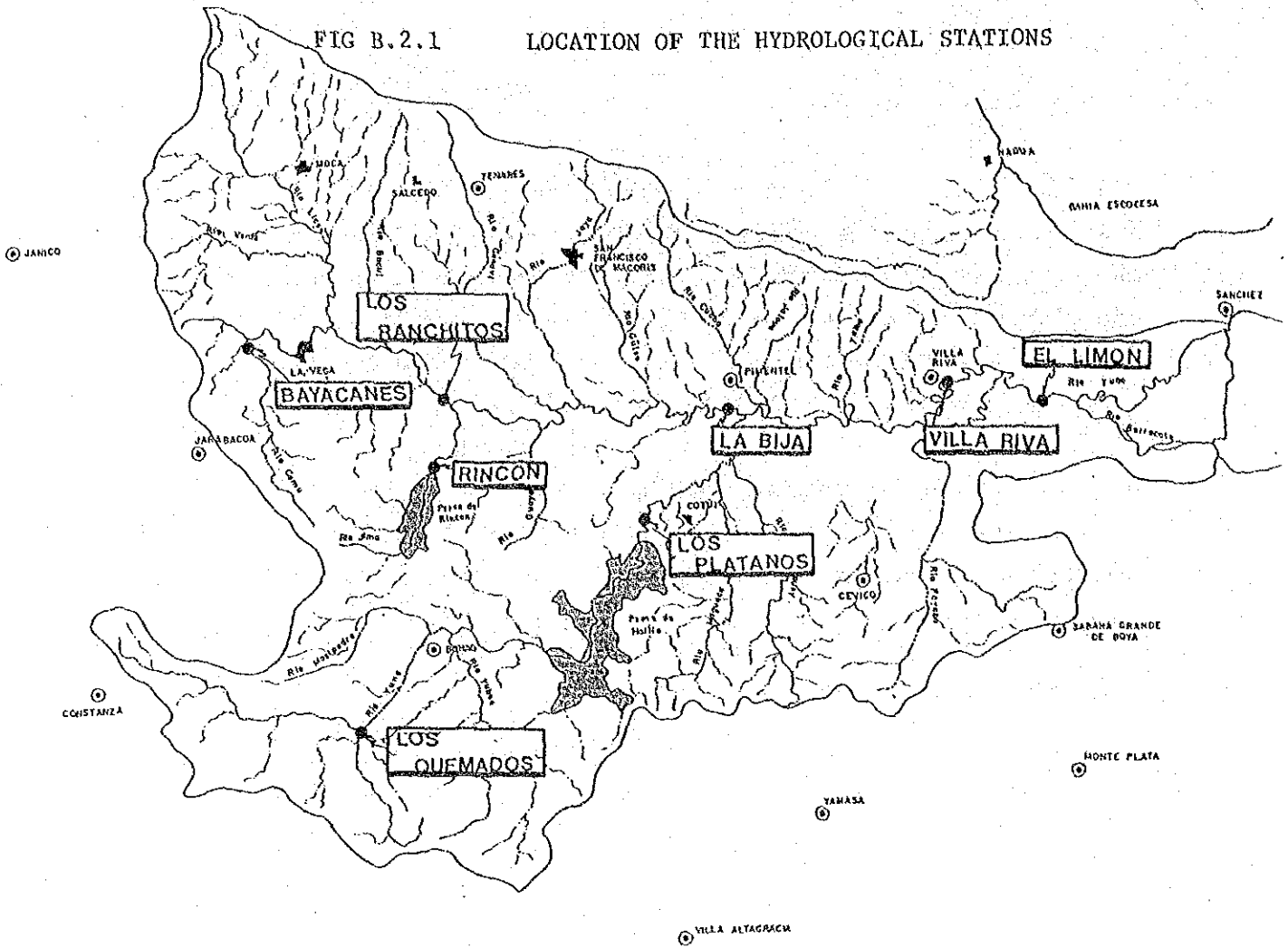
2.2.2 New Gauging Stations

The Yuna river is divided into its main course and the Barracote branched river at the Barracote Diversion Works, and greater portion of the flow goes to the Barracote branched river. Under the circumstances, the water level observation station has been installed at La Jagua so as to study the correlation of the discharge between the main course of the Yuna river and the Barracote branched river.

In addition to this station, the water level gauges have been installed at the confluence of the Yuna and the Guayabo Rivers, and upper stream of the Guayabo River so that the evaluation of the water level in the Guayabo River may be observed.

FIG B.2.1

LOCATION OF THE HYDROLOGICAL STATIONS

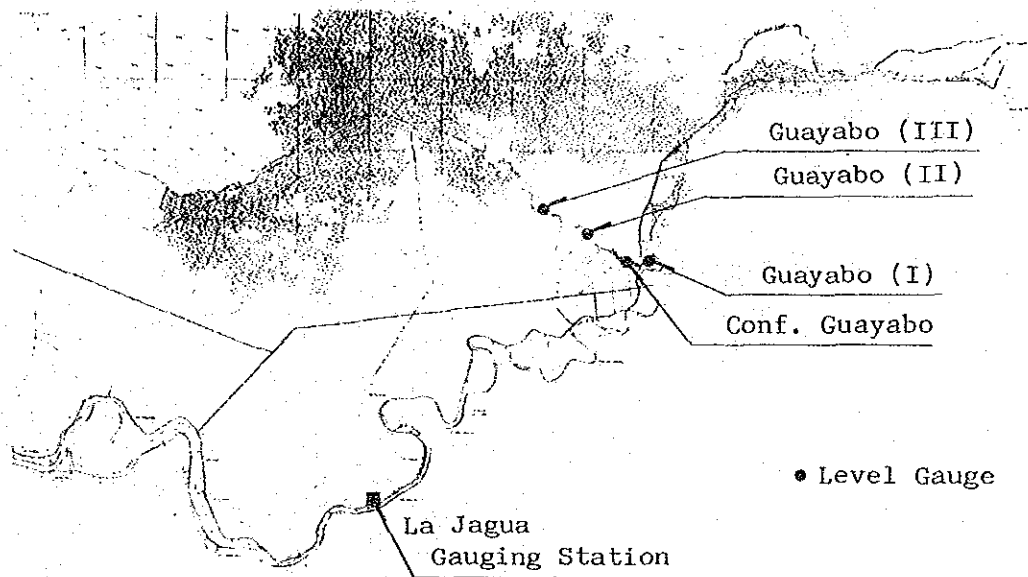


LIST OF OBSERVATION

No	Station	Cause	Catchment area (km ²)	Observation Time						
				55	60	65	70	75	80	
	BAYACANES	CAMU	143.0			██████████	██████████	██████████	██████████	
	LOS QUEMADOS	YUNA	338.0		██████████	██████████	██████████	██████████		
	RINCON	JIMA	159.0		██████████	██████████	██████████			
	LOS PLATANOS	YUNA	1167.0				██████████	██████████	██████████	
	LOS RANCHITOS	CAMU	1160.0				██████████	██████████	██████████	██████████
	LA BIJA	CAMU	2336.0				██████████	██████████	██████████	██████████
	VILLA RIVA	YUNA	4680.0	██████████	██████████	██████████	██████████	██████████	██████████	██████████
	EL LIMON	YUNA	5115.0				██████████	██████████	██████████	██████████

The location of new water level gauging stations are shown in Fig. B.2.2.

FIG. B.2.2 LOCATION OF THE INSTALLED WATER LEVEL OBSERVATION

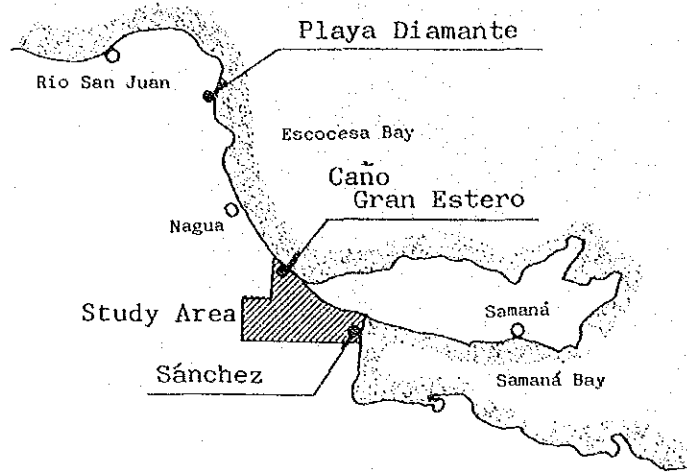


2.3 Tide Gauging Station

Data on the oceanology are obtained from at the tide gauging station installed at Playa El Diamante in which observatin has been made since 1981. New stations have been installed at the river mouth of the Caño Gran Estero and at the Sanchez Port for the purpose of studying tide level at different sites.

Location and feature of the tide gauging station are as follows:

FIG. B.2.3 LOCATION OF THE TIDE GAUGING STATION



Station	Playa El Diamante	Caño Gran Estero	Sánchez
Observation made since	Dec. 1980	Oct. 1985	Oct. 1985
Location	Playa El Diamante	River Mouth of the Cano Gran Estero	Port of Sánchez
Tide Level	Reading - 1.09m	Reading - 0.75m	Reading - 0.67m

3. Climate

3.1 Rainfall

The rainfall of the area is characterized by the localized distribution of rain influenced by the topographic factor.

The correlation of the daily rainfall between stations is relatively small.

Generally, the annual rainfall varies from 1,500 mm to 2,500 mm and the mean annual rainfall falls in the range of 2,000mm - 2,200 mm. The maximum annual rainfall was recorded to be 4,236 mm.

TABLE B.3.1 FEATURE OF RAINFALL

Station	Sánchez	Nagua	Villa Riva	Barraquito
No. of Data available	46	33	25	15
Observation Period	1931-1984	1949-1984	1953-1979	1969-1984
Mean Annual Rainfall (mm)	2,015.3	2,068.8	2,185.2	2,026.2
Minimum Annual Rainfall (mm)	1,232.0	1,010.1	926.2	1,562.1
Maximum Annual Rainfall (mm)	2,731.6	4,326.6	4,236.0	3,096.2
Distribution of Rainfall (%)				
0 - 500	-	-	-	-
500 - 1,000	-	-	4.0	-
1,000 - 1,500	15.4	18.2	4.0	-
1,500 - 2,000	32.6	30.3	40.0	46.6
2,000 - 2,500	37.0	36.4	28.0	46.6
2,500 - 3,000	13.0	3.0	4.0	-
3,000 - 3,500	-	9.1	16.0	6.8
3,500 -	-	3.0	4.0	-

TABLE B.3.2 ANNUAL RAINFALL AT MAIN STATION

Year	Sanchez	Nagua	Villa Riva	Barraquito
31	2,098.9	-		
32	1,888.5	-		
33	1,458.6	-		
34	1,556.9	-		
35	1,941.6	-		
36	1,814.6	-		
37	2,012.9	-		
38	1,283.7	-		
39	2,150.9	-	2,084.3	
40	2,277.8	-	2,105.2	
41	1,338.4	-		
42	-	-		
43	2,551.0	-		
44	1,700.1	-		
45	-	-		
46	-	-		
47	-	-		
48	-	-		
49	2,508.1	1,850.2		
50	2,412.6	2,422.2		
51	1,862.4	2,255.1		
52	2,398.8	2,310.8		
53	-	2,178.3		
54	2,444.0	3,146.0	2,468.0	
55	1,954.0	3,411.5	3,110.8	
56	2,484.1	04,326.6	3,277.0	
57	-	2,695.0	2,357.0	
58	2,382.2	2,409.9	2,992.1	
59	1,327.9	-	1,307.5	
60	2,354.0	2,297.7	2,375.6	
61	2,107.0	1,628.8	2,152.0	
62	2,296.2	1,418.0	1,740.7	
63	2,499.9	2,001.8	2,445.6	
64	1,843.9	1,636.0	1,882.3	
65	-	2,002.7	1,712.4	
66	2,566.8	2,068.2	1,718.2	
67	1,459.9	*1,101.0	*926.2	
68	2,413.8	1,768.0	1,764.5	
69	1,766.2	1,450.6	2,054.2	
70	2,779.2	2,148.8	04,236.0	
71	2,040.6	1,456.5	2,399.2	1,564.6
72	1,979.8	1,626.2	3,328.8	2,359.2
73	1,637.2	1,982.8	1,962.9	1,519.4
74	1,740.5	1,990.9	-	2,017.6
75	1,868.0	1,572.8	-	1,674.2
76	*1,232.0	1,125.3	1,500.3	2,115.6
77	1,738.6	1,540.4	1,929.4	*1,562.1
78	1,412.6	1,485.9	1,642.8	1,752.2
79	02,731.6	2,118.7	-	2,292.9
80	1,733.4	1,583.9	-	1,938.6
81	2,640.1	3,212.2	-	03,096.2
82	2,303.4	2,046.6	-	2,014.8
83	1,878.3	-	-	2,352.2
84	2,132.6	-	-	1,992.3
85	-	-	-	2,141.1
	2,015.3	2,068.8	2,185.2	2,026.2

*: Min. Annual Rainfall
o: Max. Annual Rainfall

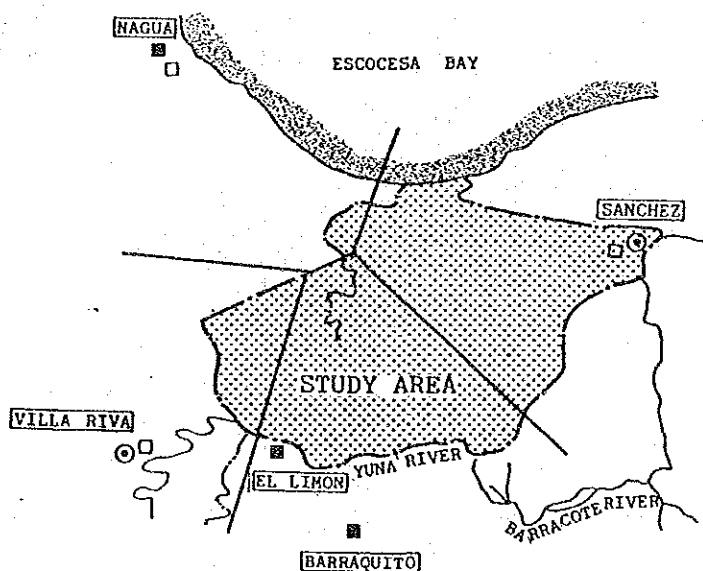
3.1.1 Division of the Area

The division of the area by the method of Thiessen is shown in Fig. B.3.1. Table B.3.3 represents the dominated area and its coefficient.

TABLE B.3.3 DOMINATED AREA AND COEFFICIENT

Station	Dominated Area (Km ²)	Coefficient (%)
Sanchez	9,559	39
Nagua	610	2
Villa Riva	2,600	11
Barraquito	11,730	48

FIG. B.3.1 DIVISION OF THE AREA BY THIESSEN METHOD



3.1.2 Maximum and Consecutive Daily Rainfall

The maximum daily rainfall and two day's and three day's consecutive rainfall at each station for the return period of 2, 5, 10, 30, 50 and 100 years are shown in Tables B.3.4, B.3.5 and B.3.6.

TABLE B.3.4 PROBABILITY OF MAXIMUM DAILY RAINFALL

Return Period	Sanchez	Nagua	Villa Riva	Barraquito	Study Area
2	107.2	112.8	95.7	96.5	101.1
5	151.3	164.9	124.8	136.7	141.6
10	179.0	198.7	142.9	227.9	198.9
30	219.4	248.8	169.0	258.4	233.2
50	237.6	271.6	180.7		
100	261.5	301.9			

TABLE B.3.5 PROBABILITY OF MAXIMUM CONSECUTIVE TWO DAY'S RAINFALL

Return Period	Sanchez	Nagua	Villa Riva	Barraquito	Study Area
2	136.6	134.3	118.4	116.0	124.6
5	206.7	201.6	161.8	169.2	183.7
10	257.9	248.3	193.9	212.1	228.7
30	341.9	321.6	247.2	288.1	305.3
50	382.9	356.4	273.4		
100	440.3	404.0			

TABLE B.3.6 PROBABILITY OF MAXIMUM CONSECUTIVE THREE DAY'S RAINFALL

Return Period	Sanchez	Nagua	Villa Riva	Barraquito	Study Area
2	157.5	153.5	124.8	133.2	142.2
5	229.7	229.2	173.1	190.1	204.5
10	279.1	281.4	208.4	236.7	251.0
30	355.9	362.7	266.2	320.3	329.1
50	392.0	401.1	294.5		
100	441.2	453.4			

TABLE B.3.7 MAXIMUM DAILY, TWO DAY'S AND THREE DAY'S CONSECUTIVE RAINFALL AT SANCHEZ

STATION: SANCHEZ

Date	Rainfall (mm)			Consecutive Rainfall (mm)			
	1 ^o	2 ^o	3 ^o	Daily	2 day	3 day	
31	12.5 - 7	6.8	48.8	76.2	125.0	130.8	
32	12.3 - 6	45.8	0.0	107.9	107.9	153.4	
33	6.27-29	11.7	3.3	82.5	85.8	97.5	
34	1.4 - 6	121.9	0.0	121.9	121.9	121.9	
35	12.5 - 7	352.0	73.2	4.8	352.0	425.2	450.0
36	5.17-19	129.3	18.5	12.4	129.3	147.8	160.2
37	5.25-27	44.7	176.0	61.2	176.0	237.2	281.9
38	11.8 -10	26.7	52.3	0.0	53.2	79.0	79.0
39	8.6 - 8	50.8	36.3	76.2	112.5	163.3	
	10.24-26	25.4	88.9	12.7	88.9		
40	1.25-27	127.0	1.0	127.0		255.0	
40	1.29- 1.31	25.4	25.4	174.9	174.9	200.3	
41	6.16-17	51.0	2.3	0.3	51.0	53.3	
	9.7 - 9	25.4	0.0	51.0		76.4	
42	7.10-12	51.0	35.4	22.9	86.4		
	10.12-14	52.0	0.0	86.0	86.0	138.0	
43	3.4 - 6	145.0	141.0	4.0	145.0	286.0	290.0
44	7.28-30	88.9	12.7	15.2	88.9	101.6	116.8
45	8.1 - 3	94.2	15.2	6.4	94.2	109.4	115.8
48	5.23-25	111.4	33.4	41.8	111.4	144.8	186.6
49	5.4 - 6	23.4	9.2	101.8	101.4	111.0	134.4
50	5.18-20	112.8	0.0	7.6	112.8	112.8	120.4
	12.21-23	65.2	92.6	3.2	92.6	157.8	161.0
51	11.21-23	10.0	86.2	107.0	107.0	193.2	203.2
52	1.30- 2.1	0.0	129.0	107.8	129.0	236.8	236.8
53	7.7 - 9	8.0	13.0	176.8	176.8	189.8	197.8
54	2.13-15	45.4	102.6	34.0	102.6	148.0	182.0
55	5.4 - 6	68.0	15.0	22.2	68.0	83.0	105.8
	9.11-13	3.0	9.0	74.2	74.2	83.2	86.2
56	2.3 - 5	8.0	152.6	66.0	152.6	218.6	226.6
57	11.14-16	194.2	204.2	49.1	204.2	398.2	447.5
58	5.4 - 6	144.1	5.3	49.0	144.1	149.4	168.4
59	9.19-21	11.0	56.8	10.4	56.8	76.8	78.2
60	9.5 - 7	10.4	122.4	0.0	122.4	132.8	132.8
61	12.3 - 5	27.2	88.2	4.2	88.2	115.4	119.6
62	12.13-15	16.4	102.8	50.2	102.8	153.0	169.4
63	4.14-16	45.2	102.8	10.8	102.8	148.0	158.8
64	3.31- 4.2	57.1	59.1	75.2	75.2	134.3	191.4
65	5.26-28	5.2	58.8	93.2	93.2	152.0	157.2
66	11.18-20	21.6	100.2	18.2	100.2	121.8	140.0
67	6.25-27	43.1	48.8	0.0	48.8	91.9	
	8.21-23	48.1	2.2	41.8		92.1	
68	12.8 -10	1.8	152.1	135.1	152.1	287.2	289.0
69	5.6 - 8	30.4	29.2	69.8	69.8	99.0	129.4

TABLE B.3.7 (Cont'd)

STATION: SANCHEZ

Date	Rainfall (mm)			Consecutive Rainfall (mm)		
	1 ^o	2 ^o	3 ^o	Daily	2 day	3 day
70 11.6 - 8	194.0	64.0	60.0	194.0		318.0
11.24-26	48.0	115.0	152.0		267.0	
71 7.27-29	89.4	0.0	89.4			
	57.6	47.2	48.2		104.8	153.0
72 5.8 -10	71.0	0.0	0.0	71.0		
4.26-28	62.4	26.8	13.2		89.2	102.4
73 4.17-19	151.4	45.0	11.2	151.4	196.4	207.6
74 10.4 - 6	12.8	158.0	6.8	158.0	170.8	177.6
75 9.15-17	22.2	6.2	110.2	110.2	116.4	138.6
76 5.12-14	77.0	0.0	0.0	77.0	77.0	77.0
77 4.15-17	23.4	40.4	11.6	40.4		
11.22-24	38.0	35.2	14.8		73.2	88.0
78 1.29-31	35.6	10.4	0.0		46.0	46.0
8.17-19	42.2	0.0	0.0	42.2		
79 8.30- 9.1	34.4	195.0	21.4	195.0	229.4	250.8
80 12.5 - 7	152.2	102.2	8.5	152.2	254.4	262.9
81 6.2 - 4	30.9	95.1	9.1	95.1	126.0	135.1
9.7 - 9	5.0	111.7	0.5	111.7	116.7	117.2
82 5.9 -11	77.8	5.7	22.3	77.8	83.5	105.8
8.8 -10	76.0	38.1	11.4	76.0	114.1	125.5
83 1.13-15	143.2	81.1	0.2	143.2	224.3	224.5
84 6.4 - 6	40.2	103.1	30.4	103.1	143.3	173.7

TABLE B.3.8 MAXIMUM DAILY, TWO DAY'S AND THREE DAY'S CONSECUTIVE RAINFALL AT NAGUA

STATION: NAGUA

Date	Rainfall (mm)			Consecutive Rainfall (mm)			
	1 ^o	2 ^o	3 ^o	1 day	2 day	3 day	
43	5.4 - 6	55.5	11.0	35.0	55.0	66.0	101.0
44	4.30- 5.2	113.0	0	3.0	113.0	113.0	116.0
49	12.3 - 5	190.0	8.0	18.0	190.0	198.0	216.0
50	5.28-30	109.0	6.0	0.0	109.0	115.0	115.0
51	11.21-23	173.4	159.0	79.0	173.4	332.4	411.4
52	1.31- 2.2	181.0	20.0	0.0	181.0	201.0	201.0
53	5.27-29	7.0	20.0	97.0	97.0	117.0	124.0
54	5.9 -11	379.0	0.0	0.0	379.0	379.0	379.0
55	4.19-21	21.3	132.0	0.0	132.0	153.3	153.3
56	11.13-15	53.2	169.0	33.5	169.0	222.2	268.5
	3.28-31	58.1					
57	11.6 - 8	62.5	38.1	155.4	155.4	193.5	256.0
58	3.22-25	17.1	58.5	116.3	116.3	174.8	191.9
59	1.12-14	49.3	19.2	10.2	49.3	63.1	73.3
60	3.5 - 7	23.2	219.3	9.2	219.3	242.5	251.2
61	11.29-12.1	26.3	132.3	138.2	138.2	270.5	296.8
62	11.25-27	85.2	0	0	85.2	85.2	85.2
63	5.14-16	149.3	0	0	149.3	149.3	149.3
64	8.26-28	16.2	0	119.2	119.2	119.2	135.4
65	12.7 - 9	0	28.4	114.6	114.6	143.0	143.0
	5.2 - 4	86.4	62.2	47.6		148.6	196.2
66	3.26-28	16.2	4.2	117.4	117.4	168.2	208.6
	11.18-20	69.8	98.4	40.4			
67	10.27-29	52.0	0	2	52.0	52.0	54.0
68	11.14-16	126.0	28.0	82.0	126.0	154.0	236.0
69	5.8 - 9	40.8	42.4	52.6	52.6	95.0	135.8
70	10.18-20	68.2	11.4	45.0	68.2	72.2	117.2
71	12.17-19	9.6	69.4	11.4	69.4	80.8	90.4
72	6.14-16	9.6	4.2	104.8	104.8	109.0	116.6
73	11.11-13	12.2	176.0	16.8	176.0	192.8	204.4
74	12.3 - 5	63.4	110.2	82.0	110.2	192.2	255.6
75	11.17-19	58.8	22.2	13.6	58.8	81.0	94.6
76	10.9 -11	7.2	3.0	47.2	47.2	50.2	57.4
77	4.16-18	174.8	17.6	49.2	174.8	192.4	241.6
78	5.12-14	97.2	0	0	97.2	97.2	97.2
79	2.12-14	9.4	85.8	11.0	85.8	96.8	106.2
80	12.5 - 7	80.8	57.6	20.3	90.8	148.4	168.7
81	4.27-29	186.6	24.2	30.5	186.6	210.8	241.3
82	5.1 -13	75.8	31.3	14.8	75.8	27.1	138.4
83	3.18-20	75.0	3.4	0	75.0	78.4	780.4

TABLE B.3.9 MAXIMUM DAILY, TWO DAY'S AND THREE DAY'S CONSECUTIVE RAINFALL AT VILLA RIVA

STATION: VILLA RIVA

Date		Rainfall (mm)			Consecutive Rainfall (mm)		
		1°	2°	3°	1 day	2 day	3 day
39	10•24~26	76.2	38.1	50.8	76.2	114.3	165.1
40	1•31~2•2	102.0	51.0	0.0	102.0	153.0	153.0
52	6•22~24	76.8	25.0	0.0	76.8	101.8	101.8
53	5•26~28	50.0	25.0	142.0	142.0	167.0	217.0
54	2•13~15	45.0	65.0	110.6	110.6	175.6	220.6
56	4• 1~ 3	115.8	10.4	0.0	115.8	126.2	126.2
57	6•16~18	105.0	14.0	0.0	105.0	119.0	119.0
58	7• 6~ 8	25.0	6.0	90.0	90.2	96.2	121.2
59	5•16~18	30.0	91.7	30.8	91.7	122.5	152.5
60	11•29~12•1	68.0	35.0	0.0	68.0	103.0	103.0
61	11•30~12•2	108.0	19.0	0.0	108.0	127.0	127.0
62	5• 8~10	4.2	0.0	96.0	96.0	96.0	96.0
63	3•23~25	125.0	195.0	52.3	195.0	320.0	320.0
64	4• 1~ 3	17.8	100.4	6.0	100.4	118.2	118.2
65	9•30~10•2	120.0	12.0	0.0	120.0	132.0	132.0
66	3•26~28	42.0	32.0	71.0	71.0	103.0	103.0
67	5•20~22	100.0	10.0	12.0	100.0	110.0	110.0
68	12• 9~11	29.8	139.0	32.4	139.0	171.4	171.4
69	5•25~27	14.2	15.2	78.4	78.4	93.6	93.6
70	5•25~27	137.5	0.0	58.6	137.5	137.5	137.5
71	5• 9~11	49.2	86.4	54.2	86.4	140.6	140.6
72	2•18~20	18.2	60.2	160.0	160.0	220.2	220.2
73	6•14~16	49.8	49.4	1.0	49.8	99.2	99.2
74	4•25~27	37.6	82.2	12.2	82.2	119.8	119.8
76	4•21~23	80.2	0	0	80.2	80.2	80.2
77	11•21~23	12.4	56.4	37.4	56.4	93.8	93.8
78	3•21~14	59.2	0	0	59.2	59.2	59.2

TABLE B.3.10 MAXIMUM DAILY, TWO DAY'S AND THREE DAY'S CONSECUTIVE RAINFALL AT BARRAQUITO

Station; BARRAQUITO

Date	Rainfall (mm)			Consecutive Rainfall (mm)		
	1 ^o	2 ^o	3 ^o	1 day	2 day	3 day
69 6.16-	49.4	52.2	17.2		101.6	118.8
10.7 -	90.0	11.0	13.0	90.0		
70 10.6 -	4.2	69.1	191.7	191.7	260.8	265.0
71 2.17-	56.5	19.2	39.1		75.7	114.8
4.24-	0.2	64.3	0.0	64.3		
72 6.14-	8.4	54.0	62.9			125.3
8.7 -	101.2	5.4	0.0	101.2	106.6	
73 8.24-	65.8	3.0	41.0	65.8	68.8	109.8
74 2.26-	15.8	107.4	34.1	107.4	141.5	157.3
75 5.13-	5.8	34.6	80.5	80.5	115.1	120.9
76 4.20-	0.0	128.0	0.0	128.0	128.0	128.0
77 4.20-	112.2	34.2	29.6	112.2	146.4	
12.28-	93.2	44.2	75.2			212.6
78 4.19-	93.3	30.0	0.0	93.3	123.3	123.3
79 8.29-	0.8	22.8	281.4	281.4	304.2	305.0
80 5.22-	27.4	0.0	97.3	97.3	97.3	124.7
81 1.30-	1.8	75.9	89.5		165.4	167.2
12.2 -	21.2	92.4	8.0	92.4		
82 5.9 -	71.6	5.3	48.4	71.6		125.3
5.14-	10.2	44.1	50.9		95.0	
83 11.16-	0.0	127.2	0.0	127.2	127.2	127.2
84 3.22-	3.8	70.9	0	70.9	74.7	74.7

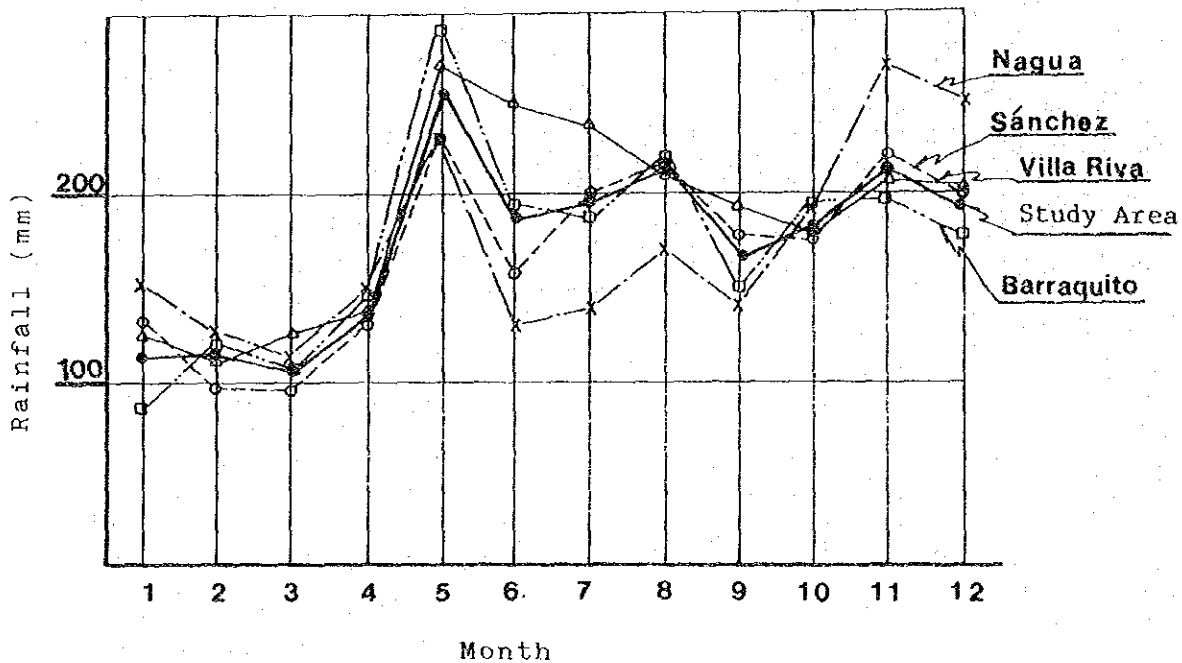
3.1.3 Mean Monthly Rainfall

The mean monthly rainfall within the study area is as follows:

TABLE B.3.11 MEAN MONTHLY RAINFALL

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Sanchez	132.5	97.9	94.3	128.4	228.6	156.3	197.5	211.2	175.5	171.2	218.3	195.4	2007.1
Nagua	154.1	128.6	111.6	145.8	228.0	129.0	138.3	166.1	139.4	187.0	263.4	242.2	2038.5
Villa Riva	122.3	115.3	121.9	130.9	263.2	247.5	234.3	214.6	187.8	173.2	201.1	197.9	2210.5
Barraquito	81.2	118.9	103.3	143.0	281.3	192.5	182.7	215.1	142.9	187.5	190.9	177.0	2016.3
Mean	107.2	110.5	102.0	136.0	257.7	183.1	193.3	212.5	160.5	179.6	204.2	187.8	2034.4

FIG. B.3.2 MEAN MONTHLY RAINFALL



The driest period is during January to March and the wettest period is in May. From June on, the monthly rainfall is almost in the same level ranging between 160 mm and 210 mm.

TABLE B.3.12 MONTHLY RAINFALL AT SANCHEZ

STATION: SANCHEZ

(mm)

Year	Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1931		116.2	84.2	163.6	170.1	225.7	274.3	68.6	148.3	209.3	116.1	293.9	228.6	2,098.9
32		106.0	59.5	39.6	124.7	310.2	95.5	102.1	145.5	249.1	94.2	323.1	239.0	1,888.5
33		73.0	5.8	183.1	36.9	156.0	167.0	179.4	145.5	182.3	40.0	151.2	138.4	1,458.6
34		197.6	112.7	22.4	20.3	249.0	80.6	96.6	218.0	154.5	124.0	98.9	182.3	1,556.9
35		45.0	47.8	25.7	38.6	128.4	49.5	124.1	234.5	200.7	336.2	104.8	606.3	1,941.6
36		97.8	58.8	12.9	28.0	413.5	28.0	263.5	272.9	175.7	96.9	131.4	235.2	1,814.6
37		400.0	8.9	6.9	100.9	534.9	16.0	82.9	276.8	60.6	17.4	241.4	266.2	2,012.9
38		56.3	27.7	4.2	3.8	25.8	103.4	270.5	150.1	122.3	103.8	277.8	138.0	1,283.7
39		92.1	94.1	110.4	97.1	258.6	203.2	105.0	254.2	119.9	266.6	311.0	238.7	2,150.9
40		509.7	32.91	99.1	261.7	121.7	108.5	202.2	30.1	135.3	143.7	108.4	228.3	2,277.8
41		16.0	5.0	10.2	133.3	209.6	155.1	74.4	241.6	169.2	147.6	78.3	98.1	1,338.4
42		266.8	71.2	46.6	75.7	98.7	-	211.7	174.1	65.8	296.0	108.0	158.0	-
43		312.0	286.0	197.9	328.8	279.7	149.1	204.6	176.5	239.5	145.4	113.8	117.7	2,551.0
44		42.4	51.6	24.9	155.9	159.6	236.2	152.6	161.5	215.1	209.5	177.2	113.6	1,700.1
45		67.4	56.1	56.9	29.8	167.7	157.2	190.1	2461.	201.5	90.4	236.8	-	-
46		-	-	-	-	-	-	-	-	-	-	-	-	-
47		-	-	-	-	-	-	-	-	-	-	-	-	-
48		-	71.8	38.8	19.2	369.0	156.2	449.6	206.7	127.6	253.0	174.4	145.4	-
49		88.0	45.8	137.6	43.4	363.0	166.4	287.0	412.5	128.0	176.6	123.8	536.0	2,508.1
50		159.8	161.2	92.8	57.0	341.4	102.4	268.6	229.4	108.6	148.4	414.2	328.8	2,412.6
51		146.8	37.0	20.2	127.0	245.8	146.8	242.0	100.0	283.6	85.0	336.4	91.8	1,862.4
52		220.8	127.6	58.8	381.4	196.8	130.8	311.0	142.6	308.8	220.4	207.6	92.2	2,398.8
53		254.4	49.2	159.6	40.4	193.0	325.8	444.0	151.6	341.2	159.7	244.4	-	-
54		131.6	365.8	45.0	185.4	281.6	328.4	192.0	192.0	233.4	168.6	144.8	175.4	2,440.0
55		91.8	129.2	50.6	101.6	276.6	176.6	177.0	159.6	291.4	139.8	148.4	211.4	1,954.0
56		40.8	414.6	453.0	184.9	208.2	173.2	143.2	231.4	84.2	212.2	99.6	238.8	2,484.1
57		47.0	62.2	32.2	104.0	75.4	172.0	235.0	-	186.7	121.0	732.1	137.3	-
58		240.5	52.0	55.9	37.9	521.8	471.2	279.7	86.9	186.7	226.2	164.4	59.0	2,382.2
59		69.5	24.3	16.1	122.0	141.0	55.0	171.2	226.8	171.2	135.6	147.8	47.4	1,327.9
60		165.0	125.6	125.6	203.8	153.4	132.2	277.4	216.3	203.4	266.2	257.9	227.2	2,354.0

TABLE B.3.12. MONTHLY RAINFALL AT SANCHEZ

STATION: SANCHEZ

(mm.)

Year	Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
61		65.0	72.6	164.0	114.8	112.2	202.4	172.4	304.4	148.6	183.6	309.6	258.4	2,107.0
62		141.2	26.6	140.2	197.8	209.4	211.6	244.0	502.4	109.8	113.8	98.0	301.4	2,296.2
63		202.6	70.6	185.8	307.2	304.2	127.2	258.2	239.4	271.5	284.4	172.6	76.2	2,499.9
64		75.0	99.8	110.3	314.9	118.8	189.6	98.3	211.9	130.0	182.3	134.8	178.2	1,843.9
65		60.4	30.0	88.9	75.8	499.7	89.2	-	-	-	-	202.0	223.2	-
66		256.2	53.8	189.8	111.2	340.2	135.2	164.2	355.4	179.4	142.8	440.4	198.2	2,566.8
67		107.4	133.8	79.6	66.2	97.7	169.1	188.0	222.9	115.4	132.0	108.6	39.2	1,459.9
68		201.0	53.8	99.8	51.8	143.6	288.2	287.8	194.0	74.6	171.0	352.2	396.0	2,413.8
69		106.4	84.0	24.8	100.8	396.2	123.4	113.8	201.4	149.8	160.4	175.6	129.6	1,766.2
70		87.9	173.0	40.0	49.2	265.2	157.4	183.6	270.0	251.6	439.8	709.4	152.1	2,779.2
71		80.0	142.0	98.0	265.4	227.0	96.8	586.6	218.2	111.6	145.8	97.6	171.6	2,040.6
72		38.9	133.0	203.8	165.3	136.4	93.2	239.4	137.8	267.8	157.6	180.2	226.4	1,979.8
73		106.4	127.2	149.2	246.4	44.6	152.4	116.6	188.3	186.4	173.2	145.8	202.7	1,837.2
74		120.8	142.2	83.8	95.0	132.4	226.0	138.0	151.6	177.4	382.0	139.1	152.2	1,940.5
75		56.9	32.6	54.9	7.0	166.4	44.4	154.4	133.0	315.6	144.8	521.8	236.2	1,868.0
76		70.0	132.4	51.8	80.4	204.2	177.6	85.0	109.0	139.0	182.6	0	0	1,232.0
77		43.0	42.6	26.6	202.8	161.4	62.4	282.8	265.7	173.8	79.4	234.1	164.0	1,738.6
78		89.2	84.2	156.6	120.6	166.8	135.8	135.2	186.2	93.2	73.4	102.3	69.1	1,412.6
79		85.2	69.2	126.6	301.3	454.8	209.7	228.4	387.0	216.2	186.9	332.0	134.3	2,731.6
80		124.7	50.2	187.0	118.6	100.1	107.8	137.1	172.2	138.2	128.5	90.2	378.3	1,733.4
81		235.8	130.3	257.9	214.4	389.3	268.3	252.1	151.9	305.3	156.8	159.7	118.1	2,640.1
82		175.5	181.6	66.6	66.9	486.0	146.2	187.7	306.8	95.0	141.3	239.5	210.3	2,303.4
83		261.1	56.3	68.3	129.2	276.0	171.6	167.3	242.0	186.8	146.3	66.3	107.1	1,878.3
84		77.6	163.7	70.6	35.5	336.0	326.7	261.7	80.0	61.9	297.8	300.5	120.8	2,132.6

TABLE B.3.13 MONTHLY RAINFALL AT NAGUA

Station: Nagua

(Unit: mm)

Month Year	1	2	3	4	5	6	7	8	9	10	11	12	T
1943	-	-	-	169.0	176.0	88.0	81.0	106.0	94.0	130.0	137.0	134.0	-
1944	38.0	15.0	143.0	165.0	87.0	172.0	90.0	142.0	169.0	169.0	196.0	-	-
1949	113.5	82.7	171.8	14.1	241.1	133.2	90.2	103.5	184.5	124.2	132.5	459.0	1850.3
1950	302.3	299.7	95.0	100.0	171.0	109.0	210.0	253.2	135.5	106.5	353.7	286.3	2422.2
1951	110.6	33.0	25.0	65.3	296.4	182.0	175.0	118.0	207.8	120.0	657.7	282.3	2255.1
1952	225.0	59.3	59.0	489.4	198.0	135.0	376.7	126.3	242.7	114.5	175.6	109.3	2310.8
1953	178.6	24.0	133.4	0.0	298.9	243.7	220.8	108.7	162.6	257.9	367.9	181.8	2178.3
1954	217.2	494.9	24.0	200.0	507.0	130.1	194.0	262.3	181.2	313.5	182.9	438.9	3146.0
1955	272.9	384.9	57.2	261.1	312.6	194.7	291.8	505.9	343.1	264.2	209.2	313.9	3411.5
1956	231.1	542.4	505.2	74.1	344.1	336.4	244.5	488.4	91.2	256.7	499.2	713.3	4326.6
1957	355.9	296.6	56.0	69.1	41.9	241.5	93.9	125.9	148.3	232.3	600.9	433.5	2695.8
1958	196.9	136.0	228.3	81.0	480.0	384.6	189.7	95.8	146.8	165.1	243.4	62.3	2409.9
1959	200.0	101.4	13.2	94.5	204.6	27.0	123.9	193.8	117.6	-	177.8	118.3	-
1960	316.4	147.0	329.1	250.8	227.0	139.9	82.1	193.7	26.2	162.7	244.5	178.3	2297.7
1961	104.4	36.5	67.9	83.9	123.4	83.9	81.7	183.2	37.4	205.6	336.3	284.6	1628.8
1962	72.4	8.4	68.6	71.7	192.2	151.5	67.6	240.4	123.6	132.2	125.7	163.9	1418.0
1963	43.0	34.6	128.4	328.5	260.3	164.7	255.3	67.1	181.6	222.3	143.2	172.8	2001.8
1964	137.6	73.5	19.3	236.9	192.8	122.4	99.8	245.4	119.3	75.6	184.9	128.5	1636.0
1965	70.6	23.1	102.6	39.4	506.0	148.0	40.4	179.2	170.4	97.8	279.6	345.6	2002.7
1966	233.0	30.8	185.2	192.8	194.6	55.6	99.6	94.5	96.4	194.4	476.1	215.2	2068.2
1967	158.8	120.4	31.8	20.4	27.4	58.0	152.4	109.8	152.0	105.0	134.0	31.0	1101.0
1968	200.0	72.0	99.0	40.0	185.0	12.0	136.0	143.0	94.0	19.0	413.0	355.0	1768.0
1969	43.0	19.0	20.0	69.2	287.4	102.9	90.0	110.3	197.4	230.8	183.8	96.8	1450.6
1970	93.6	164.8	4.8	4.2	277.0	107.5	125.7	259.4	171.4	339.8	340.4	260.2	2148.8
1971	184.4	45.6	19.1	191.0	83.2	42.0	113.4	75.1	53.0	121.0	211.3	317.4	1456.5
1972	77.0	101.5	124.6	118.2	93.6	153.0	74.4	129.9	135.2	221.2	188.0	209.6	1626.2
1973	78.4	218.0	174.2	93.0	13.6	110.2	110.6	65.6	168.4	332.8	345.0	273.0	1982.8
1974	231.3	132.6	210.8	153.2	106.6	27.8	40.0	122.3	124.0	302.8	167.7	371.8	1990.9
1975	66.4	34.2	30.0	12.0	126.4	33.0	56.2	157.4	178.2	249.4	418.4	211.2	1572.8
1976	94.0	143.6	50.0	90.2	63.4	79.6	75.0	81.8	81.8	208.1	88.6	69.2	1125.3
1977	65.0	49.2	14.4	339.6	191.2	35.4	90.4	133.0	36.2	104.0	323.4	156.6	1540.4
1978	69.4	84.0	118.6	184.2	210.3	84.0	67.6	66.2	165.6	116.4	161.6	158.0	1485.9

TABLE B.3.13 (Cont'd)

STATION: NAGUA

Unit: mm

Year	Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
1979		50.4	132.8	102.2	249.7	308.8	159.6	142.0	132.0	124.4	150.0	455.5	111.3	2,118.
1980		139.8	37.6	141.0	67.9	241.7	60.2	125.2	155.8	119.8	137.8	57.7	299.4	1,583.
1981		228.4	188.8	217.8	455.9	397.2	190.9	158.0	363.9	121.0	308.2	262.3	319.8	3,212.
1982		172.8	132.0	51.8	74.4	411.0	132.5	281.1	92.6	139.0	178.6	166.9	213.9	2,046.
Average		150.6	126.6	107.7	135.9	213.8	126.7	132.6	164.2	141.2	182.7	277.4	238.8	1,998.
1983		175.8	130.7	195.1	244.6	356.4	141.8	170.7	114.1	117.2	264.1	102.8	-	2,013.
Average		153.4	124.4	141.6	218.5	343.0	137.0	175.4						

TABLE B.3.14 MONTHLY RAINFALL AT VILLA RIVA

STATION: VILLA RIVA

(Unit: mm)

Month Year	1	2	3	4	5	6	7	8	9	10	11	12	T
1939	173.0	47.7	93.5	110.1	285.8	279.6	142.9	77.4	78.8	281.4	355.5	158.6	2084.3
1940	201.2	82.0	2.5	77.9	461.1	147.1	232.2	79.9	45.7	271.8	173.8	330.0	2105.2
1952	-	-	-	-	-	269.2	294.2	134.8	140.6	125.2	96.2	110.8	-
1953	305.8	42.4	113.8	39.4	386.2	231.2	297.0	295.6	176.8	93.2	174.0	312.6	2468.0
1954	183.4	444.0	87.0	260.6	260.4	504.2	356.4	203.6	247.4	163.4	184.6	215.8	3110.8
1955	-	-	-	-	-	-	-	-	-	-	-	-	-
1956	170.3	264.6	465.0	206.4	354.2	384.8	267.8	336.5	139.4	292.6	65.8	329.6	3277.0
1957	148.0	194.4	29.2	75.6	156.2	437.0	198.2	167.8	265.8	264.2	251.6	169.0	2357.0
1958	187.6	41.2	61.0	84.6	392.2	396.6	349.9	155.6	106.2	186.4	176.8	54.0	2992.1
1959	91.0	35.8	8.4	78.2	375.7	62.8	161.3	100.8	101.8	147.2	77.8	66.7	1307.5
1960	97.1	84.9	33.2	208.0	117.3	180.4	128.6	197.8	124.9	117.8	352.2	133.4	1775.6
1961	27.5	98.2	135.1	120.4	158.6	294.7	782.2	243.6	153.1	207.8	333.4	97.4	2152.0
1962	136.6	15.2	94.0	158.4	259.4	313.8	81.0	166.8	157.2	33.2	187.5	137.6	1740.7
1963	84.1	18.1	512.1	114.6	263.5	221.1	252.6	115.1	358.2	241.4	230.4	35.3	2445.6
1964	90.4	25.0	60.8	253.0	37.4	223.2	115.0	377.4	209.3	135.0	189.8	166.0	1882.3
1965	82.0	21.0	24.4	0.0	287.0	124.0	128.0	202.0	352.0	59.0	207.0	226.0	1712.4
1966	58.0	50.5	349.0	44.0	252.4	76.4	225.3	123.5	97.3	80.0	192.2	169.6	1718.2
1967	72.2	83.6	43.6	26.0	159.6	79.4	104.6	124.0	86.2	178.2	51.0	17.8	926.2
1968	113.1	57.8	34.6	31.2	139.4	249.5	137.4	158.2	92.6	72.7	348.4	329.6	1764.5
1969	57.2	22.6	52.6	54.0	306.0	342.6	266.8	295.4	160.8	183.8	174.0	138.4	2054.2
1970	84.4	326.6	144.2	40.2	457.7	274.2	446.5	445.6	394.3	742.9	419.7	459.7	4236.0
1971	69.3	231.0	188.5	370.8	302.7	265.6	223.1	419.5	399.6	86.9	107.9	444.3	3299.2
1972	154.0	231.5	275.2	167.8	194.2	363.7	424.6	351.6	317.2	229.4	259.0	360.7	3328.8
1973	249.2	200.7	126.6	120.2	19.4	331.8	62.2	242.0	226.6	64.2	156.6	163.4	1962.9
1974	142.2	-	54.3	179.4	249.8	250.6	81.6	233.6	221.4	186.4	193.2	176.6	-
1976	73.0	186.5	71.0	127.2	194.4	150.0	120.6	125.6	107.0	150.0	99.8	95.2	1500.3
1977	45.2	32.8	19.2	196.0	230.8	114.8	178.2	254.8	193.2	103.6	241.6	319.2	1929.4
1978	65.6	57.4	118.4	174.2	306.4	172.2	131.0	165.2	117.8	78.8	128.6	127.2	1642.8
1980	139.8	102.6	94.8	217.4	497.4	190.4	284.7	-	-	-	-	-	-
Average	122.3	115.3	121.9	130.9	263.2	247.5	234.8	214.6	187.8	173.2	201.1	197.9	2210.5

TABLE B.3.15 MONTHLY RAINFALL AT BARRAQUITO

		ESTACION												TABLA No.
		BARRAQUITO												
		ELEVACION												
		(mm)												
ANO	MES	ENERO	FEBRERO	MARZO	ABRIL	MAYO	JUNIO	JULIO	AGOSTO	SEPT.	OCT.	NOV.	DIC.	ANUAL
1968		-	-	-	-	-	-	102.8	122.3	103.6	52.9	35.0	300.2	
69		84.6	19.9	18.0	151.6	363.4	250.5	126.8	104.8	107.7	184.1	72.0	81.2	1564.6
70		40.9	159.9	57.7	41.4	279.8	160.4	161.9	351.8	180.3	551.8	116.4	256.9	2359.2
71		64.2	210.2	84.3	234.2	114.9	43.1	213.5	161.0	112.7	81.8	78.7	120.8	1519.4
72		79.1	171.3	178.7	129.7	175.3	214.5	186.3	258.6	198.8	182.3	105.7	137.3	2017.6
73		60.2	127.7	210.8	77.4	11.8	171.5	154.8	218.5	157.7	155.3	131.7	196.8	1674.2
74		163.2	212.6	85.7	142.3	189.1	234.2	141.9	246.6	173.6	235.4	85.8	205.2	2115.6
75		17.4	*22.3	89.5	9.0	256.4	49.6	103.4	61.0	166.1	175.5	374.2	237.7	1562.1
76		31.4	167.1	124.4	229.3	165.9	210.8	138.9	162.3	64.6	248.6	129.9	79.0	1752.2
77		25.8	19.9	40.1	371.1	206.5	72.5	291.9	317.1	101.6	176.0	381.1	289.3	2292.9
78		121.6	71.2	172.1	201.6	281.8	145.1	191.3	176.4	219.3	116.9	154.4	86.9	1938.6
79		92.8	48.2	116.2	254.7	654.2	244.3	189.7	491.9	190.1	251.6	350.9	211.6	3096.2
80		91.7	85.0	60.4	121.5	423.8	189.8	218.4	300.1	104.9	158.6	40.0	220.6	2014.8
81		189.2	255.3	150.7	180.6	348.6	133.4	269.5	220.8	107.4	159.8	117.1	219.8	2352.2
82		96.9	137.8	29.8	42.7	409.9	310.1	177.7	160.6	157.8	99.5	230.1	139.4	1992.3
83		66.3	51.3	82.1	101.8	343.9	264.7	289.1	243.8	169.4	195.3	220.3	113.1	2141.1
84		100.1	163.6	91.3	82.8	275.0	386.0	147.2	59.7	113.6	161.6	221.2	84.0	
	prom.	81.2	118.9	103.3	143.0	281.3	192.5	182.7	215.1	142.9	180.5	190.9	177.0	
TOTAL														
PROMEDIO														

3.2 Temperature

The mean monthly temperature characteristics at four stations are summarized in the table below. The mean annual temperature is 26.2 °C with a maximum during August-September and minimum in January.

TABLE B.3.16 MEAN MONTHLY TEMPERATURE

Station													(°C)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Sánchez	25.3	25.5	25.9	26.5	27.4	28.0	28.2	28.3	28.3	28.3	27.2	26.0	27.1
Nagua	24.6	24.8	25.1	25.4	25.8	26.4	26.5	26.7	26.8	26.3	25.6	24.7	25.7
Villa Riva	24.1	24.7	25.3	25.9	26.8	27.0	27.4	27.5	27.3	26.9	25.9	24.6	26.1
Barraquito	23.4	23.9	24.7	25.6	26.6	27.4	27.2	27.1	27.1	26.8	25.6	23.8	25.8
Mean	24.4	24.7	25.3	25.9	26.7	27.2	27.3	27.4	27.4	27.1	26.1	24.8	26.2

3.3 Evaporation

The annual mean evaporation is 1,253 mm with the higher evaporation recorded in June and July and lower evaporation is November and December. The monthly mean evaporation may be summarized as follows:

TABLE B.3.17 MEAN MONTHLY EVAPORATION

Station													(mm/month)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sanchez	77	94	129	139	99	136	129	115	102	90	47	53	1,353
Nagua	74	85	127	136	92	147	147	127	125	94	35	36	1,236
Villa Riva	83	94	125	146	88	100	122	123	116	98	68	689	1,229
Barraquito	59	59	95	138	152	152	131	134	87	78	50	63	1,195
Mean	73	83	119	140	108	134	132	125	108	90	50	55	1,253

3.4 Relative Humidity

The relative humidity in the Study area is generally high with a monthly average more than 75%. The characteristics in each station are as summarized below.

TABLE B.3.18 MEAN MONTHLY RELATIVE HUMIDITY

Station													(%)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sánchez	83.0	78.0	76.0	79.0	90.0	82.0	86.0	88.0	84.0	83.0	89.0	88.0	
Nagua	86.0	83.0	79.0	80.0	93.0	81.0	82.0	85.0	82.0	86.0	97.0	94.0	
Villa Riva	82.0	80.0	79.0	78.0	94.0	92.0	89.0	87.0	85.0	86.0	89.0	87.0	
Barraquito	85.5	83.8	81.2	80.0	81.9	83.2	83.8	84.4	84.7	84.6	86.1	86.6	
Mean	84.1	81.2	78.8	79.3	89.7	84.6	85.2	86.1	83.9	84.9	90.3	88.9	

3.5 Wind Direction

Observation of the wind direction was made at Nagua and Barraquito.

TABLE B.3.19 FREQUENCY OF THE WIND DIRECTION

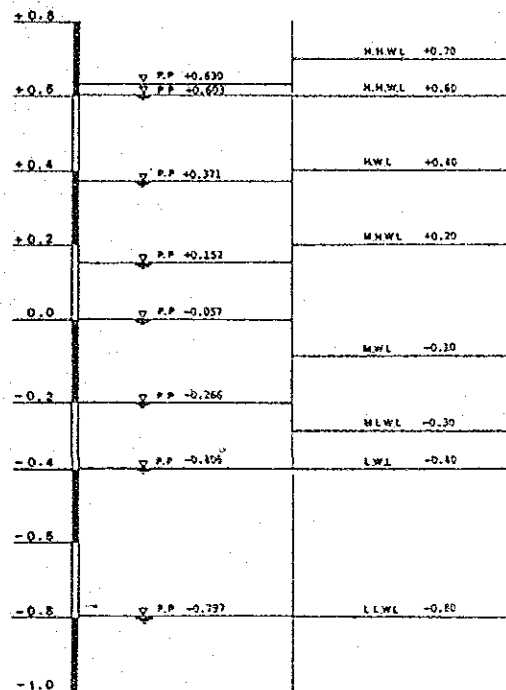
													(%)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
SE	75.8	81.0	75.1	75.0	69.9	77.2	68.6	72.0	75.6	75.8	62.5	70.3	
NE	24.2	19.0	24.9	25.0	30.1	22.8	31.4	28.0	24.4	24.2	37.5	29.7	
Others	-	-	-	-	-	-	-	-	-	-	-	-	-

4. Oceanology

4.1 Tide Level at Playa El Diamante

Data on the tide level are available at the station installed at Playa El Diamante in 1981. Based on these data tide level was summarized in the figure below.

FIG. B.4.1. TIDE LEVEL



4.2 Correlation of the Tide Level between Playa El Diamante and New Stations

The mean tide level for each station are as follows:

Stations	12/12/85 - 28/12/85	14/11/85 - 20/11/85	1/11/85 - 6/11/85	Total
Playa El Diamante	0.07 m	0.15 m	0.23 m	0.18 m
Caño Gran Estero	0.12 m	0.30 m	-0.04 m	0.05 m
Sanchez Port	-0.05 m	0.10 m	0.16 m	0.08 m

November

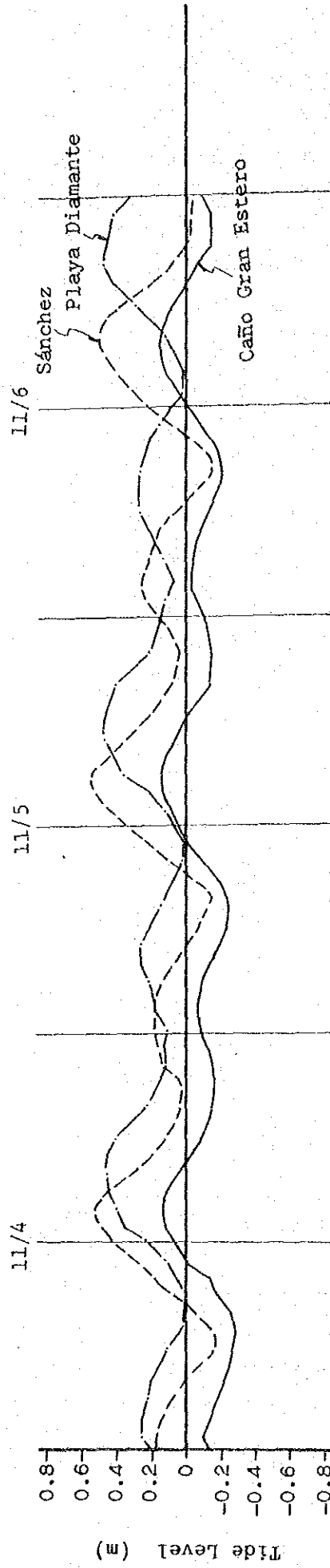
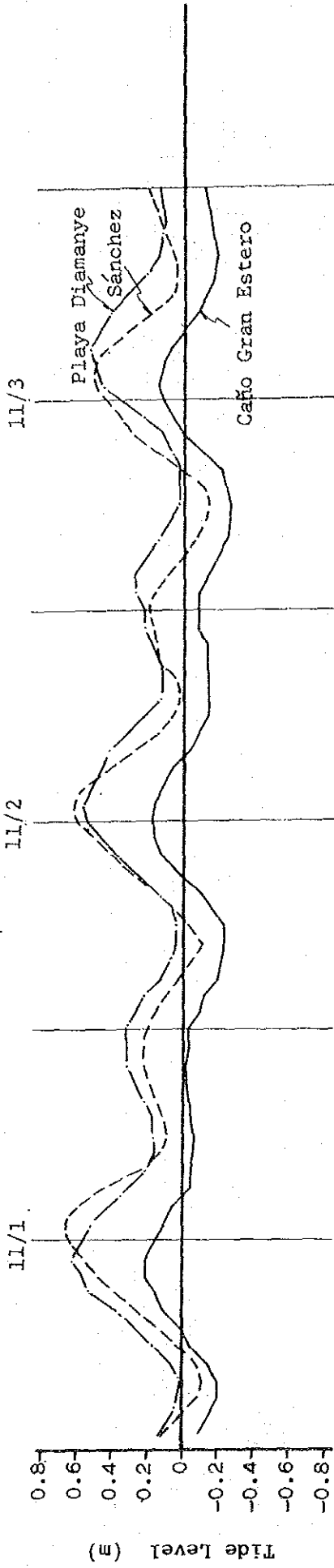


FIG. B.4.2 CORRELATION OF THE TIDE LEVEL BETWEEN PLAYA EL DIAMANTE AND NEW STATIONS

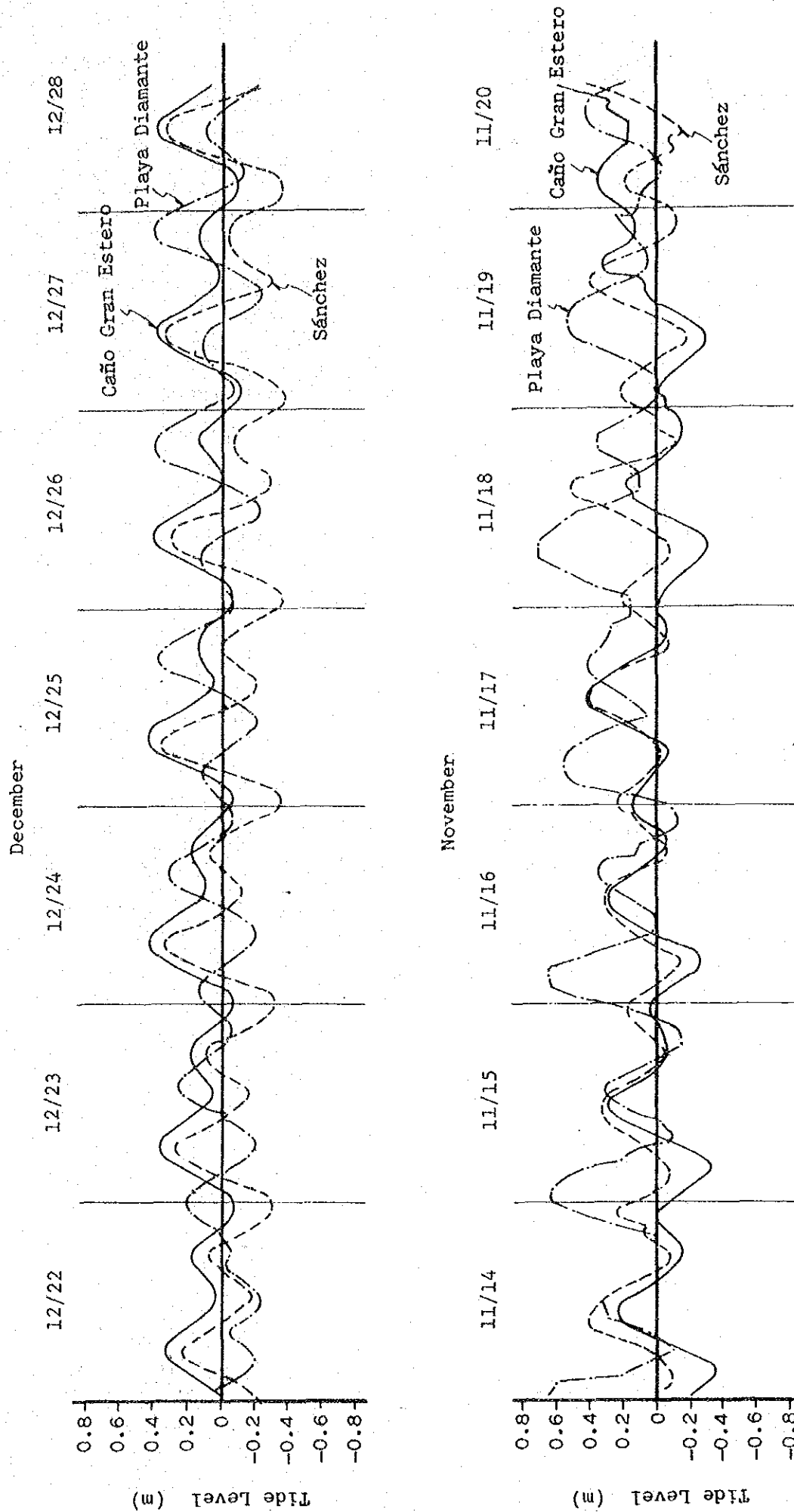


FIG.B.4.2 CORRELATION OF THE TIDE LEVEL BETWEEN PLAYA EL DIAMANTE AND NEW STATIONS

5. Hydrology

The study area can be classified into two parts: the Yuna River catchment area and the Caño Gran Estero catchment area.

The Yuna River flows to the east through the southern part of the area, whose catchment area 4,680 km².

The Caño Gran Estero flows to the north passing through the central zone of the area.

5.1 General Description of the Yuna River Catchment Area

The Yuna River is classified in three parts:

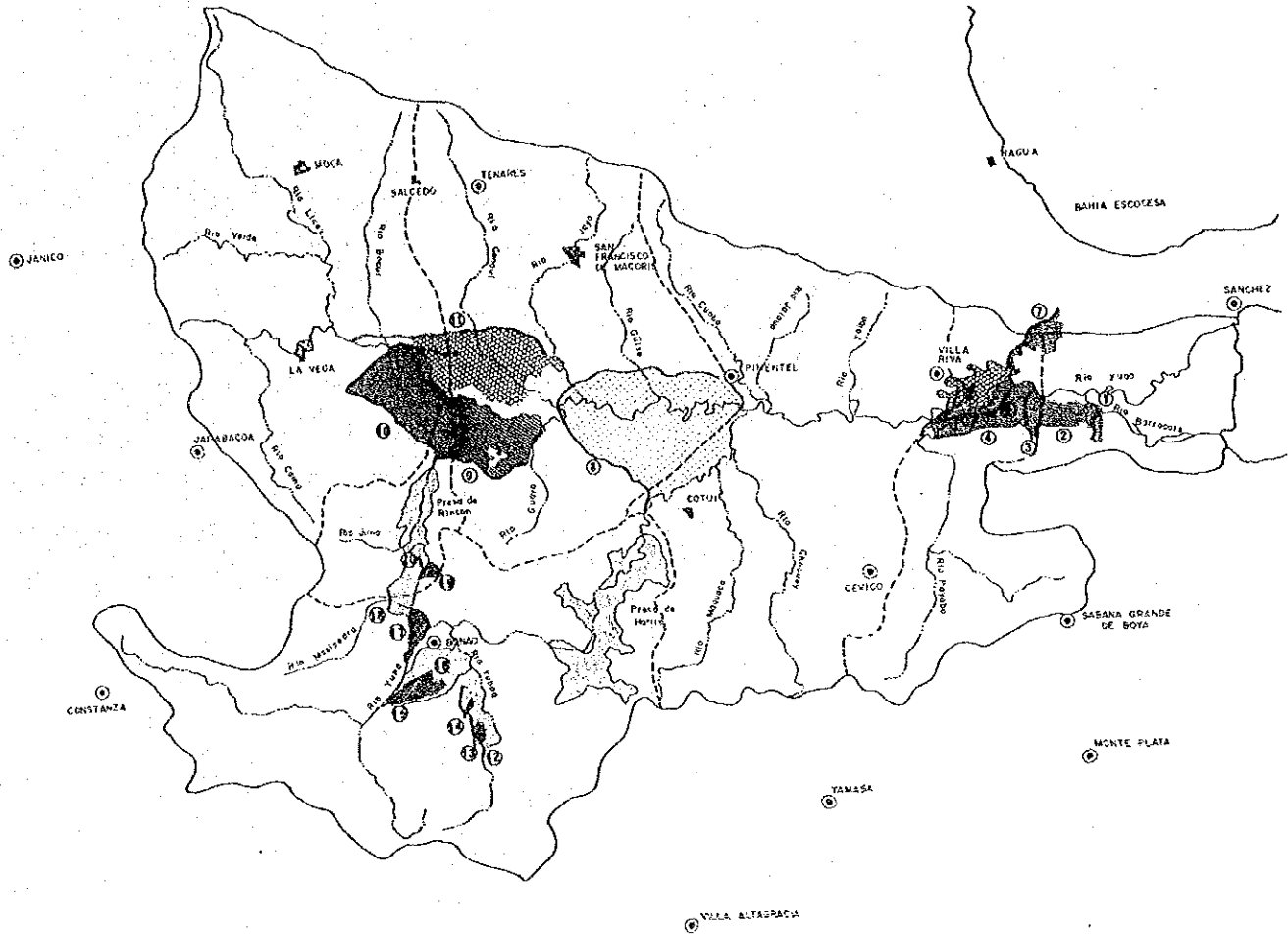
- a) Camu River basin
- b) The Yuna River basin up to the confluence with Camu River
- c) The lower reaches of the Yuna River

The basin of the Camu River is covered by the semiarid zone and, on the contrary, the Yuna River basin is covered by the rainy zone.

The Basin includes approximately 40,000 ha of paddy field. Two dams: the Hatillo and the Rincon were constructed in the upper stream of the Yuna River. The locatin of dams and irrigation canals are shown in Fig. B.5.1.

FIG. B.5.1

LOCATION OF THE CANAL AND IRRIGATION AREA

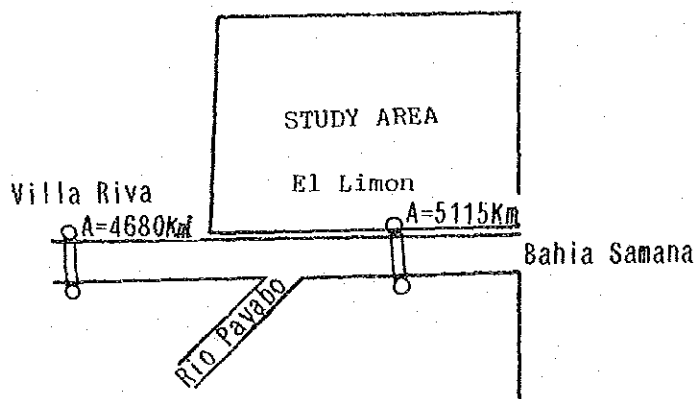


No	Canal	Discharge (M3 S)	Irrigation Area (Ha)	Fountain
1	Las Cuevas		430	Las Cuevas
2	Guaraguo No1			Guaraguo
3	Guaraguo No2		1058	Guaraguo
4	Payabo	2.5	1886	Rio Payabo
5	Arequin		1250	Lago Arequin
6	Ponton		1271	Caño Ponton
7	El Aguacate		1732	Rio Yuna
8	Yuna	29.0	16875	Rio Yuna
9	Jima Margen Derecha	5.0	3040	Rio Jima
10	Jima Margen Izquierda	5.0	3837	Rio Jima
11	Camu	4.7	6851	Camu
12	Yuboa	2.0	292	Rio Yuboa
13	Senador		47	Rio Senador
14	Ingenio	0.7	33	Aó Ingenio
15	Yuna-Bejucal	1.0	1610	Rio Yuna
16	Yuna-Caracol		219	Rio Yuna
17	Yuna-Cañabon	4.0	610	Rio Yuna
18	Masipedro		328	Rio Masipedro
19	Tayaco No1	1.0	150	Aó Cañabon
20	Tayaco No2		150	Aó Cañabon

5.2 Hydrological Features of the Yuna River

There are two water level gauging stations on the lower reaches of the Yuna River, one at Villa Riva installed in 1956 and the other at El Limon installed in 1969.

From 1984 when the Hatillo Dam was completed there has been a change in the flow of the Yuna River. In this sub-section, the description on the flow of Yuna River will be made with relation to the previous situation before the construction of the Hatillo Dam; the situation after the commencement of its operation will be mentioned in the subsequent sub-section.

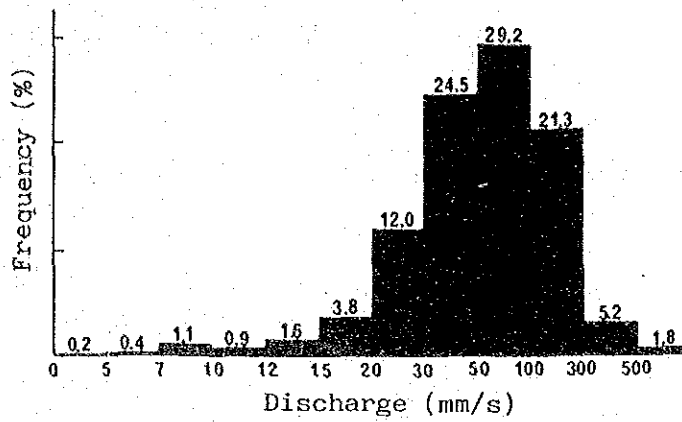


5.2.1 River Flow at Villa Riva

(1) Flow Frequency

The mean discharge at Villa Riva is at $86.9 \text{ m}^3/\text{s}$ and is more frequent discharges are observed between $50 \text{ m}^3/\text{s}$ and $100 \text{ m}^3/\text{s}$, in which 29% of the flow falls. The minimum flow was recorded at $3.85 \text{ m}^3/\text{s}$ in 1977 and the maximum at $871.2 \text{ m}^3/\text{s}$ in 1968.

FIG. B.5.2 FLOW FREQUENCY AT VILLA RIVA



The monthly distribution of the flow is summarized in Table B.5.1; the flow less than 10 m³/s frequently occurs in March and in April and December and January are the months when the flow increases to more than 15 m³/s.

TABLE B.5.1 MONTHLY FREQUENCY OF RIVER FLOW

Flow (m ³ /s)	Frequency (%)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0-5	0.0	0.0	.9	1.3	0.0	0.0	0.0	0.0	.1	0.0	0.0	0.0
5-7	0.0	0.0	1.7	.6	1.0	0.0	.5	0.0	0.0	0.0	0.0	0.0
7-10	0.0	.3	1.5	6.0	.9	0.0	1.2	.6	0.0	1.2	0.0	0.0
10-12	0.0	1.3	2.5	3.5	.3	.4	.3	.7	0.0	.7	.2	0.0
12-15	0.0	2.4	5.6	2.9	.6	2.1	1.2	.7	.4	1.2	.2	0.0
15-20	3.2	5.2	10.9	4.9	1.4	3.6	2.6	2.7	2.9	2.1	.8	.3
20-30	13.8	13.8	19.0	11.5	6.5	8.9	10.6	9.9	12.0	10.0	6.9	4.3
30-50	22.5	31.4	21.7	18.5	11.5	17.3	21.6	23.1	30.4	25.5	18.2	19.0
50-100	41.9	26.3	18.1	22.6	24.7	23.9	25.1	29.4	25.8	23.1	23.1	26.8
100-300	13.4	9.9	9.4	15.8	31.0	22.7	20.8	18.9	15.5	21.5	22.4	25.1
300-500	.5	1.9	.9	3.6	6.7	4.3	1.5	2.2	.9	2.4	5.1	4.6
500	1.0	.4	.5	1.8	4.5	2.6	.3	1.0	1.4	1.6	1.5	2.1

(2) Probability of Flow

The probability of the flow for the return period of 2, 5, 10 and 20 years is as summarized in the table below.

TABLE B.5.2 PROBABILITY OF FLOW AT VILLA RIVA

(m³/s)

Return Period	Droughty Discharge	Low Water Discharge	Average Discharge	Ninety-Five-Day Water Discharge	Maximum Discharge
2	17.61	36.79	55.93	92.84	520.16
5	10.84	26.12	38.94	65.12	630.88
10	8.21	21.17	32.54	55.21	697.85
20	6.42	17.38	28.23	48.75	758.30

(3) H.Q Curve at Villa Riva

The flow of Yuna River has been observed monthly at Villa Riva since the installation of the station and the following diagram was prepared to estimate the discharge at Villa Riva.

TABLE B.5.3 HYDROLOGICAL REGIME AT VILLA RIVA

Year	Villa Riva						
	Min.	Droughty	Low Water	Medium	95 day	Max.	Average
1956	20.0	25.7	40.0	63.9	90.5	514.25	79.6
1957	17.6	19.3	24.1	33.5	58.3	447.63	50.4
1958	15.6	17.9	36.2	61.4	127.8	706.3	107.8
1959	15.8	17.6	35.4	43.3	56.5	331.7	52.0
1960	25.2	32.4	46.6	67.2	98.0	377.3	81.8
1961	29.5	36.9	50.8	75.5	106.9	719.9	107.6
1962	19.2	21.4	37.6	55.6	111.5		99.4
1963	9.6	11.7	44.8	81.8	187.7		195.3
1964	11.3	12.9	31.6	47.8	85.6		80.9
1965	7.4	8.3	30.8	112.3	170.7		174.4
1966	48.8	56.1	84.0	171.8	217.2	857.5	183.0
1967	-	-	-	-	-	-	-
1968	5.4	6.6	14.1	21.9	41.9	871.2	35.6
1969	12.1	16.8	33.2	51.4	92.8	424.2	78.2
1970	7.8	9.1	48.9	84.6	145.0	514.5	124.1
1971	28.0	32.3	45.6	60.6	86.5	534.7	84.5
1972	25.1	32.5	48.4	69.4	105.8	562.2	92.3
1973	5.3	8.7	22.0	41.6	59.2	283.5	47.3
1974	-	-	-	-	-	-	-
1975	8.6	14.9	41.3	65.0	97.6	601.3	84.4
1976	16.8	18.5	31.2	44.1	64.9	506.9	62.3
1977	3.9	4.6	16.5	28.0	53.5	609.9	48.6
1978	15.3	19.3	27.8	40.2	75.2	643.9	63.4
1979	11.9	16.3	62.6	121.6	225.9	691.5	158.8
1980	13.7	18.4	32.6	44.7	66.4	552.2	62.3
1981	-	-	-	-	-	-	-
1982	18.0	20.4	33.2	53.7	96.6	553.3	86.0
1983	12.1	18.1	32.0	43.5	100	433.8	68.1

Time	H-Q Curve	No of Date	Max Discharge	Min Discharge
①	16/6/56	$Q=7.2526(H+1.800)^{1.7736}$	---	---
②	12/6/58	$Q=13.4739(H+0.410)^{1.6767}$	---	---
③	3/10/59	$Q=31.8487(H-0.725)^{1.7402}$	---	---
④	7/12/61	$Q=14.8439(H+0.110)^{1.6726}$	---	---
⑤	30/5/59	$Q=23.1767(H-0.415)^{1.6706}$	---	---
⑥	9/10/58	$Q=18.6246(H+0.200)^{1.7114}$	---	---
⑦	7/2/69	$Q=20.1813(H+0.200)^{1.7977}$	---	---
⑧	1/3/69	$Q=14.6946(H+0.320)^{1.6729}$	---	---
⑨	12/5/70	$Q=18.5635(H+0.130)^{1.8585}$	---	---
⑩	22/2/71	$Q=19.0617(H+0.120)^{1.6353}$	---	---
⑪	2/8/74	$Q=22.2524(H+0.100)^{1.5702}$	---	---
⑫	7/1/77	$Q=21.2912(H-0.255)^{1.6789}$	---	---
⑬	23/10/77	$Q=20.1137(H-0.205)^{1.6407}$	---	---
⑭	1/7/85	$Q=16.8138(H-0.105)^{1.7899}$	---	---

FIG B.5.3 H-Q CURVE AT VILLA RIVA

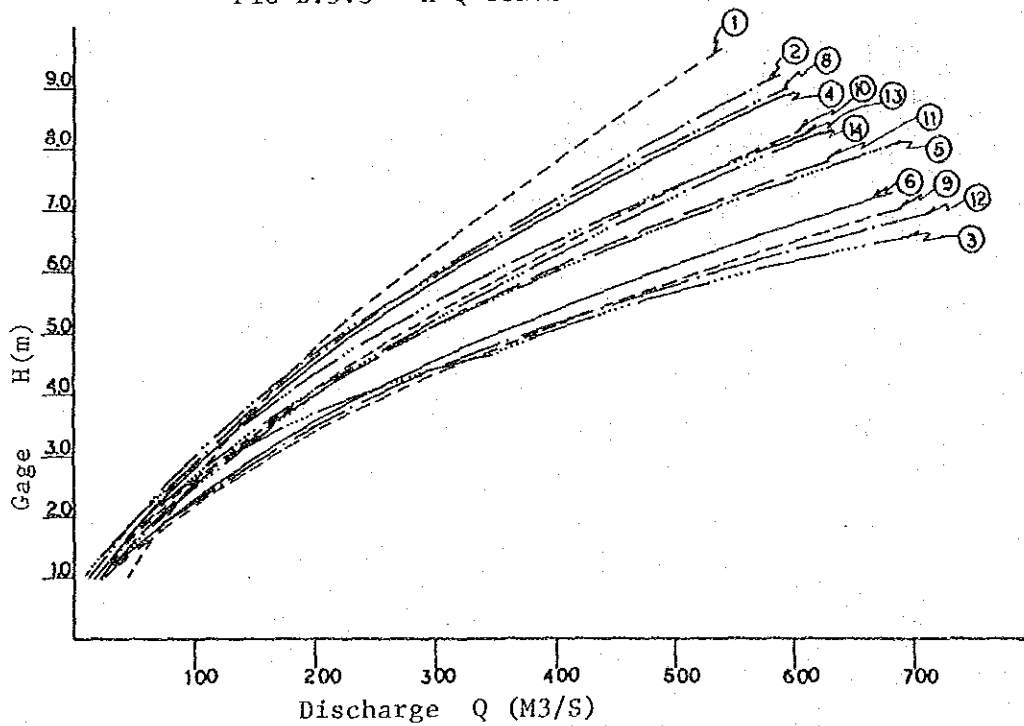


TABLE B.5.4 MONTHLY MEAN DISCHARGE AT VILLA RIVA

REPUBLICA DOMINICANA
 INSTITUTO NACIONAL DE RECURSOS HIDRAULICOS
 SECCION DE HIDROMETEOROLOGIA
 DIVISION DE HIDROLOGIA
 BANCO DE DATOS DE CAUDALES, DIARIOS

** CAUDALES MEDIOS MENSUALES EN M3/S **
 ESTACION NO. 123 * NOMBRE VILLA RIVA

* CUENCA/RIO YUNA/YUNA * AREA 4680.0 KM2

TIPO DE EST. 04 * CODIGO 18 3 * LAT. 19 G. 10 N.10 S. * LON. 69 G. 54 M. 20 S. * ELEV. 10 *

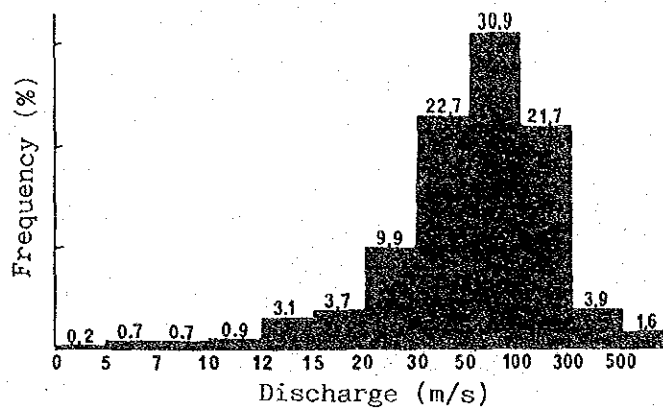
ANO I	ENE I	FEB I	MAR I	ABR I	MAY I	JUN I	JUL I	AGO I	SEP I	OCT I	NOV I	DIC I	I ANUAL MIN.	PICO
56	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	100.13	72.46	38.31	66.01	85.02	112.65	29.94	478.74
57	61.83	110.92	43.22	30.23	29.96	35.00	28.07	37.85	32.50	45.33	81.22	93.48	52.4722	29 421.05
58	83.32	40.22	25.37	28.18	235.42	358.36	368.65	57.00	83.83	152.58	61.93	21.99	126.40	3.37181.09
59	29.99	19.10	4.55	51.61	81.07	81.72	25.09	48.73	32.43	50.76	61.97	51.33	44.86	1.24 594.42
60	50.34	81.76	60.37	142.19	-1.00	-1.00	77.02	104.00	37.99	33.14	62.83	96.70	22.87	360.15
61	51.79	67.71	136.78	64.35	69.26	59.93	88.93	79.38	50.11	60.42	206.89	384.94	110.0426	691303.29
62	106.54	53.71	38.23	170.94	294.18	306.70	108.40	141.74	119.92	-1.00	94.86	63.67	29.28	701.74
63	53.44	55.84	152.64	279.29	267.14	150.30	-1.00	158.55	142.90	362.99	259.97	140.33	424.74	120.32
64	67.33	49.14	33.37	134.45	82.66	87.79	113.66	207.22	141.91	107.66	114.85	120.15	105.0228	01 806.61
65	75.03	56.04	40.93	24.24	506.75	280.25	142.59	130.36	173.30	111.69	299.13	-1.00	167.3020	181303.29
66	278.99	84.93	110.59	177.99	319.25	200.67	172.48	184.15	81.20	252.56	-1.00	-1.00	50.74	855.71
67	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.00****	0.00
68	-1.00	29.25	17.15	9.59	33.98	18.48	34.15	78.99	35.06	12.42	98.44	-1.00	36.75	5.60 969.15
69	109.25	32.59	19.90	132.64	251.38	44.66	36.47	45.75	58.55	73.33	192.74	150.13	95.6210	88 733.45
70	47.67	48.81	34.62	10.15	232.97	107.50	-1.00	133.46	119.35	214.36	249.76	255.73	132.22	7.41 924.69
71	74.91	211.50	72.65	131.48	104.17	46.34	56.65	77.86	67.63	75.35	70.00	55.15	86.9728	09 632.28
72	62.07	-1.00	96.39	56.97	82.94	118.03	110.22	116.26	116.87	119.19	50.08	124.26	95.7525	30 676.71
73	62.29	54.40	58.28	39.98	31.51	17.96	18.26	27.78	39.44	83.60	60.43	80.78	47.89	7.14 315.24
74	104.10	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.00	256.99
75	-1.00	31.28	20.87	-1.00	-1.00	-1.00	-1.00	-1.00	42.76	59.57	215.13	-1.00	7.33	699.61
76	68.17	123.36	128.37	65.58	59.29	35.70	27.31	23.36	39.61	122.13	48.84	57.65	66.6216	21 586.25
77	22.85	14.18	6.07	68.36	106.29	37.95	21.83	58.04	63.94	38.41	-1.00	111.30	3.85	730.58
78	152.98	36.75	44.79	145.96	102.59	47.51	57.44	69.09	30.90	37.14	37.49	41.79	67.0315	34 774.06
79	30.16	24.12	70.20	189.81	395.87	331.11	251.18	146.29	-1.00	147.96	265.79	103.59	12.05	837.13
80	93.40	45.25	35.98	41.64	153.73	74.02	44.10	112.28	45.03	57.52	26.15	57.08	65.5113	79 656.03
81	42.06	116.18	95.15	162.63	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	25.79	502.75
82	119.07	226.59	50.29	27.89	191.01	88.00	45.67	45.49	45.42	27.49	-1.00	150.87	92.5218	04 657.55
83	109.45	35.63	27.04	45.02	213.50	102.92	58.09	61.72	41.71	35.70	59.76	32.14	68.5612	18 505.45
84	26.05	137.47	31.93	30.59	45.43	150.99	73.29	47.85	65.67	150.99	122.77	57.31	78.3613	56 668.21
85	55.96	48.37	59.46	65.74	90.49	44.29	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	33.92	426.00
MEDIA	78.42	70.58	56.12	89.52	165.87	117.76	89.55	90.71	69.85	99.93	122.87	107.41	85.51	
D.STD	59.60	60.59	43.87	76.99	147.18	116.16	93.69	62.87	50.72	90.89	104.80	98.95	48.28	

5.2.2 River Flow at El Limon

(1) Flow Frequency

The mean discharge at El Limon is at $96.5 \text{ m}^3/\text{s}$ and is more frequent discharges are observed between $50 \text{ m}^3/\text{s}$ and $100 \text{ m}^3/\text{s}$, in which 31% of the flow falls. The minimum flow was recorded at $4.9 \text{ m}^3/\text{s}$ in 1977 and the maximum at $877.5 \text{ m}^3/\text{s}$ in 1982.

FIG. B.5.4 FLOW FREQUENCY AT EL LIMON



The monthly distribution of the flow at El Limon is summarized in Table B.5.5; the flow less than $10 \text{ m}^3/\text{s}$ frequently occur in March and in April and December and January are the months when the flow increases to more than $15 \text{ m}^3/\text{s}$.

TABLE B.5.5 MONTHLY FREQUENCY OF RIVER FLOW AT EL LIMON

Flow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0-5	0.0	0.0	0.0	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-7	0.0	0.0	3.8	2.1	0.0	.2	1.0	0.0	0.0	0.0	0.0	0.0
7-10	0.0	0.0	2.0	1.9	.4	2.5	.6	.6	0.0	0.0	0.0	0.0
10-12	0.0	1.1	.4	3.8	1.2	.6	1.6	.8	0.0	0.0	0.0	0.0
12-15	0.0	2.5	1.6	1.3	1.4	2.3	3.4	.6	0.0	.7	0.0	0.0
15-20	.4	4.9	2.6	6.9	4.2	2.5	6.3	2.2	3.1	6.2	1.6	0.0
20-30	8.3	8.3	15.1	14.8	3.8	11.5	11.5	14.5	10.8	5.8	3.2	3.2
30-50	18.8	24.4	30.4	21.7	14.9	18.3	20.8	18.3	21.7	29.2	22.1	12.3
50-100	41.3	29.9	25.0	19.6	24.2	26.9	34.2	24.8	35.2	25.4	24.5	33.9
100-300	17.7	12.4	10.9	18.1	28.4	17.5	12.7	23.0	19.4	22.4	34.2	27.6
300-500	.4	3.1	1.8	2.1	11.9	3.0	1.2	1.6	2.5	3.6	5.2	6.7
500	.6	.9	0.0	1.3	3.2	2.2	.4	1.0	1.0	.4	2.9	3.8

(2) Probability of Flow

The probability of the flow for the return period of 2, 5, 10 and 20 years is summarized below.

TABLE B.5.6 PROBABILITY OF FLOW AT EL LIMON

Return Period	Droughty Discharge	Low Water Discharge	Average Discharge	Ninety-Five-Day Water Discharge	Maximum Discharge
2	20.25	39.27	61.16	96.13	542.39
5	13.57	27.40	43.07	73.31	643.72
10	10.53	21.99	35.60	66.04	704.02
20	8.24	17.90	30.29	61.62	757.89

(m³/s)

(3) H-Q Curve at El Limon

The flow of Yuna River has been observed monthly at El Limon since the installation of the station and the following diagram was prepared in order to estimate the discharge at El Limon.

TABLE B.5.7 HYDROLOGICAL REGIME AT EL LIMON

Year	(m ³ /s)						
	Min.	Droughty	Low Water	Medium	95 day	Max.	Average
1969	24.8	26.5	41.2	57.9	95.6	662.3	87.0
1970	15.8	16.6	44.2	93.7	178.5	752.1	142.4
1971	20.7	25.0	39.1	59.6	92.6	520.8	88.1
1972	11.8	26.2	45.6	71.4	114.1	515.3	94.0
1973	12.0	16.9	33.7	50.5	73.9	323.8	60.2
1974	17.7	19.8	44.1	68.7	101.3	490.1	90.6
1975	6.6	7.5	13.3	28.2	64.3	569.9	71.4
1976	15.5	21.3	36.8	49.4	68.1	466.5	65.5
1977	4.9	5.7	18.5	32.8	66.2	577.0	60.2
1978	18.7	23.1	33.6	50.9	78.6	614.7	69.9
1979	15.0	17.8	63.6	122.7	227.8	605.9	170.9
1980	-	-	-	-	-	-	-
1981	33.3	39.5	74.9	112.9	191.4	-	156.1
1982	23.9	27.0	40.3	63.2	105.8	877.5	95.2
1983	16.2	22.4	41.8	55.7	98.5	450.1	85.5

Time	H-Q Curve	No. of Data	Max. Discharge (m ³ /s)	Min. Discharge (m ³ /s)
19/ 5/70 - 6/12/72	$Q=0.00150(H+6.3049)^{4.9863}$	-	-	-
7/12/72 - 26/12/82	$Q=10.0610(H+0.525)^{1.9726}$	-	-	-
27/12/82 - 30/ 6/85	$Q=14.5744(H+0.510)^{1.8367}$	124	726.62	5.84
1/ 7/85 -	$Q=12.5071(H+0.600)^{1.9084}$	133	"	"

FIG. B.5.5 H-Q CURVE AT EL LIMON

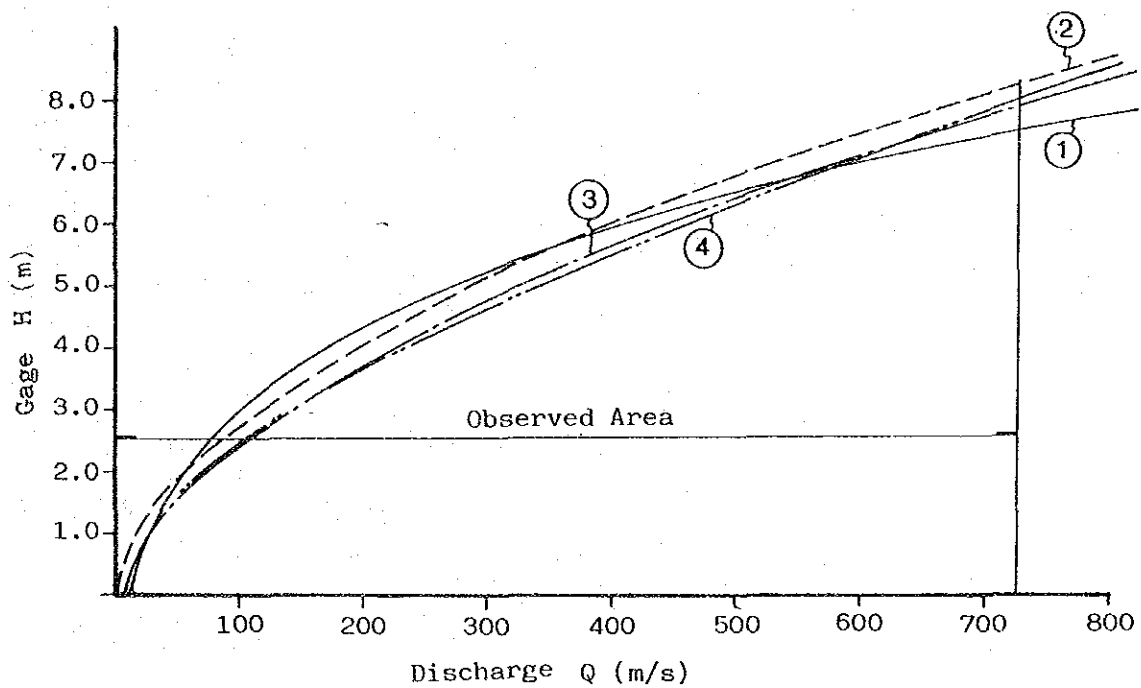


TABLE B.5.8 MONTHLY MEAN DISCHARGE AT EL LIMON

REPUBLICA DOMINICANA
 INSTITUTO NACIONAL DE RECURSOS HIDRAULICOS
 SECCION DE HIDROMETEOROLOGIA
 DIVISION DE DATOS DE CAUDALES DIARIOS

** CAUDALES MEDIOS MENSUALES EN M3/S **
 ESTACION NO. 124 * NOMBRE EL LIMON

* CUENCA/RIO YUNA/YUNA

TIPO DE EST. Q1 * CODIGO 18 4 * LAT. 19 G. 09 M.10 S. * LON. 69 G. 49 M. 09 S. * ELEV. 8 * * AREA 5130.0 KM2

ANO I	ENE I	FEB I	MAR I	ABR I	MAY I	JUN I	JUL I	AGO I	SEP I	OCT. I	NOV I	DIC I	ANUAL MIN.	PICO
68	59.99	-1.00	62.46	66.94	89.02	51.72	-1.00	-1.00	-1.00	-1.00	-1.00	305.06	14.75	570.42
69	94.79	46.98	37.83	119.12	190.12	51.78	59.79	44.29	54.14	64.90	152.43	128.09	87.0224	81.662.31
70	43.91	44.18	34.75	17.84	224.49	-1.00	-1.00	150.52	147.12	243.14	259.68	258.78	142.4415	82.752.09
71	85.11	205.94	75.98	130.71	107.10	42.12	54.58	80.59	71.11	77.69	73.55	53.02	88.1320	66.520.84
72	-1.00	-1.00	87.46	43.66	71.13	104.99	104.88	112.53	115.79	119.82	47.91	132.18	11.80	515.30
73	71.22	65.48	75.33	52.87	38.56	25.59	27.70	44.61	55.55	103.87	73.49	88.28	60.2112	20.323.78
74	111.95	88.75	159.29	68.22	62.76	75.02	27.59	46.31	106.99	101.97	123.83	113.90	90.5517	65.490.13
75	55.88	33.69	23.47	10.85	19.94	11.19	12.98	29.27	61.74	64.13	214.21	319.60	71.41	6.61.569.88
76	61.26	108.29	115.49	64.11	56.65	41.75	41.15	27.04	43.47	117.78	51.93	57.12	65.5015	50.466.50
77	24.20	15.09	7.18	67.13	100.30	35.38	22.67	63.95	77.51	35.37	172.88	101.20	60.24	4.86.577.01
78	141.10	40.14	45.16	135.93	104.45	57.35	67.41	74.92	139.03	40.87	44.84	47.90	69.9218	70.614.74
79	36.15	27.18	67.73	164.11	333.60	286.74	221.78	133.90	315.46	130.49	236.10	97.29	170.8814	98.605.94
80	98.82	57.22	43.51	54.43	154.73	88.16	61.46	-1.00	-1.00	-1.00	-1.00	21.32	499.46	
81	55.30	125.48	81.28	158.16	377.37	240.39	96.77	222.24	93.98	138.81	247.99	85.68	162.8033	25.610.34
82	117.86	212.35	58.53	32.89	194.39	96.24	58.29	55.48	59.36	34.84	66.06	154.38	95.0623	93.540.37
83	109.33	39.77	31.10	47.87	232.68	122.53	70.23	79.87	56.49	48.05	67.99	42.88	79.0716	26.466.31
84	35.29	132.36	38.22	35.80	50.30	166.33	81.54	73.14	76.60	160.09	131.00	65.41	87.1723	87.570.16
85	62.60	55.09	67.33	-1.00	26.36	20.30	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	17.71	144.15
MEDIA	74.40	81.12	61.78	74.74	135.22	89.27	67.25	82.58	91.62	98.79	130.93	128.17		
D.STD	37.91	66.75	35.77	51.54	104.23	80.24	57.80	63.30	78.74	70.34	95.88	99.51	40.39	

5.3 Water Resources within the Yuna River Basin

5.3.1 Consideration on the Development Opportunity

The Study on the water resources of the Yuna River Basin was carried out in the detailed design stage of the AGLIPO (El Pozo) Project. In this study, on the basis of existing irrigation facilities, dams and future development programs, the calculation was made for the period 1972-1981 with available data. As illustrated in Fig. B.5.1, a total of 40,000 ha of paddy field is found within the catchment area. Besides having completed two dams, the construction of the Alto Yuna Dam is considered and, according to the implementation program, some part of the river water will be conducted from the Alto Yuna Dam to the Rincon Dam after the completion of the former.

Considering aforementioned conditions, the study on the water balance of the Yuna River was made with regard to: past time (before the completion of two dams), present (after the completion of two dams) and future (after the completion of the Alto Yuna Dam). Conditions given to each case are as mentioned hereinafter.

TIME	CASE	CONDITIONS
Past	1	Calculated based on river situation before the completion of two dams: the Hatillo and the Rincon. River water is irrigated to 40,000 ha of paddy field. Double harvest is taken into account.
Present	2	The operation of two dams for the generation of electric power is considered subject to the regular water discharge.
Present	3	The operation of two dams for the supply for irrigation water is considered subject to water is discharged in comply with the requirement of lower catchment area.

.... cont'd

TIME	CASE	CONDITIONS
Future	4	In addition to the conditions made in the Case 2, the influence by the construction of the Alto Yuna is taken into account. The discharge from the Alto Yuna to the Rincon is also considered.
Future	5	In addition to the conditions made in Case 3, the operation of the Alto Yuna is considered. The discharge from the Alto Yuna is considered to be regular.

Given above conditions, the maximum possible discharge for each case has been calculated as follows:

TABLE B.5.9 MAXIMUM POSSIBLE DISCHARGE

(m³/s)

Return Period	Past		Present		Future	
	Recorded	Case 1	Case 2	Case 3	Case 4	Case 5
1/2	18.2	19.0	29.0	26.4	30.7	30.6
1/5	13.0	10.7	22.7	25.3	24.8	30.1
1/10	8.2	7.4	19.9	25.0	22.2	30.0
1/20	6.2	5.2	17.6	24.9	20.3	30.0
1/30	5.3	4.2	16.5	24.8	19.4	30.0

In order to get the discharge of 25.3 m³/s (Case 3, with the return period of 5 years), the sophisticated operation of two dams is indispensable, which will be at variance with the actual situation. Consequently, the maximum possible discharge is considered to be 22.7 m³/s (Case 2) with return period of 5 years.

5.3.2 Possible Discharge for this Project

The possible discharge at El Limon are:

- In the case that water is discharged for the principal purpose of the generation of electricity 22.7 m³/s
- In the case that water is discharged principally for the agricultural purpose 25.3 m³/s

In the present feasibility study, another two factors as mentioned below are taken into account in order to attain more appropriate discharge.

- Regulated discharge at the Hatillo Dam
- Irrigation facilities in the catchment area of the Yuna River

(1) Discharge at the Hatillo Dam

The discharge volume at the Hatillo Dam is not regulated at present but it is determined temporarily by the mutual consensus between the Dominican Electric Corporation (C.D.E.) and the INDRHI. According to the design criteria, the Hatillo Dam operates with discharge sufficient enough to supply water to be diverted to the Yuna Canal. It is supposed that the INDRHI inform the C.D.E. the required volume of the canal and the C.D.E. decides the discharge at the Hatillo Dam, but this procedure has not established yet.

The discharge record at the Hatillo Dam from the commencement of the operation is as listed below.

TABLE B.5.10 DISCHARGE RECORD AT HATILLO DAM

Month	Mean Discharge 3 (M /S)	Max. 3 (M /S)	Min. 3 (M /S)	Sec. Min. 3 (M /S)	Water Level
1984-5	41.5	204.5	5.4	6.8	76.85
6	87.5	239.2	8.7	18.5	80.09
7	36.5	144.4	5.5	13.4	79.9
8	43.1	279.5	8.1	13.0	79.06
9	48.2	235.6	13.3	13.4	78.83
11	69.4	140.1	15.7	21.8	83.5
12	27.4	54.2	15.5	17.1	82.8
1985-1	27.7	94.4	8.7	10.9	83.6
2	44.4	58.5	6.5	8.2	82.4
3	43.3	99.0	18.2	18.2	83.3
4	38.0	105.2	13.5	16.5	83.8
5	20.2	78.2	12.6	12.6	81.2
6	11.5	23.9	4.5	4.5	82.9
Mean	42.2	136.5	10.5	13.5	81.4

The mean discharge at the Hatillo Dam is to be 42.2 m³/s with the maximum at 239.2 m³/s and the minimum at 4.5 m³/s.

(2) Irrigation Facilities in the Catchment Area of the Yuna River

No improvement has been made since the stage of the detailed design for the AGLIPO (El Pozo) Project.

(3) In Case of the Regulated Discharge from the Hatillo Dam to the Lower Stream is Established between C.D.E. and INDRHI

a) The minimum semi-monthly discharge at El Limon will be as follows:

TABLE B.5.11 MINIMUM SEMI-MONTHLY DISCHARGE AT EL LIMON

 (m^3/s)

Probabi- lity	Distinct Regulated Discharge at Hatillo Dam					
	0	5	10	15	20	25
1972	31.57	31.57	31.57	31.57	31.57	32.50
1973	16.01	16.01	16.01	10.59	23.36	27.99
1974	24.05	24.05	24.05	23.39	32.28	10.06
1975	5.74	5.74	5.74	7.49	12.49	10.49
1976	30.62	24.46	22.62	24.11	29.11	39.58
1977	9.43	6.34	2.19	7.19	12.19	17.19
1978	30.18	29.78	27.78	29.88	18.99	23.99
1979	20.77	20.77	20.77	20.77	27.49	32.49
1980	28.33	28.75	28.33	28.33	28.33	28.33
1981	46.12	46.12	46.12	46.12	47.05	51.28

The probability of the minimum semi-monthly discharge is also calculated:

TABLE B.5.12 PROBABILITY OF THE MINIMUM SEMI-MONTHLY DISCHARGE AT EL LIMON

 (m^3/s)

Probabi- lity	Distinct Regulated Discharge at Hatillo Dam					
	0	5	10	15	20	25
1/2	22.7	21.2	20.6	21.6	24.5	26.6
1/5	13.6	12.2	10.8	13.1	17.1	18.0
1/10	9.7	8.6	6.8	9.7	14.1	14.3
1/20	6.9	6.0	4.0	7.3	12.0	11.6
1/30	5.5	4.9	2.6	6.2	11.0	10.3

According to the agreement made between INDRHI and C.D.E. the regulated discharge from the Hatillo Dam to the lower stream is established at 20 m³/s and with this volume, the minimum semi-monthly discharge at El Limon for the return period of 5 years is calculated at 17.1 m³/s.

- b) If the discharge at the Hatillo Dam is secured sufficient enough as to satisfy the requirement of the Yuna Canal, the minimum discharge at Limon will become as listed below.

TABLE B.5.13 MINIMUM DISCHARGE AT EL LIMON

(m³/s)

Year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Discharge	39.47	16.91	23.75	5.74	23.25	12.30	31.11	21.57	39.26	46.77

The minimum discharge for each return period of 2, 5, 10, 20 and 30 years is shown in the following table.

TABLE B.5.14 PROBABILITY OF MINIMUM DISCHARGE

Return Period	2	5	10	20	30
Discharge (m ³ /s)	22.7	14.0	10.3	7.5	6.2

In the case of the situation considered, expected discharge for 5 years return period at El Limon is the following:

Expected Discharge 14.0 m³/s