

Table 20 Farm Budget Under Present Condition for Three Farm Size Groups in the Project Area

Farm Size		Small	Medium	Large	
Item	(Unit)				
(1) Family Size	No.	5	5	4	
(2) Range of Farm Size(1)	(ha)	0.3 to 1.0	1.1 to 2.0	More than 2.0	
(3) Average Farm Size(1)	(ha)	0.61	1.3	4.3	
(4) Average Crop Production (2)	(ton)				
1	Plantain	5.44	12.28	45.12	
2	Tomato	0.22	0.49	1.81	
3	Sweet potato	0.02	0.01	0.15	
4	Melon	0.31	0.70	2.58	
5	Pepper	0.16	0.37	1.34	
6	Papaya	0.43	0.98	3.59	
7	Cassava	0.09	0.21	0.75	
8	Banana	0.36	0.81	2.99	
9	Pigeon pea	0.00	0.00	0.01	
10	Corn	0.01	0.03	0.10	
11	Bean	0.00	0.01	0.03	
12	Eggplant	0.02	0.05	0.19	
13	Rice	0.00	0.01	0.03	
(5) Agricultural Income (2)	(RD \$)	25,350	57,210	210,280	
1	Plantain	20,295	45,797	168,313	
2	Tomato	707	1,595	5,860	
3	Sweet potato	76	172	633	
4	Melon	821	1,853	6,811	
5	Pepper	979	2,208	8,117	
6	Papaya	1,360	3,069	11,280	
7	Cassava	442	998	3,669	
8	Banana	418	942	3,463	
9	Pigeon pea	14	32	117	
10	Corn	49	111	417	
11	Bean	54	122	449	
12	Eggplant	109	245	901	
13	Rice	30	68	250	
(6) Non-Agricultural Income (2)	(RD \$)	11,500	11,500	0	
(7) Total Income (5)+(6)	(RD \$)	36,850	68,710	210,280	
(8) Production Costs (2)	(RD \$)	2,697	8,730	48,820	
	Farm Materials	2,300	4,850	27,360	
	Paid Labor	0	3,020	16,630	
	Other costs	397	860	4,830	
			(%)	(%)	
(9) Living Expenditure (2)	(RD \$)	34,320	100.0	56,950	100.0
	Food	19,200	55.9	26,500	46.5
	Alcohol Beverages	1,750	5.1	3,800	6.7
	Water supply	200	0.6	300	0.5
	Housing	3,000	8.7	6,000	10.5
	Clothing	1,800	5.2	3,000	5.3
	Health care/Medicine	2,250	6.6	6,200	10.9
	Education	1,500	4.4	2,200	3.9
	Electricity	910	2.7	1,200	2.1
	Cooking Gas	860	2.5	950	1.7
	Transportation	850	2.5	2,500	4.4
	Gifts	1,000	2.9	1,800	3.2
	Others	1,000	2.9	2,500	4.4
(10) Total Expenditure (8+9)	(RD \$)	37,020		65,680	
(11) Balance (7-10)	(RD \$/year)	-170		3,030	
					49,710

Notes: (1) Based on ENDRH's data, the percentage distribution of farm size in the Project Area is estimated at about 51.6 % small farms, 35.8 % medium farms, and 12.6 % large farms

(2) Based on Analysis of Farm household Survey made to 59 farmers by JICA Study Team

Table 21 Water Quality (EC, pH) in the Study Area

Code	Location	Date	EC (mS/cm)	pH	Details	Source
SI	Sabana Alta, SJ	Dec 23,97	0.56	8.2	End of San Juan ID	INDRHI
	El Cacheo, Mijo river	Dec 23,97	0.13	8.5	Mijo headworks	
	Arrojo Loro	Dec 23,97	0.58	8.1	Main drain of JJ Puello	
	Paso de Lima, SJ	Dec 23,97	0.17	8.2	Upstream of Sabaneta	
	El Rosario, SJ	Jun 29,93	0.65	7.4		
AI	El Puente, YDS	Dec 22,97	0.27	7.5	Downstream of SY dam	INDRHI
	Los Guiros, YDS	Dec 22,97	0.83	8.4	End of Azua ID	
	- do -	Mar 17,89	1.10	8.1		
	Quita Corasa, YDS	Jan 7,98	1.06	8.2		
	Villarapando, YDS	Jan 8,98	0.51	8.4	Downstream of headworks	
	Tabara river	Jan 8,98	0.43	8.4	Downstream of Tabara HW	
	Los Toros, Viafara river	Jan 8,98	0.35	8.4	Ysura conveyance canal	
BNI	Santana headworks, YDS	Jan 7,98	0.91	8.1		JICA Saline Soil
	- do -	1988	0.57 - 0.80	7.8 - 7.9		JICA Saline Soil
	- do -	Dec 29,98	0.50	7.6		Phase-2
	Palo Alto, YDS	Jan 7,98	1.36	7.9		
	- do -	Dec 29,98	0.47	7.9		Phase-2
	El Jobo, YDS	Jan 7,98	1.09	7.7	Upstream of the intake to Rincon	
	- do -	Dec 28,98	0.49	7.8		Phase-2
	Palo Alto, YDS	Mar 16,89	0.95	8.0		INDRHI
	Habanero, YDS	Jan 7,98	1.36	7.8	Downmost reach of YDS	
	- do -	Dec 29,98	0.56	7.8		Phase-2
	El Caheon, YDS	Jan 7,98	0.95	7.2	Between No.9 and 11	
	- do -	Dec 29,98	0.54	7.8		Phase-2
	Rincon lake (laguneta seco)	Jan 8,98	5.10	7.9		
	- do -	Dec 22,98	1.17	7.9		Phase-2
	Rincon lake (northern shore)	Jan 8,98	7.20	8.3		
	Rincon lake (Cablar)	Jan 8,98	8.40	8.9		
	- do -	1988	7.00	7.9 - 8.2		JICA Saline Soil
	- do -	Dec 22,98	0.93	8.0		Phase-2
	Rincon L, 0.0 m (surface)	Dec 30,98	0.83	6.6		Phase-2
	Rincon L, 1.0 m	Dec 30,98	0.82	7.9		Phase-2
	Rincon L, 2.0 m	Dec 30,98	0.82	7.9		Phase-2
	Rincon L, 3.0 m	Dec 30,98	0.81	7.9		Phase-2
	Rincon L, 4.0 m	Dec 30,98	0.80	8.0		Phase-2
	Cristobal Canal	Dec 30,98	0.77	7.9		Phase-2
	Arroyo Drain, Guara Guao	Jan 8,98	2.00	7.9	Main drain at Santana	
	- do -	1988	1.30 - 1.60	7.6 - 7.8		JICA Saline Soil
	- do - (upstream)	1988	1.10 - 1.20	7.6 - 7.8		JICA Saline Soil
	- do -	Dec 30,98	0.90	7.8		Phase-2
	Spring, Las Marias	Jan 8,98	0.54	7.4		
	- do -	1988	0.59	7.5		JICA Saline Soil
	Enriquillo lake	Jan 8,98	>100.00	8.0		
	Las Marias river, Neiba	Jan 8,98	2.00	8.2	Drain of northern Neiba Plain	
	- do -	1988	2.70 - 5.00	7.8		JICA Saline Soil
- do -	Dec 30,98	1.20	7.7		Phase-2	
Ramillo channel	Jan 8,98	14.80	8.2	Drain of central Neiba Plain		
- do -	1988	3.00 - 3.80	7.8		JICA Saline Soil	
- do -	Dec 30,98	1.20	8.0		Phase-2	
Bermesi river	Jan 8,98	11.40	7.6	Drain of southern Neiba Plain		
- do -	Dec 30,98	14.73	7.4		Phase-2	
Groundwater, Galvan Neiba	1988	0.60	7.1		JICA Saline Soil	
Groundwater, Neiba Plain	1988	1.80	7.7		JICA Saline Soil	
Majagual, Colotrado, Mangu	1988	0.27 - 0.33	7.6 - 7.7	Rivers north of Neiba Valley	JICA Saline Soil	
Enriquillo Lake	Oct 28,93	88.2 - 98.5	8.2 - 8.3		INDRHI	

NOTE: EC, Electric conductivity
YDS; Yaque del Sur River
SJ; San Juan River

Table 22 Present Farming Practices for main Crops in the Project Area

Crop: Plantain	Present/Without Project
Crop: Plantain	
Variety	"Macho por Hembra", "Gigante", "Enano"
Planting Density and Planting Materials	1,300 plants per ha. Planting material taken from previous plantation or neighbor farm without adequate treatment for insects and disease control. Long periods (up to 30 years) without replanting.
Fertilizer (kg/ha)	N=80; P=50; and K= 40 kg/ha; About 30% of farmers do not apply fertilizers, and many apply very low quantity.
Labor (man-day/ha)	105
On-farm Water Management	Very irregular irrigation frequency varying from once in a month to once in two months. Some times excess of water is applied.
Insects & Diseases Control	The insects <i>Cosmopolites sordidus</i> and several Nematodes species are pest main problems. Very poor control of insects and nematodes; Some 36 % of farmers do not apply pesticides; Many apply pesticides more than required amount (25 kg/ha); Very few farmers use of Integrated Pest Management practices.
Crop: Tomato	
Variety	Gem, UC-82, Pepto, Napoli, and Chico
Planting Density and Planting Materials	30,000 plants per ha. Transplanting method
Fertilizer (kg/ha)	N=150, P=75; and K= 75 kg/ha;
Labor (man-day/ha)	110
On-farm Water Management	Inadequate water application, due to water shortage and farmers lack of knowledge on adequate on-farm water management. Most times soil moisture is deficient, some times excess of water is applied.
Insects & Diseases Control	The insect identified as "White fly" (<i>Bemisia tabaci</i>) is the mayor problem affecting tomato production. Integrated pest management practice is not extensively used by tomato producers in the project area. About 18 kg/ha of pesticides are used for insects and disease control.
Crop: Melon	
Variety	"Smith Perfect"
Planting Density and Planting Materials	0.7 kg/ha of seeds; direct seeding to open fields.
Fertilizer (kg/ha)	N=180; P=150; and K= 150 kg/ha;
Labor (man-day/ha)	65
On-farm Water Management	Insufficient irrigation water supply.
Insects & Diseases Control	The insect identified as "White fly" (<i>Bemisia tabaci</i>) is the mayor problem affecting tomato production. Integrated pest management practice is not extensively used by tomato producers in the project area. About 20 kg/ha of pesticides are used for insects and disease control.
Crop: Papaya	
Variety	"Solo I", "Hawaiiana", "Red Lady"
Planting Density and Planting Materials	About 1,200 plants per ha.
Fertilizer (kg/ha)	N=103; P=55; and K= 55 kg/ha;
Labor (man-day/ha)	120
On-farm Water Management	Irregular irrigation frequency, plants often suffer from water shortage.
Insects & Diseases Control	Virus disease is the most serious problem; Pest control is not adequate, due to lack of orientation to farmers; Use about 26 kg/ha pesticides for insects and disease control.
Crop: Pepper	
Variety	"Cubanela" and "California Wonder"
Planting Density and Planting Materials	Seeds are sown on nursery beds; seedling are transplanted when reach about 15 cm high at about 30 days old. Planting spacing is 1 m between rows and 0.75 m between plants for a planting density of about 13,000 plants per ha.
Fertilizer (kg/ha)	N=90, P=60; and K= 60 kg/ha;
Labor (man-day/ha)	125
On-farm Water Management	Inadequate water application, due to water shortage and farmers lack of knowledge on adequate on-farm water management. Most times soil moisture is deficient, some times excess of water is applied.
Insects & Diseases Control	Several types of insects species attack pepper plants in the project area; the "White Fly" is the mayor problem affecting pepper production because it transmit a virus disease. Integrated pest management practice is not extensively used by pepper producers in the project area. About 12 kg/ha of pesticides are used for insects and disease control.

Table 23 Present Irrigation System

	Name of System	Gravity Pump	Left/Right	Irrigation Area [ha]	Co-ordination of intake		Pump [HP]		
					N	W	Capacity [HP]	[liter/sec]	
1	Vicente Noble-INDRHI	G	L	1,717	18 22 206	71 10.348	-	-	
2	Los Habitantes	G	R	a			-	-	
3	Charco Blanco	G	R	a	624 [total a]		-	-	
4	Anon-Uvilla	G	R	a	18 23.775	71 11.630	-	-	
5	Santana Lat-B	G	-	74			-	-	
6	Santana Lat-E	G	-	122			-	-	
7	Santana Lat-H	G	-	120			-	-	
8	Caño Trujillo	G	R	190	18 20.799	71 11.984	-	-	
9	Mena - IAD	P	R	144			250HP		
10	Guaba de Mena	P	R	82	18 20.366	71 11.881	30	158	
11	Bombita-CEA	P	L	575	18 19.940	71 09.782	150&150		
12	Bombita-INDRHI	P	L	b	18 19.940	71 09.782	150&150	284&284	
13	Jaquimes	P	L	b	485 [total b]	18 19.124	50&75	221&442	
14	Juan Benito	P	L	b			75	442	
15	Palo Alto-INDRHI/IAD	P	L	b	18 18.238	71 09.918	75&100	221&315	
16	Palo Deleche	P	R	182	18 19.055	71 10.386	50&75 HP	126&473	
17	Puente Palo Alto (Peñon I)	P	R	117	18 17.195	71 10.351	75&75	158&158	
18	Palo Alto-CEA	P	L	888	18 17.195	71 10.351			
19	Fundacion I	P	L	c	18 17.742	71 10.707	40	379	
20	Fundacion II	P	L	c	1,486 [total c]	18 16.843	71 12.017	40	379
21	Fundacion III	P	L	c	18 18.331	71 12.056	40	189	
22	Peñon II	P	R	108	18 16.843	71 12.017	40&30	315&315	
23	La Isleta	P	L	c	18 16.061	71 12.397	60&80 HP	189&189	
24	La Guineá	P	R	81	18 15.863	71 12.965	30 HP	126	
25	Oswaldo Feliz	P	L	c	18 15.370	71 13.328			
26	La Elena (Cachon)	P	L	c	18 15.358	71 12.140	50&50HP		
27	Paso La Elena	P	R	24	18 15.358	71 12.14	50&50HP		
28	Veras Pescaderia	P	L	c	18 15.421	71 10.955			
29	La Coco - IAD	P	L	c			75HP		
30	Caballero (INDRHI)	P	R	d	18 14.740	71 09.364	150&150HP		
31	Caballero 1-IAD (Habanero 1-IAD)	P	R	d	77 [total d]	18 15.120	71 09.433	38HP	
32	Caballero 2-IAD (Habanero 2-IAD)	P	R	d			50HP		
33	Hato Viejo - Pescaderia	P	L	c	18 15.589	71 09.587	30&30HP	221&158	
34	Pescaderia - IAD	P	L	c	18 15.355	71 09.418	75HP		
35	La Hoya	P	L		104	18 15.256	71 08.838	20&20 HP	126&126
36	Habanero	P	R		175	18 15.139	71 08.375	30	158
37	Dumit	P	L		33	18 15.787	71 08.131	100HP	
	Total			7,128					

by Main Canal	5,533	(w/o CEA) 4,202ha (CEA) 241ha
by Santana(CEA)	318	Lat-8, E.H
from the River	1,277	by Gravity-1, Pump-13
Total	7,128	(w/o CEA) 5,885ha

Note: G = Gravity, P = Pump

Table 24 Inventory of National Roads

(1) Secondary National Road

Code DA-Ruta.Tr	Origin	Section Final	Length (km)		Surface Type	
			Pavement	No Pav	Pavement	No Pav
44-044.020	El Higuíto (La Virgen)	C/C 514 (C/Vicente Noble)	11.9		ASF	
44-044.030	C/C 514 (C/Vicente Noble)	Canoa	4.6		ASF	
44-044.040	Canoa	C/C 048 (C/Palo Alto)	6.6		ASF	
44-044.050	C/C 048 (C/Palo Alto)	C/C 046 (C/Cabral)	8.0		ASF	
44-044.060	C/C 046 (C/Cabral)	Estrada Barahona	3.7		ASF	
44-044.070	Salida Barahona	Paraiso	30.4		ASF	
44-044.080	Paraiso	Enriquillo	15.4		ASF	
44-044.090	Enriquillo	Oviedo	23.3		ASF	
44-044.100	Oviedo	ACC. Cabo Rojo	36.0		ASF	
44-044.110	ACC. Cabo Rojo	C/C 044 (Cabral)	11.8		ASF	
44-046.010	C/C 044 (Cabral)	C/C 533 (Cabral)	10.8		ASF	
44-046.020	C/C 533 (Cabral)	C/C 518 (C/Salinas)	11.2		ASF	
44-048.010	C/C 044 (Palo Alto)	C/C 529 (ACC. A Tamayo)	8.2		ASF	
44-046.020	C/C 529 (ACC. A Tamayo)	Batey 2 (Limite Ayudantia)	12.4		ASF	

(2) Tertiary National Road

Code DA-Ruta.Tr	Origin	Section Final	Length (km)		Surface Type	
			Pavement	No Pav	Pavement	No Pav
44-514.010	C/C 044 (ACC/Vicente Noble)	Vicente Noble	5.9		TSA	
44-514.020	Vicente Noble	Tamayo	4.6		TSA	
44-518.010	C/C 048	C/C 046 (C/Salinas)		9.0		GRA
44-529.010	C/C 048 (C/Mena)	Tamayo	6.2		TSA	
44-531.010	C/C 046 (C/Cabral)	El Peñon	8.0		ASF	
44-531.020	El Peñon	C/C 048		2.2		GRA
44-533.010	C/C 046 (Cabral)	Polo	19.9		ASF	

Remarks; ASF: Asphalt pavement (Asfalto)
 TSA: Superficial Asphalt Treatment (Tratamiento Superficial Asfáltico)
 GRA: Gravel (Grava)

(3) Rural Road

Code	Route	Length (km)
43-03-05-01-28	Tamayo - San Ramón	5.0
44-04-07-00-36	Canoa - Vicente Noble	3.9
44-04-07-02-40	Vicente Noble - Arroyo Grande	12.5
44-04-09-01-33	Fundación - Pasos de las Elenas	4.2
44-04-09-04-32	Habanero - Fundación	7.6
-	El Vigia-Peñon	4.8
-	Peñon-Palo de Leche	1.5
-	La Uvilla-salsipuede	2.9
-	Vicente Noble-El quemado	3.2
-	Canoa-La zurza	3.2
-	Salsipuede-El copo	1.7
-	El Quemado-La cerca	1.7
-	El copo cont. Tamayo-Vicente Noble	3.0
-	Vicente Noble-Canoa La Baitoa	3.3
-	Fondo Negro-El Maitazo	3.8
-	Fondo Negro-El Memiso	2.0

Code	Route	Length (km)
-	Fondo Negro- Los Fondos	1.0
-	El Maitazo	3.0
-	Canoa-Mata Frio	3.0
-	Palo Alto -El Sitio	1.2
-	Bombita-al 25	1.7
-	Jaquimeyes-San Benito	4.3
-	Palo Alto-San Benito	2.6
-	Palo Alto-El Sitio	1.2
-	Canoa-Playa	20.0
-	Habanero-Cabral	2.8
-	La Hoya-	1.7
-	La Isleta-La cu(fundacion)	3.6
-	Cachon-Pescaderia	2.2
-	Fuadacion-Guayacanes	2.2
-	Cohoa-Pescaderia	3.8

Table 25 Inventory of Water Supply System (INAPA)

	Vicente Noble Multiple Aqueduct	Tamayo Multiple Aqueduct	Uvilla-El Jobo Multiple Aqueduct	Mena Multiple Aqueduct	Pescaderia Multiple Aqueduct	Cabral Multiple Aqueduct
Service Community	Vicente Noble, Arroyo Grande, Canoa	Tamayo, Mouserrate	Uvilla, El Jobo	Mena arriba, Mena abajo	Caballero, Habanero, La Holla, Hato Viejo, Pescaderia	Cabral, Tierra Blanca, Guayuyo, Penuela, Carbon, Peñon, Fuadación, Palo Alto, Jaquimeves
Source	Yaque del Sur river	Yaque del Sur river	Groundwater	Groundwater	Groundwater	Groundwater and spring
Type	Pump	Pump, 2 nos. φ 24" H.S., L=101.8 m	Vertical pumps, 200 gpm, 15 HP	Vertical pumps, 100 gpm, 7.5 HP Submergible pumps, 140 gpm, 10 HP	Pump, 25 HP	No.1 Pump, 300 gls/min, with 40 HP engine No.2 Pump, 1,300 gls/min, with 150 HP engine No.3 Pump, 250 gls/min, with 30 HP engine
Treatment	Simple chlorinating	Simple chlorinating	Simple chlorinating	Simple chlorinating		Simple chlorinating
Impulsion Line	φ 20" L.I., L=3,381.6 m φ 12" P.V.C. (RDS-26) L=100.0 m	φ 20" L.I., L=2,030.0 m φ 12" P.V.C. (RDS-26) L=100.0 m	Well No.1: φ 6" P.V.C. (RDS-26) L=517.0 m Well No.1: φ 4" P.V.C. (RDS-26) L=633.0 m Well No.2: φ 6" P.V.C. (RDS-26) L=473.80 m	φ 4" P.V.C. (RDS-26) L=382.35 m	φ 6" H.F., (RDS-26) L=888.45 m	φ 12" steel, L=273.7 m φ 12" H.F., (RDS-26) L=2,469.9 m φ 3" steel, (RDS-26) L=145 m
Storage Tank	Superficial regulating tank 1,200 m ³	Superficial regulating tank 300,000 gls	Reinforced concrete elevated tank H=12.0 m, V=66,000 gls	Reinforced concrete elevated tank H=15 m, V=26,400 gls	Superficial regulating tank 500 m ³	Superficial metallic tank 100,000 gls, 500,000 gls
Main Line	φ 12" PVC (SVR-26), L=1,651.0 m	φ 12" PVC (SVR-26), L=3,367.1 m	φ 4" PVC (SVR-26), L=25.4 m	φ 4" PVC (SVR-26), L=33.9 m, 2 pipes	φ 8" A.C.(Class C), L=1,295.0 m,	φ 6" A.C. class D(SVR-26), L=866.4 m φ 12" PVC (SVR-26), L=780.0 m φ 12" PVC (SVR-26), L=1,571.2 m φ 12", φ 8", φ 6", φ 4", φ 3" and φ 2" PVC (SVR-26 and 21)
Conduction Line	φ 6" PVC (SVR-26), L=618.4 m φ 4" PVC (SVR-26), L=2,821.4 m		φ 4", φ 3" and φ 2" PVC (SVR-26 and 21) L=6,398.55 m	φ 4", φ 3" and φ 2" PVC (SVR-26 and 21) L=6,968.24 m		
Distribution System	φ 6", φ 4", φ 3" and φ 2" PVC (SVR-26 and 21)	φ 6", φ 4", φ 3" and φ 2" PVC (SVR-26 and 21)			φ 6"(Class B), φ 4", φ 3" (SVR-26) and φ 2" PVC (SVR-21)	
Connections	2,000 units	1,928 units	459 units	408 units	518 units	3,921 units
Population	13,333 (actual in 1995) 21,333 (designed for 20 years)	11,586 (actual in 1992) 18,509 (designed for 20 years)	2,754 (actual in 1995) 4,460 (designed for 20 years)	2,448 (actual) 3,197 (designed for 20 years)	3,108 (actual in 1998) 4,973 (designed for 20 years)	24,033 (actual in 1993) 37,821 (designed for 20 years)
Design Dow	28.90 lit/sec (actual in 1995) 46.30 lit/sec (designed for 20 years)	32.52 lit/sec (actual in 1992) 50.42 lit/sec (designed for 20 years)	5.98 lit/sec (actual in 1992) 9.56 lit/sec (designed for 20 years)	5.31 lit/sec (actual in 1992) 8.50 lit/sec (designed for 20 years)	6.74 lit/sec (actual in 1998) 16.19 lit/sec (designed for 20 years)	52.15 lit/sec (actual in 1993) 83.44 lit/sec (designed for 20 years)

Table 26 Proposed Farming Practices for Main Crops in the Project Area

Crop: Plantain	
Variety	"Macho por Hembra", "Enano"
Planting Density/Planting Materials	Planting at 2.5 m between rows and 2 m between plants for a density of about 2,000 plants per ha. Use of Seedlings grown by tissue culture that are free from insects and diseases. Replanting every 5 years. Introduction of Inter-cropping in newly replanted areas.
Fertilizer (kg/ha)	N=160; P=110; and K= 200 kg/ha; divide the total amount of each nutrients in 3 applications per year; apply fertilizer the second, fourth, and sixth month after planting.
Labor (man-day/ha)	144
On-farm Water Management	Irrigation water applied on defined schedule based on crop water requirements, irrigation intervals at about 10 days. For plantain in the Project area is better to apply frequent irrigation even of small water depth, and not to irrigate at long intervals with large water depth. Avoid depletion of more than 35 % of soil available water, also avoid excess of soil moisture.
Insects & Diseases Control	Use of planting materials free from insects and nematodes; Extensive adoption of Integrated Pest Management, including: introduction of fungus and nematodes that function as biological control of Cosmopolites and Nematodes pest of plantain, proper disposal of stems, timely control of weeds, proper fertilization, and water application in order to have healthy plantations more resistant to damages. Use of insecticide-nematicides of commercial name "Mocap 10G" and/or "Furadan" at a rate of 15 kg/ha/year divided in 3 applications.
Crop: Tomato	
Variety	Hybrid Germ
Planting Density/ Planting Materials	Planting distance at about 0.85 m between rows and 0.3 m between plants, for a density of about 40,000 plants per ha. Transplanting method; Proper care of seedlings to avoid virus disease
Fertilizer (kg/ha)	N=200; P=150; and K= 150 kg/ha; divide half at planting and half at the second month.
Labor (man-day/ha)	120
On-farm Water Management	Irrigation water applied on defined schedule based on crop water requirements. Frequent application of small amount of water is more important than large amount applied at long intervals. The most critical period for water demand is during flowering; excess of water during flowering period may cause drop of flowers. Avoid deficits and excess of soil moisture. Water application can be reduced at ripening period.
Insects & Diseases Control	Extensive use of Integrated Pest Management will be introduced, including planting date, use of more resistant varieties, adequate care of seedlings, appropriate planting dates, weed control, etc. Use about 14 kg/ha of pesticides divided in 3 applications.
Crop: Melon	
Variety	"Hooney Dew"
Planting Density/Planting Materials	1 kg/ha of seeds
Fertilizer (kg/ha)	N=210; P=180; and K= 210 kg/ha; Divide the total amount of each nutrients in 2 applications half at planting time and half one month after planting.
Labor (man-day/ha)	90
On-farm Water Management	Irrigation water applied on defined schedule based on crop water requirements. Avoid deficits and excess of soil moisture.
Insects & Diseases Control	Extensive use of Integrated Pest Management will be introduced, including use of more resistant varieties, adequate care of seedlings, appropriate planting dates, weed control, etc. Use about 20 kg/ha of pesticides divided in 5 applications.
Crop: Papaya	
Variety	"Cubana" and "Red Lady"
Planting Density/Planting Materials	Planting distance at 3 m between rows and 2 m between plants for a density of 1,600 plants per ha.
Fertilizer (kg/ha)	N=150; P=90; and K= 90 kg/ha per year, Divide the total amount of each nutrients in 2 applications, half at planting time and half 3 months after planting.
Labor (man-day/ha)	147
On-farm Water Management	Irrigation water applied on defined schedule based on crop water requirements. Apply shallow irrigation depth at frequent intervals; do not allow to deplete more than 40 % of soil available water.
Insects & Diseases Control	Use of variety most resistant to virus disease such as "Cubana"; this variety is also more resistant to damage during transportation. Adoption of Integrated Pest Management, including timely control of weeds, proper fertilization and water application in order to have healthy plantations. Use of 20 kg/ha of pesticides divided in 6 applications per year, mainly when plant are small, 1 to 5 month old.
Crop: Pepper	
Variety	"Cubanela"
Planting Density/ Planting Materials	Planting distance at 1m between rows and 0.6 m between plants for a density of about 16,700 plants per ha. Transplanting method; Proper care of seedlings to avoid virus disease in seedlings.
Fertilizer (kg/ha)	N=125; P=90; and K= 90 kg/ha; divide in 3 applications, at first, second, and third months after transplanting.
Labor (man-day/ha)	120
On-farm Water Management	Irrigation water applied on defined schedule based on crop water requirements. Avoid deficits and excess of soil moisture.
Insects & Diseases Control	Extensive use of Integrated Pest Management will be introduced, including planting date, use of more resistant varieties, adequate care of seedlings, appropriate planting dates, weed control, etc. Use about 10 kg/ha of pesticides divided in 5 applications.

Table 27 Labor Balance Under With Project Condition

(1) Proposed Cropping Pattern

Unit: ha planted/month

Crop	Area (ha)	Unit: ha planted/month											
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Cassava	220	220	220	183	110	37		37	110	183	220	220	220
Pigeon pea	140				70	140	140	70					
Tomato	250	187	250	250	187	21							21
Tomato (inter-cropping)	640	428	640	640	428	54							54
Pepper	180	174	180	190	174	83							83
Pepper (inter-cropping)	125	114	125	175	114	41							41
Melon 1	100	92	100	87	8								33
Melon 2	100				40	100	60	40					
Melon 1 (inter-cropping)	105	87	105	70	8								35
Melon 2 (inter-cropping)	105				45	105	60	45					
Corn	100							25	75	100	100	75	25
Bean	60	20	55	60	40	5							
Rice 1	20							7	18	20	20	18	7
Rice 2	20	7	18	20	20	18	7						
Sweet Potato	450						75	225	375	450	375	225	75
Sweet Potato (inter-cropping)	100						17	50	83	100	83	50	17
Eggplant	30	28	30	30	28	10							10
Eggplant (inter-cropping)	90	84	90	90	84	30							30
Plantain (Replant 20 %)	910	910	910	910	910	910	910	910	75	195	435	660	660
Plantain (Maintenance 80%)	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640
Banana (Replant 20 %)	34	34	34	34	34	34	34	34	34	34	14	24	34
Banana (Maintenance 80 %)	136	136	136	136	136	136	136	136	136	136	136	136	136
Papaya (Replant 50%)	120	120	120	120	120	120	120	120	120	120	120	25	75
Papaya (Maintenance 50%)	120	120	120	120	120	120	120	120	120	120	120	120	120
Total													

(2) Monthly Labor Requirement

Unit: man-day/month

Crop	Area (ha)	Unit: man-day/month												TOTAL	per ha	
		Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct			
Cassava	220	3,099	2,735	1,952	888			848	2,428	3,362	3,397	3,030	2,854	24,583	112	
Pigeon pea	140				1,134	2,172	2,228	1,190						6,724	48	
Tomato	250	5,785	8,222	9,239	5,215	847								742	30,050	120
Tomato (inter-cropping)	640	7,630	10,788	12,237	11,716	2,162								1,001	50,534	79
Pepper	190	5,394	6,482	7,053	5,246	1,182	160							1,887	27,384	144
Pepper (inter-cropping)	125	1,871	2,283	2,690	2,216	785	84							518	10,407	83
Melon 1	100	2,622	2,663	2,326	204									1,066	9,001	90
Melon 2	100				1,328	2,786	2,674	2,166							8,964	90
Melon 1 (inter-cropping)	105	1,375	1,953	2,159	269									567	6,328	60
Melon 2 (inter-cropping)	105				729	1,449	2,144	2,010							6,332	60
Corn	100							450	1,211	1,349	1,211	985	355	5,567	56	
Bean	60	648	1,555	1,236	687	83								4,207	70	
Rice 1	20							396	872	431	558	492	82	2,591	130	
Rice 2	20	358	672	431	558	492	82							2,591	130	
Sweet Potato	450						1,590	4,170	5,925	7,020	8,350	4,805	1,920	31,390	70	
Sweet Potato (inter-cropping)	100						187	414	482	721	896	845	435	3,960	40	
Eggplant	30	852	685	607	418									448	3,108	104
Eggplant (inter-cropping)	90	2,860	2,055	1,821	1,254									1,350	9,340	2326
Plantain (Replant 20 %)	910	14,348	13,389	12,260	13,490	9,037	7,633	6,163	8,291	5,504	10,697	13,839	16,486	131,155	144	
Plantain (Maintenance 80%)	3,640	14,888	14,888	43,134	49,977	38,784	44,590	34,889	53,817	43,425	28,536	38,184	20,129	420,821	116	
Banana (Replant 20 %)	34	516	519	454	442	338	314	245	207	154	551	517	857	4,914	145	
Banana (Maintenance 80 %)	136	556	554	1,612	1,887	1,374	1,868	1,296	2,003	1,622	991	1,427	752	15,722	116	
Papaya (Replant 50%)	120	1,591	1,485	1,449	1,278	880	599	980	1,388	2,777	1,274	1,700	2,244	17,625	147	
Papaya (Maintenance 50%)	120	2,184	1,880	1,580	1,452	1,380	1,579	492	300	1,388	1,388	1,388	1,388	16,199	135	
Total Monthly Labor Requirement		66,871	72,595	107,240	100,457	61,721	85,530	55,469	78,504	67,753	53,855	87,012	54,889	849,697		
Estimated Available Farm Household Labor		225,000	225,000	225,000	225,000	225,000	225,000	225,000	225,000	225,000	225,000	225,000	225,000			
Balance of Farm Household Labor		158,329	152,404	117,760	124,543	163,279	159,470	169,531	146,496	157,247	171,145	157,988	170,111			

Table 28 Project Design Matrix of Irrigation Project

Comprehensive Irrigation Water Management Project		Project Area : Cropping area situated in the downstream of Sistema de Obras and served by the Yaque del Sur river except OEA area	
Target group : Farmers		Means of Verification	
Narrative Summary		Important Assumptions	
Overall Goal Increase of water availability and crop production	In Year 2010, 90 % of the project area is irrigated.	Yaque del Sur Irrigation district and Barahona Regional Office of Ministry of Agriculture	Government policy in crop production is not changed. Agricultural support and extension services are assured.
Project Purpose Water is efficiently used.	Irrigation efficiency is 47 %.	Records of water distribution and cropping area	
Outputs A-1. Farmers positively participate in O&M and pay water charge having a sense of solidarity and cooperation. A-2. Operation staffs properly execute water management. B-1. Water can be distributed smoothly. B-2. Maintenance is properly executed.	A-1. More than 90% of farmers join to WUA and more than 80% pay water charges. A-2. Water distribution schedule is properly made and water is supplied within 20 % error in comparison with the scheduled amount. B-1. Within 15% error in the time required for water delivery compared with the design. B-2. Operation rate of maintenance equipment is over 70%.	A-1. Member list of WUA and records of payment. A-2. Monitoring and field inspection B-1. Field monitors. B-2. Maintenance records and field inspection	
C. Operation of water diversion can be easily made at Villar Pardo.	C. Gates can be smoothly operated.	C. Maintenance records and field test.	Priority of water allocation = 1. Drinking, 2. Irrigation, 3. Power generation - is not changed.
D. Water management is timely and precisely executed in consideration of storage, flow, supply, and demands under the promise of activities of item C.	D. River flow is not lowered by 10 % of water demands at Santana.	D. Gate operation records and discharge records of both Villar Pardo and Santana and water diversion schedule at Santana	The year is not a severe drought year. Other irrigation systems are also properly operated.
Activities A-1. To carry out the activities for farmers to understand the project and their duty and right in the project. A-2. To prepare Bylaw, water rules & distribution manual. A-3. To organize farmers and establish water users organization. A-4. To prepare operation and maintenance manuals and provide training in accordance with the O&M manuals. A-5. To purchase vehicles for operation activities. A-6. To check and instruct farmers and technical staffs to keep rules in their field activities. B-1. To improve irrigation facilities. B-2. To provide regulation ponds. B-3. To purchase maintenance equipment. B-4. To prepare operation and maintenance manuals and provide training in accordance with the O&M manuals. C-1. To provide sluice gates to supply Yaque del Sur. C-2. To replace intake and sand flush gates with new gates. C-3. To provide training on O&M. D-1. To establish a new water management office. D-2. To purchase office instrument and vehicles. D-3. To introduce a telemetering system. D-4. To make a training program and train staffs for river water management. D-5. To establish demand-oriented water management	Project Features and Inputs Project implementation period: 5 years Milestones: - Expanding organization - Project manager, a construction management engineer, construction supervisors, surveyors, design engineers, a metal work engineer and an electric engineer. An institutional expert, organizers and the residents, O&M experts, local government staff, extension officers, leading farmer, etc. Consultant and Experts A. team leader, a construction management engineer, design engineers, an institutional expert, O&M expert, a river water Project costs Irrigation & drainage development only: ROS xxxxxxx in total O&M costs Irrigation & drainage only: ROS 6 million/year.	Farmers who are illiterate (the rate is about 40%) is educated. Local government positively cooperates the Project to establish WUA. Farmers do not oppose the land acquisition. Farmers participate to the project.	

Note : Item D -1 to D-5 of the above activities belongs to the Overall Water Management Plan presented in Section 7.4.

Table 29 Proposed Rural Water Supply System

Name of Water Supply System	Bombita	Los Robres	Altagracia
Water Source	Proposed Main Canal at Night Storage Pond No. 5	Yaque del Sur River	Proposed Main Canal at Night Storage Pond No. 7
Designed beneficiary (Estimated Population in 2018)	2,000	500	1,600
Nos. of Families	465	116	372
Beneficiaries per faucet	4.3	4.3	4.3
Averaged daily water requirement	125 lit/day/person	125 lit/day/person	125 lit/day/person
Max. daily water requirement	190 lit/day/person 380 m ³ /day	190 lit/day/person 95 m ³ /day	190 lit/day/person 304 m ³ /day
Design Discharge lit/sec	4.4 lit/sec	1.1 lit/sec	3.52 lit/sec
LWL of pond / river at intake	11.80	10.50	8.00
HWL of pond / river at intake	13.30	15.50	9.50
Intake pump, Design discharge	260 lit/min	66 lit/min	210 lit/min
Design head	2.4 m	7.4 m	6.1 m
Treatment Plant	Settling basin + Filtration gallery + Chlorination	Settling basin + Filtration gallery + Chlorination	Settling basin + Filtration gallery + Chlorination
Filtration Gallery	10m(L) x 7.6m(W) x 2.9m(D)	5m(L) x 3.8m(W) x 2.9m(D)	8m(L) x 7.6m(W) x 2.9m(D)
Discharge pump, Design discharge	260 lit/min	66 lit/min	210 lit/min
Design head	14.1 m	19.4 m	13.1 m
Discharge pipe, Length	280 m	350 m	1,300 m
Elevated water tank, Capacity	200 m ³	48 m ³	150 m ³
Height	13.1 m	11.4 m	13.5 m
Distribution pipe	φ 4", φ 2"	φ 2"	φ 4", φ 2"

Table 30 Project Cost

Project	Cost [DR\$ 1000]		
	F/G	L/C	Total
(1) Agriculture and Agricultural Support Services Plan			
A - Direct Construction Cost			
- Project for Strengthening Research and Extension Service	2,206	23,163	25,370
- Project for Strengthening Credit Services	1,015	18,411	19,426
- Agricultural Cooperative Model Project and Market Information System Project	3,334	7,035	10,370
Total of (A)	6,556	48,610	55,165
B - Operation and Maintenance Equipment			
C - Consulting Service	983	7,291	8,275
D - Administrative Cost	328	2,430	2,758
E - Physical Contingency	787	5,833	6,620
Total (A) + (B) + (C) + (D) + (E)	8,653	64,165	72,818
(2) Overall Water Management Plan			
A - Direct Construction Cost			
- Yaque del Sur River Water Management Center Project	160,444	40,111	200,555
Total of (A)	160,444	40,111	200,555
B - Operation and Maintenance Equipment			
C - Consulting Service	4,813	1,203	6,017
D - Administrative Cost	3,209	802	4,011
E - Physical Contingency	16,847	4,212	21,059
Total (A) + (B) + (C) + (D) + (E)	185,313	46,328	231,641
(3) Irrigation Development and Water Management in the Field Improvement Plan			
A - Direct Construction Cost			
- Preparatory Works	17,972	6,610	24,582
- Villarpando HW	11,472	4,389	15,861
- Main Canal System (canal work)	62,731	24,410	87,141
- Main Canal structures	17,427	5,791	23,218
- Regulation Ponds	53,374	12,886	66,260
- Lateral Canal	174,077	65,026	239,103
- Siphon	24,400	12,395	36,795
- Santana Headworks	11,607	6,655	18,262
- Drainage (lateral level, total 7 km)	4,348	865	5,013
Total of (A)	377,408	138,827	516,235
B - Operation and Maintenance Equipment	897	897	1,794
C - Consulting Service	58,611	20,824	77,435
D - Administrative Cost	18,870	6,941	25,812
E - Land Acquisition and Compensation		18,249	18,249
F - Physical Contingency	45,379	18,574	63,952
Total (A) + (B) + (C) + (D) + (E) + (F)	499,165	204,312	703,477
(4) Rural Infrastructure Improvement Plan			
A - Direct Construction Cost			
- Rural water supply	9,189	5,730	14,919
- Project for community center	8,832	2,208	11,040
Total of (A)	18,021	7,938	25,959
B - Operation and Maintenance Equipment			
C - Consulting Service	2,703	1,191	3,894
D - Administrative Cost	901	397	1,298
E - Physical Contingency	2,163	953	3,115
Total (A) + (B) + (C) + (D) + (E)	23,788	10,478	34,266
(5) Environmental Conservation Plan			
A - Direct Construction Cost			
- Greenbelt formation project for waterfront conservation		609	609
- Environmental monitoring program in Rincon Lagoon	1,390	882	2,272
Total of (A)	1,390	1,491	2,881
B - Operation and Maintenance Equipment			
C - Consulting Service	209	224	432
D - Administrative Cost	70	75	144
E - Physical Contingency	167	179	346
Total (A) + (B) + (C) + (D) + (E)	1,835	1,967	3,802
Total ; (1)+(2)+(3)+(4)+(5)	718,754	327,251	1,046,005

Table 32 Crop Budget With and Without Project Conditions

(unit:DR\$/ha)

	Without Project Condition			With Project Condition		
	Gross Income	Production Cost	Net Income	Gross Income	Production Cost	Net Income
Economic Crop Budget						
Plantain	62,730	9,800	52,930	82,246	13,790	68,456
Tomato	68,150	14,910	53,240	97,359	17,090	80,269
Sweet Potato	49,040	9,860	39,180	69,480	11,210	58,270
Cassava	31,600	9,950	21,650	58,340	11,570	46,770
Rice	19,360	16,680	2,680	39,600	20,340	19,260
Bean	13,050	8,710	4,340	21,750	11,710	10,040
Pigeon Peas	13,640	5,960	7,680	27,280	6,450	20,830
Eggplant	69,830	12,250	57,580	93,100	14,010	79,090
Corn	7,870	4,820	3,050	12,240	6,990	5,250
Melon	79,200	24,180	55,020	105,600	28,210	77,390
Sweet Pepper	78,650	13,400	65,250	108,900	15,990	92,910
Papaya	131,795	15,485	116,310	156,900	16,800	140,100
Banana	27,770	9,980	17,790	40,724	14,192	26,532

Table 33 Irrigation Benefit in the Full Stage

	(unit:DRS/ha)							
	Without Project Condition				With Project Condition			
	Net income per ha	Cultivated area (ha)	net income (RD\$)	Net income per ha	Cultivated area (ha)	Total net income (RD\$)	Irrigation benefit (DR\$)	
Plantain	52,930	3,430	181,549,900	68,456	4,550	311,474,800		
Tomato	53,240	120	6,388,800	80,260	250	20,065,000		
Sweet Potato	39,180	20	783,600	58,270	450	26,221,500		
Cassava	21,650	160	3,464,000	46,770	220	10,289,400		
Rice	2,680	20	53,600	19,260	40	770,400		
Bean	4,340	50	217,000	10,040	60	602,400		
Pigeon Peas	7,680	10	76,800	20,830	140	2,916,200		
Eggplant	57,580	15	863,700	79,090	30	2,372,700		
Corn	3,050	70	213,500	5,250	100	525,000		
Melon	55,020	115	6,327,300	77,390	200	15,478,000		
Sweet Pepper	65,250	140	9,135,000	92,910	190	17,652,900		
Papaya	116,310	110	12,794,100	140,100	240	33,624,000		
Banana	17,790	170	3,024,300	26,532	170	4,510,440		
Total		4,430	224,891,600		6,640	446,502,740	221,611,140	

Table 34 Rural Water Supply Benefit

Year	Population			Family			Total	Benefit (RDS/lit.)
	Bombita	Los Robres	Altagracia	Bombita	Los Robres	Altagracia		
1	1,133	358	876	263	83	204	550	
2	1,167	362	902	271	84	210	565	
3	1,202	367	929	280	85	216	581	
4	1,238	372	957	288	86	222	597	
5	1,275	377	985	297	88	229	613	3,736,666
6	1,313	381	1,015	305	89	236	630	5,934,564
7	1,353	386	1,045	315	90	243	648	6,098,400
8	1,393	391	1,077	324	91	250	665	6,266,966
9	1,435	397	1,109	334	92	258	684	6,440,402
10	1,478	402	1,142	344	93	266	703	6,618,852
11	1,523	407	1,177	354	95	274	722	6,802,463
12	1,568	412	1,212	365	96	282	742	6,991,388
13	1,615	418	1,248	376	97	290	763	7,185,785
14	1,664	423	1,286	387	98	299	784	7,385,813
15	1,714	428	1,324	399	100	308	806	7,591,640
16	1,765	434	1,364	411	101	317	829	7,803,438
17	1,818	440	1,405	423	102	327	852	8,021,382
18	1,873	445	1,447	436	104	337	876	8,245,654
19	1,929	451	1,490	449	105	347	900	8,476,442
20	1,987	457	1,535	462	106	357	925	8,713,937
21	2,046	463	1,581	476	108	368	951	8,713,937
22	2,108	469	1,629	490	109	379	978	8,713,937
23	2,171	475	1,678	505	110	390	1,005	8,713,937
24	2,236	481	1,728	520	112	402	1,034	8,713,937
25	2,303	488	1,780	536	113	414	1,063	8,713,937
26	2,372	494	1,833	552	115	426	1,093	8,713,937
27	2,443	500	1,888	568	116	439	1,124	8,713,937
28	2,517	507	1,945	585	118	452	1,155	8,713,937
29	2,592	513	2,003	603	119	466	1,188	8,713,937
30	2,670	520	2,063	621	121	480	1,222	8,713,937
31	2,750	527	2,125	640	123	494	1,256	8,713,937
32	2,833	534	2,189	659	124	509	1,292	8,713,937
33	2,918	541	2,254	679	126	524	1,329	8,713,937
34	3,005	548	2,322	699	127	540	1,366	8,713,937
35	3,095	555	2,392	720	129	556	1,405	8,713,937
36	3,188	562	2,464	741	131	573	1,445	8,713,937
37	3,284	569	2,537	764	132	590	1,486	8,713,937
38	3,382	577	2,614	787	134	608	1,528	8,713,937
39	3,484	584	2,692	810	136	626	1,572	8,713,937
40	3,588	592	2,773	834	138	645	1,617	8,713,937
41	3,696	599	2,856	860	139	664	1,663	8,713,937
42	3,807	607	2,942	885	141	684	1,711	8,713,937
43	3,921	615	3,030	912	143	705	1,760	8,713,937
44	4,039	623	3,121	939	145	726	1,810	8,713,937
45	4,160	631	3,214	967	147	748	1,862	8,713,937
46	4,285	639	3,311	996	149	770	1,915	8,713,937
47	4,413	648	3,410	1,026	151	793	1,970	8,713,937
48	4,545	656	3,512	1,057	153	817	2,027	8,713,937
49	4,682	665	3,618	1,089	155	841	2,085	8,713,937
50	4,822	673	3,726	1,121	157	867	2,145	8,713,937

Table 35 Cost and Benefit Flow

Year	Capital Cost		O&M Cost		Replacement Cost		Total Cost		Benefit		Net Cash Flow
	Water Management Center Project	Irrigation Project	Water Management Center Project	Irrigation Project	Water Management Center Project	Irrigation Project	Water Management Center Project	Irrigation Project	Water Management Center Project	Irrigation Project	
1	422	47,094					47,516				-47,516
2	8,025	57,278					65,303				-65,303
3	10,828	155,477	88	309			166,702				-166,702
4	9,188	178,002	383	1,337			209,143				-196,346
5	5,804	123,907	677	2,865	262		143,214				-81,401
6			866	3,027	404		4,297				112,822
7			866	3,027	409		4,302				158,777
8			866	3,027	414		4,307				181,863
9			866	3,027	419		4,312				198,325
10			866	3,027	425		4,318				217,160
11			866	3,027	431		4,324				223,906
12			866	3,027	436		4,329				224,084
13			866	3,027	442		4,335				224,267
14			866	3,027	448		4,341				224,456
15			866	3,027	455	2,830	7,178				221,818
16			866	3,027	461		4,354				224,849
17			866	3,027	468		4,361				225,059
18			866	3,027	475		4,368				225,264
19			866	3,027	482		4,375				225,482
20			866	3,027	489		4,382				225,705
21			866	3,027	489		4,382				225,943
22			866	3,027	489		4,382				225,943
23			866	3,027	489		4,382				225,943
24			866	3,027	489	2,830	13,210				217,115
25			866	3,027	489		4,382				225,943
26			866	3,027	489		4,382				225,943
27			866	3,027	489		4,382				225,943
28			866	3,027	489		4,382				225,943
29			866	3,027	489		4,382				222,405
30			866	3,027	489		7,920				222,405
31			866	3,027	489	3,538	11,458				225,943
32			866	3,027	489		4,382				225,943
33			866	3,027	489		4,382				225,943
34			866	3,027	489		4,382				225,943
35			866	3,027	489		4,382				225,943
36			866	3,027	489		4,382				225,943
37			866	3,027	489		4,382				225,943
38			866	3,027	489		4,382				225,943
39			866	3,027	489		4,382				225,943
40			866	3,027	489		4,382				225,943
41			866	3,027	489		4,382				225,943
42			866	3,027	489		4,382				225,943
43			866	3,027	489		4,382				225,943
44			866	3,027	489		4,382				225,943
45			866	3,027	489	2,830	7,212				225,943
46			866	3,027	489		4,382				225,943
47			866	3,027	489		4,382				225,943
48			866	3,027	489		4,382				225,943
49			866	3,027	489		4,382				225,943
50			866	3,027	489		10,360				219,945

IRR: 23.0%

Table 36 Farm Budget With Project Condition for Three Farm Size Groups in the Project Area

Farm Size		Small	Medium	Large	
Item	(Unit)				
(1) Family Size	No.	5	5	4	
(2) Range of Farm Size (1)	(ha)	0.3 to 1.0	1.1 to 2.0	More than 2.0	
(3) Average Farm Size (1)	(ha)	0.61	1.3	4.3	
(4) Average Crop Production (2)	(ton)				
1	Plantain	9.39	20.02	66.21	
2	Tomato	2.76	5.89	19.48	
3	Sweet potato	0.96	2.06	6.80	
4	Melon	1.71	3.64	12.04	
5	Pepper	0.59	1.26	4.18	
6	Papaya	1.30	2.77	9.17	
7	Cassava	0.27	0.58	1.91	
8	Banana	0.53	1.13	3.73	
9	Pigeon pea	0.04	0.09	0.31	
10	Corn	0.03	0.06	0.20	
11	Bean	0.01	0.02	0.06	
12	Eggplant	0.24	0.52	1.72	
13	Rice	0.02	0.04	0.14	
(5) Agricultural Income	(RD \$)	64,013	136,422	451,243	
1	Plantain	35,035	74,666	246,971	
2	Tomato	8,967	19,110	63,209	
3	Sweet potato	3,942	8,400	27,785	
4	Melon	4,509	9,610	31,786	
5	Pepper	3,587	7,645	25,287	
6	Papaya	4,081	8,697	28,768	
7	Cassava	1,317	2,806	9,283	
8	Banana	612	1,303	4,311	
9	Pigeon pea	399	851	2,815	
10	Corn	127	271	895	
11	Bean	133	283	935	
12	Eggplant	1,136	2,421	8,007	
13	Rice	169	360	1,192	
(6) Non-Agricultural Income (3)	(RD \$)	11,500	11,500	0	
(7) Total Income (5)+(6)	(RD \$)	75,513	147,922	451,243	
(8) Production Costs	(RD \$)	8,997	25,147	96,030	
	Farm Materials	7,650	16,400	53,910	
	Paid Labor	0	5,916	30%	32,612 50%
	Other costs	1,347	2,831	9,512	
(9) Living Expenditure (4)	(RD \$)	44,616	74,035	100	145,275 100
	Food	24,960	34,450	55.9	55,640 38.3
	Alcohol Beverages	2,275	4,940	5.1	10,400 7.2
	Water supply	260	390	0.6	780 0.5
	Housing	3,900	7,800	8.7	16,380 11.3
	Clothing	2,340	3,900	5.2	8,840 6.1
	Health care/Medicine	2,925	8,060	6.6	17,160 11.8
	Education	1,950	2,860	4.4	5,200 3.6
	Electricity	1,183	1,560	2.7	2,340 1.6
	Cooking Gas	1,118	1,235	2.5	1,235 0.9
	Transportation	1,105	3,250	2.5	13,000 8.9
	Gifts	1,300	2,340	2.9	6,500 4.5
	Others	1,300	3,250	2.9	7,800 5.4
(10) Total Expenditure (8+9)	(RD \$)	53,613	99,182	241,305	
(11) Balance (7-10)	(RD \$/year)	21,900	48,740	209,940	

Notes: (1) Based on INDRHF's data, the percentage distribution of farm size in the Project Area is estimated at about 51.6% small farms, 35.8% medium farms, and 12.6% large farms

(2) Target Yield With Project Condition.

(3) Non-agricultural income With Project is assumed same as Without Project conditions

(4) Living Expenditure under With Project Condition was estimated by increasing Living Expenditure under present condition by 30% (1.3 times)

Table 37 Results of Case studies for Water User' Organization Project on Social Change

Study Item	Sun Juan (Junta de Regante Presa Sabaneta)	Azua (Junta de Regante YSURA)
Outline of WUO	Area: 13,045ha No. of user: 3,404 established in 1994	Area: 7,555ha No. of user: 4,683 established in 1987
Parentage of Water Charge Payment	95/96 96/97 97/98 46% 52% 60%	95/96 96/97 97/98 49% 58% 72%
Function of Organization 1) and Election	The Association works better than that of Azua to distribute water. Users pay charge for its administration. There is election in each 2 years in all level of organization.	In the level of the Irrigation committee and Association, there is a election in each 2 years. In the level of Committee and Nucleus, the election can be held every year.
Meeting	Members of Committee have a meeting in every 2 weeks. In the level of Association and Irrigation Committee, meeting is held in same frequency. In the meeting, they sometimes discuss about agricultural technique. Normally in drought season, meetings are held more frequently.	Normally in the level of Nucleus and Association, a meeting is held once a month. But in drought season, it is held once a week or more. Members of Irrigation Committee meet every morning in the office.
Water Management and Collaborated Work	The key of intake gates is kept by a water distributor of each nucleus. The gates are managed by him. Cleaning of canals and management roads is done by all users several times in a year.	The key of intake gates is kept by a water distributor of each nucleus. The gates are managed by him. For example, in the Lateral 2 there are 33 distributors in Nucleus level. Cleaning of canals and management roads is done by all users 2 times in a year.
System to Resolve Problems	Problems of water distribution in the tertiary canal level, they are resolved by discussion between nucleuses. If problem in lateral or main canal level, discussion in higher level, Committee or Association, is held.	Problems of water distribution in the tertiary canal level, they are resolved by discussion between nucleuses. If problem in lateral or main canal level, discussion in Irrigation Committee is normally held.
Comparison of Water Management Condition between Before and After Set up the WUO	<ul style="list-style-type: none"> - Before set up the WUO, water distribution was sometimes determined by not democratic way, using bribe and influenced by political power. After the set up, the distribution has been determined through discussion among users. The water distribution is done fairly not depending on economical and political power of users. - Before set up the WUO, problems of robbery of water, conflict with violence between users, and bribery were usually happened. Now no or less such problems happen. The rural society has become more stable. - Before set up the WUO, for example in the Lateral 2 of Azua, only a distributor from the INDRHY managed. After the set up, since 33 distributors of nucleus take care the intake gates, water management has been able to done more efficiently. - Claim to government, such as INDRHY, is done more powerful than before, as a consequence of the organization. 	

Note: 1) The smallest unit of WUO is Nucleus which consist of 10 to 15 users, then Committee is formed of several nucleus. After that several committees form an Association. Finally several associations form Irrigation Committee (Junta Directiva). The field survey was conducted in the lateral 3 area in San Juan and in the lateral 2 area in Azua.

Table 38 Results of Environmental Assessment (1/2)

Project Name	Result of EIA
Irrigation Water Management Improvement Project	As the result of the study showing in (3) 7.3.3, the set up of the WUO will bring the change of the social characteristics and structure, and this social change will bring a positive impact for farmer's lifestyle and society. The water use condition will be better as a result of the set up of the WUO. Few negative impacts are foreseen.
Irrigation Facilities Improvement Project	Agricultural production will increase as a result of better water supply and the increase of the harvesting area from 4,430 ha to 7,805 ha. It will make the rural economy and farmer's activities more active. Concerning soil salinization, since the whole project area is already irrigated, drastic increase of salinization area by the project implementation will not occur. It is possible that in some areas, for example in Canoa area, salinization problems would decrease as a result of better water supply to the land. In the southern part of the project area, where the altitude is low, collocation of gates to prevent backwater from sea is necessary. Turbidity of river water occurs during the construction work at Santana Headworks, but it is a temporary and small impact. Countermeasures for expected impacts concerning water born diseases, and land use change are shown in (2) 7.3.3.
Villarpando Headworks Improvement Project	Water use condition will become better as a result of better management of water distribution. The water volume to distribute for Azua area will not change. Agricultural production will increase as a result of better water supply. It will make the rural economy and farmer's activities more active. Turbidity of river water occurs during the construction work at the Headworks, but it is a temporary and small impact.
River Water Management Reinforcement Project	Water use condition will become better as a result of better management of water distribution. The irrigation efficiency will change from about 30% to about 48%. Agricultural production will increase as a result of better water supply. It will make the rural economy and farmer's activity more active.
Project of Overall Water Management in Yaque del Sur River Basin	Water use condition will become better as a result of better management of water distribution. Agricultural production will increase as a result better water supply. It will make the rural economy and farmer's activity more active. Change in vegetation and land use will occur by the construction of the water management center at Canoa, Villarpando. But the center occupies a small area and the impact will be reduced by creation of wooded area around the center.
Project for Strengthening Agriculture Support Service	As the result of the research and extension project, the volume of pesticide use per hector in each crop and the total volume used in whole project area will reduce. The volume of fertilizer use per hector in each crop will increase for the purpose of increasing the production. But the efficiency of agrochemical use will become higher as the result of the extension and research project. It is possible that eutrophication of river water will be brought as a result of the increase of fertilizer use.
Rural Water Supply Project	In the project area, lack of water supply is a critical problem. In the project area, the number of beneficial household by this project in the target year (2018) is 960. Some cases of water born diseases such as diarrhea will be reduced. This project will bring positive impacts for rural life. The carry of water is now a task for women and children. Their burden will be reduced. The local people now buy water. So household condition will be improved by the project implementation.

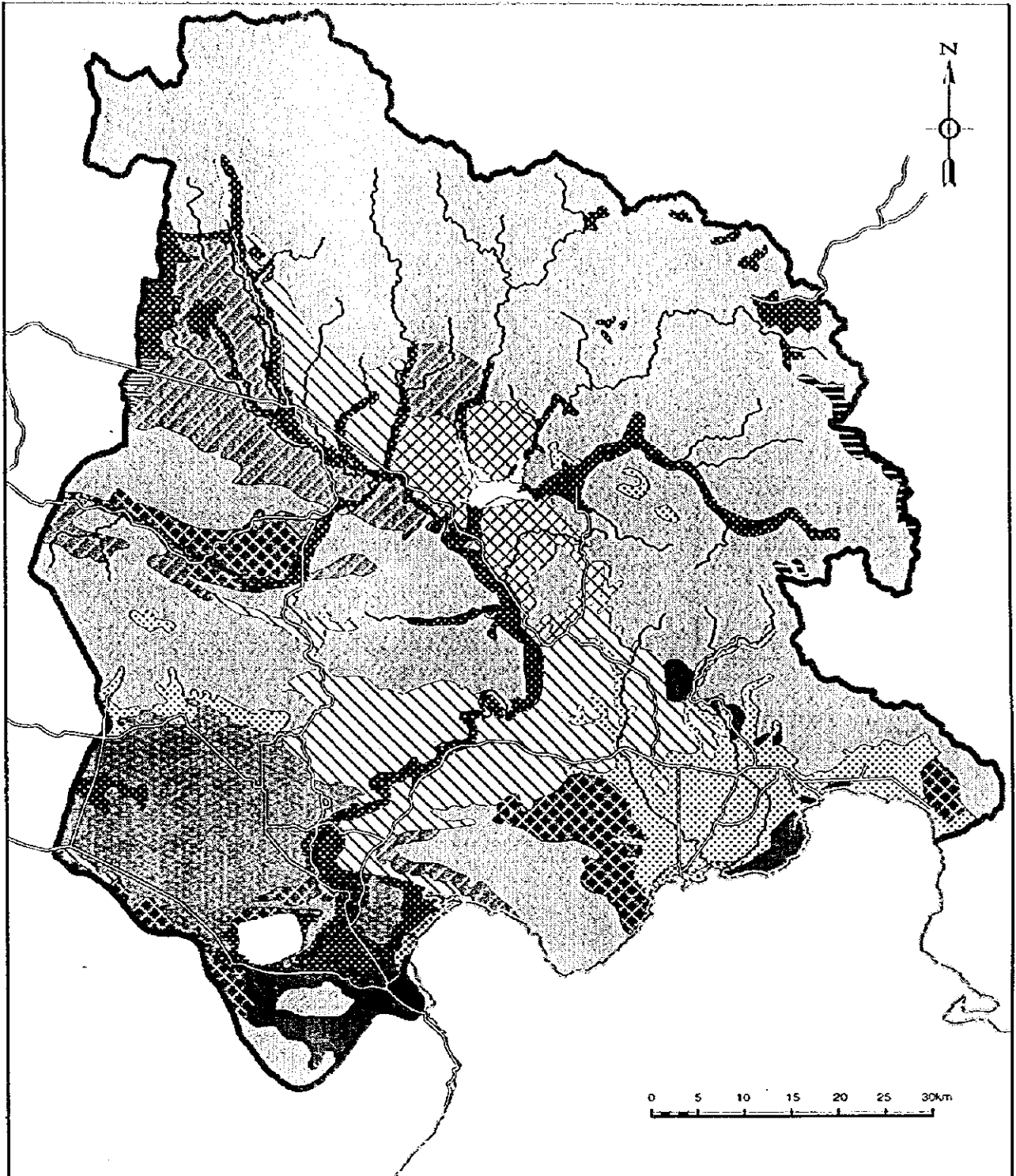
Table 38 Results of Environmental Assessment (2/2)

Project Name	Result of EIA
Community Hall Construction Project	The community hall supports social activities and social participation of the local people. The project will make social life and structure more active. Since the construction of the hall will cause land use change, appropriate compensation to the land owners is necessary.
Green Belt Formation for Waterfront Conservation	The creation of green area and recreation facility will make local people's life rich. While forest area will increase, agricultural lands along the river would reduce. In case that tree planting carries out in existing agricultural land, appropriate compensation to the land owners is necessary.
Environmental Monitoring Program in Rincon Lagoon	This is only environmental monitoring project, so it does not cause fiscal impact to the environment. The result of the monitoring will be useful for the conservation of wildlife and water environment in Rincon Lagoon.

Figures



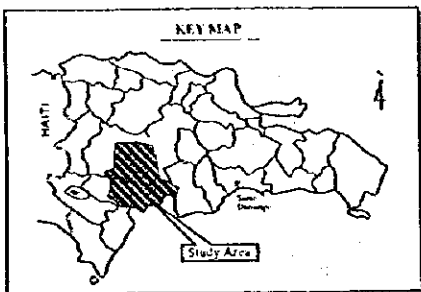
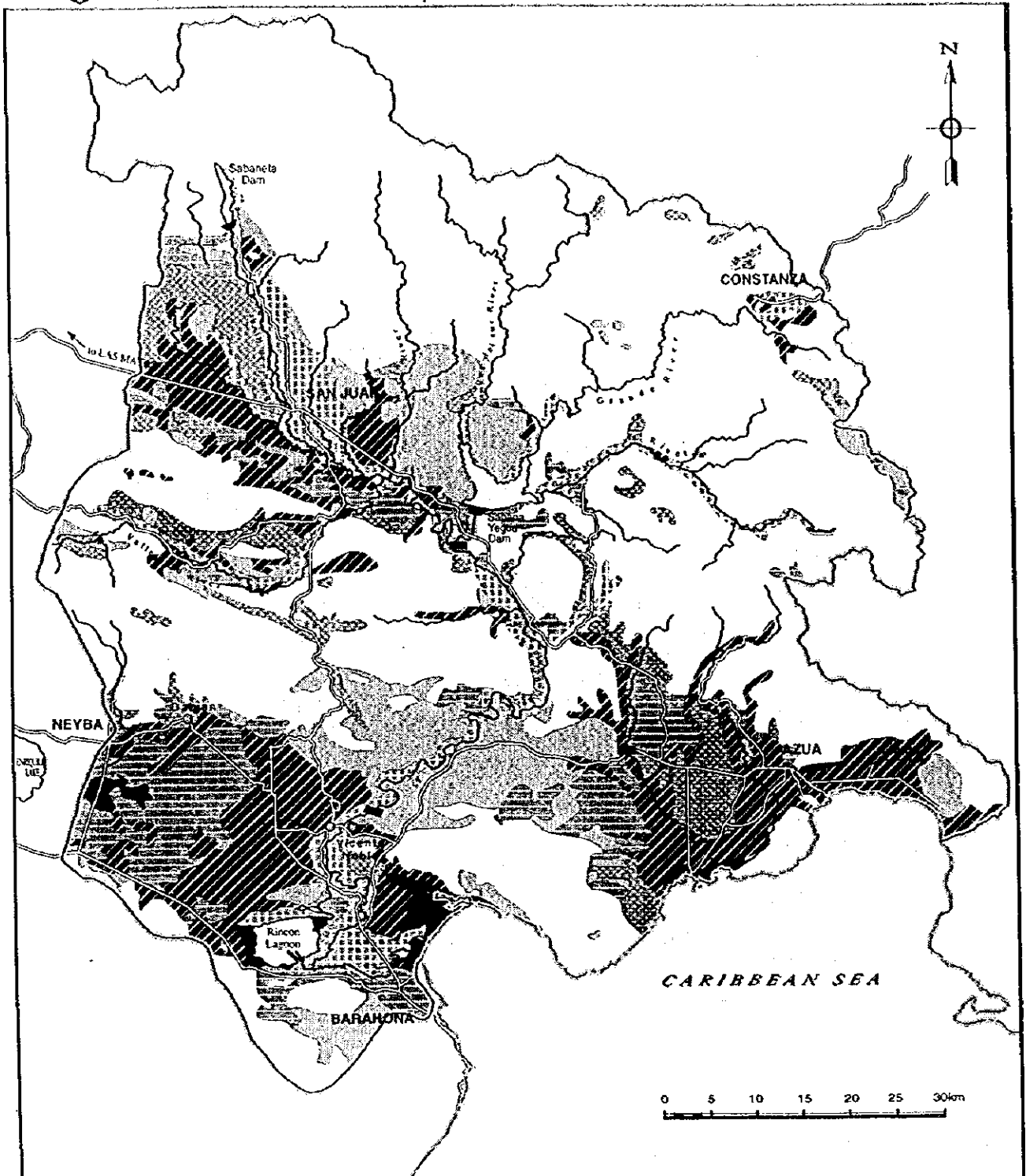
Fig. 1 Soil Association Map for Entire
Study Area



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Project Area	Asociacion Valle Nuevo	Asociacion Cacheo
Road	Asociacion San Juan Hatico	Asociacion Guama
River	Asociacion Quita Coraza	Asociacion Guanito Villarpando
	Asociacion Azua	Suelos Aluviales Recientes
	Asociacion Elias Pina-Las Matas	Cienagas Costera E Interior
	Asociacion La Jina-Yuma	Terreno Escabroso No Calizo Y Calizo
	Asociacion Los Bucaros	Logos Y Lagunas

Fig. 2 Land Capability Map



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Symbol	Description	Land Class	Area(km ²)	%
[Hatched Box]	Project Area	CLASE II	465	6.5
[Double Line]	Road	CLASE III	860	12.1
[Triangle]	Dam	CLASE IV	425	6.0
[Square]	Headworks	Sub-Total II to IV	1,750	24.6
[Wavy Line]	River	CLASE V	565	8.0
		CLASE VI	680	9.6
		CLASE VII	4,035	56.8
		CLASE VIII	70	1.0
		Sub-Total V to VIII	5,350	75.4
		Total	7,100	100

Fig. 3 Climatic Features in the Study Area

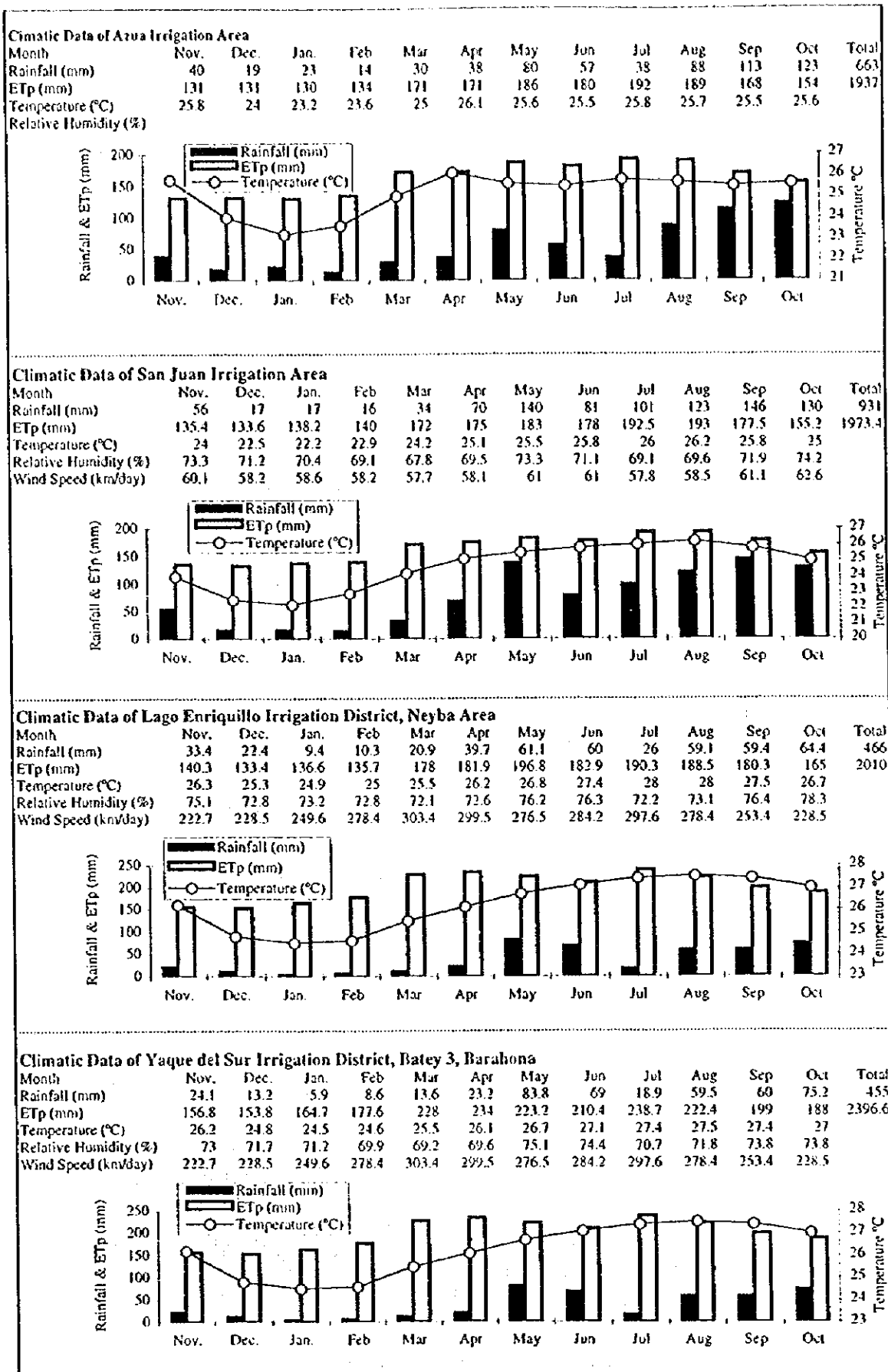
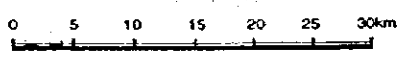
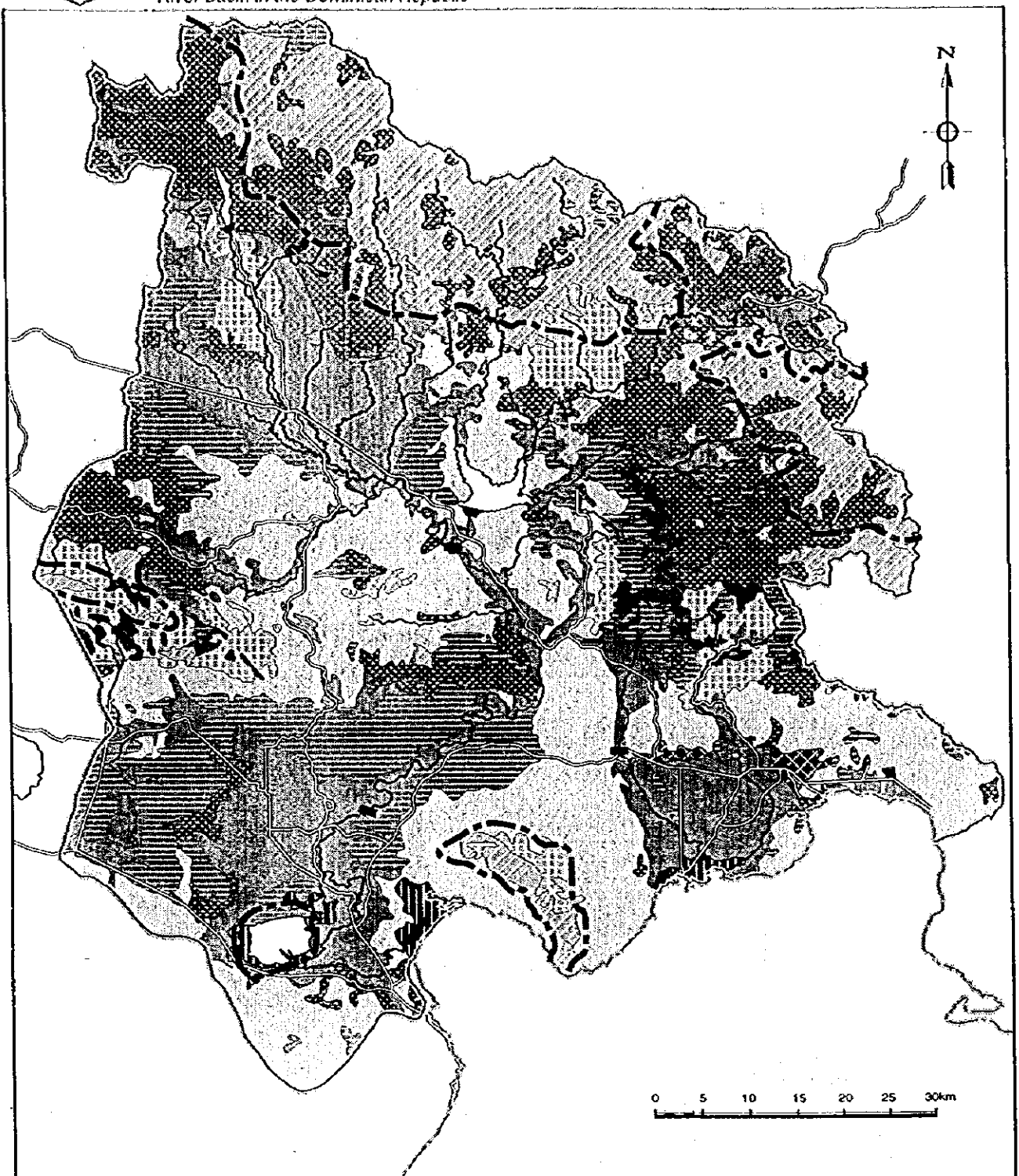




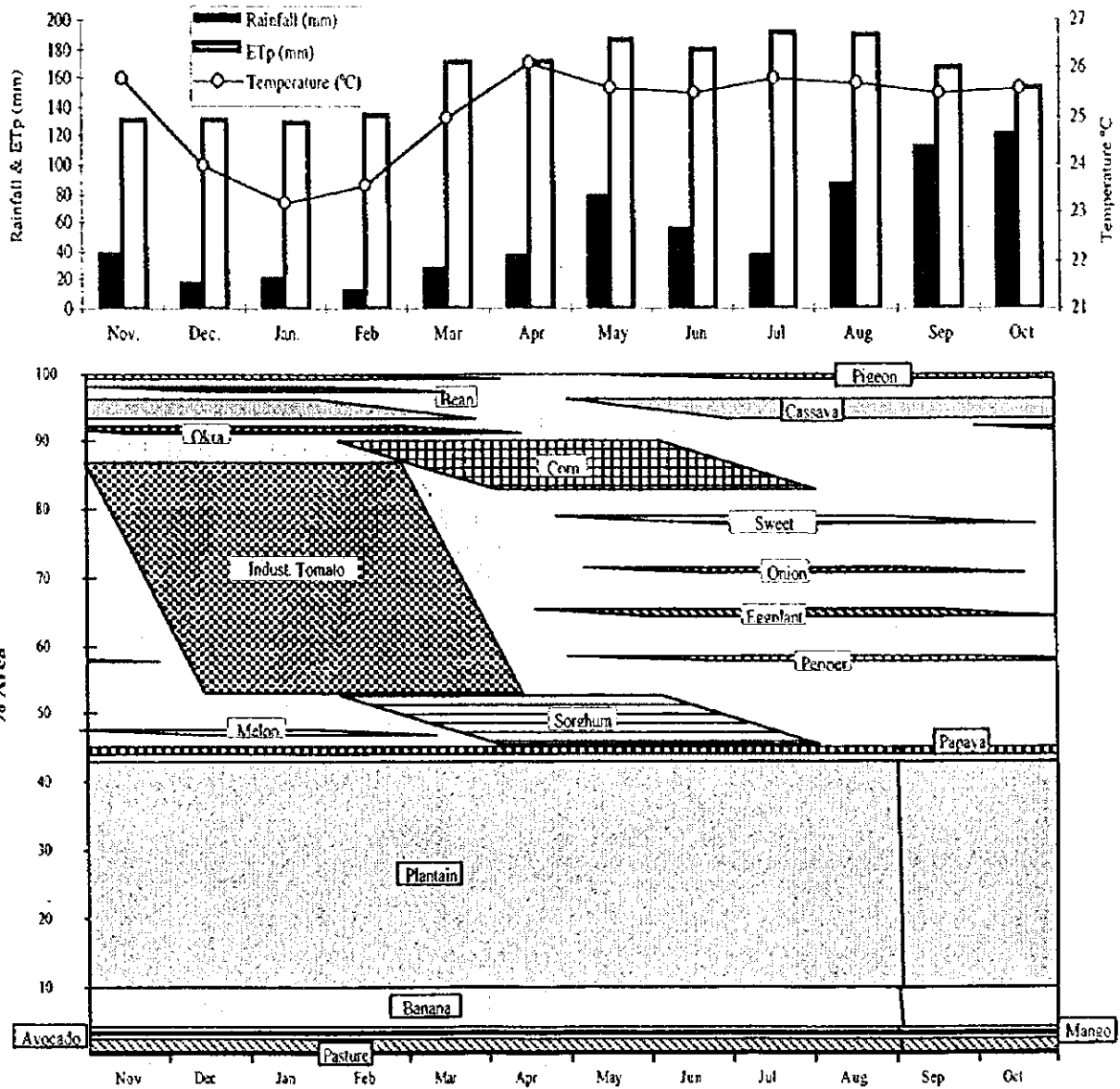
Fig. 4 Present Land Use Map of Study Area



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- | | | |
|---------------|---|----------------|
| Project Area | Irrigated Land | Bush and shrub |
| National Park | Rainfed Agriculture (Except Shifting Cultivation) | Wet land |
| Road | Shifting culture and natural pasture | Barren land |
| Dam | Dry land forest | Coffee |
| Headworks | Humidland forest | Urban Area |
| River | | |

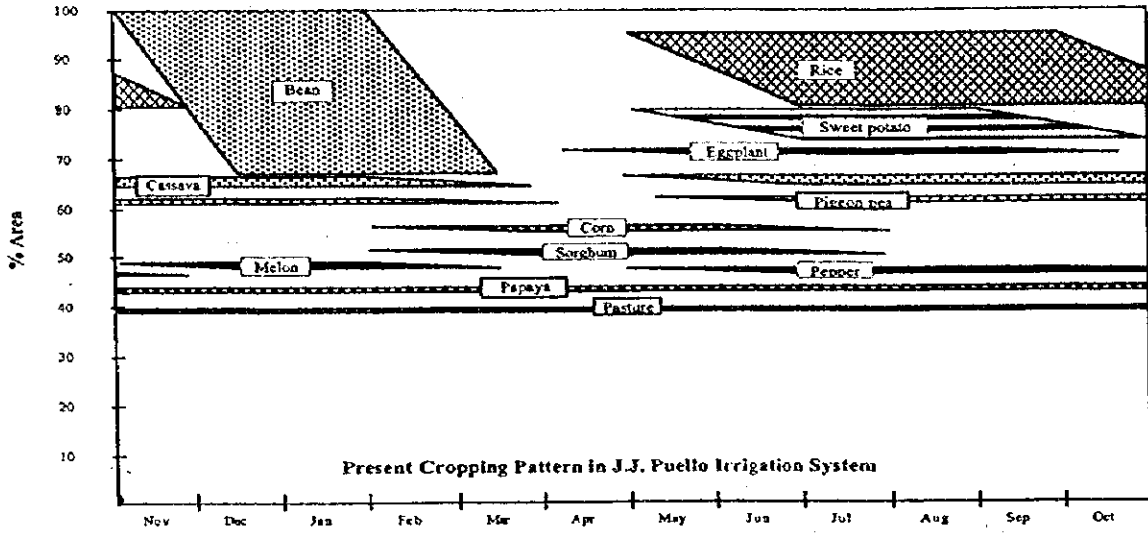
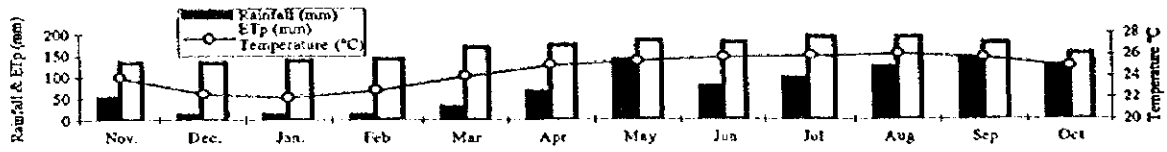
Fig. 5(1/3) Typical Cropping Pattern of Main Irrigation Systems (1 of 3)



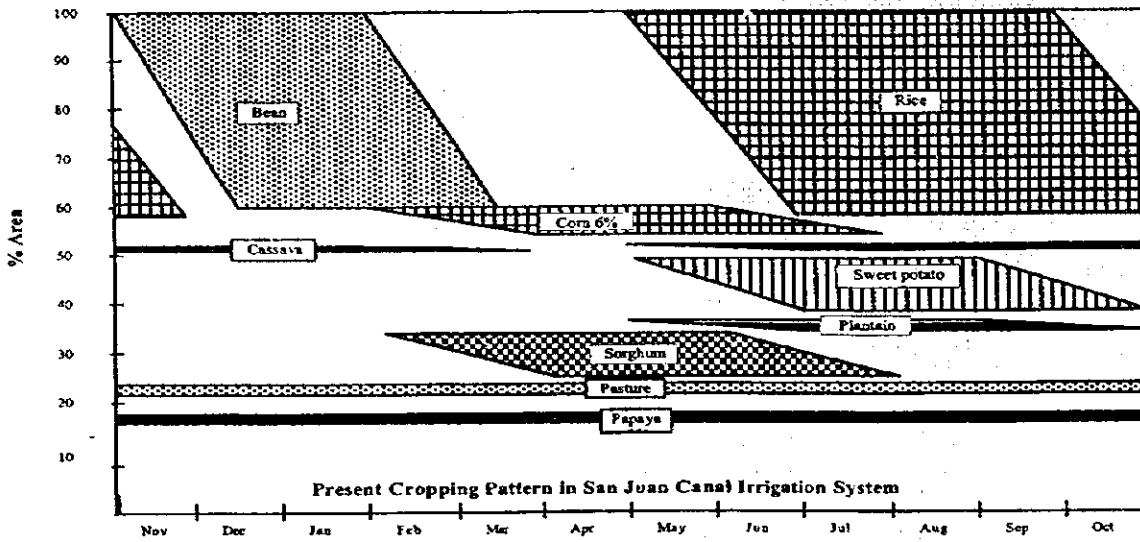
Typical Present Cropping Pattern of YSURA Irrigation System (Laterals 1 to 6), Azua Irrigation District



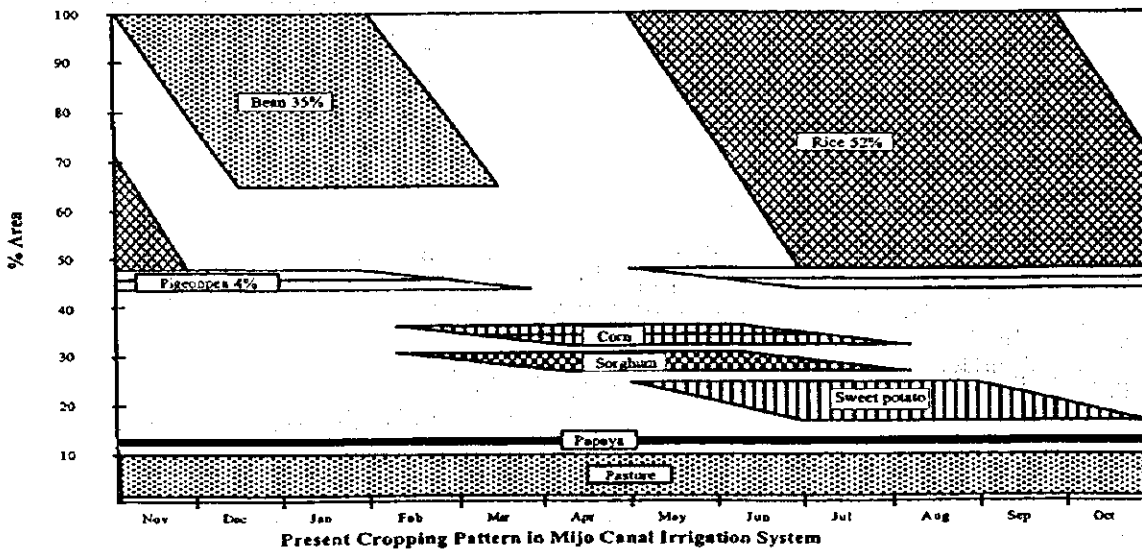
Fig. 5(2/3) Typical Cropping Pattern of Main Irrigation Systems (2 of 3)



Present Cropping Pattern in J.J. Puello Irrigation System



Present Cropping Pattern in San Juan Canal Irrigation System



Present Cropping Pattern in Mijo Canal Irrigation System



Fig. 5(3/3) Typical Cropping Pattern of Main Irrigation Systems (3 of 3)

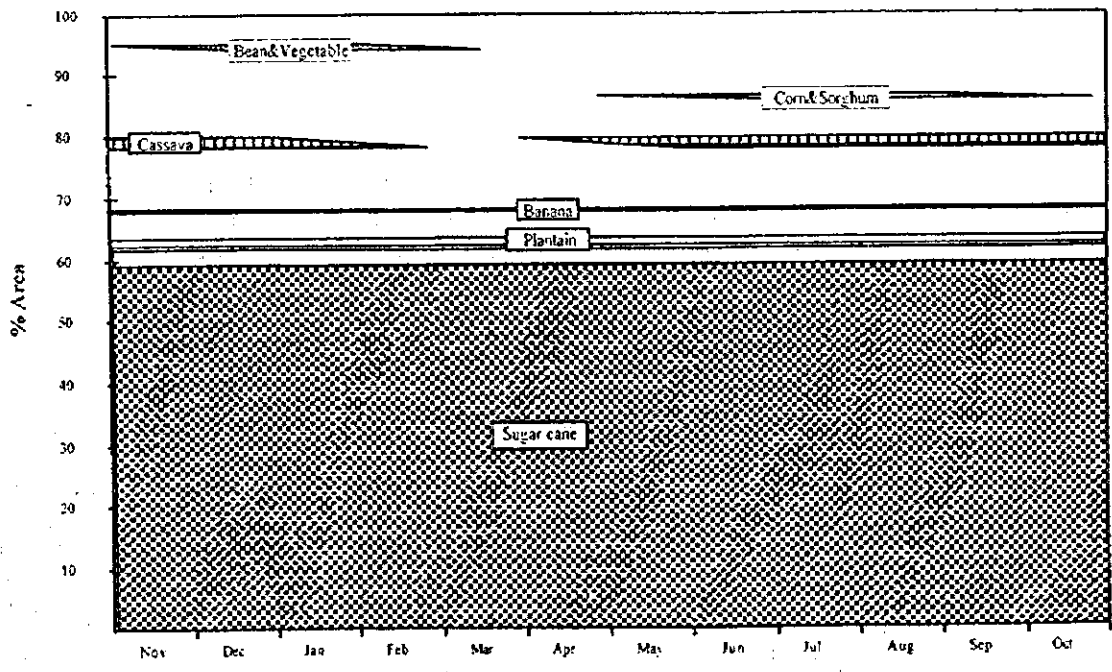
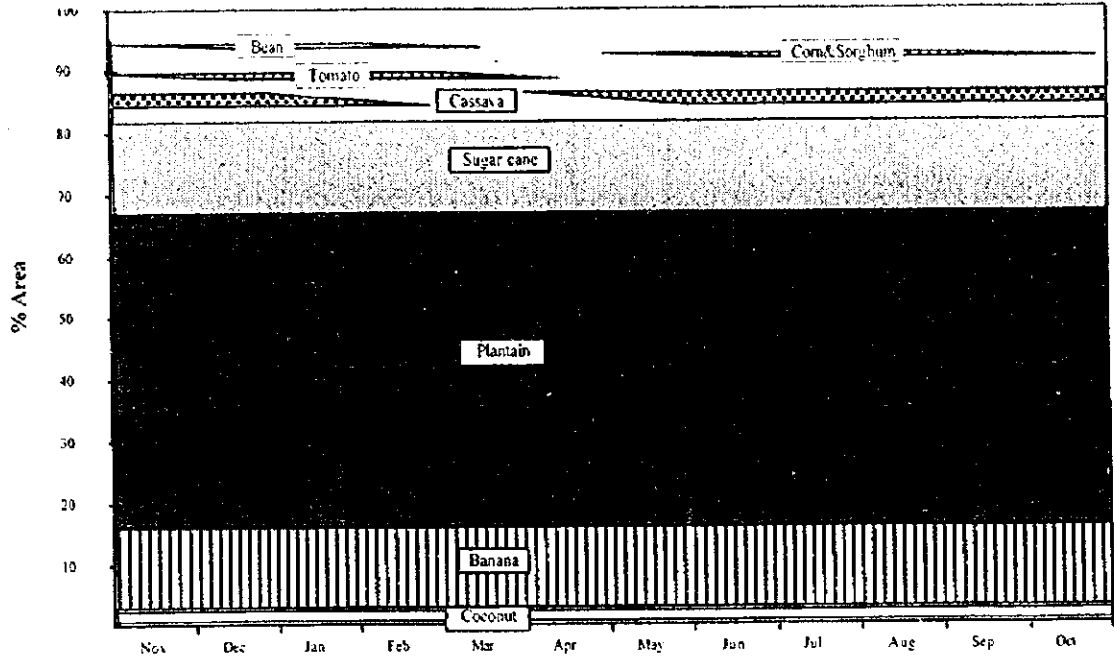
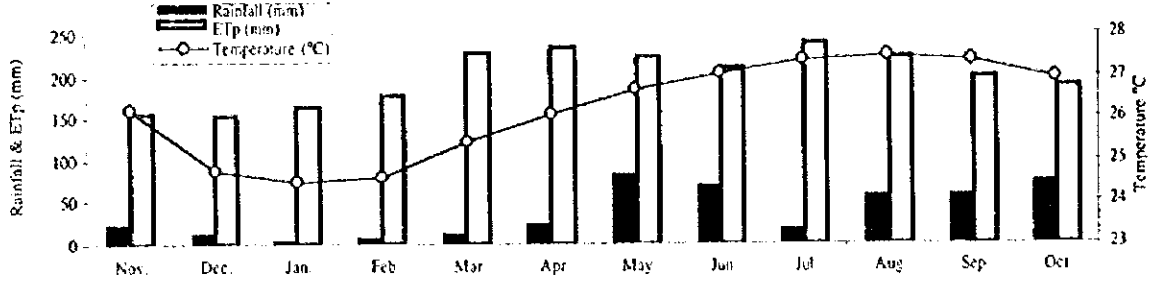
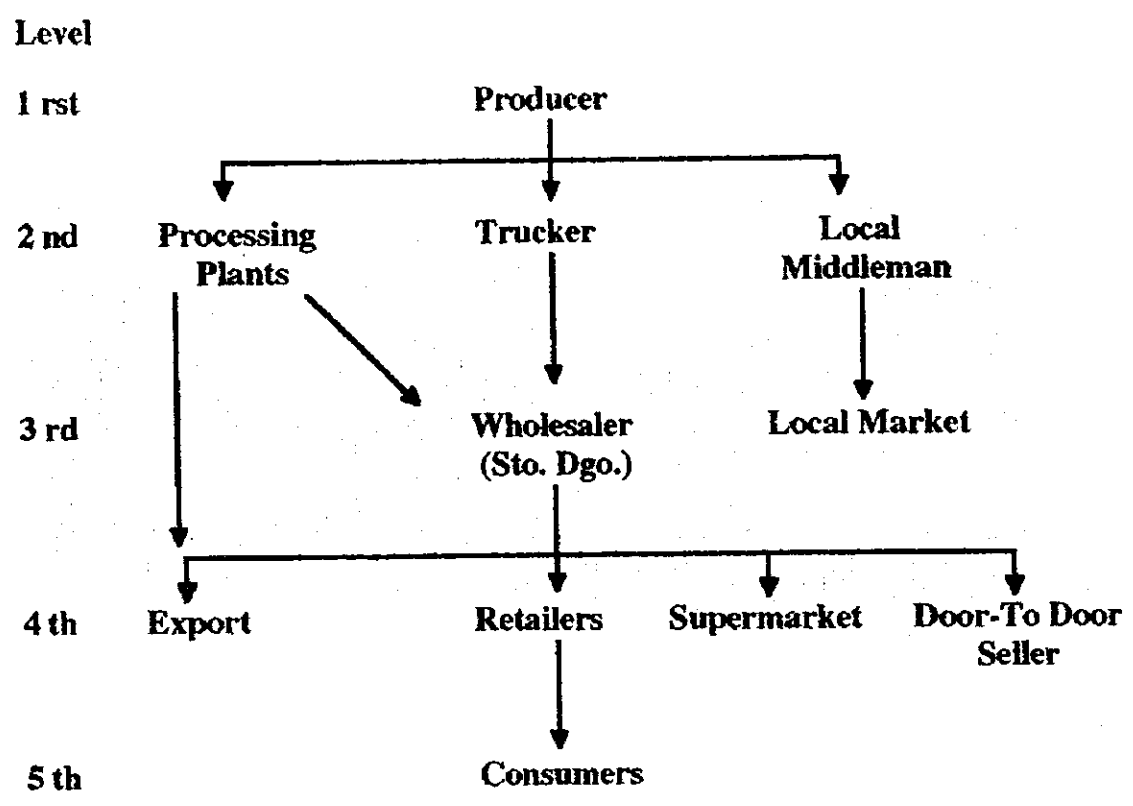


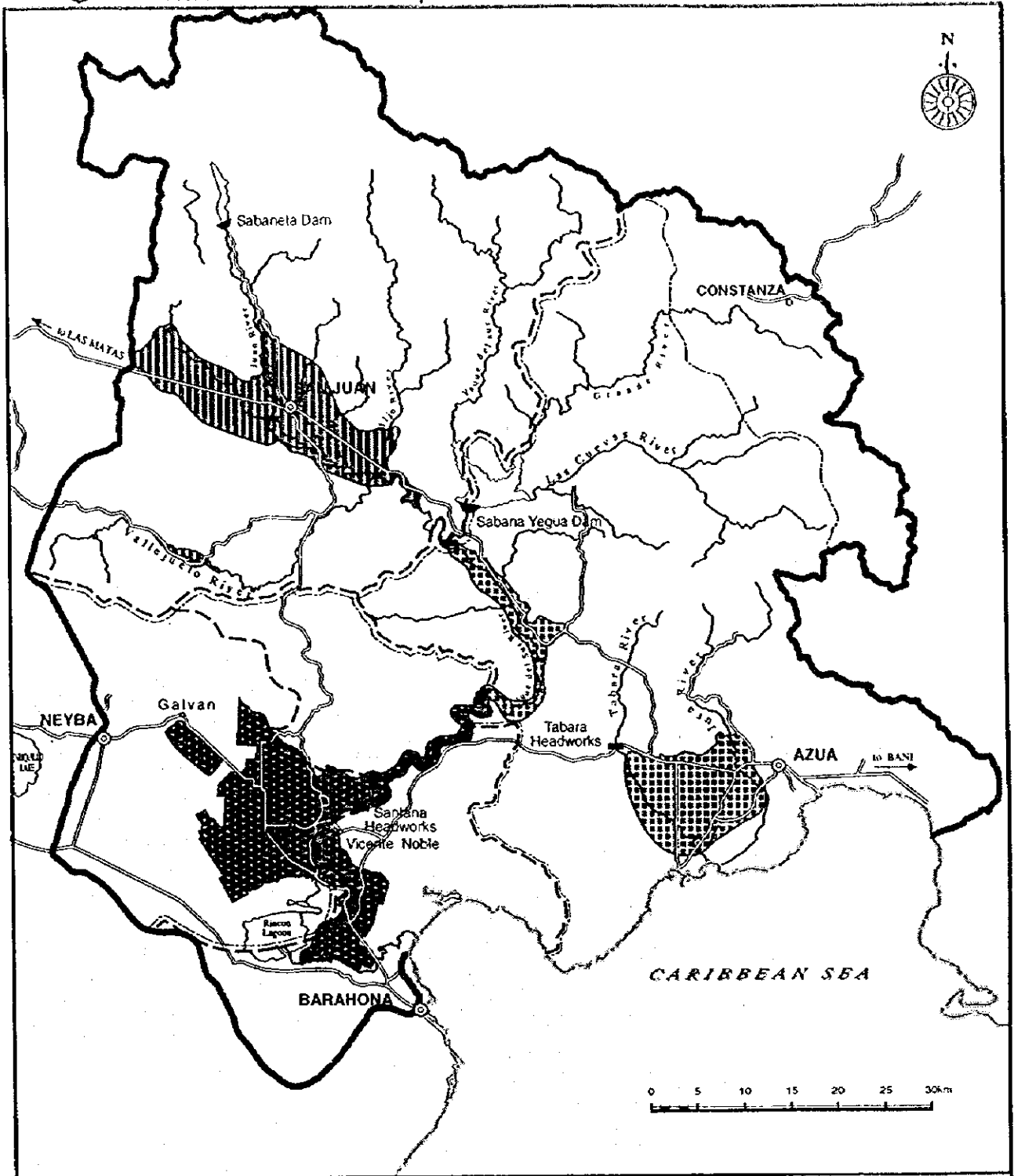
Fig. 6 Marketing System in the Study Area



Source : Secretaría de Estado de Agricultura, Subsecretaría Técnica de Planificación Sectorial, 1977 validated by Jica Study Team, 1998.



Fig. 7 Major Irrigation Area in the Study Area



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	Boundary of Project Area		Village
	Irrigation District Boundary		Dam
	Provincial Boundary		Headworks
	Municipality Boundary		River
	Road		Contour
	San Juan Area		
	Azua Area		
	Yaque del Sur & Lago Enriqueillo Area		

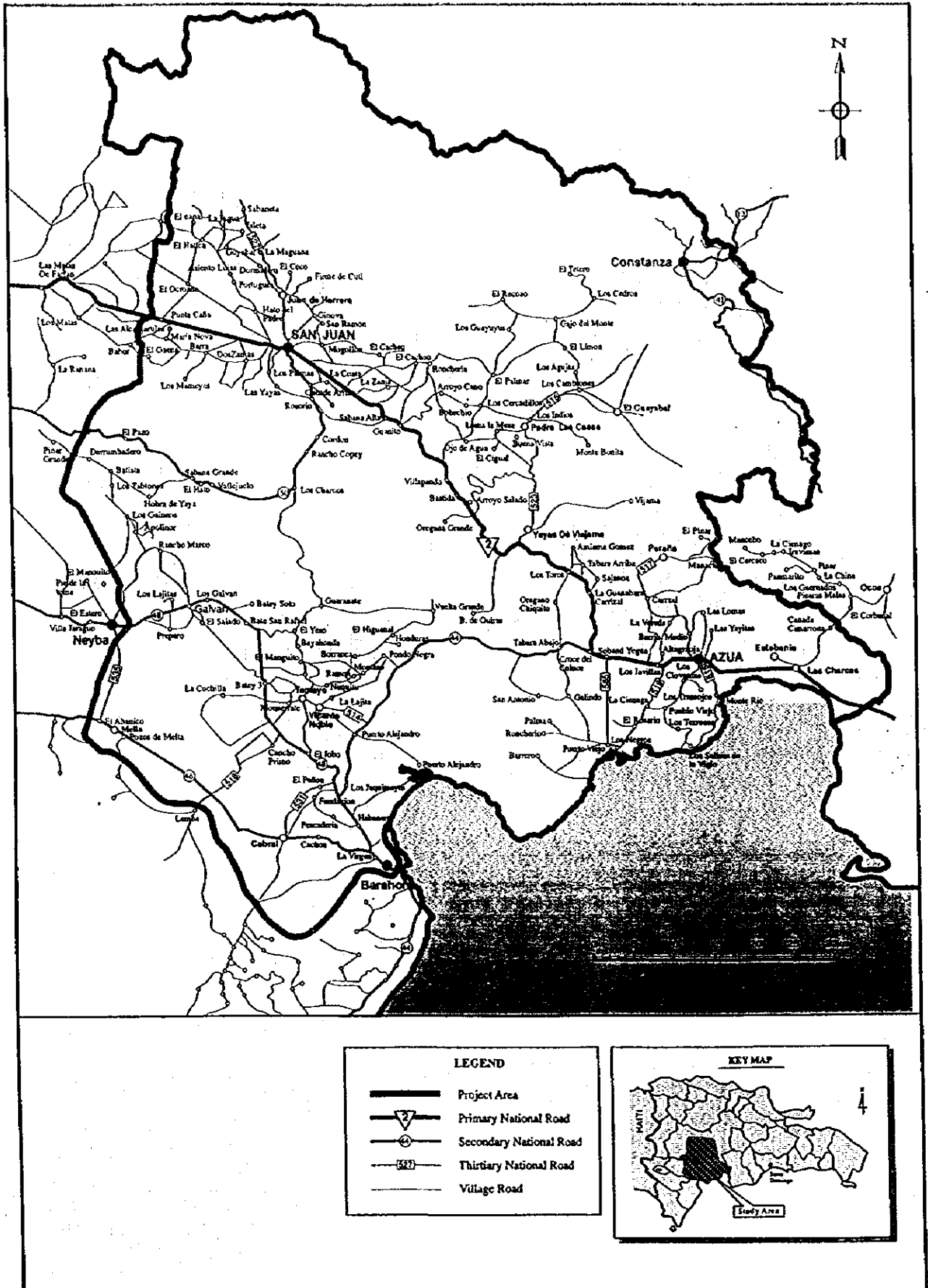
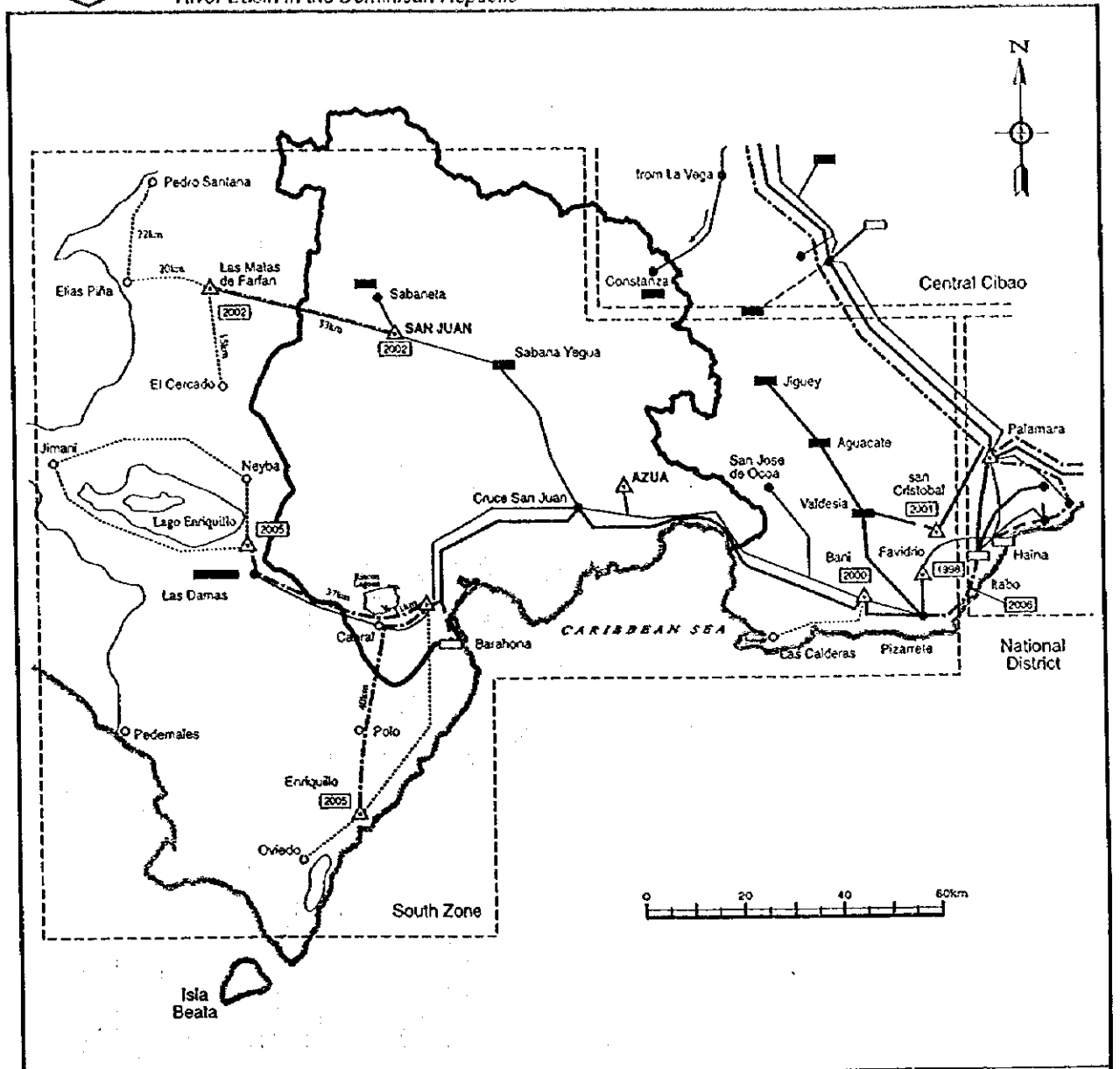




Fig.9 Location Map of Electricity Supply System



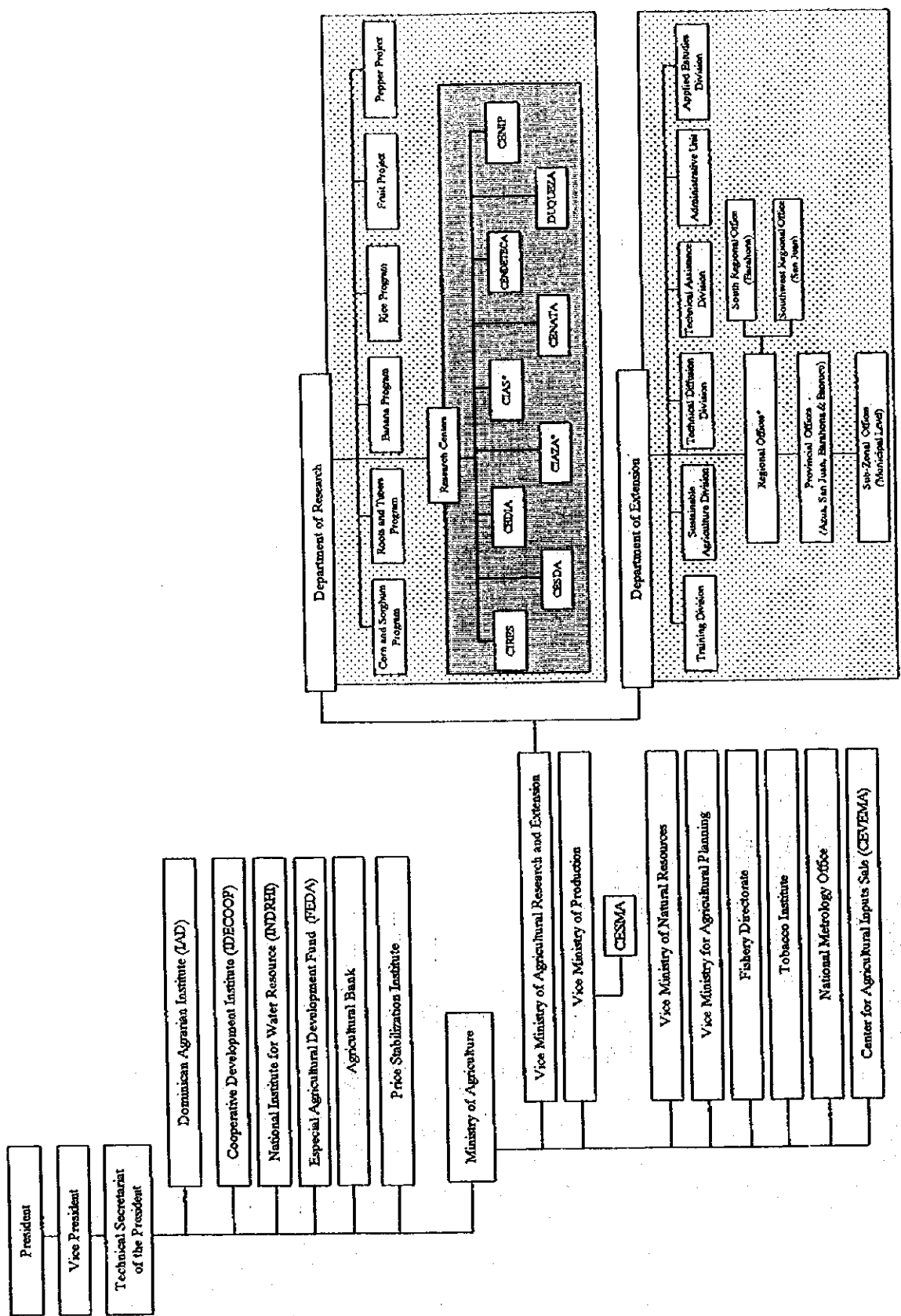
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<ul style="list-style-type: none"> — Study Area ■ Hydropower plant □ Thermal plant ● Transformer Sub-Station △ New sub-station 2000 Target Year 	<table border="0"> <tr> <td></td> <td style="text-align: center;">Existing</td> <td style="text-align: center;">under Construction</td> <td style="text-align: center;">Required works</td> </tr> <tr> <td style="text-align: right;">>138kV</td> <td style="text-align: center;">—</td> <td style="text-align: center;">- - -</td> <td style="text-align: center;">- - -</td> </tr> <tr> <td style="text-align: right;">69kV</td> <td style="text-align: center;">—</td> <td style="text-align: center;">- - -</td> <td style="text-align: center;">- - -</td> </tr> <tr> <td style="text-align: right;">34.5kV</td> <td style="text-align: center;">—</td> <td style="text-align: center;">- - -</td> <td style="text-align: center;">- - -</td> </tr> </table>		Existing	under Construction	Required works	>138kV	—	- - -	- - -	69kV	—	- - -	- - -	34.5kV	—	- - -	- - -
	Existing	under Construction	Required works														
>138kV	—	- - -	- - -														
69kV	—	- - -	- - -														
34.5kV	—	- - -	- - -														

Source : CDE 1993



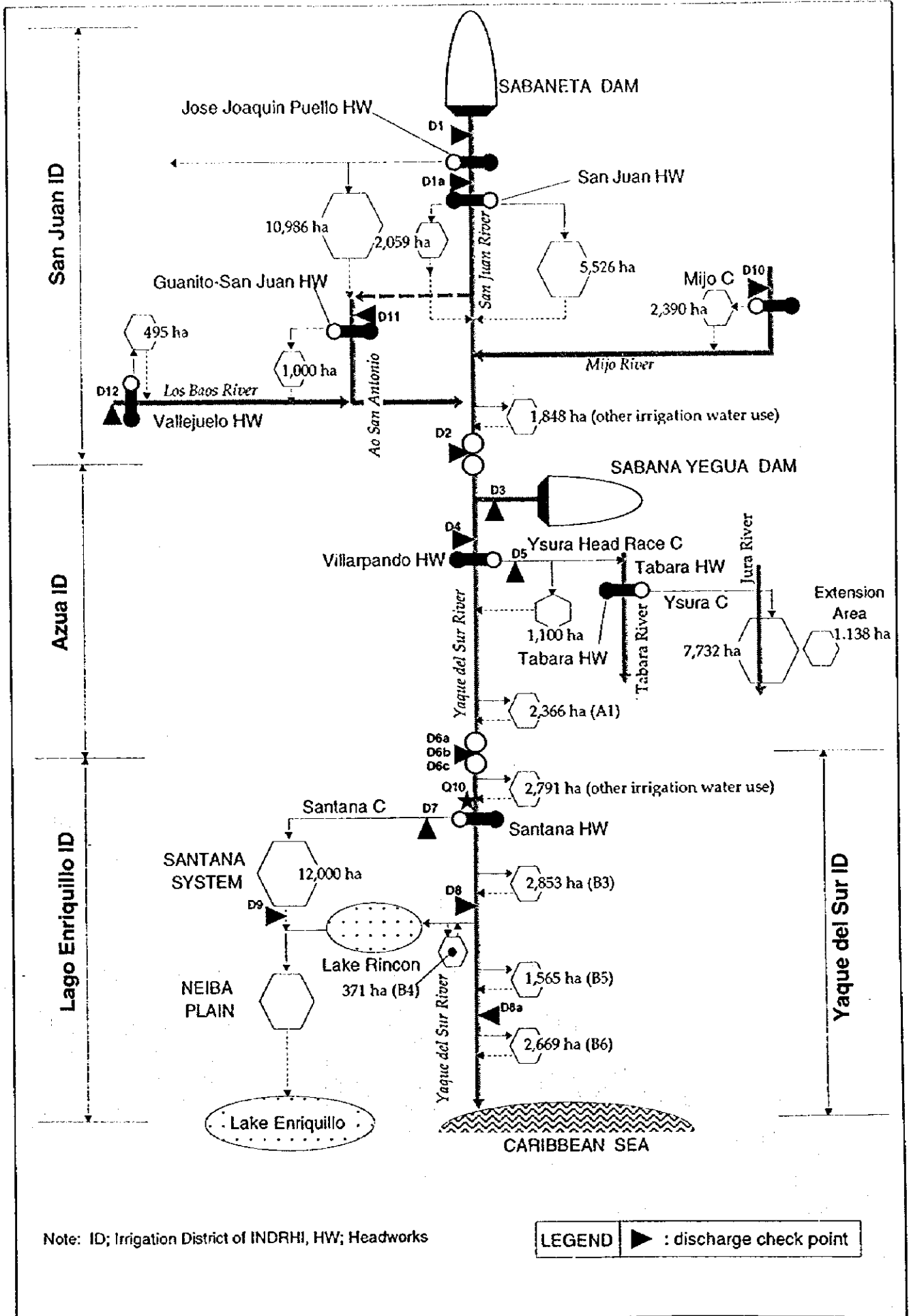
Fig. 10 Agricultural Support System
in the Dominican Republic



Note : * shows that the organization operates within the Study Area.

SOURCE : FUNDACION DE DESARROLLO AGROPECUARIO, INC. 1996

Fig. 11 Present Water Distribution System in the Yaque del Sur River Basin

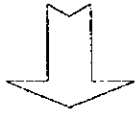


Setting of Hydrological Blocks

- San Juan Block**
- Sabaneta Dam
 - Jose Juuquin Puello
 - San Juan
 - Hato de Padre
 - Guanito-San Juan
 - Mijo
 - Valejuelo
 - Others

- Azua Block**
- Sabana Yegua Dam
 - Ysura Conveyance Canal
 - Ysura Canal
 - Ysura Canal (Extension)
 - Others

- Barahona/Neiba Block**
- Yaque del Sur (upstream)
 - Santana Canal
 - Yaque del Sur (middle-stream 1)
 - Tomate Drain
 - Yaque del Sur (middle-stream 2)
 - Yaque del Sur (downstream)
 - Neiba



Preparation of Data

- Data / Records**
- Rainfall
 - River Discharge
 - Canal Discharge
 - Water Level
 - Evaporation
 - Water Requirement
 - Operation Rule

Type of Data/Records

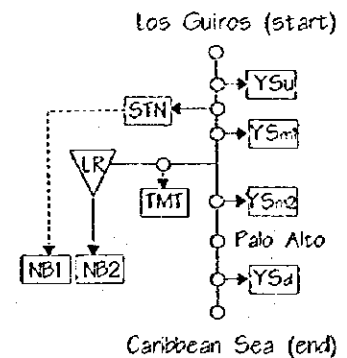
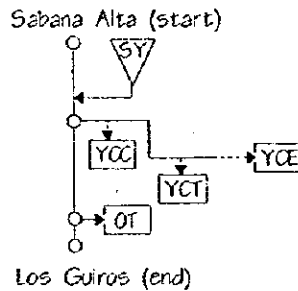
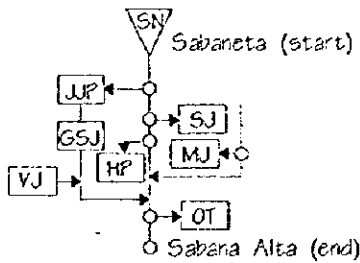
- Level 1: Actual Records
- Level 2: Correlation Equation
- Level 3: Neighboring Stations
- Level 4: Interpolation
- Level 5: Simulation
- Level 6: Hypothesis



Simulation - 1
San Juan Block

Simulation - 2
Azua Block

Simulation - 3
Barahona Block



- SN: Sabaneta Dam
- JJP: Jose Juuquin Puello
- GSJ: Guanito - San Juan
- VJ: Valejuelo
- SJ: San Juan
- HP: Hato de Padre
- MJ: Mijo
- OT: Others

- SY: Sabana Yegua Dam
- YCC: Ysura Conveyance Canal
- YCT: Ysura Canal (Tabara)
- YCE: Ysura Canal (Extension)
- OT: Others

- YSu: Yaque del Sur (Los Guiros - Coinuquito)
- STN: Santana
- YSm1: Yaque del Sur (Coinuquito - El Jobo)
- TMT: Tomate Drain
- YSm2: Yaque del Sur (El Jobo - Palo Alto)
- YSa: Yaque del Sur (Palo Alto - Sea)
- LR: Lake Rincon
- NB1: Neiba (Arroyo Drain)
- NB2: Neiba (Cristbal Canal)

Fig. 13

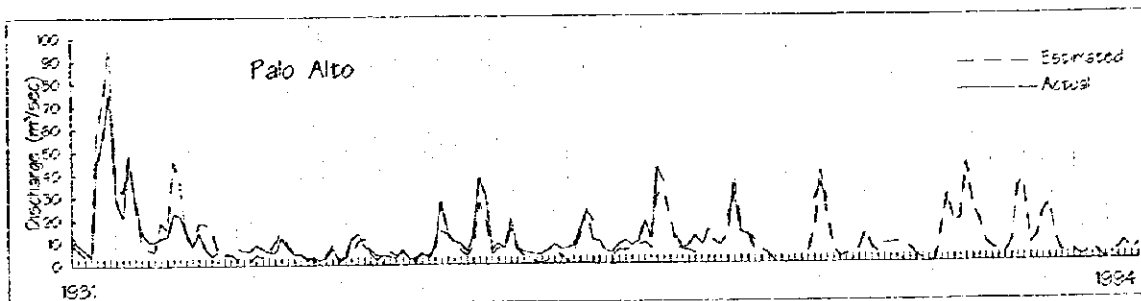
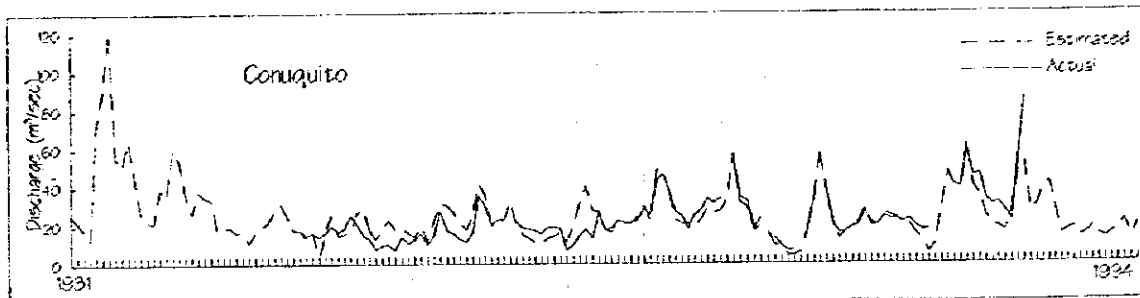
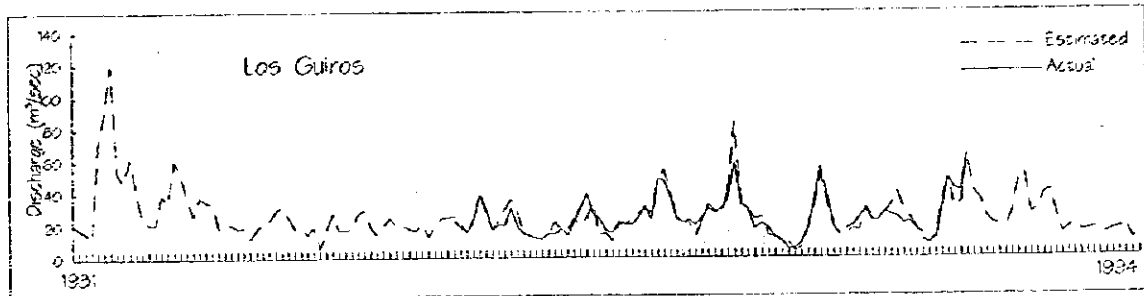
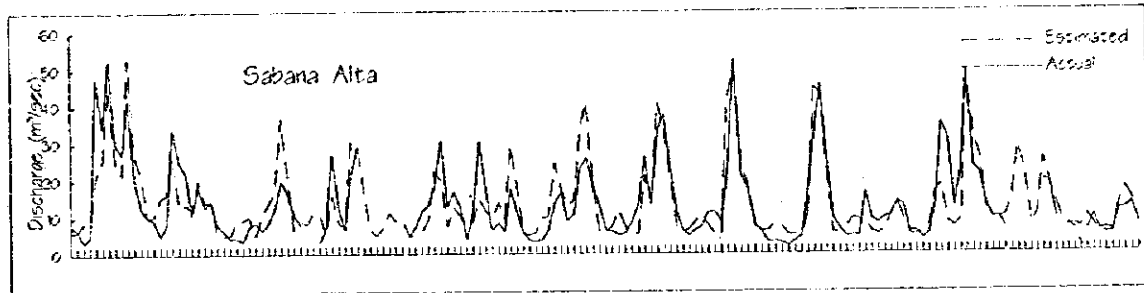
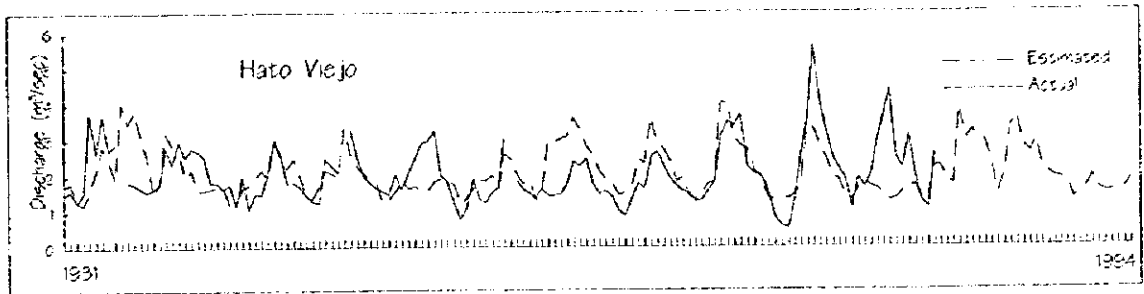
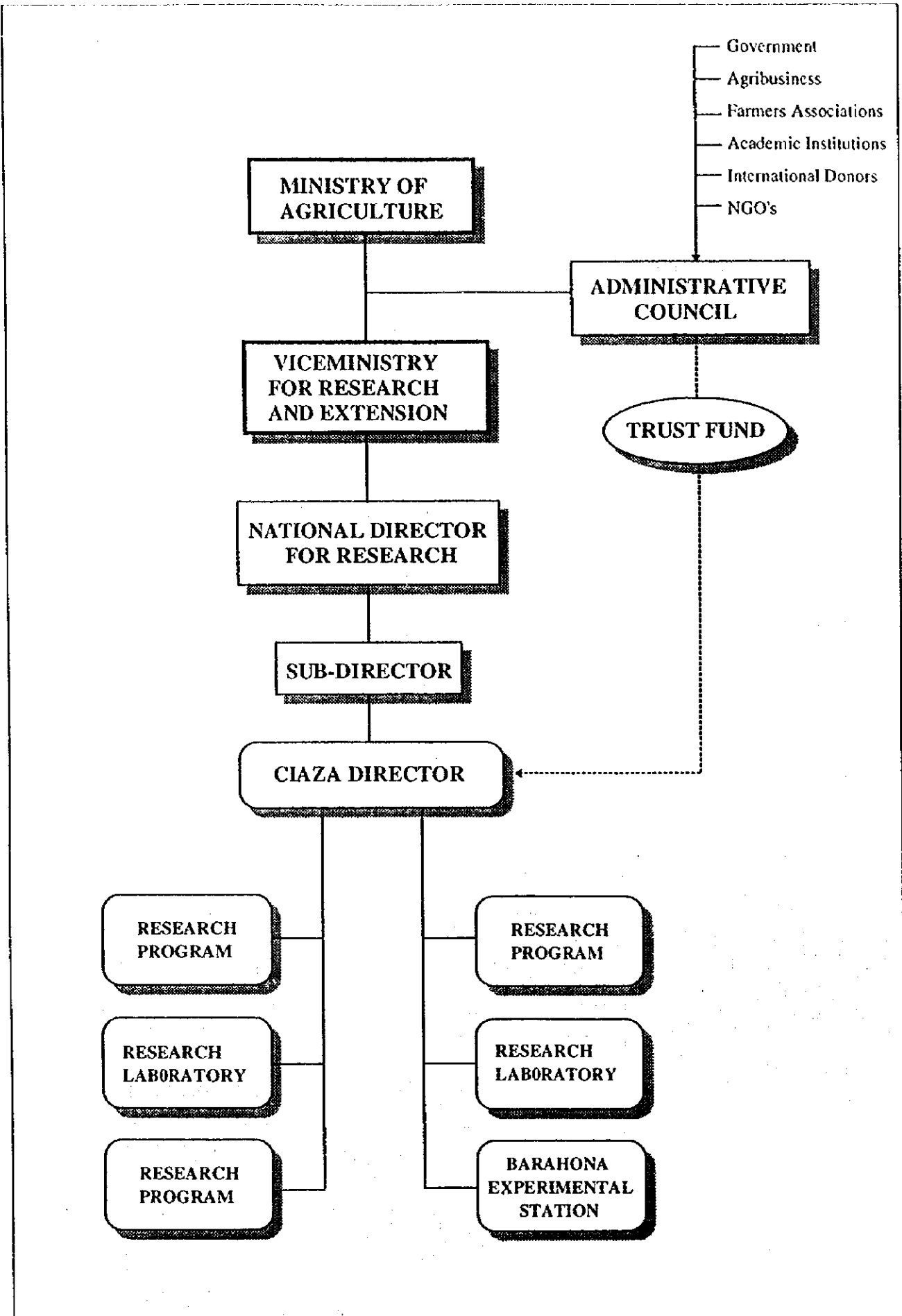
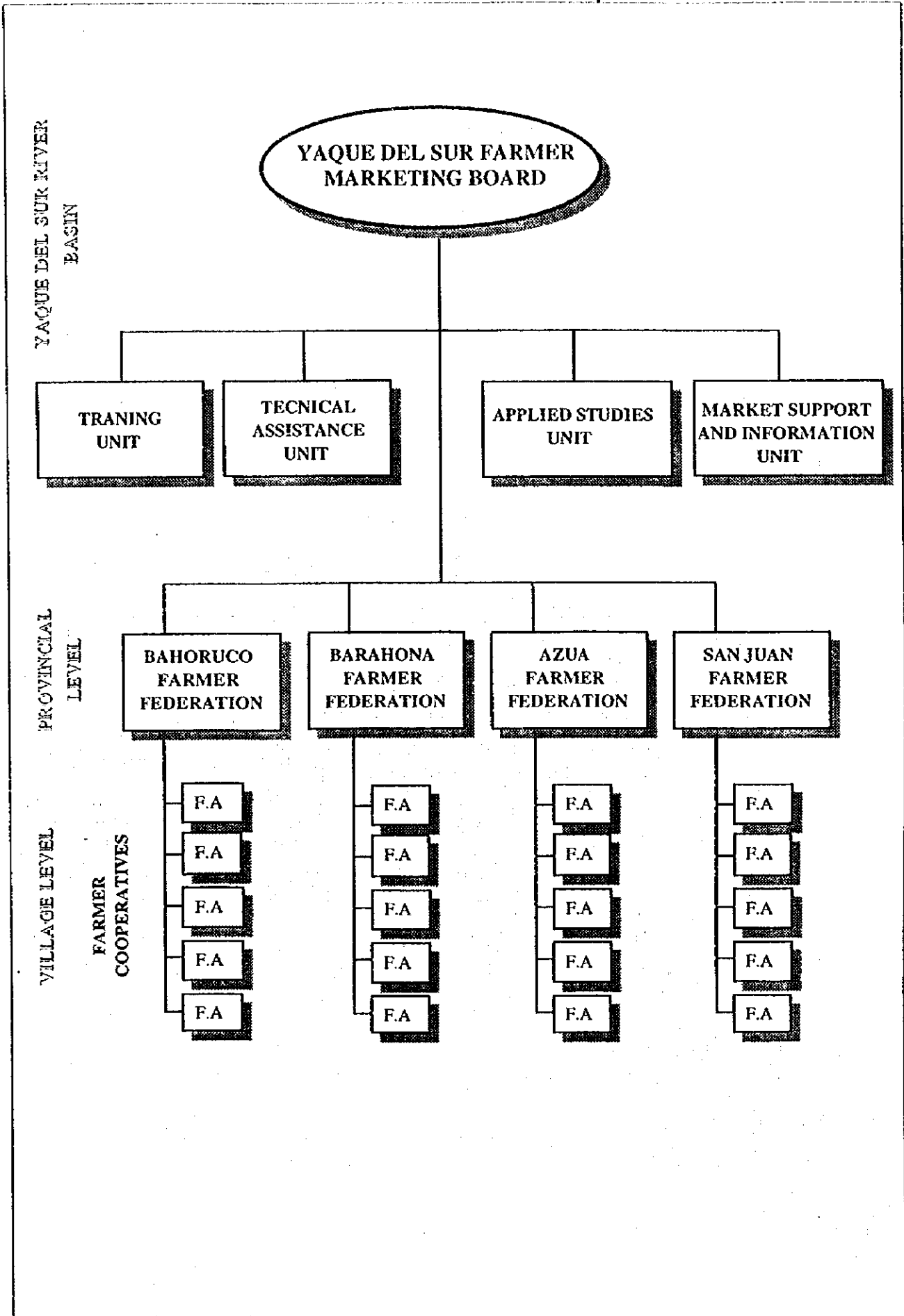
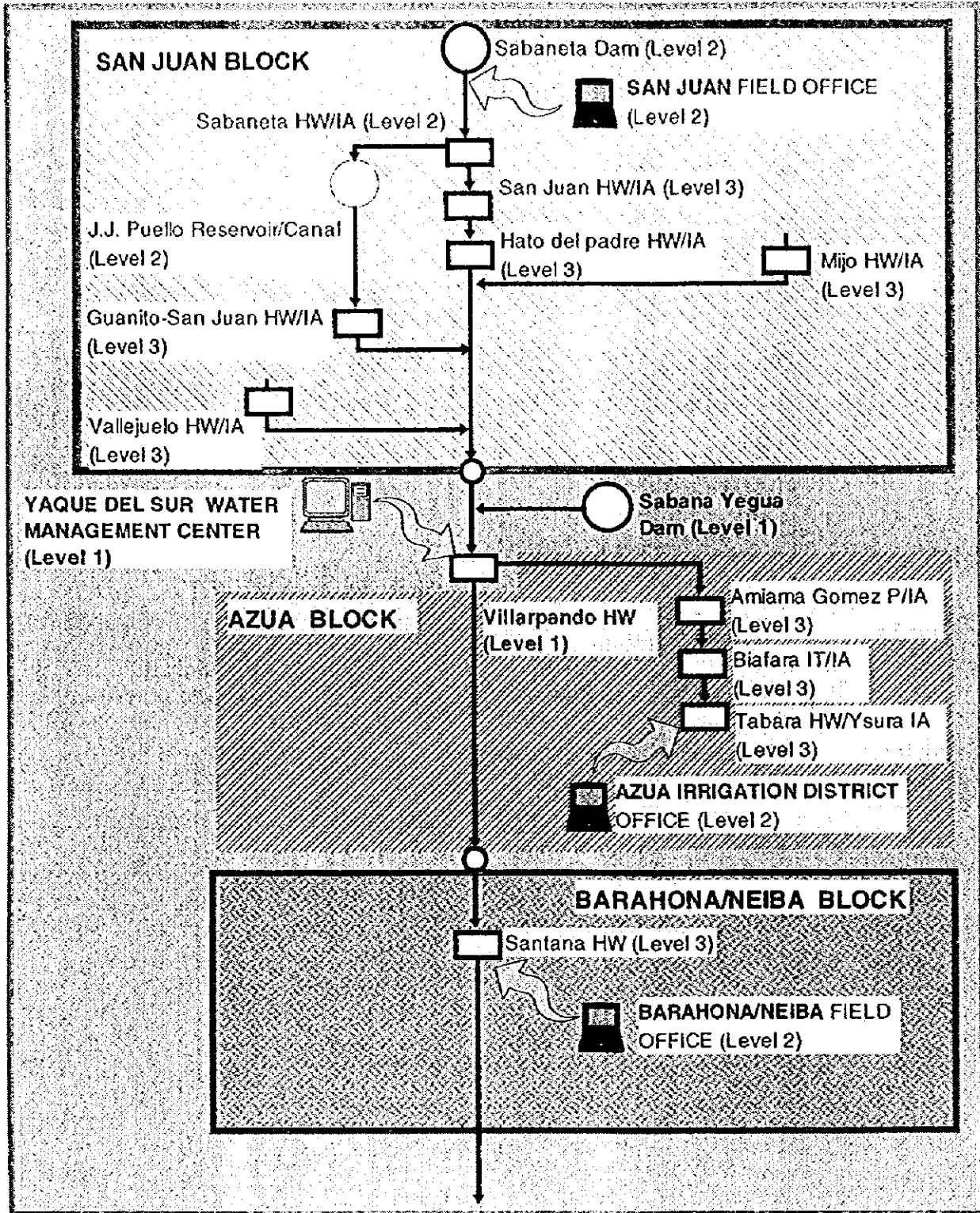


Fig. 14 Proposed Structure for CIAZA Research Center.



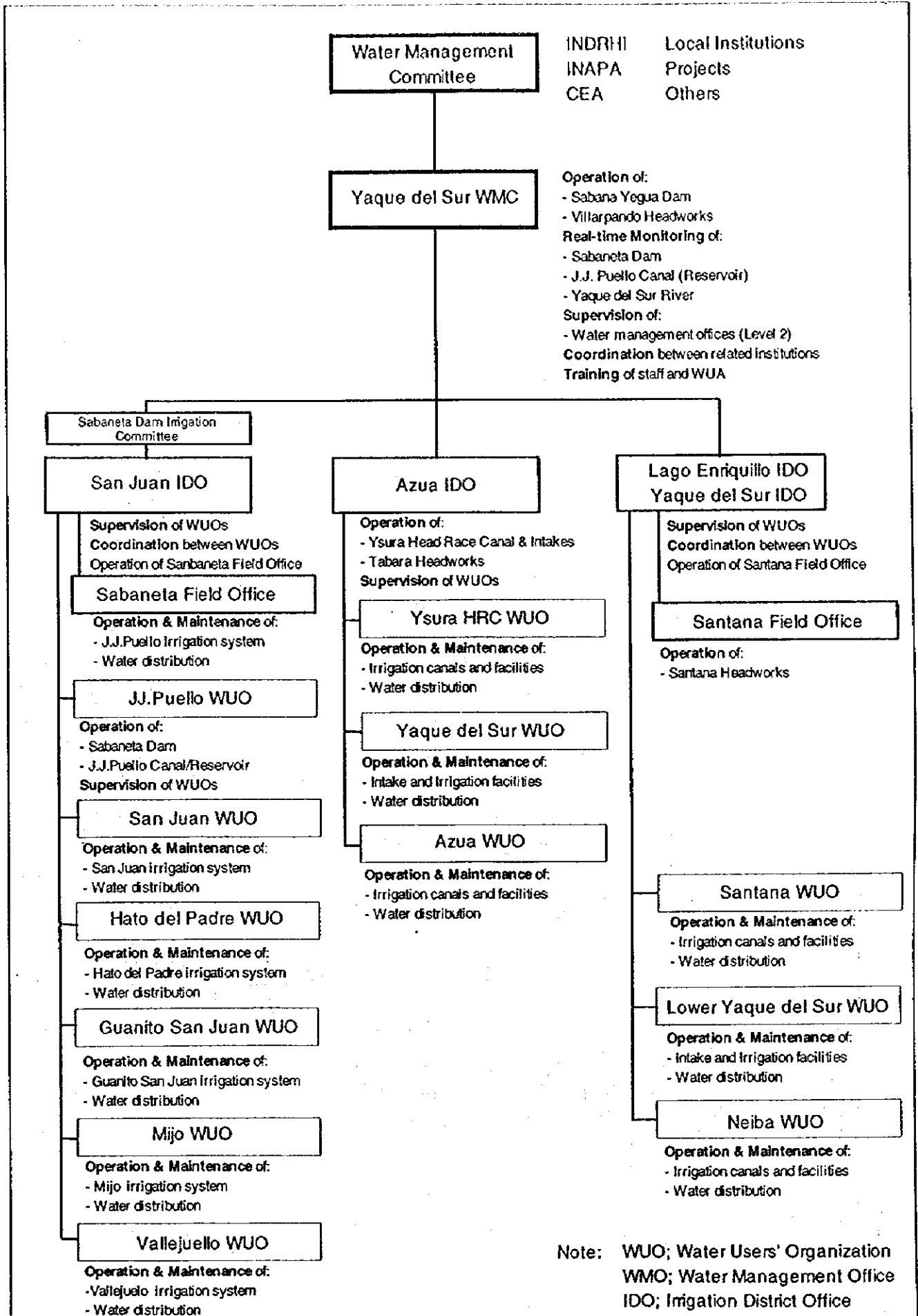


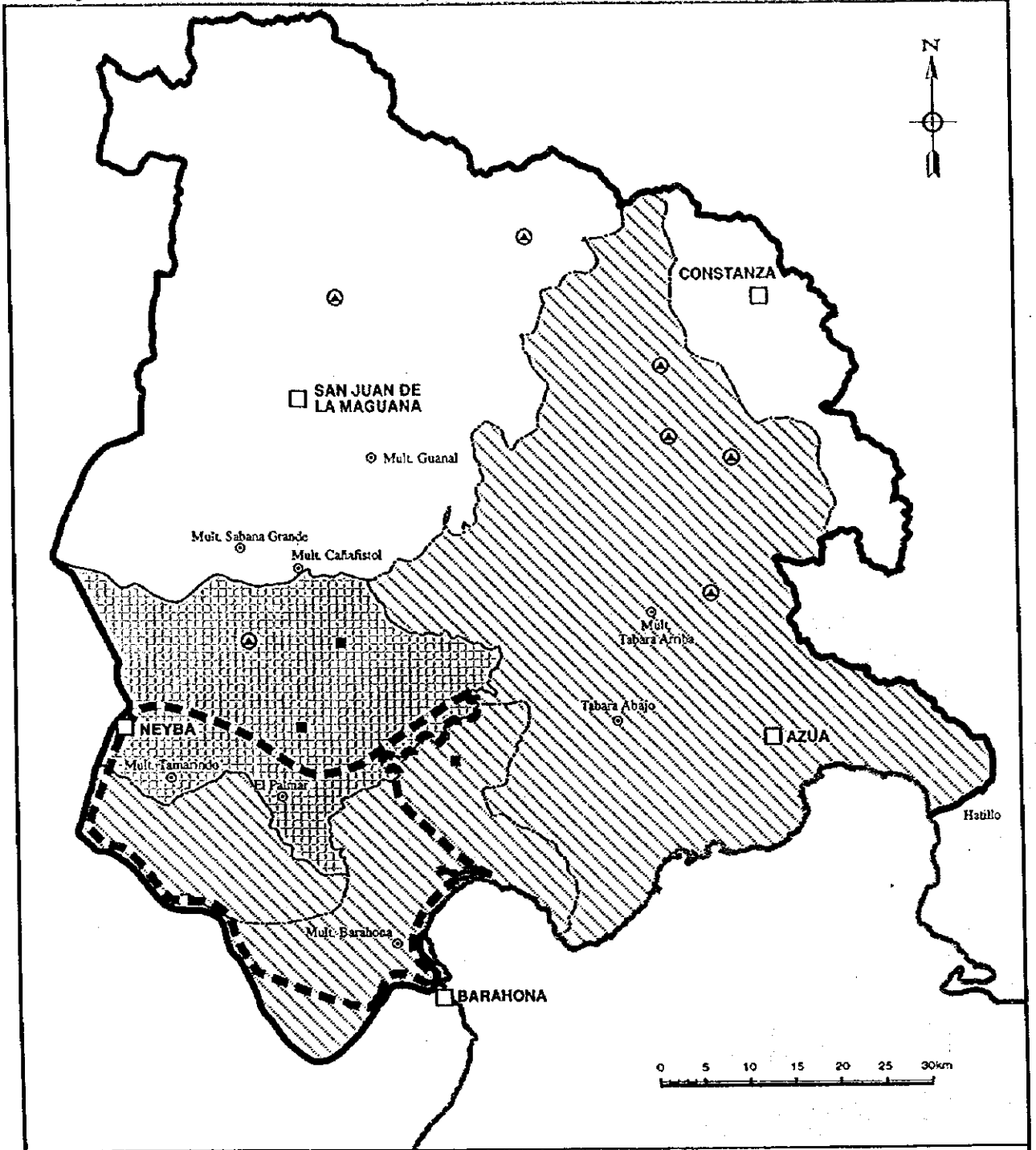


LEGEND

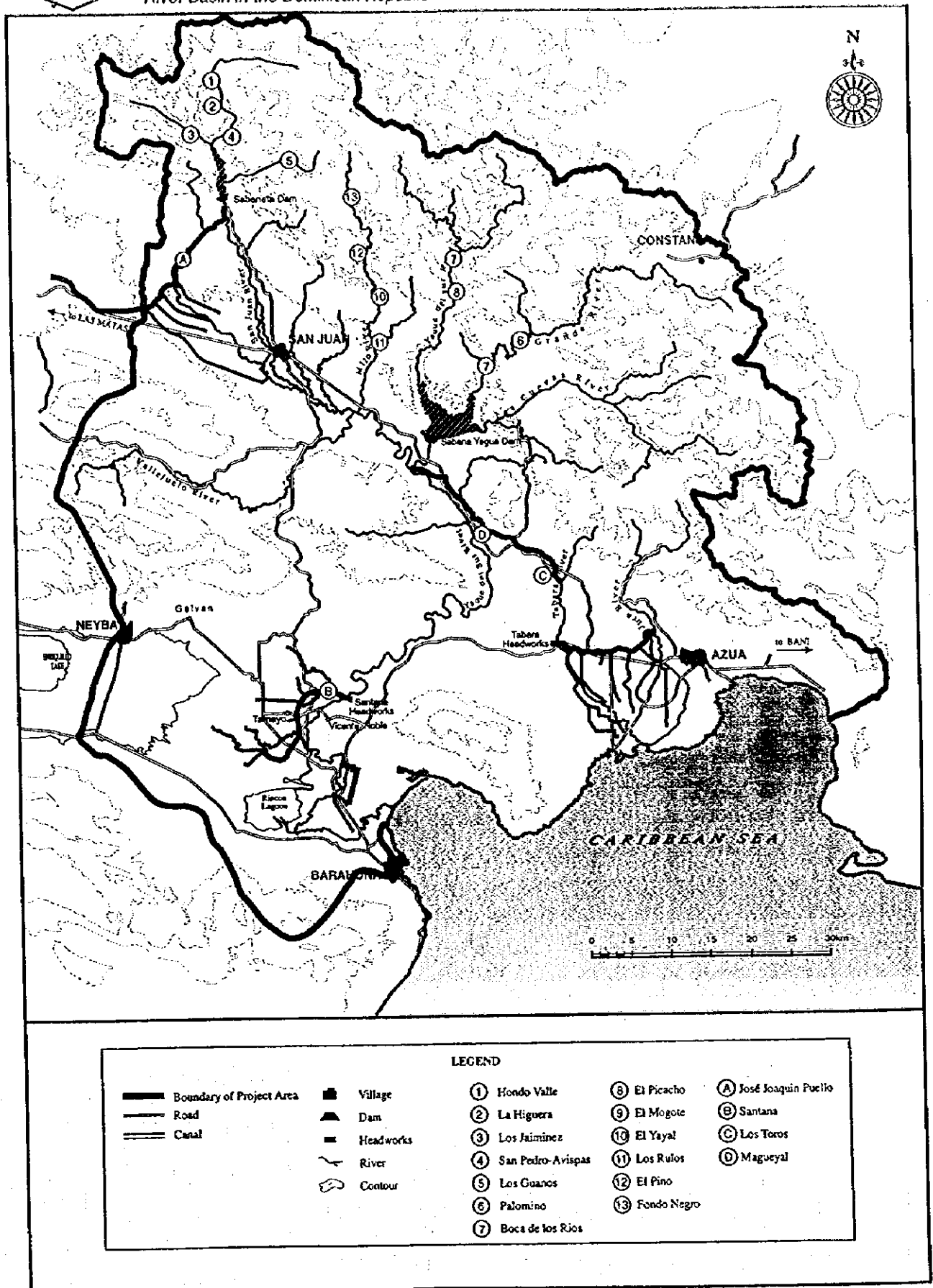
- Existing reservoir
- Existing headworks
- Proposed reservoir
- Proposed reservoir

Note: HW; headworks
IA; irrigation area
IT; intake





LEGEND	
	Project Area
	Provincial Boundary
	Water Supply Project Planned for Construction by INAPA
	Water Supply Project Proposed in the Present Study (Tube Well)
	Water Supply Project Proposed in the Present Study (Surface Water)
	Planned Barahona Water Supply Project under Detailed Design by INAPA
	Master Plan Study for Groundwater Development Planned by INAPA (Stage I)
	Master Plan Study for Groundwater Development Planned by INAPA (Stage II)



LEGEND				
Boundary of Project Area	Village	① Hondo Valle	⑧ El Picacho	Ⓐ José Joaquín Puello
Road	Dam	② La Higuera	⑨ El Mogote	Ⓑ Santana
Canal	Headworks	③ Los Jaiminez	⑩ El Yayal	Ⓒ Los Toros
	River	④ San Pedro-Avispas	⑪ Los Rulos	Ⓓ Magueyal
	Contour	⑤ Los Guanos	⑫ El Pino	
		⑥ Palomino	⑬ Fondo Negro	
		⑦ Boca de los Ríos		

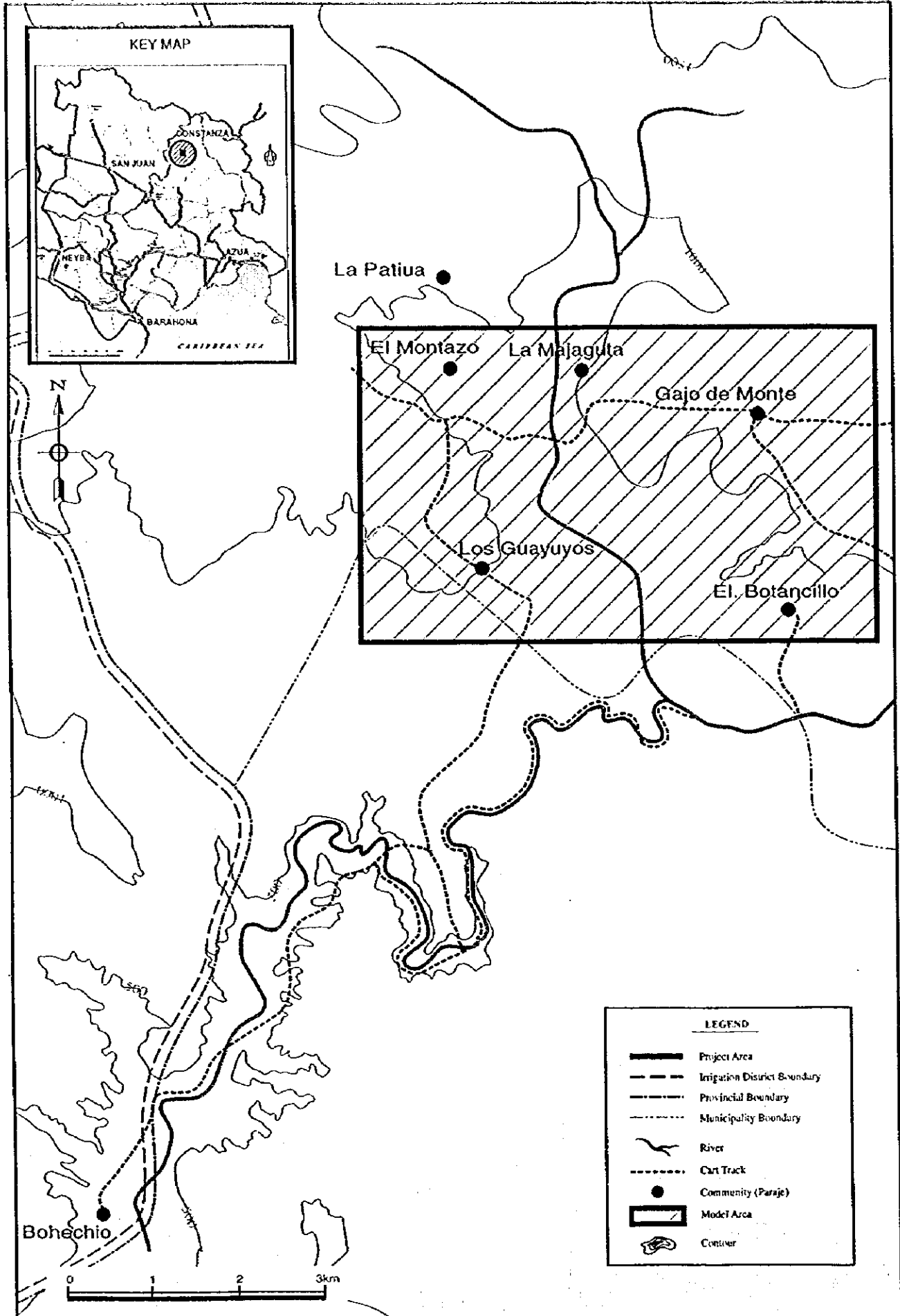


Fig. 21 Plan of Implementation Schedule

Name of Project	: F/S, D/D, Program preparation : Construction / Training : Operation / Implementation of Program											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
Agriculture												
A-1 Coffee Production Improvement Project												
<i>Pilot Area (2 plots) and Training Center</i>												
<i>Formation of farmers association / Training</i>												
<i>Nurseries / Planting</i>												
<i>Drying Yard / Storage Facilities / Procurement of Equipment</i>												
<i>Rural Roads</i>												
Agricultural Support												
S-1 Plan for Credit Services												
S-2 Plan for Strengthening CLAZA Research Center												
S-3 Plan for Seed Multiplication												
S-4 Plan for Strengthening Extension Services												
S-5 Plan for Market Information Systems												
S-6 Plan for Agricultural Cooperatives												
Overall Water Management												
O-1 Plan of Villarpando Water Management Center												
<i>Rehabilitation of Villarpando Headworks / Installation of Telemetry System</i>												
<i>Training</i>												
Irrigation and Drainage												
I-1 Night Storage Pond Project												
<i>in J.J. Puejo</i>												
<i>in Hato del Padre</i>												
<i>in San Juan</i>												
<i>in Mijo</i>												
I-2 Guanito San Juan Irrigation System Improvement Project												
I-3 YSURA Area Irrigation Improvement Project												
I-4 YSURA Extension Area Development Project												
I-5 YSURA Headrace Small Irrigation System Improvement Project												
I-6 Yaque del Sur Lower Reaches Irrigation and Drainage Project												
<i>Left Bank System</i>												
<i>Santana System</i>												
I-7 Galvan Groundwater Irrigation Project												
I-8 Yaque del Sur Small Gravity Irrigation System Improvement Project												
Rural Infrastructure												
R-1 Magueyal Mini-Hydropower Project												
R-2 Rural Water Supply Plan												
R-3 Rural Road Improvement Plan												
R-4 Other Social Infrastructure Improvement Plan												
Environment												
E-1 Reforestation Plan in the Upper Watershed Area of Grande River												
E-2 Wildlife Conservation Plan in Rincon Lagoon												
Water Resources												
W-1 J. J. Puella Dam Development Project												
W-2 Sabana Yegua Dam Rehabilitation Project												