terrace soil shows about 5 me/100g. They contain few base and their cation-saturation degree is very low. Effective phosphoric acid content of the soil shows low and it varies sample to sample, especially soils on the river terrace are obviously lack of effective phosphoric acid. As shown in Table 5-2-3, salinity of each soil are no problems. And micro-elements contents show rather small, but there will not be problem for the normal cultivation.

5.2.4 Physical Properties

Soil textures of the lower land soil are silty or clayey soil and infiltration ratio and permeability show relatively low. This property is typical for the GU series which is widely spreaded in the project area. The porosity of surface soil and subsoil is 40 to 45 and 35 to 40 percent, respectively. As shown in Table 5-2-4, soil air content of subsoil during dry season shows less than 10 percent, these poor drainage and low soil air contents cause the lack of oxygen. In general, these fine texture soils show low water holding capacity and after drainage, soils formulate a hard pan and the tillage becomes low.

On the other hand, soil textures of the river terrace soil are sandy soils except clayey LT series. Therefore their permeabilities show high and they are well drained. But because of the severe eluviation, the soil fertility shows low. The porosity of surface and subsurface soil are 40 to 50 percent, and they are rather over dry conditions. In dry season, soil air and liquid contents are 35 to 40 and 4 to 10 percent, respectively.

Results of the three phases of soil investigation in June, 1983, are shown in Table 5-2-5. Effective water of each soil group are estimated assuming that root zone depth is 100cm, by the following equation.

$$E.W. = F.C. - W.P.$$

where, E.W. = effective water
F.C. = field capacity moisture content
W.P. = wilting point moisture content

A), B) Lower land soil (18 points average): 125mm/100cm
C) River terrace soil (7 points average): 78mm/100cm
D) Average (25 points average): 115mm/100cm

Remarks: 1. field capacity moisture contents are assumed 1/10 and 1/3 atmosphic pressure for the sandy soils and other soils.

2. wilting point moisture contents are permanent wilting point of 15 atmosphic pressure.

Table 5–2–2 Physical and Chemical Properties of Soil in the Project Area

Soil Series	Site No.	Depth cm	Particle Size Sand %	Silt %	Clay %	Texture	Bulk Density g/cm³	Porosity %	Organic Matter Carbon %	Nitrogen %	C/N	PH	CEC me/100g	Exchangeable Cations Ca me/100g	Mg me/100g	K me/100g	Na me/100g	Base Saturation %	Available P2O5 PPM
Javilla	1/ 13	0-30	24	40	36	CL	1.39	44	0.72	0.15	4 8	4.70	20.40	3 77	1.99	0.20	0.34	30.9	5
		30-150	26	36	38	CL	1.57	40	0.25	0.08	3 1	4.80	19.15	4.51	3.01	0.20	0.30	41.9	6
		150-180	62	26	12	SL	1 60	41	0 16	0.05	3.2	4.85	11.45	3.05	1.83	0.12	0.37	46 9	75
		180-270	32	40	28	CL			0 23	0.06	3.8	4.95	12.90	4.03	1.75	0.10	0.18	47 0	75
	1/ 14	0-10	46	40	14	L			1.35	0.20	6.8	5.55	11.65	4.95	1.94	0.36	0.48	66.3	17
		10-40	44	35	21	L			0.36	0.08	4.5	5.00	11.45	3.68	1.85	0.09	0.30	51 7	2
		40-80	51	31	18	L			0.25	0.05	5.0	4.90	10 50	3.20	1.79	0.12	0.27	51.2	17
		80-180	28	44	28	CL			0.22	0.06	3.7	5.05	15 65	5.53	2.69	0.19	0.27	54 8	16
		180-250	12	50	38	SICL			0 33	0 09	3.7	5.25	22.90	10.61	3 75	0.17	0.34	64 9	37
	1/ 22	0-30	20	57	23	SIL	1.55	41	0.54	0 15	3.6	7.30	17 20	14.82	2.22	0.30	0.26	104.9	83
		30-70	12	58	30	SICL	1.53	44	0.48	0.10	4.8	7.45	14.60	12.07	2.22	0.22	0.31	104.7	88
		70-100	12	50	38	SICL	1 37	50	0.50	0.11	4.5	6.70	18 20	12.42	2.35	0.19	0.26	83.6	77
		100-200	30	52	18	CL	1.46	47	0 15	0.05	3.0	6.70	11.40	7.10	1.68	0.10	0.61	83.2	88
		200-300	15	56	29	SICL	1 50	44	0.33	0.08	4.1	6.70	17.40	11.02	2.31	0.20	0.30	79 5	95
	1/ 25	0-30	26	45	29	CL	1.74	34	0.70	0 12	5.8	5.80	16.75	11.01	1.83	0.19	0.23	79 2	11
		30-90	47	27	26	SCL	1.58	39	0 25	0 05	5.0	5 90	9.30	5 89	1.25	0.13	0.24	80.8	47
		90-135	47	39	14	L	1.50	42	0.20	0.04	5.0	6.10	9.85	6.24	1 45	0.10	0.23	81.4	50
		135-210	29	47	24	L	1.57	42	0.26	0.06	4.3	6.05	13.80	9.44	1.34	0.15	0.26	81.2	62
		210-300	23	51	26	SIL			1.09	0.12	9.0	6.20	15.80	10.60	1.63	0.18	0.38	80.9	82
	2/ 26	0-23				C	1.49	43	1.1			5.3	9.2	5.5	1.5	0.11	0.10	78.4	7
		23-35				C	1.66	37	0.6			5.2	8.7	4.6	2.0	0.11	0.13	78.6	4
		35-90				C	1.66	37				5.2	10.7	6.0	2.7	0.22	0.03	83.6	7
		90-150				C	1.65	38				5.2	10.5	5.5	2.8	0.20	0.01	81.0	11
	1/ 38	0-25	62	31	7	SL	1 37	48	0 29	0.04	7.3	7.60	9.10	13.22	1.17	0.18	0.22	171.1	57
		25-80	16	49	35	SICL	1.40	47	1 13	0.17	6.6	7.15	23.65	18.60	2.49	0.27	0 26	91.4	88
		80-180	18	43	39	SICL	1.49	45	0.29	0.08	3.6	6.65	19 25	11 26	2.35	0.21	0.24	73.0	22
		180-300	34	44	22	L			0.27	0.05	5.4	6.10	16 70	7.60	3.51	0.13	0.51	70.4	100
Javilla	1/ 56	0-15	39	39	22	L	1.60	39	2.34	0.27	8.7	6.50	23.65	16.27	3 15	0.24	0.21	84.0	33
		15-70	31	38	31	CL	1.69	37	0.35	0.08	4.4	4.85	12.20	4.56	1.54	0.12	0.20	52.6	8
		70-110	25	47	28	CL	1.73	34	0.23	0.06	3.8	4.80	12.20	4.36	1.54	0.10	0.23	51.1	18
		110-190	17	45	38	SICL	1.60	42	0.23	0 07	3.3	4.95	15.35	7.06	2 07	0.19	0.29	62.6	25
		190-300	20	48	32	CL			0.33	0.08	3.8	5.25	14.85	7.92	2 92	0.15	0.31	74.4	55
	2/ 57	0-30				CL			1.6			5.3	12.7	6.2	1 9	0.12	0.01	72.6	4
	1/ 66	0-20	21	45	34	CL	1.64	38	1.53	0.23	5.7	6.05	21.55	12.37	2.17	0.46	0.27	70.9	47
		20-50	29	41	30	CL	1.68	38	0.58	0.12	5.7	6.20	15.50	9.50	1.26	0.23	0.23	72.4	25
		50-90	23	55	22	SICL	1.52	42	0.36	0.06	6.0	6.25	13.00	8.23	0.85	0.13	0.27	72.9	66
		90-230	21	43	36	CL	1.67	38	0.51	0.09	5.7	6.10	19.20	11.95	1.55	0.19	0.28	72.8	70
		230-300	45	37	18	L			0.28	0.05	5.6	6.20	11.80	6.97	1.22	0.12	0.26	72 6	100
	2/ 78	0-30				CL			1.6			6.1	10.6	7.8	1.6	0.2	0.01	90.7	31
Cambulos	1/ 6	0-40	16	34	50	C	1.60	42	0.80	0.16	5.0	5.65	24.50	14.92	2.60	0.26	0.35	74 0	10
		40-80	18	46	36	SICL	1.57	43	0.40	0.09	4.4	5.40	19.30	9.44	1.71	0.15	0.38	60.5	12
		80-100	36	40	24	L	1.42	49	0.16	0 05	3.3	5.15	13.00	5.28	1.40	0.13	0.37	55.2	55
		100-300	72	23	5	SL			0.19	0 04	4.8	7.50	7.80	9.00	1.72	0.12	0.21	141.7	62
	1/ 43	0-25	64	26	10	SL			0.98	0.16	6.1	5.00	8.80	1.77	0.68	0.17	0.30	33.2	30
		25-80	56	22	22	SCL			0.18	0 04	4.5	4.55	8.80	0.81	0.62	0.08	0.35	21.1	8
		80-150	74	14	12	SL			0.11	0 03	3.4	4.85	6.80	1 76	0.71	0.09	0.21	40.7	61
		150-300	34	40	26	L			0.22	0.05	4 0	5.40	14.20	6.12	2.14	0.13	0.26	61.1	23
	2/ 44	0-30				C			2.7			5.2	17.0	6.9	1.5	0.2	0.01	50.6	17
	1/ 48	0-10	22	60	18	SIL			0.79	0.10	7.9	7.40	14.80	23.02	2.67	0.21	0.28	176.9	42
		10-40	29	58	13	SIL			0.78	0.10	7.8	7.45	13.45	21.53	1 93	0.13	0.28	177.4	26
		40-65	17	61	22	SIL			0.72	0.11	6.5	7.40	16.85	25.98	2 84	0.25	0.41	175 0	23
		65-85	35	55	10	SIL			0.49	0.08	6.1	7.40	10.85	15.94	1.72	0.18	0.43	164.4	79
		85-130	17	57	26	SIL			0 55	0.09	6.1	7.40	17.90	22.38	2.47	0.24	0.35	145 8	57
		130-300	94	3	3	S			0 08	0.03	2.7	7.30	4.70	7 23	0 88	0.07	0.20	178 3	34
	2/ 55	0-23				C	1.40	53	1.1			7.0	17.4	21.7	2.2	0.2	0.13	139.3	35
		23-65				C	1.42	54	1.1			6.8	17.8	21.3	2.6	0.2	0.11	136.1	36
		65-130				C	1.49	56	0.5			6 5	14.6	12 3	2.2	0.2	0.07	101.3	9

Cúmbulos	1/ 64	0-45	39	46	15	L	1.50	44	0.93	0.12	7.8	7 45	12.20	19.19	2.08	0.43	0.22	178 0	95
		45-90	43	44	13	SL	1 50	44	0.42	0.06	7 0	7 50	9 60	13.56	1.92	0.44	0.18	167 7	70
		90-300	91	6	3	S			0.13	0.02	6.5	7 40	4.25	7.80	0 82	0.09	0.18	209.2	43
	2/ 65	0-30				CL			1 1			7.80	11.5	27.6	1.3	0.2	0.01	253.1	39
	1/ 69	0-15	84	8	8	LS	1 41	48	0.13	0 02	6.5	7.45	6.55	10.19	0.81	0 09	0.19	171.0	57
		15-60	36	44	20	L	1.46	47	0.78	0.11	7.1	7.30	16 55	21.05	2.06	0.22	0.31	142.8	83
		60-90	94	4	2	S	1 56	44	0.05	0.02	2.5	7.10	3 05	2.21	0.48	0.07	0 27	99 3	43
		90-115	62	30	8	SL	1 33	48	0.44	0.09	4.9	7.40	10 90	14.37	1.10	0 13	0.23	145.2	73
		115-300	90	4	6	S			0.07	0 03	2 4	7.50	6.80	10.06	0.56	0.34	0.55	177.2	46
Pamplonita	1/ 70	0-30	25	51	24	SiL	1.40	45	1.10	0.16	6.9	7.35	17.10	21 38	2.53	0.22	0.22	142.2	80
		30-120	67	25	8	SL	1.38	48	0.21	0 03	7.0	7.55	6.50	8 72	1.14	0.09	0.20	156.2	73
		120-300	67	12	1	S			0.11	0.02	5.5	7.60	4.40	7.38	0.98	0.08	0.15	195.2	48
	2/ 95	0-31				LS	1.63	37	0.5			6 7	7.2	8.4	1.3	0.2	0 01	137.6	26
		31-76				S	1.41	47	0.3			6.6	4.1	4 9	0.7	0.08	0.01	138.8	33
		76-105				C	1 59	40	0.5			6.4	14 0	16.3	1.7	0.2	0.05	130.4	6
		105-140				C	1.74	34				6 3	10.4	10 3	1.0	0.2	1.01	120.3	4
	1/ 96	0-25	45	33	22	L	1.57	41	1.26	0.19	6 6	6.30	22.10	12 77	2.48	0 19	0 42	71.7	48
		25-45	91	3	6	S	1.03	61	0.18	0 03	6.0	6.40	5.55	3 04	0.56	0.08	0.07	67.6	48
		45-300	91	3	6	S	1.50	46	0 11	0.03	3 7	6 35	5.85	3.04	0.64	0.08	0.18	67.3	43
	2/ 97	0-30				SL			1.1			6 0	8.6	10.3	1.1	0.1	0.01	191.8	35
Zulia	2/ 39	0-16				L	1.34	49	2.2			7.8	10.5	25 7	2.7	1.0	0.04	280.4	33
		16-35				SL	1.45	47	0 5			7.8	6.1	21.8	1.1	0.3	0.01	297.6	33
		35-90				SiL			1.1			7.7	9.3	25.4	1.3	0.3	0.01	290.4	48
	1/ 40	0-20	10	60	30	SiCL	1 50	45	0.91	0.12	7 6	7 10	20.45	19.47	4.85	0.44	0.35	122.8	17
		20-80	12	23	65	C	1.39	49	1.35	0 23	5 9	6.50	37.85	32 90	2 66	0.36	0 35	95.8	33
		80-250	10	23	67	C			0.52	0 13	4.0	6.25	22 10	16.22	4.08	0 34	0.33	94.8	25
		250-300	8	9	83	C			0.56	0.14	4 0	6.05	30 60	16.66	4.71	0.41	0.88	74 0	44
	2/ 61	0-30				L			1.6			6.2	11.6	10.4	1.9	0 1	0.01	200.2	27
Guaramito	1/ 1	0-25	22	40	38	CL	1.63	37	0.99	0.18	5.5	4.95	18.65	4.86	2.24	0.27	0.26	40.9	10
		25-150	22	35	43	C	1 64	38	0.34	0.10	3.4	4.80	19.90	4.79	3.13	0 20	0.52	43.4	7
		150-230	32	48	20	L	1 60	40	0.13	0.05	2.6	6.90	15.50	4.28	6.75	0.09	1.72	82.5	9
		230-300	34	48	18	L	1.74	36	0.11	0.05	2.2	6.70	17.00	4.15	7 16	0.08	1.63	76.6	10
	1/ 4	0-40	28	34	38	CL	1 69	36	0.28	0.09	3.1	5.00	14.95	3.40	2.86	0.15	0 73	47 8	6
		40-70	16	38	46	C	1.62	38	0.17	0.07	2.4	5.70	20.00	6.46	4.61	0.16	2.13	66.8	3
		70-130	16	36	48	C	1.61	41	0.12	0.07	1.7	7.70	17.50	8.72	6 28	0.13	2.83	102.6	15
		130-220	44	27	29	CL	1.61	41	0.11	0.05	2.2	7 60	13.00	6.60	4.96	0.10	1.49	101.2	14
		220-300	56	29	15	SL			0.14	0.03	4.7	6.60	11.15	6 41	2.25	0.09	0.34	81.5	17
	1/ 12	0-20	13	31	56	C	1.32	49	1.74	0.27	6.4	6.20	36 90	21.20	4 93	0.31	0.58	73.2	28
		20-110	19	33	48	C	1.48	42	0.18	0.08	2.2	4.90	21.15	4.54	3.40	0 19	0.86	42.5	2
		110-190	13	29	58	C	1.59	40	0.18	0.08	2.2	7.60	28.10	10.14	8.68	0 13	4.29	82.7	8
		190-300	24	22	54	C			0.07	0.06	1.2	7.60	23.80	18.30	5.42	0.16	1.20	105.4	4
	2/ 20	0-30				C	1.49	43	0 5			5.1	8.0	5.2	0 9	0.13	0.03	78.3	2
		30-70				L	1 67	36	0.5			4.9	9.2	4.4	1.1	0.12	0.07	61.8	1
		70-108				SL	1 57	40				4 9	7.5	3.1	0.9	0 08	0.08	55.5	16
		108-150				L	1.57	40				4.9	9.1	4.2	1.3	0.11	0.09	62.6	7
	1/ 21	0-20	12	49	39	SiCL	1.48	45	0.95	0.16	5.9	5.10	17.50	7.00	2.74	0.20	0.77	61.2	9
		20-70	12	36	52	C	1.36	51	0.34	0.09	3.8	5.15	21.75	6.80	5.62	0.21	1.39	65.8	6
		70-180	12	38	50	C	1.35	50	0.26	0 14	1.9	6.30	22.30	9.49	6.70	0.17	2.10	84.7	5
		180-230	22	49	29	CL			0 15	0.05	3.0	7 30	16.40	7.27	5.89	0.10	1.55	91.8	13
		230-300	62	34	14	SL			0.12	0.03	4 0	6.55	10.90	3.76	3.93	0.07	0.54	76.1	32
	1/ 29	0-25	10	38	52	C			1.96	0.29	6 8	6.00	39.00	23.01	3.65	0.33	0.45	70.3	62
		25-60	12	34	54	C			1.12	0.19	5.9	6 45	33.15	20.05	3.46	0.20	0.32	72.5	72
		60-150	15	35	50	C			0.59	0 13	4.5	6 30	26.70	15.05	3.06	0.20	0.34	69.8	79
		150-300	11	29	60	C			0.33	0.10	3.3	6.40	29 95	16.94	3.54	0.27	0.53	71.0	38
	2/ 34	0-30				C			2.2			6.1	12 5	16.6	3.0	0.3	0 03	159.4	8
	2/ 35	0-30				C			1.6			5.5	5.6	3.1	0.5	0.08	0.01	82.1	14
	1/ 42	0-40	14	29	57	C	1.61	40	1.57	0 25	6.3	5 80	32 40	17.66	4.67	0.96	0.33	73.5	19
		40-170	17	32	51	C	1.53	41	0 30	0 08	3.8	4 85	21.95	9.11	3.45	0.26	0.47	60.5	7
		170-250	17	20	63	C			0.28	0 10	2.8	5.15	25.05	9 85	5.81	0.29	0 94	67.5	8
		250-310	19	24	57	C			0.17	0.08	2.1	6 05	16.20	8.34	3 93	0.18	0.78	81.7	13

Guaramito	2/ 59	0-30				L			2.2			5 7	12 7	10.8	1.4	0.13	0 01	97.2	1
	1/ 67	0-15	14	13	53	C			1.76	0.30	5 9	6 40	33 00	20.10	4.67	0.49	0.35	77.7	88
		15-40	18	35	47	C			0 80	0.16	5.0	6 30	26 00	15 53	3 46	0 28	0 35	75.5	20
		40-100	16	43	41	SIC			0.26	0 08	3 3	4 95	22.30	6.85	1.66	0.20	0.50	58.3	10
		100-210	18	31	51	C			0.39	0 11	3 5	5.10	26.50	11.35	3.59	0.23	0 45	58.9	12
	2/ 68	0-30				CL			2.7			6.0	19.6	16.7	2.4	0 3	0.04	99.2	14
	1/ 71	0-15	11	45	44	SIC	1.25	5.3	1.97	0.26	7.6	7.10	31.83	31 58	4.05	0 06	0.21	112.6	58
		15-60	12	36	52	C	1.34	49	1.21	0.20	6.1	6.40	35.20	22 02	3.61	0 34	0 37	74.0	38
		60-160	7	32	61	C	1.49	45	0.35	0.06	5 8	5.95	28.20	17.57	3.80	0.26	0.40	78 1	17
		160-300	5	34	61	C			0.34	0.06	5 8	7.25	26.90	22.36	4.56	0.23	0 58	103 1	100
	2/ 73	0-30				C			1.1			4.5	8.5	0.91	0.3	0.13	0.01	15.9	4
	1/ 74	0-15	14	13	53	C			1.76	0.30	5.9	6.40	33.00	20.10	4.67	0.49	0.35	77.7	94
		15-40	18	35	47	C			0.80	0.16	5.0	6.30	26.00	15.53	3.46	0.28	0.35	75.5	20
		40-100	16	43	41	SIC			0.26	0 08	3.3	4 95	22.30	6 85	3.66	0.20	0 50	58.3	10
		100-210	18	31	51	C			0.39	0.11	3.5	5.10	26.50	11.35	3.59	0.23	0 45	58.9	12
	2/ 81	0-20				CL	1.50	42	0.5			4 0	10.7	3 6	2.7	0.14	0.01	60.2	3
		20-55				C	1.58	39	1.1			5.1	9 8	4.6	2.8	0.2	0 02	87.8	2
		55-85				SL	1.75	34				5.0	7.3	2.6	2.3	0.1	0 03	68.9	2
		85-140				C	1.69	35				5 1	12 7	4.9	4.9	0.2	0 05	79.1	2
La Unión	1/ 30	0-20	13	46	41	SIC			1.58	0.22	7 2	6 80	26 70	19.80	3.32	0.25	0 41	89.1	79
		20-60	17	44	39	SICL			1.17	0.18	6 5	6.45	21 90	14.62	2.74	0.26	0.30	81.8	28
		60-100	23	47	30	CL			0.52	0.09	5.8	6.15	14 30	8.95	2 10	0 20	0.31	80.8	37
		100-270	15	41	44	SIC			0.41	0.08	5.1	6.20	18 95	12.22	2.61	0.20	0.32	81.0	13
	2/ 31	0-24				CL	1.32	48	1.1			7.4	13.0	21.8	1.9	0.3	0.05	185.0	34
		24-55				CL	1.35	49	0.5			6.5	11.3	12.2	2.0	0.3	0.08	129.0	25
	1/ 36	0-60	14	60	26	SIL	1.47	45	0.92	0.13	7.1	7.30	24 80	24 15	1.70	0 26	0 23	106.2	55
		60-120	14	37	49	C	1.58	42	1 15	0.18	6.4	6.70	28.60	20.71	3.51	0 33	0 34	87.0	62
		120-230	12	41	47	SIC	1.64	38	0.56	0.13	3.3	6 80	23 70	17.03	2 88	0 31	0.31	86.6	79
		230-300	40	44	16	L			0.31	0.05	6 2	6 85	9 85	7.82	0 77	0.13	0.23	90.9	100
La Union	1/ 47	0-10	28	46	26	L			1.27	0.18	7.1	6.25	19.65	12.16	3.09	0 28	0.30	80.6	100
		10-45	66	12	12	SL			0.31	0 05	6.0	5.75	8 10	4.95	0 85	0.17	0.20	76.1	75
		45-100	22	54	24	SIL			0.47	0.09	5.2	6.90	21.65	16.08	1.33	0 14	0.32	82.5	95
		100-190	10	34	56	C			0.71	0.12	5.9	6.85	28.00	19.83	2.71	0.32	0.40	83 1	100
		190-230	10	30	60	C			0.45	0.07	6.5	6.90	22.45	15.79	2.60	0.28	0.39	85 0	33
		230-300	7	40	53	SIC			0.42	0.07	6.0	6.90	20.15	14.80	3.03	0.26	0.34	91.4	62
	2/ 49	0-30				CL			2.7			6.4	17.1	19.3	2.4	0.3	0.01	128.7	31
	2/ 52	0-30				C			1.6			5.9	16.8	17.2	2.5	0.2	0.01	118.5	23
	2/ 60	0-30				C			2.2			5.9	17.0	16.1	3.4	0.2	0.01	117.1	9
	1/ 75	0-25	27	43	30	CL			1.68	0.24	7.0	6.85	26.30	18.56	2.74	0.21	0.31	83.0	46
		25-45	37	37	26	L			0.73	0.15	4.9	5 95	17.30	9.37	1.61	0.12	0 31	65.9	8
		45-100	53	31	16	SL			0.34	0.07	4.9	5.60	9.85	5.15	0.85	0.09	0.23	64.1	23
		100-130	38	22	40	C			0.26	0.06	4.3	5 75	16.05	8.04	1.73	0.14	0.35	63.9	11
		130-200	38	22	40	C			0.26	0.06	4.3	5.15	18.20	7.25	2.13	0.17	0 29	64.1	26
		200-300	78	5	17	SL			0.11	0.04	2.8	5 10	10.00	3 40	0.92	0.09	0.27	46.8	100
	2/ 77	0-35				CL	1.50	43	0.5			5.1	7.5	3.4	1.6	0.09	0.12	69.5	2
		35-55				CL	1.64	36	0.5			4.8	7.7	2.3	1.5	0 10	0.11	83.5	2
		55-90				CL	1.65	36				4.9	8.0	1.8	1.5	0.08	0 15	72.0	8
		90-140				CL	1.71	35				5 0	9 0	2 6	2.7	0 11	0.44	65.0	8
La Jarra	1/ 45	0-15	26	56	18	L			1.05	0 15	7.0	3.55	10 50	0 27	0.16	0.13	0 36	8.7	8
		15-60	21	49	30	CL			0.09	0.04	2.2	4 20	4.80	0 14	0.09	0.04	0 16	9.0	3
		60-95	15	33	52	C			0.27	0.08	3 4	4.10	13.30	0.43	0.25	0.10	0.31	8.2	4
		95-230	20	34	46	C			0.13	0.04	3.3	4.05	16 50	0.32	0.16	0.10	0 13	4.3	3
		230-310	81	9	10	LS			0.05	0.02	2.5	4.15	5.60	0 09	0.14	0.04	0 16	7.7	7
	2/ 63	0-25				CL	1.46	44	0.5			4.4	7.1	0 4	0.07	0.07	0.01	7.7	4
		25-50				CL	1.68	36	0.5			4.3	6.2	0 04	0.01	0.04	0.01	1 6	1
		50-83				C	1.64	38				4.3	7.5	0 04	0.01	0.06	0.01	1 6	1
		83-140				C	1.61	39				4.4	10.7	0 02	0.01	0.09	0.01	1.2	1

Alto Viento	2/ 62	0-30				S			1.1			5.4	4.0	0.5	0.05	0.05	0.01	15.3	4
	1/106	0-35	70	13	17	SL	1 44	45	0 56	0.08	7.0	4 10	6.80	0 29	0.20	0 06	0.13	10.0	9
		35-55	66	13	21	SCL	1 67	37	0.13	0.03	4 3	4 05	6.05	0.18	0.14	0.14	0.21	9 6	4
		55-110	52	9	39	SC	1 54	43	0.19	0.06	3.2	3.95	11 80	0.13	0.05	0 05	0.17	3.5	9
		110-210	64	5	31	SCL	1.62	40	0.11	0.04	2.8	4 00	8.65	0.08	0 09	0.09	0.16	4.5	2
		210-300	85	8	7	LS			0.04	0.02	2.0	4.40	2.50	0 12	0.07	0 07	0.18	16.8	25
	2/ 111	0-30				LS			1.1			4 5	5.2	0.36	0.25	0 16	0.02	15.2	2
Fortaleza	2/ 72	0-30				S			0.5			4.6	2.0	0.16	0.06	0.04	0.01	13.5	3
	2/ 82	0-30				LS			1.1			4.9	2.7	0.6	0.4	0.1	0.01	41.1	4
	1/ 85	0-20	92	5	3	S			0.66	0.06	10.0	4 40	4.85	0.60	0.10	0.09	0.17	19.8	12
		20-100	88	5	7	LS			0.05	0.03	1.7	4.25	5.50	0.50	0.18	0.07	0.32	19.4	16
		100-300	70	8	22	SCL			0.13	0.04	3.3	4.20	5.70	0.20	0.10	0.07	0.18	9 7	5
	2/ 86	0-30				LS			0.5			5.5	3.3	0.7	0.2	0.4	0.02	40.0	10
	2/ 88	0-30				LS			1.1			4.7	5.0	0.9	0.2	0.09	0.01	24.0	34
	2/ 91	0-30				SL			1.1			4.7	4.0	1.0	0.3	0 08	0.01	34 8	6
	2/ 100	0-30				LS			1.1			4.4	3.5	0.14	0.06	0 06	0.01	7.7	3
	1/ 101	0-25	77	18	7	LS	1.44	45	0.79	0.09	8.8	4.30	5.55	0.32	0.25	0.09	0.15	14 7	13
		25-50	71	16	13	SL	1.51	44	0.35	0.05	7.0	4.20	4.90	0.13	0.15	0 05	0.15	9.2	7
		50-150	65	14	21	SCL	1.58	42	0.12	0.04	3.0	4.15	6.50	0.19	0.20	0.05	0.15	10.5	6
	2/ 103	0-30				LS			1.1			4.5	3.6	0.20	0.12	0.11	0.01	12.2	4
	2/ 104	0-30				S	1.37	46	0.5			4.6	12.2	0 05	0.04	0.03	0.01	1.1	4
		30-58				S	1 42	46	0.5			5.0	2.8	0.01	0.01	0.01	0.01	1.4	4
		58-85				S	1 51	43				5.0	3.0	0.01	0 01	0.01	0.01	1.3	5
		85-120				S	1.58	40				5.2	3.4	0.01	0.01	0.01	0.01	1.7	13
	1/ 107	0-45	82	14	4	LS			0.30	0.04	7 5	4.05	4.85	0.14	0.09	0.04	0.14	8.4	7
		45-70	76	16	8	SL			0.15	0.04	3.8	4.25	3.70	0.13	0.04	0.03	0.15	9.5	3
		70-130	62	16	22	SCL			0.11	0.03	3.7	4 05	7 35	0.10	0.18	0.08	0.12	6 5	2
		130-180	66	12	22	SCL			0.11	0.03	3.7	4.05	7.00	0.12	0.17	0.06	0.15	7.1	3
		180-310	34	40	26	L			0.05	0.02	2.5	4 10	7.50	0.19	0.17	0 09	0.13	7.7	8
Marañon	1/ 109	0-20	91	6	3	S	1 41	46	0.54	0.06	9.0	4.70	2.15	0.15	0 10	0.04	0.13	19.5	20
		20-42	85	8	7	LS	1.41	46	0.29	0.04	7.2	4.70	2.30	0.17	0.10	0 05	0.13	19.6	13
		42-80	82	15	3	LS	1.46	44	0.08	0.02	4.1	5.35	4.10	0.42	0.32	0.06	0 14	21.4	4
		80-160	77	12	11	SL	1.41	47	0.11	0.03	3 7	5.15	3 50	0.22	0.32	0.05	0.13	20.6	38
		160-250	71	10	19	SL			0.06	0.03	2.0	4.35	4.85	0.36	0.09	0 05	0.14	13.4	16
	1/ 110	0-30	92	4	4	S			0 53	0.05	10.6	4 00	5 90	0.16	0.08	0.06	0.12	7.1	3
		30-50	88	7	5	S			0.22	0.04	5.5	4.40	3.85	0.12	0.03	0.06	0.11	8.3	4
		50-200	82	8	10	LS			0.11	0.03	3 7	4.30	5 60	0.24	0.03	0.08	0.29	11.4	4
		200-300	76	8	16	SL			0.06	0.02	3.0	4.20	6.12	0.12	0.11	0.06	0.14	7.1	4

1/ INCORA' Report (1970)

2/ Bulk Density & Porosity: DAIKI Others: ICA Laboratory

Table 5–2–3 Salinity and Micro-Elements of Soils

Soil series	Site No.	Depth cm	EC mmho/cm	ESP %	Fe ppm	B ppm	Cu ppm	Mn ppm	Zn ppm
JA	26	0-23	0.15	1.08	128	0.6	1.8	21.5	1.5
		23-35	0.05	1.49	81	0.1	1.2	6.0	1.1
		35-90	0.05	0.28	88	0.1	1.5	4.2	1.3
		90-150	0.05	0.09	91	0.2	7.1	3.1	1.5
JA	57	0-30	0.15	0.09	184	0.2	2.5	23.6	3.8
JA	78	0-30	0.15	0.15	214	0.3	4.3	9.4	4.6
CA	44	0-30	0.20	0.06	621	0.6	7.4	57.9	14.9
CA	55	0-23	0.25	0.74	25	0.7	1.9	2.7	1.3
		23-65	0.15	0.61	40	0.6	3.4	2.9	2.6
		65-130	0.15	0.47	83	0.7	3.4	3.1	2.2
CA	65	0-30	0.15	0.08	71	0.7	2.8	6.4	2.1
PA	95	0-31	0.13	0.13	55	0.6	1.0	3.6	1.2
		31-76	0.05	0.24	29	0.4	0.5	1.9	0.5
		76-105	0.05	0.05	88	0.6	3.2	3.3	2.1
		105-150	0.05	0.09	37	0.6	1.8	1.7	1.1
ZU	39	0-16	0.73	0.38	93	0.6	2.7	17.2	2.4
		16-35	0.33	0.16	30	0.1	0.7	4.0	0.7
		35-90	0.35	0.10	21	0.4	1.3	2.7	0.9
ZU	61	0-30	0.18	0.08	200	0.3	3.2	10.1	4.6
GU	20	0-30	0.08	0.37	106	0.3	1.8	23.3	1.6
		30-70	0.05	0.76	65	0.2	1.3	13.5	2.4
		70-108	0.05	1.06	91	0.1	1.4	12.8	3.5
		108-150	0.35	1.00	76	0.2	2.2	10.2	4.1
GU	34	0-30	0.18	0.24	209	0.6	4.5	14.8	7.5
GU	35	0-30	0.15	0.17	410	0.6	2.5	13.2	1.7
GU	59	0-30	0.15	0.07	266	0.4	3.3	8.2	7.8
GU	68	0-30	0.25	0.20	135	0.4	4.9	18.1	10.0
GU	73	0-30	0.10	0.12	406	0.3	3.8	14.4	4.8
GU	81	0-20	0.13	0.09	146	0.4	2.9	48.4	6.2
		20-55	0.08	0.20	68	0.4	2.1	15.2	2.9
		55-85	0.05	0.41	40	0.3	1.4	6.5	3.2
		85-140	0.05	0.39	52	0.4	3.1	8.1	5.5
LU	31	0-24	0.65	0.38	96	0.3	2.7	7.2	2.7
		24-55	0.38	0.70	213	0.3	3.7	36.9	4.6
LU	49	0-30	0.23	0.06	107	0.7	3.0	5.5	3.1
LU	52	0-30	0.23	0.05	228	0.3	4.1	12.2	5.1
LU	60	0-30	0.28	0.06	108	0.3	1.9	7.8	7.9
LU	77	0-35	0.08	1.60	68	0.4	1.8	15.4	6.6
		35-55	0.05	1.43	45	0.3	1.6	11.0	4.9
		55-90	0.05	1.88	81	0.6	2.5	11.6	5.1
		90-140	0.05	4.89	50	0.6	1.9	11.0	3.3
LJ	63	0-25	0.10	0.14	930	0.3	0.8	3.0	1.2
		25-50	0.63	0.16	303	0.2	0.5	0.8	0.4
		50-83	0.43	0.13	170	0.4	0.6	0.6	0.4
		83-140	0.05	0.09	100	0.1	0.9	0.3	0.5
AV	62	0-30	0.10	0.25	518	0.7	0.5	1.7	0.7
AV	111	0-30	0.08	0.38	235	0.3	0.6	11.7	1.9
FO	72	0-30	0.10	0.50	149	0.3	0.3	1.4	0.5
FO	82	0-30	0.10	0.37	621	0.7	0.1	2.1	0.4
FO	86	0-30	0.28	0.28	411	0.6	0.1	1.3	0.1
FO	88	0-30	0.18	0.20	890	0.6	0.7	4.2	5.0
FO	91	0-30	0.10	0.25	372	0.7	0.1	4.2	0.4
FO	100	0-30	0.08	0.28	255	0.2	0.1	1.2	0.4
FO	103	0-30	0.10	0.28	440	0.3	0.4	1.6	1.1
FO	104	0-30	0.08	0.35	65	0.4	0.1	0.3	0.1
		30-58	0.05	0.50	72	0.7	0.1	0.2	0.1
		58-85	0.05	0.33	113	1.0	0.1	0.2	0.1
		85-120	0.03	0.41	37	0.6	0.1	0.1	0.1

EC: Electrical conductivity

ESP: Exchangeable-sodium percentage

Table 5–2–4 Moisture Retention Capacity & Available Moisture

Soil Series	Site No.	Depth cm	Texture	Porosity Vol.%	Retention Capacity of Moisture vol. % Atmospheric pressure 1/10	1/3	10	15	Available Moisture Retention Capacity vol.%	mm	Total mm/100cm
JA	13	0-30	CL	44	38.1	31.9	18.8	16.5	15.4	46.2	144.2
		30-120	CL	40	35.0	30.8	18.7	16.8	14.0	98 0	
	14	0-10	L		27.4	21.1	10.5	8.5	12 6	12.6	111.4
		10-40	L		25 3	18.9	10.4	8.5	10.4	31.2	
		40-80	L		30.3	17.4	9.6	7.8	9 6	38.4	
		80-120	CL		34.7	25.6	13.6	11 0	14.6	29.2	
	22	0-30	SiL	41	37.1	28.3	11.5	10.0	18.3	54.9	160.4
		30-70	SiCL	44	34.8	25.2	12.2	10.3	14.9	59.6	
		70-100	SiCL	50	35.1	29.1	15.5	13.8	15.3	45.9	
		100-120	CL	47	28.3	18.1	7.5	6.9	11.2		
	25	0-30	CL	34	32.5	25.6	13.4	11.6	14.0	42.0	87.9
		30-90	SCL	39	17.6	12.7	6.9	6.1	6.6	39.6	
		90-120	L	42	21.3	11.9	6.3	5.6	6.3	6.3	
	38	0-25	SL	48	13.8	6.5	4.0	3.4	10.4	26.0	153.0
		25-80	SiCL	47	40.0	33.1	18.3	15.0	18.1	99.6	
		80-120	SiCL	45	33.4	27.8	15.9	14.1	13.7	27.4	
	56	0-15	L	39	37.4	28.4	15.3	13.1	15.3	23.0	127.6
		15-70	CL	37	29.2	24.3	13.9	12.1	12.2	67.1	
		70-110	CL	34	27.0	23.3	12.5	10.8	12.5	37.5	
		110-120	SiCL	42	30.9	28.6	16.9	14.5	14.1		
	66	0-20	CL	38	37.9	35.0	17.2	15.4	19.6	39.2	134.7
		20-50	CL	38	31.0	25.5	12.4	11.9	13.6	40.8	
		50-90	SiCL	42	30.1	19.5	9.8	9.0	10.5	42.0	
		90-120	CL	38	33.0	27.6	14.3	14.9	12.7	12.7	
CA	6	0-40	C	42	41.2	30.5	19.5	8.9	21.6	86.4	139.0
		40-80	SiCL	43	31.2	21.6	19.6	13.5	8.1	32.4	
		80-100	L	49	29.2	15.3	8.2	5.2	10.1	20.2	
		100-120	SL		11.3	5.0	2.2	1.0	10.3		
	43	0-15	SL		24.5	19.1	10.6	9.4	15.1	22.7	91.0
		15-80	SCL		12.0	9.3	5.3	4.7	4.6	29.9	
		80-120	SL		30.0	25.7	13.3	11.8	19.2	38.4	
	48	0-10	SiL		37.8	18.2	8.0	6.9	11.3	11.3	118.3
		10-40	SiL		35.2	29.1	12.1	10.8	18.3	54.9	
		40-65	SiL		19.7	12.8	5.9	5.8	7.0	17.5	
		65-85	SiL		34.4	27.8	12.1	10.9	16.9	33.8	
		85-120	SiL		2.7	2.1	1.8	1.6	0.5	0.8	
	64	0-45	L	44	35.5	29.9	12.1	10.9	19.0	85.5	137.6
		45-90	SL	44	14.0	5.1	3.6	3.3	10.7	48.2	
		90-120	S		6.0	3.1	3.1	2.1	3.9	3.9	
	69	0-15	LS	48	7.7	4.0	2.6	2.2	5.5	8.3	87.2
		15-60	L	47	29.8	21.3	10.1	7.8	13.5	60.8	
		60-90	S	44	3.3	2.6	1.7	1.4	1.9	5.7	
		90-120	SL	48	17.4	9.8	5.3	5.0	12.4	12.4	

Soil Series	Site No.	Depth cm	Texture	Porosity Vol.%	Retention Capacity of Moisture vol. % Atmospheric pressure 1/10	1/3	10	15	Available Moisture Retention Capacity vol.%	mm	Total mm/100cm
PA	70	0-35	SiL	45	35.5	20.9	12.1	10.9	10.0	35.0	104.6
		35-120	SL	48	14.0	5.1	3.6	3.3	10.7	69.6	
	96	0-25	L	41	40.9	18.4	13.9	10.4	8.0	20.0	91.4
		25-45	S	61	23.2	8.7	5.3	3.2	20.0	40.0	
		45-120	S	46	6 5	3.6	2.9	0.8	5.7	31.4	
ZU	40	0-20	SiCL	45	37.3	31.2	13.8	11.6	19.6	39.2	170.2
		20-80	C	49	49.5	40.9	26.2	24.3	16.6	99.6	
		80-120	C		45.7	37.8	23.8	22.1	15.7	31.4	
GU	1	0-25	CL	37	40.8	36.3	21.1	20.1	16.2	40.5	88.5
		25-120	C	38	35.8	24.5	20.9	18.1	6.4	48.0	
	4	0-40	CL	36	31.4	21.5	15.7	14.2	7.3	29.2	67.9
		40-70	C	38	33.7	24.4	19.0	17.6	6.8	20.4	
		70-110	C	41	32.0	23.1	18.4	17.0	6.1	18.3	
		110-120	CL	41	25.3	20.7	19.2	11.1	9.6		
	12	0-20	C	49	50.0	41.0	28.2	26.0	15.0	30.0	132.4
		20-110	C	42	39.4	32.3	21.2	19.5	12.8	102.4	
		110-120	C	40	37.9	33.0	21.2	19.9	13.1		
	21	0-20	SiCL	45	39.4	33.7	19.1	14.7	19.0	38.0	112.5
		20-70	C	51	38.5	33.2	22.0	19.0	14.2	56.8	
		70-120	C	50	31.7	14.0	10.0	8.1	5.9	17.7	
	29	0-25	C		43.1	35.7	23.9	20.8	14.9	37.3	133.1
		25-60	C		40.7	32.0	23.5	20.3	11.7	41.0	
		60-120	C		42.1	35.3	25.2	21.6	13.7	54.8	
	42	0-40	C	40	46.6	33.6	25.7	24.0	9.4	37.6	122.8
		40-120	C	41	38.4	35.3	21.9	21.1	14.2	85.2	
LU	30	0-20	SiC		42.7	31.8	25.0	18.9	12.9	25.8	148.2
		20-60	SiCL		40.0	33.8	23.5	17.7	16.1	64.4	
		60-120	CL		31.5	27.0	13.5	12.5	14.5	58.0	
	36	0-60	SiL	45	36.4	30.6	12.8	11.4	19.2	115.2	178.8
		60-120	C	42	42.1	37.0	22.2	21.1	15.9	63.6	
	47	0-10	L		13.4	9.9	5.6	4.9	5.0	5.0	165.9
		10-45	SL		32.0	24.7	12.4	10.1	21.9	76.7	
		45-120	SL		42.8	37.0	23.8	21.7	15.3	84.2	
	75	0-25	CL		39.4	33.4	21.4	15.9	17.5	43.8	113.9
		25-45	L		29.0	23.0	11.8	10.8	12.2	24.4	
		45-100	SL		21.4	15.9	8.1	7.6	8.3	45.7	
		100-120	C		29.3	25.6	14.2	13.1	12.5		
LJ	45	0-15	L		24.1	18.1	9.6	8.0	10.1	15.2	98.0
		15-60	CL		37.7	29.5	22.1	20.4	9.1	41.0	
		60-95	C		39.1	31.9	29.2	20.6	11.3	40.0	
		95-120	C		10.4	8.3	6.2	4.7	3.6	1.8	

Source: INCORA soil report

Table 5–2–4 Moisture Retention Capacity & Available Moisture

Soil Series	Site No.	Depth cm	Texture	Porosity Vol.%	Retention Capacity of Moisture vol. % Atmospheric pressure 1/10	1/3	10	15	Available Moisture Retention Capacity vol.%	mm	Total mm/100cm
AV	106	0-35	SL	45	22.4	11.2	4.3	4.2	18.2	63.4	105.9
		35-55	SCL	37	21.4	10.4	5.9	5.8	4.6	9.2	
		55-110	SC	43	32.2	21.3	14.0	13.9	7.4	33.3	
		110-120	SCL	40	20.3	15.6	11.1	9.5	6.1		
FO	85	0-20	S		6.8	4.6	2.4	1.9	4.9	9.8	45.0
		20-100	LS		7.1	5.2	2.9	2.7	4.4	35.2	
		100-120	SCL		12.2	10.3	6.0	6.0	4.3		
	101	0-25	LS	45	15.3	8.4	4.4	3.7	11.6	23.2	79.0
		25-50	SL	44	18.1	9.1	5.2	4.4	13.7	34.3	
		50-120	SCL	42	20.7	11.5	7.6	7.2	4.3	21.5	
	107	0-45	LS		9.6	8.5	2.8	2.1	7.5	33.8	76.2
		45-70	SL		18.3	16.1	9.8	9.4	8.9	22.3	
		70-120	SCL		19.7	16.8	10.4	10.1	6.7	20.1	
MA	109	0-20	S	46	13.8	3.6	2.6	1.8	12.0	24.0	78.1
		20-42	LS	46	9.6	4.1	1.8	1.4	8.2	18.0	
		42-80	LS	44	6.3	3.2	0.7	0.7	5.6	21.3	
		80-120	SL	47	11.4	6.8	4.7	4.0	7.4	14.8	
	110	0-30	S		5.3	4.3	2.3	1.8	3.5	10.5	60.5
		30-50	S		7.6	6.2	3.8	3.1	4.5	9.0	
		50-120	LS		15.6	11.8	7.6	7.4	8.2	41.0	

Source: INCORA soil report

Table 5–2–5 Three Phase of Soils by Actual-Volumenometric Method

Soil series	Site No.	Depth cm	Total weight g/100ml	Actual volume ml/100ml	Weight of solid phase g/100ml	Volume of three phase: Vs: Solid phase ml/100ml	Vl:Liquid phase ml/100ml	Va: Gas phase ml/100ml	Specific gravity	Porosity %	Water sat. percent. %
JA	26	0-23	175.9	83.8	148.9	56.8	27.0	16.2	2.62	43.2	62.5
		23-35	196.1	93.6	165.5	63.0	30.6	6.4	2.63	37.0	82.7
		35-90	193.9	91.1	165.6	62.8	28.3	8.9	2.64	37.2	76.1
		90-150	194.2	91.4	165.0	62.2	29.2	8.6	2.65	37.8	77.2
CA	55	0-23	177.4	91.0	139.5	53.1	37.9	9.0	2.63	46.9	80.8
		23-65	178.2	90.6	142.0	54.4	36.2	9.4	2.61	45.6	79.4
		65-130	182.8	90.4	148.6	56.2	34.2	9.6	2.64	43.8	78.1
PA	95	0-31	185.7	85.7	162.7	62.7	23.0	14.3	2.59	37.3	61.7
		31-76	149.6	61.7	141.0	53.1	8.6	38.3	2.66	46.9	18.3
		76-105	186.3	87.1	158.9	59.7	27.4	12.9	2.66	40.3	68.0
		105-150	196.0	93.3	173.7	65.6	22.3	12.1	2.65	34.4	64.8
ZU	39	0-16	171.0	87.9	134.4	51.3	36.6	12.1	2.62	48.7	75.2
		16-35	182.2	90.6	145.1	53.5	37.1	9.4	2.71	46.5	78.8
GU	20	0-30	163.2	71.1	149.4	57.3	13.8	28.9	2.61	42.7	32.3
		30-70	191.9	89.0	166.8	63.9	25.1	11.0	2.61	36.1	69.5
		70-108	191.0	93.7	157.3	60.0	33.7	6.3	2.62	40.0	84.3
		108-150	188.1	91.1	157.2	60.2	30.9	8.9	2.61	39.8	77.6
GU	81	0-20	177.4	85.2	150.0	57.1	27.4	14.8	2.60	42.2	64.9
		20-55	188.9	91.4	158.2	60.7	30.7	8.6	2.61	39.3	78.1
		55-85	202.2	93.1	175.1	66.2	26.9	6.9	2.65	33.8	79.6
		85-140	199.2	94.8	169.2	64.8	30.0	5.2	2.61	35.2	85.2
LU	31	0-24	169.2	89.5	131.7	52.0	37.5	10.5	2.53	48.0	78.1
		24-55	172.4	88.1	135.0	50.7	37.4	11.9	2.66	49.3	75.1
		55-120	175.7	87.2	143.8	55.3	31.9	12.8	2.60	44.7	71.4
LU	77	0-35	173.2	80.3	150.0	57.1	23.2	19.7	2.63	42.9	54.1
		35-55	193.4	92.7	164.4	63.7	29.0	7.3	2.58	36.3	79.9
		55-90	193.9	93.0	164.5	63.6	29.4	7.0	2.59	36.4	80.8
		90-140	198.9	92.1	171.4	65.6	27.5	7.9	2.65	35.4	77.7
LJ	63	0-25	168.9	78.6	146.6	56.3	22.3	21.4	2.60	43.7	51.0
		25-50	190.7	86.3	168.4	64.0	22.3	13.7	2.63	36.0	61.9
		50-83	195.3	93.1	164.2	62.0	31.1	6.9	2.65	38.0	81.8
		83-140	190.7	91.6	160.5	61.4	30.2	8.4	2.61	38.6	78.2
FO	104	0-30	146.0	62.5	137.2	53.7	8.8	37.5	2.55	46.3	19.0
		30-58	152.0	64.9	141.5	54.4	10.5	35.1	2.60	45.6	23.0
		58-85	154.6	61.1	150.8	57.3	3.8	38.9	2.63	42.7	8.9
		85-120	162.2	64.7	157.5	60.0	4.7	35.3	2.63	40.0	11.8

Table 5–2–6 Result of Intake Rate Tests

Soil series	Site No.	Texture	$D=CT^n$ Accumulated infilteration (mm)	$Ic=60nT^{n-1}$ Intake rate (mm/min)	Basic[2/] intake rate (mm/h)
LOW-LAND					
JA	13	CL	$D=2.5T^{0.66}$	$Ic=99.0T^{-0.34}$	16.2
JA	14	L	$D=1.83T^{0.38}$	$Ic=41.7T^{-0.62}$	1.06
JA	25	CL	$D=1.13T^{0.71}$	$Ic=48.1T^{-0.29}$	10.8
JA	38	SiCL	$D=0.65T^{0.59}$	$Ic=23.0T^{-0.41}$	2.4
JA	66	CL	$D=2.4T^{0.44}$	$Ic=63.4T^{-0.56}$	2.4
JA	78[1/]	CL	$D=1.03T^{0.42}$	$Ic=26.0T^{-0.58}$	0.87
CA	6	C	$D=2.2T^{0.51}$	$Ic=67.3T^{-0.49}$	4.2
CA	69	L	$D=1.02T^{0.74}$	$Ic=45.3T^{-0.26}$	12.2
CA	93[1/]	CL	$D=1.90T^{0.41}$	$Ic=46.7T^{-0.59}$	1.46
PA	70	SiL	$D=2.3T^{0.61}$	$Ic=84.2T^{-0.39}$	10.0
PA	94[1/]	SL	$D=2.5T^{0.67}$	$Ic=100.5T^{-0.33}$	17.5
ZU	40	SiCL	$D=0.78T^{0.54}$	$Ic=25.3T^{-0.46}$	1.91
GU	1	CL	$D=0.98T^{0.78}$	$Ic=45.9T^{-0.22}$	15.7
GU	4	CL	$D=1.66T^{0.68}$	$Ic=57.8T^{-0.42}$	5.7
GU	11[1/]	C	$D=2.4T^{0.40}$	$Ic=57.6T^{-0.60}$	1.69
GU	42	C	$D=2.3T^{0.53}$	$Ic=73.1T^{-0.47}$	5.2
GU	54[1/]	C	$D=5.9T^{0.30}$	$Ic=106.2T^{-0.70}$	1.54
GU	71	C	$D=0.63T^{0.72}$	$Ic=27.2T^{-0.28}$	6.5
AVERAGE			$D=1.90T^{0.56}$	$Ic=63.8T^{-0.44}$	5.5
TERRACE					
LJ	36	SiL	$D=2.4T^{0.65}$	$Ic=93.6T^{-0.35}$	14.4
LJ	77[1/]	CL	$D=2.9T^{0.37}$	$Ic=64.4T^{-0.63}$	1.53
AV	62[1/]	SL	$D=6.6T^{0.28}$	$Ic=110.9T^{-0.72}$	1.40
AV	106	LS	$D=8.0T^{0.37}$	$Ic=177.6T^{-0.63}$	4.2
FO	85	LS	$D=1.46T^{0.75}$	$Ic=65.7T^{-0.25}$	18.8
FO	89[1/]	S	$D=1.65T^{0.59}$	$Ic=58.4T^{-0.41}$	6.1
FO	101	S	$D=1.66T^{0.65}$	$Ic=64.7T^{-0.35}$	10.1
AVERAGE			$D=3.5T^{0.52}$	$Ic=109.2T^{-0.48}$	7.2
TOTAL AVERAGE			$D=2.4T^{0.55}$	$Ic=79.2T^{-0.45}$	6.4

1/ Tested in Nov. 1983, Others calculated by INCORA's soil report.

2/ Basic intake rate; $Ib=60Cn\left\{600(1-n)\right\}^{n-1}$

5.2.5 Soil Improvement

In considering the present soil conditions, following improvement methods can be adopted for the future development.

(1) Deep Plowing and Subsoil Breaking

Lower land soils are clayey or silty soils and they formulate hard and fine horizons. These properties cause many problems such as poor drainage, obstruction of root growth. In order to improve these conditions, the deep plowing and subsoil breaking shall be introduced. The deep plowing can provide for the increase and softening the surface soil. Also subsoil plowing improves the drainage condition, and increases the permeability of the soil. Both improvement works need the large scale equipment such as high power tractor or pan breaker.

(2) Application of Lime

Lower land soils show low to moderate acidity, but soils on river terrace show high acidity. These high acidic soils shall be neutralized by applying lime periodically. Lime requirement is estimated 1 to 30 ton per ha with once in 5 years.

(3) Green Manure and Leguminous Grass

Soils in the project area, generally, show a lack of organic matter. In order to increase the organic matter content and productivity of the soil, the green manure and leguminous grass, Tropical Kudzu shall be introduced. In practice, the crop rotation with pasture and cultivation crops can be adopted.

5.3 Land Classification

5.3.1 Basic Concepts

The classification followed the framework of the Land Classification System developed by the U.S. Bureau of Reclamation. However, modifications were made to fit the local environments. Specifications both for general crops and for low land rice and shown in Table 5-3-1. The criteria and ranges in Characteristics as suggested assame that the effects of other soil characteristics and qualities are favourable and are not limiting factors in placing soils in land classes. The classification is an interpretive grouping on the combined effects of soil characteristics (soil texture, effective soil depth, pH and base density), physiography (slope and requirement of leveling) and drainage conditions (groundwater table, frequency of inundation).

As shown in Table 5-3-1, the project area is divided into 5 classes. Land class 1 to 4 are suitable for cultivation and land class 6 is unsuitable for cultivation. Land class 5 is not classified. A brief description of each land class is given as follows;

Class 1: There are not limitations to a great number of climatically adapted crop. And good yields can be expected.

Class 2: There are slight limitations to a great number of climatically adapted crop. These limitations can be solved easily and fairly yields can be expected.

Class 3: There are moderate limitations to a great number of climatically adapted crop. After improving these limitations, standard yield can be expected.

Class 4: There are strong limitations to a great number of climatically adapted crop. The land is even possible for cultivation but the land use is limited or low yields may be expected.

Class 5: There are very strong limitations to a great number of climatically adapted crop. Crops will not developed or it will not be feasible to plant them and it will not favourable to develop from the land conservation purpose.

5.3.2 Limitation Factors

(1) Soils

Soil Texture : Soil series GU (1,830 ha) is clayey soil and classified into class 3. Soil series FO and MA (1,480 ha) is loamy sand soil and classified class 2 or 3. Other soil series are classified as class 1.

Effective Soil Depth : All soil series of the project area have more than 150cm effective soil depth, therefore they are classified as class 1.

Table 5–3–1 Specification for Land Classification

Item	Class 1	Class 2	Class 3	Class 4	Class 6
1) Soil Texture	Sandy loam to clay loam	Loamy sand to permeable clay	Loamy sand to permeable clay	Sand to clay	
Depth of Soil	150cm	120cm	90cm	60cm	Lands which do not meet the minimum requirements for the other classes
Alkality or acidity	pH5.5 to 8.0	pH5.0 to 8.5	pH4.5 to 9.0	pH4.0 to 9.0	
Salinity	Saturation of Na 10% and EC 2mmho/cm	Saturation of Na 12% and EC 4mmho/cm	Saturation of Na 15% and EC 6mmho/cm	Saturation of Na 20% and EC 8mmho/cm	
2) Topography Slope	3%	7%	7%	12%	
Leveling requirement	No	Low	Medium	High	
Cover	Cultivated or pasture	Cultivated or pasture	Cultivated, pasture or bush	Cultivated, pasture, bush or forest	
3) Drainage Ground-water table	1.5m	1.2m	1.0m	0.5m	
Flooding	No	Occasional (1 time in 10 years)	Moderate (1 time in 5 years)	Frequent (1 time in 2 years)	

Soil pH : All soil series on the river terrace (2,030 ha) show below pH 5 and are classified as class 3 or 4.

Salinity : All soil series of the project area have no limitations on salinity.

(2) Physiography

Slope : Whole project area present gentle (less than 3 percent in gradient) except terrace scarp (150 ha) which formulated along the terrace.

Requirement of leveling : The Zuro type erosion (spreading 300 ha) is formulated on the soil series GU, LU, JA and CA, therefore, these areas are classified as class 2 or 3.

Vegetation : Land which is covered by slub and forest and has possibility for cultivation, is classified as class 3 or 4.

(3) Drainage

Groundwater Table : About 75 percent of lower land soils show the groundwater table higher than 1.5 meter and are classified as class 2 or 3. Annual variation of groundwater table of these soils is ranging from 0.5 to 1.5 meter from ground surface.

Frequency of Inundation : According to the classification shown in Table 5-3-1, the flooding area along the Pamplonita and Zulia river is classified as below class 2.

5.3.3 Areal distribution

Areal distribution of these land is shown in Fig. 5-3-1, and Table 5-3-2.

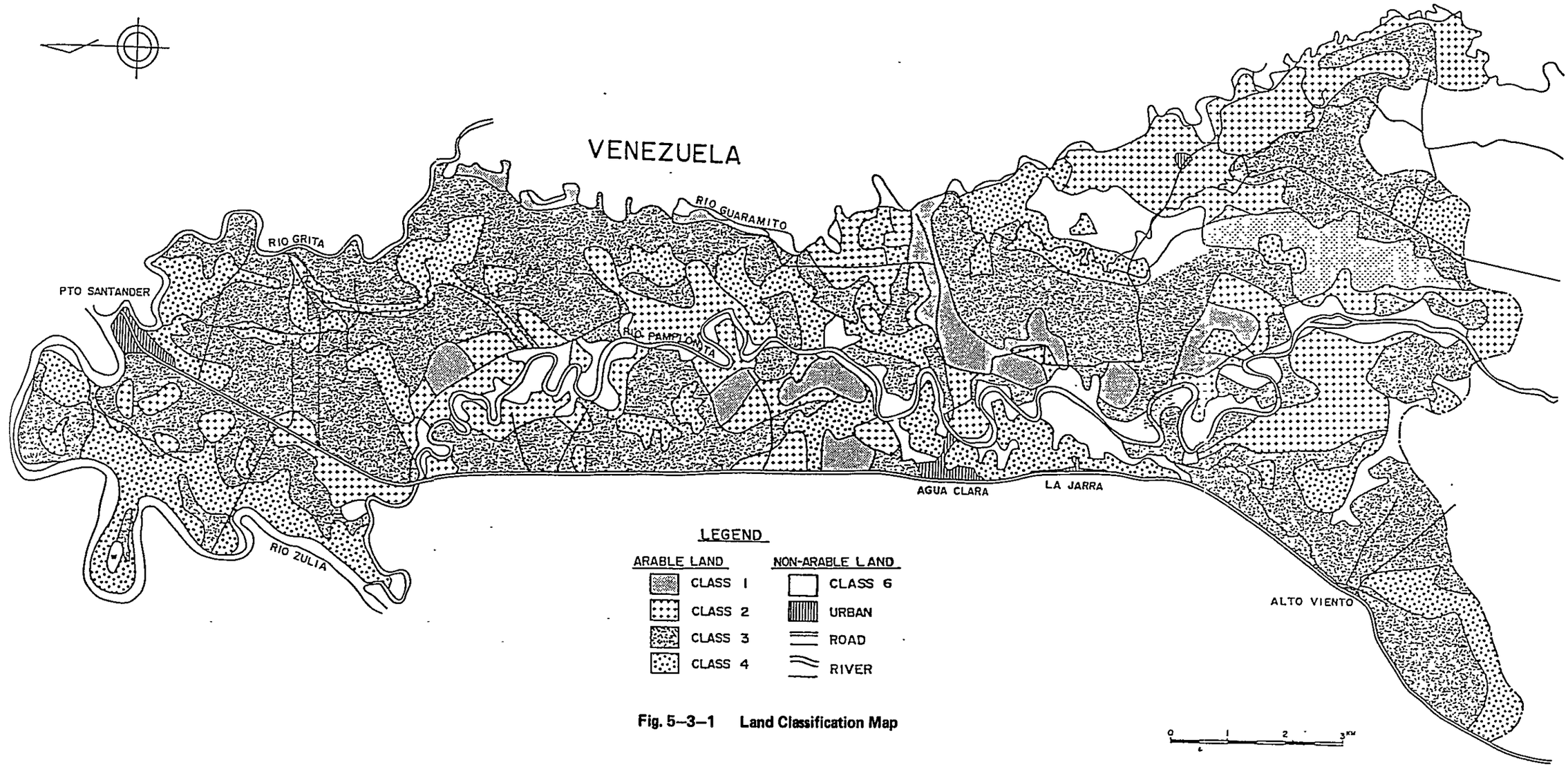


Fig. 5–3–1 Land Classification Map

Table 5–3–2 Land Classfication

Land Class	Area (ha)	Percentage (%)
A) Arable land		
Class 1	740	5.5 (6.7)
Class 2	1,790	13.2 (16.2)
Class 3	5,410	40.1 (49.0)
Class 4	3,100	23.0 (28.1)
Sub-total	11,040	81.8 (100.0)
B) Non-arable land		
Class 6	1,740	12.9
M-land	450	3.3
River & roads	270	2.0
Sub-total	2,460	18.2
Grand-total	13,500	100.0

5.4 Groundwater

Since 1970, groundwater table in the Project area has been observed by the HIMAT. Originally, totally 33 observation well were established, but because of collapse of wells, only 8 wells are continuously observed upto now. Monthly average water table at each observation well and their location are shown in Table 5-4-1 and Fig. 5-4-1, respectively.

According to these data, it can be said that the water table inclines from north to south of the Project area. Average water table at Zone A (lower area; 4 wells), B (12 wells), C (9 wells) and D (hilly area; 8 wells) shows 80cm, 96cm, 145cm and 229cm, respectively. In November-December shows that highest water table and the lowest water table veriation at the hilly area shows very small, 0.3m, in contrast with Im at the lower area.

Even within the lower area, there is difference of drainage condition, 70 percents and 60 percents of period at Zone A and B shows the water table below 1 meter from ground surface but in contrast Zone C shows 25 percent of the period that shows the water table below 1 meter from ground surface.
On the other hand, the groundwater table around existing Campo Alegre drainage canal was surveyed during this investigation period. These results are shown in Fig. 5-4-3. According to these survey results, it is uncovered that drainage canal effects the lowering of groundwater table within 50 to 80 meter from ground surface width along the canal.

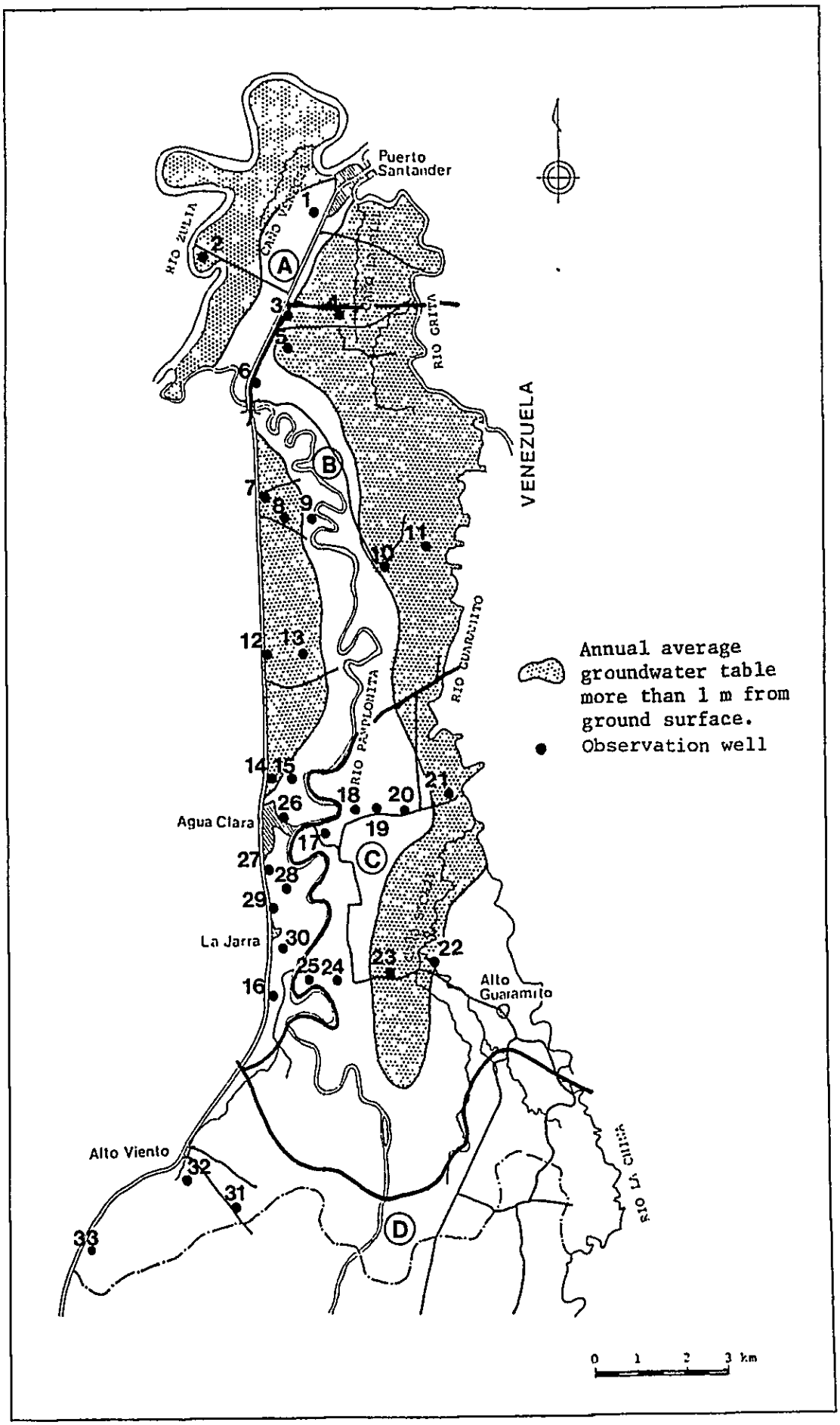


Fig. 5–4–1 Location of Observation Well for Groundwater Table

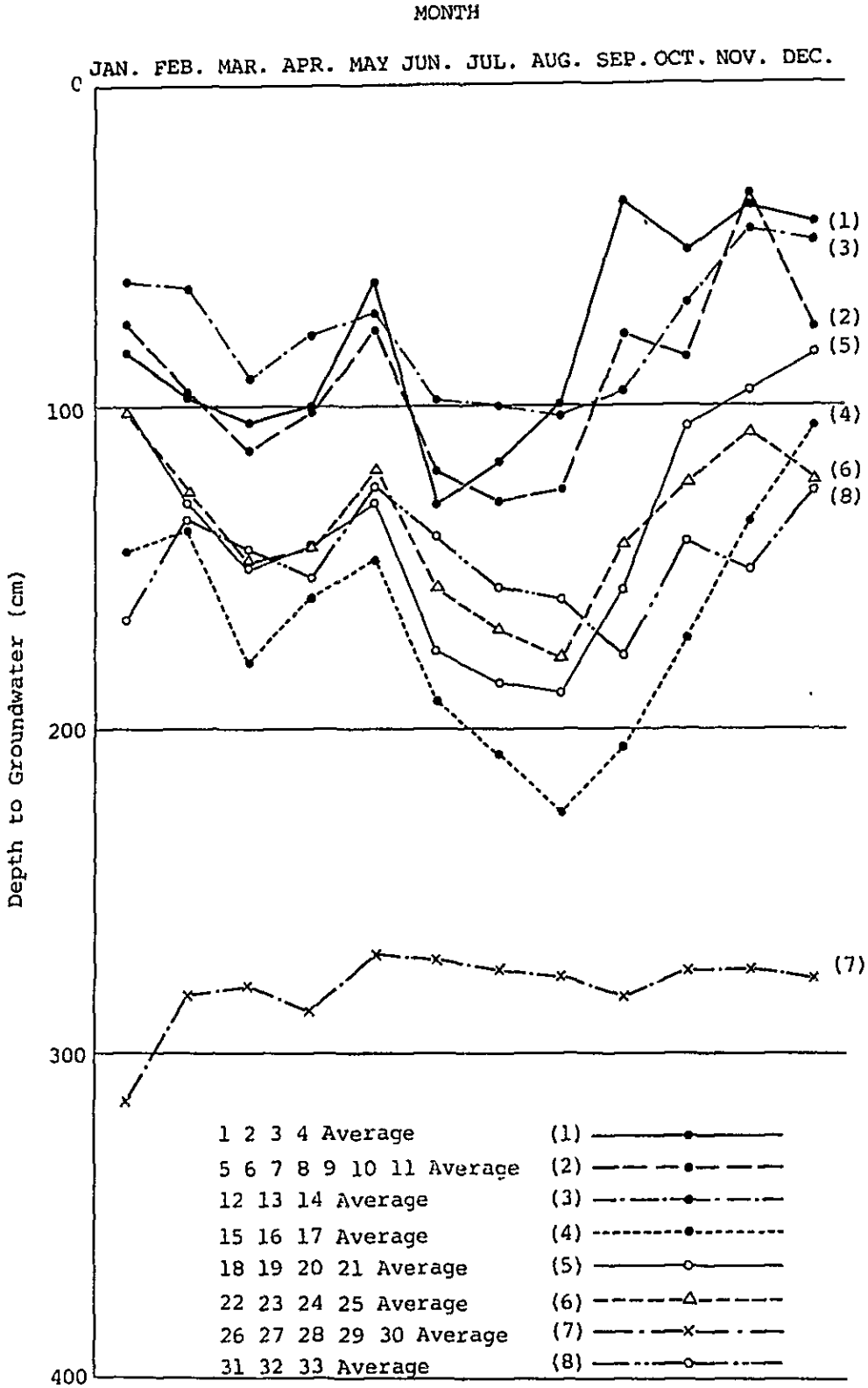


Fig. 5–4–2 Groundwater Table from Ground Surface

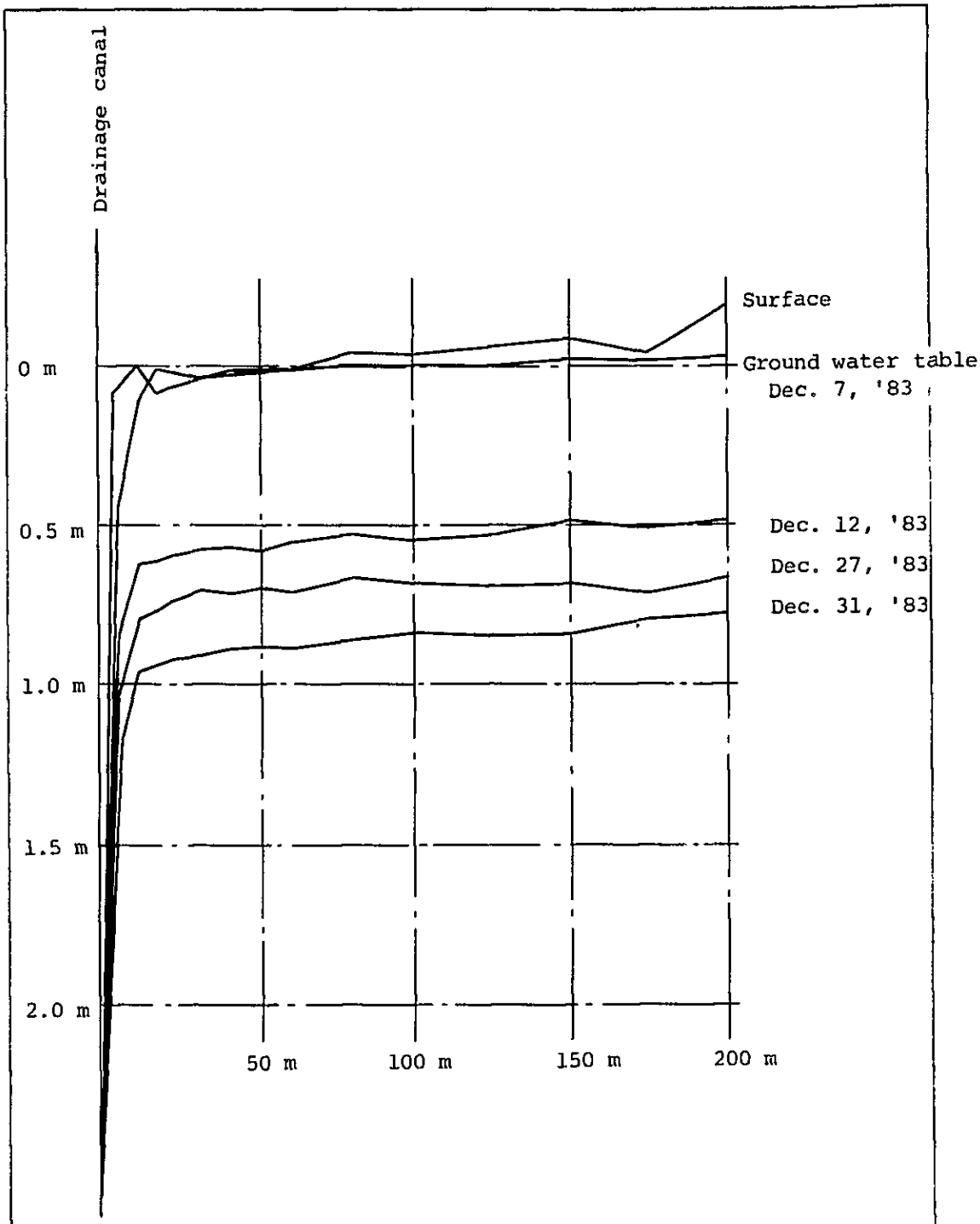


Fig. 5–4–3 Relationship Between Drainage Canal and Groundwater Table

Table 5–4–1 Groundwater Table in the Project Area

(cm from surface)

Well No.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean	Observation period / year
Zone A														
1	125	153	148	111	102	180	218	148	32	68	51	41	115	7
2	83	99	109	103	41	105	72	87	41	45	31	29	70	9
3	46	50	84	102	38	128	58	53	36	25	27	39	57	3
4	78	85	79	83	64	108	118	106	39	70	43	63	78	12
												(Mean	80)	
Zone B														
5	46	72	79	85	71	111	143	130	52	66	28	35	77	8
6	127	153	152	107	97	120	136	154	90	80	34	60	109	13
7	47	64	63	47	42	67	84	72	34	46	28	40	53	12
8	69	117	115	102	79	107	115	129	65	65	25	35	85	13
9	126	155	169	155	109	171	175	177	144	138	51	101	139	8
10	52	54	99	114	64	126	118	105	67	44	29	56	77	4
11	56	59	111	97	67	135	132	113	84	53	47	68	85	4
12	45	54	71	64	58	81	98	77	67	40	26	53	61	4
13	67	72	123	110	89	120	136	148	134	104	48	39	99	9
14	70	64	79	59	66	69	65	83	83	61	60	55	68	9
15	198	173	193	196	187	239	254	264	233	170	156	71	195	5
16	76	85	110	115	86	79	112	152	145	118	68	83	102	4
												(Mean	96)	
Zone C														
17	161	156	235	168	168	256	255	274	237	226	182	163	207	3
18	78	94	110	84	84	161	210	206	146	53	37	20	107	7
19	90	133	161	164	148	206	200	198	157	116	110	114	150	11
20	161	186	210	225	193	227	222	240	228	179	163	131	197	13
21	75	107	119	101	94	108	113	110	96	74	68	68	94	11
22	92	168	196	174	150	187	211	232	166	142	119	158	166	13
23	19	28	25	38	26	74	76	104	48	20	19	16	41	3
24	70	101	147	120	100	134	144	155	135	103	72	84	114	13
25	227	205	223	245	203	229	244	219	220	226	222	234	225	13
												(Mean	145)	
Zone D														
26	316	307	308	307	294	307	321	310	319	303	297	310	308	10
27	348	339	337	317	321	318	324	337	331	315	332	335	330	4
28	375	286	267	269	274	262	264	263	265	260	262	256	267	7
29	287	287	278	282	270	275	277	279	284	279	274	274	280	13
30	251	192	204	217	185	194	184	192	213	214	198	203	204	8
31	135	72	93	87	67	79	108	118	119	119	133	69	100	6
32	186	173	180	188	159	170	188	175	190	176	171	169	177	13
33	177	160	159	183	150	171	173	188	223	132	150	139	167	9
												(Mean	229)	

Source: calculated by observation data of HIMAT

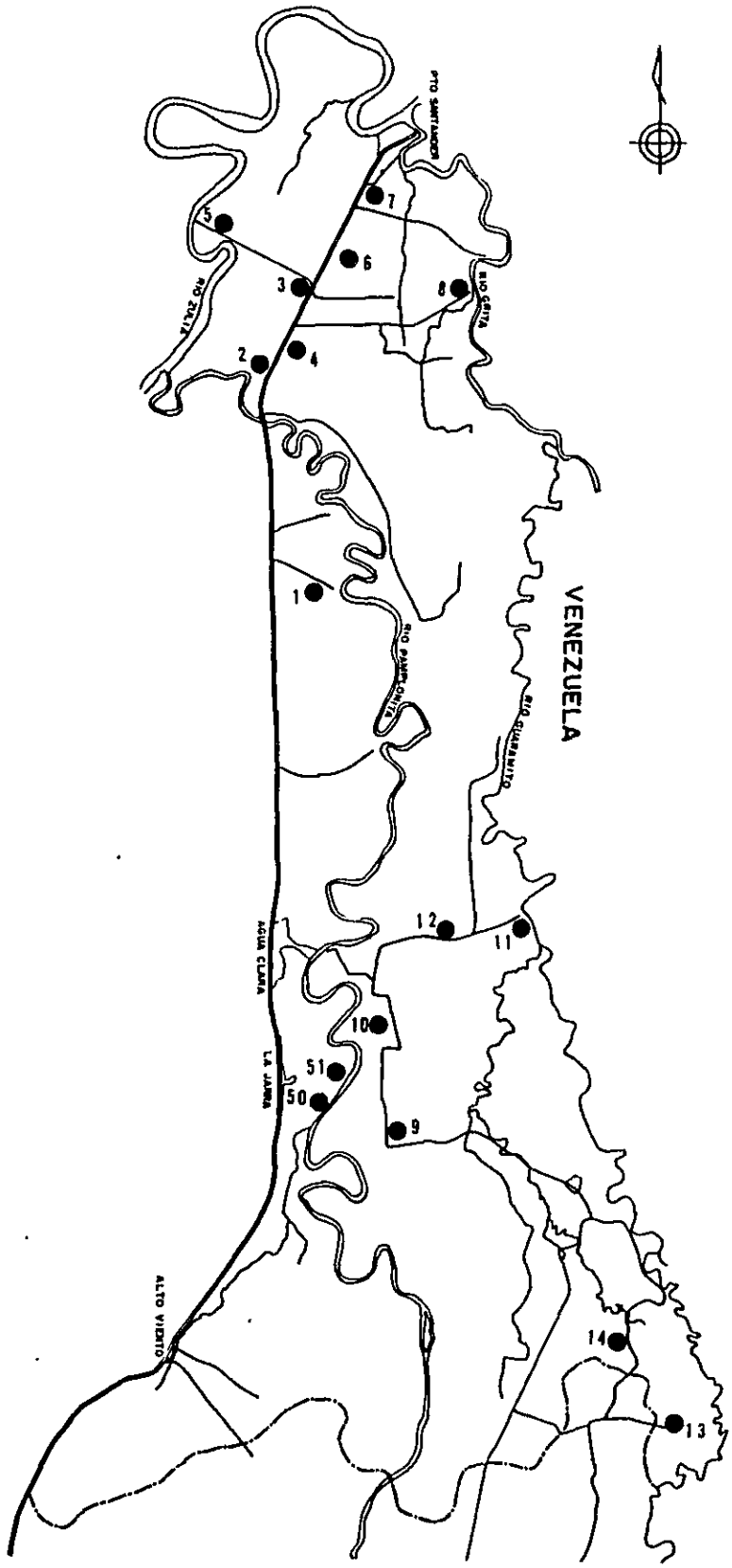


Fig. 5–4–4 Sampling Location for Water Quality Test

Table 5–4–2 Chemical Analysis of Shallow Ground Water

Ground Water

Item		3306	3307	3308	3309	3310	3311	3312	3313	3315	3314	3316	3317	3318	3319	3320	3321
Date																	
Temp.	°C																
pH																	
E.C.	micÜ																
Ca^{++}	ppm																
	meq	60	66	73	58	56	48	61	40	76	74	90	76	50	87	32	71
Mg^{++}	ppm																
	meq	18	17	16	15	17	22	16	23	10	11	9	20	50	6	42	14
Na^{+}	ppm																
	meq	20	15	11	26	27	28	22	36	13	14	4	10		7	26	10
K^{+}	ppm																
	meq	2	2	-	1	-	2	1	1	1	1	-	4		-		5
Total	ppm																
	meq																
HCO_3^{-}	ppm	95	89	78	57	91	83	98	90	91	95	40	74	36	69	42	65
	meq																
Cl^{-}	ppm	5	10	7	3	9	11	1	7	7	4	55	21	36	23	58	27
	meq																
SO_4^{--}	ppm	-	1	15	-	-	6	1	3	2	1	5	5	28	8	-	8
	meq																
Total	ppm																
	meq																
Hard-ness	ppm																
Class																	

Station: Pajarito

Item		599	598	821	815	820	446	431	438	609	611	622	600		
Date															
Temp.	°C														
pH															
E.C.	micÜ														
Ca^{++}	ppm	66	62	43	40	32	51	48	28	54	68	53	62		
	meq														
Mg^{++}	ppm	10	15	38	40	49	28	30	47	30	14	30	15		
	meq														
Na^{+}	ppm	24	23	29	20	19	21	22	25	14	18	17	23		
	meq														
K^{+}	ppm														
	meq														
Total	ppm														
	meq														
HCO_3^{-}	ppm	74	66	69	73	70	77	78	53	64	68	81	72		
	meq														
Cl^{-}	ppm	22	22	18	16	16	21	21	13	23	21	19	24		
	meq														
SO_4^{--}	ppm	4	4	13	11	14	2	1	34	13	11		4		
	meq														
Total	ppm														
	meq														
Hard-ness	ppm														
Class															

Station: Puerto Leon

Item		601	602	603	404	428	441		
Date								Feb. '70	
Temp.	°C								
pH									
E.C.	micΩ								
Ca^{++}	ppm	59	57	55	48	46	48	31	
	meq								
Mg^{++}	ppm	16	16	19	30	33	30	49	
	meq								
Na^{+}	ppm	23	25	26	18	18	18	20	
	meq								
K^{+}	ppm	2	2	-	4	3	4		
	meq								
Total	ppm								
	meq								
HCO_3^{-}	ppm	78	79	70	74	65	69	74	
	meq								
Cl^{-}	ppm	22	21	24	20	18	18	10	
	meq								
SO_4^{--}	ppm	-	-	6	6	17	13	16	
	meq								
Total	ppm								
	meq								
Hard-ness	ppm								
Class									

Station: La Donjuana

Item		604	606	605	806	812	868		
Date									
Temp.	°C								
pH									
E.C.	micΩ								
Ca^{++}	ppm	77	57	68	60	59	60		
	meq								
Mg^{++}	ppm	8	15	15	24	23	24		
	meq								
Na^{+}	ppm	15	28	17	16	18	16		
	meq								
K^{+}	ppm								
	meq								
Total	ppm								
	meq								
HCO_3^{-}	ppm	47	81	80	76	78	76		
	meq								
Cl^{-}	ppm	10	19	20	16	14	15		
	meq								
SO_4^{--}	ppm	43	-	-	8	8	9		
	meq								
Total	ppm								
	meq								
Hard-ness	ppm								
Class									

Station: San Faustino

Item		607	608	609	431	415	7	1	
Date									
Temp.	°C								
pH									
E.C	micΩ								
Ca^{++}	ppm	66	67	62	44	54	60	64	
	meq								
Mg^{++}	ppm	18	15	13	44	36	40	21	
	meq								
Na^{+}	ppm	16	18	25	12	10	-	15	
	meq								
K^{+}	ppm								
	meq								
Total	ppm								
	meq								
HCO_3^{-}	ppm	86	85	84	82	84	84	74	
	meq								
Cl^{-}	ppm	16	15	15	10	7	7	8	
	meq								
SO_4^{--}	ppm	-	-	-	8	9	9	8	
	meq								
Total	ppm								
	meq								
Hard-ness	ppm								
Class									

Station: Agua Clara

Item		2	1	3	610	611	Dec. '69		
Date									
Temp.	°C								
pH									
E.C.	micΩ								
Ca^{++}	ppm	51	58	53	63	64	66		
	meq								
Mg^{++}	ppm	32	28	33	17	15	20		
	meq								
Na^{+}	ppm	17	14	14	10	21	14		
	meq								
K^{+}	ppm								
	meq								
Total	ppm								
	meq								
HCO_3^{-}	ppm	77	79	75	83	84	72		
	meq								
Cl^{-}	ppm	7	4	8	17	16	13		
	meq								
SO_4^{--}	ppm	16	17	17	-	-	15		
	meq								
Total	ppm								
	meq								
Hard-ness	ppm								
Class									

Station:

Item		3306	3307	3308	3309	3310	3311	3312	3313	3314	3315	3316	3317	3318	3319	3320	3321
Date		Nov. 11 '83															
Temp.	°C																
pH		7.3	7.3	7.3	7.3	7.2	7.4	7.3	7.0	7.5	7.2	6.0	9.3	6.9	7.0	6.5	6.6
E C.	micÜ	336	300	249	178	193	147	246	221	397	376	21	74	29	68	11	66
Ca^{++}	ppm	42.5	40.1	38.1	22.4	22.8	14.4	32.5	22.4	62.5	60.1	24.0	12.0	2.4	12.0	1.2	10.0
	meq	2.12	2.0	1.90	1.12	1.14	0.72	1.62	1.12	3.12	3.00	1.20	0.60	0.12	0.60	0.06	0.50
Mg^{++}	ppm	7.8	6.3	5.1	3.6	4.1	3.9	5.1	7.8	5.8	4.9	1.5	1.9	1.5	0.5	1.0	1.2
	meq	0.64	0.52	0.42	0.30	0.34	0.32	0.42	0.64	0.48	0.40	0.12	0.16	0.12	0.04	0.08	0.10
Na^{+}	ppm	16.1	10.4	6.4	11.5	12.7	9.7	13.8	23.0	13.8	11.5	0	0	0	1.2	1.2	1.6
	meq	0.70	0.45	0.28	0.50	0.55	0.42	0.60	1.00	0.60	0.50	0	0	0	0.05	0.05	0.07
K^{+}	ppm	2.7	1.6	0.8	0.8	0.8	1.2	1.2	1.6	0.8	2.0	0.4	1.2	0	0	0	1.2
	meq	0.07	0.04	0.02	0.02	0.02	0.03	0.03	0.04	0.02	0.05	0.01	0.03	0	0	0	0.03
Total	ppm	69.1	58.4	50.4	38.3	40.4	29.2	52.6	54.8	82.9	78.5	25.9	15.1	3.9	13.7	3.4	14.0
	meq	3.53	3.01	2.62	1.94	2.05	1.49	2.67	2.80	4.22	3.95	1.33	0.79	0.24	0.69	0.19	0.70
HCO_3^{-}	ppm	178.1	154.1	116.1	100.1	105.1	74.0	142.1	126.1	220.2	200.2	5.0	30.0	6.0	26.0	5.0	30.0
	meq	2.92	2.53	1.90	1.64	1.72	1.21	2.33	2.80	4.22	3.95	1.33	0.79	0.24	0.69	0.19	0.70
Cl^{-}	ppm	5.7	9.9	6.4	2.8	5.7	5.7	3.5	5.7	5.7	11.0	3.9	5.0	3.5	5.0	5.0	30.0
	meq	0.16	0.28	0.18	0.08	0.16	0.16	0.01	0.16	0.16	0.31	0.11	0.14	0.10	0.14	0.11	0.20
SO_4^{--}	ppm	-	1.7	17.5	0	0	4.0	1.5	2.8	1.0	0	0.5	1.5	4.0	2.3	0	3.0
	meq		0.04	0.36			0.08	0.03	0.06	0.02	0	0.01	0.03	0.08	0.05	-	0.06
Total	ppm	183.8	165.7	140.0	102.9	110.8	83.7	147.1	134.6	226.7	211.2	9.40	36.5	13.5	33.3	8.9	40.0
	meq	3.08	2.85	2.44	2.88	1.88	1.45	2.37	2.29	3.79	3.59	0.20	0.66	0.28	0.62	0.19	0.75
Hard-ness	ppm	138.1	126.1	116.0	71.0	74.0	52.0	102.1	88.0	180.1	170.1	12.0	38.0	12.0	32.0	0.19	0.75
Class																	

Station: River Zulia; Pajarito

Item		599	598	821	815	820	446	431	438	609	611	622	600		
Date															
Temp.	°C			24.0	24.0	24.0	26.0	26.0	26.0	25.0					
pH		-	-	7.4	7.3	7.2	7.0	7.0	7.6	8.0	8.0	8.0	-		
E.C.	micÜ	144	142	128	128	128	128	128	128	144	144	144	142		
Ca^{++}	ppm	16.2	16.0	16.0	14.0	12.0	18.0	16.0	78.0	18.0	20.0	18.0	16.0		
	meq	0.81	0.80	0.80	0.70	0.60	0.90	0.80	0.90	0.90	1.00	0.90	0.80		
Mg^{++}	ppm	1.4	2.3	8.5	8.5	10.9	6.1	6.1	18.0	6.1	2.4	6.1	2.3		
	meq	0.12	0.19	0.70	0.70	0.90	0.50	0.50	1.48	0.50	0.20	0.50	0.19		
Na^{+}	ppm	6.2	6.2	7.1	7.1	7.1	6.9	6.9	7.3	5.0	4.8	5.5	6.2		
	meq	0.27	0.27	0.31	0.31	0.31	0.30	0.30	0.60	0.22	0.21	0.24	0.27		
K^{+}	ppm	1.2	1.2	1.1	1.5	1.5	2.3	2.3	7.6	1.9	1.9	1.9	1.2		
	meq	0.03	0.03	0.03	0.04	0.04	0.06	0.06	0.19	0.05	0.05	0.05	0.03		
Total	ppm	25.0	25.7	32.7	31.1	31.5	33.3	31.3	50.9	31.0	29.1	31.5	25.7		
	meq	1.23	1.29	1.84	1.75	1.85	1.76	1.66	3.17	1.67	1.46	1.69	1.29		
HCO_3^{-}	ppm	45.5	45.5	50.0	50.0	47.5	40.0	40.0	36.0	36.0	36.0	36.0	45.5		
	meq	0.75	0.75	0.82	0.82	0.78	0.66	0.66	0.59	0.59	0.59	0.59	0.75		
Cl^{-}	ppm	7.8	8.8	7.5	6.4	6.4	6.4	6.4	5.0	7.5	6.3	5.0	8.8		
	meq	0.22	0.25	0.21	0.18	0.18	0.18	0.18	0.14	0.21	0.18	0.14	0.25		
SO_4^{--}	ppm	1.8	1.8	7.0	6.0	7.0	0.8	0.5	17.6	5.8	4.8	0	1.8		
	meq	0.04	0.04	0.15	0.13	0.15	0.02	0.01	0.37	0.12	0.10	0	0.04		
Total	ppm	55.1	56.1	64.5	62.4	60.9	47.2	46.9	58.6	49.3	47.1	41.0	56.1		
	meq	1.01	1.14	1.18	1.13	1.11	0.86	0.85	1.10	0.92	0.87	0.73	1.04		
Hard-ness	ppm	46.5	49.5	75.1	70.1	75.0	70.1	65.1	75.1	70.1	60.1	70.1	49.5		
SAR (Sodium Adsorption Ratio		0.39	0.38	0.37	0.37	0.41	0.36	0.37	0.55	0.26	0.27	0.29	0.38		

Station: River Zulia. Puerto León

Item		601	602	603	404	428	441		
Date								Feb. 23 '70	
Temp.	°C				29	29	29		
pH		4.5	4.6	4.4	7.2	7.0	7.4	7.3	
E.C.	micÜ	213	195	183	193	193	193	160	
Ca^{++}	ppm	24.3	18.0	17.6	22.0	22.0	22.1	16.6	
	meq	1.21	0.95	0.88	1.10	1.10	1.10	0.83	
Mg^{++}	ppm	3.9	3.3	3.7	8.5	9.7	8.5	16.0	
	meq	0.32	0.27	0.30	0.70	0.80	0.70	1.32	
Na^{+}	ppm	11.0	9.6	8.7	9.6	9.6	9.6	11.0	
	meq	0.48	0.42	0.38	0.42	0.42	0.42	0.48	
K^{+}	ppm	1.9	1.5	1.5	3.1	3.1	3.1	1.6	
	meq	0.05	0.04	0.04	0.08	0.08	0.08	0.04	
Total	ppm	41.1	33.4	31.5	43.2	44.4	43.3	45.2	
	meq	2.06	1.68	1.60	2.30	2.40	2.30	2.67	
HCO_3^{-}	ppm	69.5	63.0	44.5	48.0	44.0	48.0	65.9	
	meq	1.14	1.03	0.73	0.79	0.72	0.79	1.08	
Cl^{-}	ppm	11.7	9.6	8.8	7.5	7.5	7.5	5.0	
	meq	0.33	0.27	0.25	0.21	0.21	0.21	0.14	
SO_4^{--}	ppm	0	0	3.0	3.2	10.2	7.0	11.5	
	meq	-	-	0.06	0.07	0.21	0.15	0.24	
Total	ppm	81.2	72.6	56.3	58.7	61.7	62.5	82.4	
	meq	1.47	1.30	1.04	1.07	1.14	1.15	1.46	
Hard-ness	ppm	74.5	61.0	58.5	90.1	95.1	95.1		
Class									

Station: River Pamplonita. Don Juana

Item		604	605	606	806	812	808		
Date		Feb. 2 '83		Mar. 24 '83					
Temp.	°C								
pH		-	-	-	7.4	7.0	7.4		
E.C.	micÜ	175	165	165	158	158	169		
Ca^{++}	ppm	24.6	19.2	22.6	20.4	20.4	20.4		
	meq	1.23	0.96	1.13	1.02	1.02	1.02		
Mg^{++}	ppm	1.4	2.5	3.7	4.9	4.9	4.9		
	meq	0.12	0.21	0.30	0.40	0.40	0.40		
Na^{+}	ppm	4.8	4.8	5.5	5.7	6.2	5.7		
	meq	0.21	0.21	0.24	0.25	0.27	0.25		
K^{+}	ppm	1.2	1.2	1.2	1.1	1.1	1.1		
	meq	0.03	0.03	0.03	0.03	0.03	0.03		
Total	ppm	32.0	27.7	33.0	32.1	32.6	32.1		
	meq	1.59	1.41	2.00	1.70	1.72	1.70		
HCO_3^{-}	ppm	39.0	40.5	41.5	55.0	60.0	55.0		
	meq	0.64	0.66	0.68	0.90	0.98	0.90		
Cl^{-}	ppm	4.6	5.6	5.6	6.4	6.4	6.4		
	meq	0.13	0.16	0.16	0.18	0.18	0.18		
SO_4^{--}	ppm	3.0	0	0	5.0	5.0	5.0		
	meq	0.60	-	-	0.10	0.10	0.10		
Total	ppm	46.6	46.1	47.1	66.4	71.4	66.4		
	meq	1.37	0.82	0.84	1.18	1.26	1.18		
Hard-ness	ppm	72.5	58.5	72.0	70.1	70.1	70.1		
Class									

Station: River Pamplonita: San Faustino

Item		607	608	609	431	415	7	1	
Date								Mar. 12 '70	
Temp.	°C								
pH		-	-	-	7.6	7.2	7.2	7.7	
E.C.	micÜ	359	357	373	338	338	338	360	
Ca^{++}	ppm	41.3	46.9	46.6	40.1	48.1	48.1	48.1	
	meq	2.06	2.34	2.33	2.00	2.40	2.40	2.40	
Mg^{++}	ppm	7.0	6.5	6.1	24.3	19.4	19.4	9.7	
	meq	0.58	0.53	0.50	2.00	1.60	1.60	0.80	
Na^{+}	ppm	18.4	18.4	18.4	11.0	11.0	-	10.0	
	meq	0.80	0.80	0.80	0.48	0.48	-	0.43	
K^{+}	ppm	3.9	3.9	3.9	2.7	-	-	5.1	
	meq	0.oo	0.10	0.10	0.07	-	-	0.13	
Total	ppm	70.6	75.7	75.0	78.1	78.5	67.5	72.9	
	meq	3.14	3.47	3.73	4.55	4.48	4.00	3.76	
HCO_3^{-}	ppm	116.6	116.1	128.1	320.3	300.2	300.2	112.3	
	meq	1.91	1.91	2.10	5.25	4.92	4.92	1.84	
Cl^{-}	ppm	12.4	11.7	13.8	23.8	13.8	13.8	6.7	
	meq	0.35	0.33	0.39	0.67	0.39	0.39	0.19	
SO_4^{--}	ppm	0	0	0	25.0	25.0	25.0	36.0	
	meq	-	-	-	0.52	0.52	0.52	0.75	
Total	ppm	129.0	127.8	141.9	369.1	339.0	339.0	155.0	
	meq	2.26	2.24	2.49	6.44	5.83	5.83	2.48	
Hard-ness	ppm	132.1	144.1	141.6	200.2	200.2	200.2	-	
Class									

Station: River Pamplonita: Agua Clara

Item		2	1	3	610	611			
Date					Mar. 25 '83		Dec. 12 '69		
Temp.	°C	7.2	7.2	7.2					
pH									
E.C.	micÜ	293	271	271	343	349	173		
Ca^{++}	ppm	32.1	36.1	32.1	48.3	48.0	22.0		
	meq	1.60	1.80	1.60	2.41	2.41	1.10		
Mg^{++}	ppm	12.1	9.7	12.1	8.1	6.9	4.1		
	meq	1.00	0.88	1.00	0.67	0.57	0.34		
Na^{+}	ppm	8.7	8.2	8.2	15.9	15.9	5.3		
	meq	0.38	0.36	0.36	0.69	0.69	0.23		
K^{+}	ppm	6.2	1.9	1.9	2.7	2.7	0.1		
	meq	0.16	0.05	0.05	0.07	0.07	-		
Total	ppm	59.1	55.9	54.3	75.0	71.5	31.5		
	meq	3.14	3.09	3.01	3.84	3.74	1.67		
HCO_3^{-}	ppm	160.1	140.1	140.1	122.6	120.1	68.9		
	meq	2.62	2.30	2.30	2.01	1.97	1.13		
Cl^{-}	ppm	8.9	3.9	8.9	14.2	13.1	7.5		
	meq	0.25	0.11	0.25	0.40	0.37	0.21		
SO_4^{--}	ppm	25.0	24.0	25.0	0	0	11.0		
	meq	0.52	0.50	0.52	-	-	0.23		
Total	ppm	194.0	168.0	174.0	136.8	133.2	87.4		
	meq	3.39	2.91	3.07	2.41	2.34	1.57		
Hard-ness	ppm	130.1	130.1	130.1	153.6	148.6	-		
Class									

Station: River Guaramito

Item									
Date		Dec. 2 '69	Jan. 19 '70	Feb. 2 '70	Mar. 12 '70				
Temp.	°C								
pH		7.6	7.4	8.0	7.9				
E.C.	micΩ	260	345	453	292				
Ca^{++}	ppm	35.1	44.1	59.1	40.3				
	meq	1.75	2.20	2.95	2.01				
Mg^{++}	ppm	6.3	9.2	21.0	9.2				
	meq	0.52	0.76	1.73	0.76				
Na^{+}	ppm	6.0	10.8	10.1	6.2				
	meq	0.26	0.47	0.44	0.27				
K^{+}	ppm	1.6	2.0	3.5	2.3				
	meq	0.04	0.05	0.09	0.06				
Total	ppm	49.0	66.1	93.7	58.0				
	meq	2.57	3.48	5.21	3.10				
HCO_3^{-}	ppm	90.3	107.4	193.4	96.4				
	meq	1.48	1.76	3.17	1.50				
Cl^{-}	ppm	52.5	6.4	4.6	3.5				
	meq	1.48	0.18	0.13	0.10				
SO_4^{--}	ppm	7.7	37.0	11.5	12.0				
	meq	0.16	0.77	0.24	0.25				
Total	ppm	150.5	150.8	209.5	111.9				
	meq	3.12	2.71	3.54	1.93				
Hard-ness	ppm								
Class									

APPENDIX 6. AGRICULTURE

LIST OF TABLES

LIST OF FIGURES

6.1 Land Use and Land Tenure

6.1.1 Land Use

Present land use of the project area is tabulated in Table 6-1-1 at each Zone.

(1) Cultivated Crops

Main cultivation crop of the project area in cassava and maize, also watermelon, sugar cane and vegatables are cultivated at small area.

(2) Pasture

Based on the field inspection and farm survey, the pastural land is divided into artificial pasture and natural pasture, and their ratio is estimated 30 percent and 70 percent, respectively.

(3) Orchard

Most of the orchard is planted cacao and other fruits such as cashew nut, plantain (banana), guava, papaya are planted in small area. Cashew nut is cultivated only at Zone D. Cooking Banana is planted as a shade for cacao tree growing, therefore, plantain area is counted in the cacao area. Also guava and papaya planting area are counted in the cacao area.

(4) Cropped Area

Average cropped area per farm household at each zone is also shown in Table 6-1-2, and it is 32 ha for whole project area.

Present land use is shown in Fig. 6-1-1.

6.1.2 Land Tenure

Present land tenure by land size of the project area is as shown in Table 6-1-3.

Table 6–1–1 Present Land Use

(ha)

Zone	Agricultural land			Total	Non-agricultural land			Total	Grand Total
	Cultivated 1/	Pasture 2/	Orchard 3/		Forest	Urban & residential	Roads & river		
A	10	1,510	0	1,520	310	70	30	410	1,930
B	40	3,130	90	3,260	1,130	110	250	1,490	4,750
C	30	3,450	260	3,740	910	70	140	1,120	4,860
D	10	1,540	70	1,620	290	20	30	340	1,960
Total	90	9,630	420	10,140	2,640	270	450	3,360	13,500
%	0.7 (0.9)	21.3 (95.0)	3.1 (4.1)	75.1 (100.0)	20.0	2.0	3.3	24.9	100.0

Hectarage was obtained by aerial photographs (1978) and field survey.

1/ Mainly cassava and maize.

2/ Included artificial and natural pasture.

3/ Mainly cacao, included partly platano cashew nut and guava.

Table 6–1–2 Average Cropped Area

(ha)

Zone	Cultivated		Pasture		Orchard		Total	Mean area per farm household
	Cassava	Maize	Artificial	Natural	Cacao	Cashew Nut		
A	10	0	450	1,060	0	0	1,520	40
B	30	10	940	2,190	90	0	3,260	32
C	10	20	1,040	2,410	260	0	3,740	27
D	0	10	460	1,080	0	70	1,620	38
Total	50	40	2,890	6,740	350	70	10,140	32

Note: Estimated by aerial photographs, field survey and farm survey.

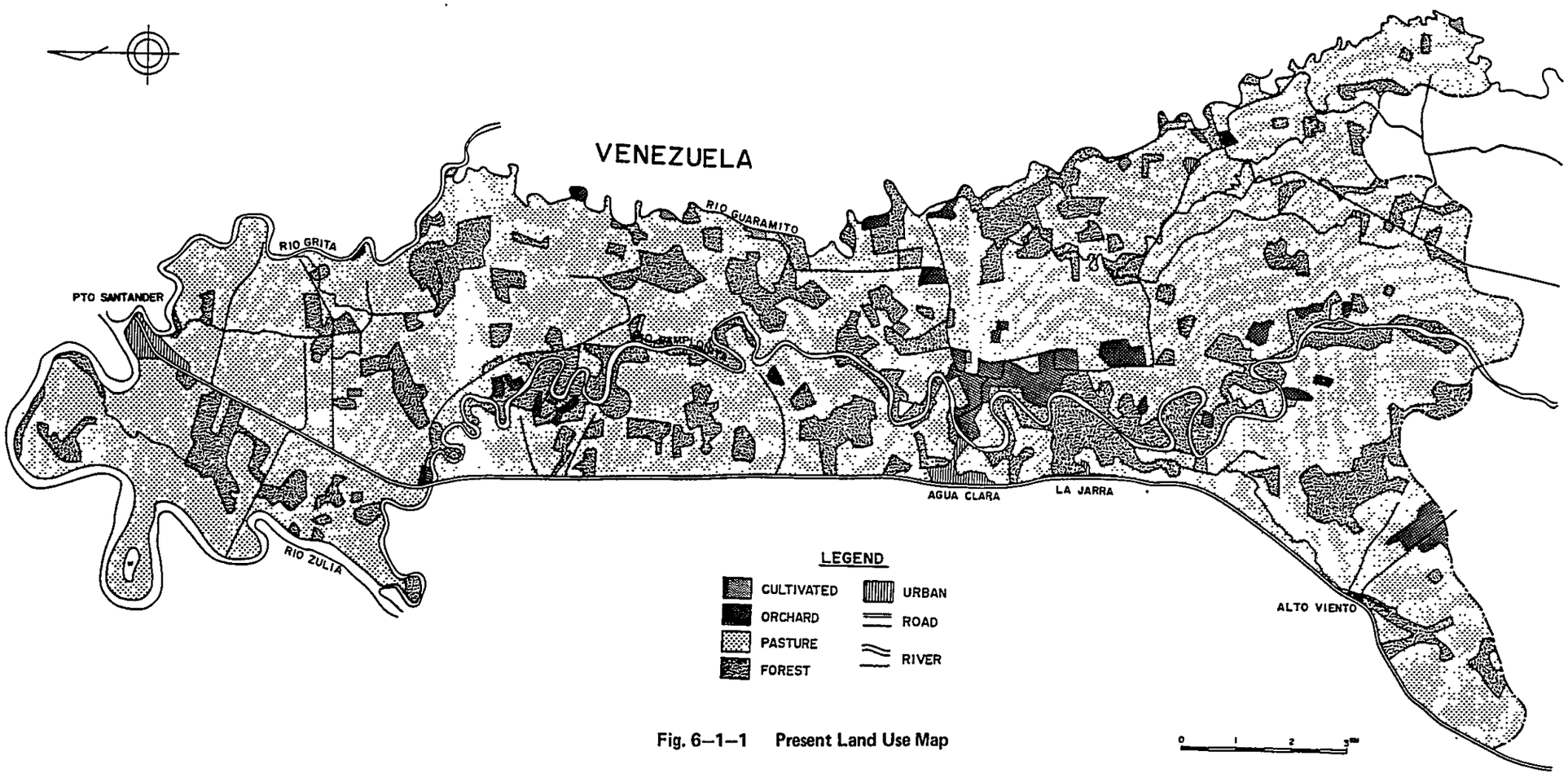


Fig. 6–1–1 Present Land Use Map

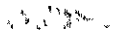


Table 6–1–3 Present Land Tenure

Land Size	Item	Zone A			Zone B			Zone C			Zone D			Total		
		I 1/	P 2/	Total	I 1/	P 2/	Total	I 1/	P 2/	Total	I 1/	P 2/	Total	I 1/	P 2/	Total
- 5ha	No. of Farms	-	-	-	-	-	-	2	-	2	-	-	-	2	-	2
	ha/Farm	-	-	-	-	-	-	3	-	3	-	-	-	3	-	3
5-25ha	No. of Farms	4	-	4	9	5	14	73	3	76	-	6	6	86	14	100
	ha/Farm	22	-	22	20	22	21	14	16	14	-	22	22	15	21	16
25-45ha	No. of Farms	27	1	28	31	29	60	44	2	46	3	16	19	105	48	153
	ha/Farm	37	36	37	34	33	33	38	36	38	42	36	37	36	34	36
45-65ha	No. of Farms	3	1	4	1	14	15	4	3	7	-	11	11	8	29	37
	ha/Farm	54	50	53	48	51	51	48	57	52	-	57	57	50	54	53
65ha -	No. of Farms	-	2	2	1	12	13	-	6	6	-	7	7	1	27	28
	ha/Farm	-	174	174	68	109	106	-	112	112	-	108	108	68	114	113
Total	No. of Farms	34	4	38	42	60	102	123	14	137	3	40	43	202	118	320
	ha/Farm	37	108	44	32	51	43	24	69	28	42	52	52	28	56	38

1/ : INCORA Migration Farmers, by INCORA's distribution maps.

2/ : Particulares, by IGAC's land register, partly estimated from aerial photographs.

6.2 Farm Survey

6.2.1 Farm Household Survey

General survey on 58 objective farmers in the study area is carried out; 11 samples in the first stage survey and 47 samples in the second stage survey. Out of the total 58 samples, 10 samples are in Zone A, 13 in Zone B, 31 in Zone C, and 4 in Zone D. Location of those samples is shown with the Sample No. in Fig. 6-2-1. Average farm scale of the samples in 32 ha, excluding 3 samples of the large scale over 65 ha. The result of farm household survey is shown in Table 6-2-1.

6.2.2 Cacao Production Survey

Cacao Production Survey on 10 objective farmers being mostly INCORA Parceleros in Campo Alegre is carried out in the second stagd survey. Average farm scale of those is 21 ha.

Cacao cropping area per house is around 5 ha on average. The proportion of the matured trees (more than 5 years old) in the area shows 70 - 80 percent. Cacao yield by ages of tree are as follows (FEDECACAO, 1982):

1st year	0
2nd year	0
3rd year	100 kg/ha
4th year	300 kg/ha
5th year	700 kg/ha
6th year	900 kg/ha
7th year	1,000 kg/ha

The result of cacao production survey is shown in Table 6-2-2.

6.2.3 Beef Cattle Production Survey

Beef Cattle Production Survey on 20 objective farmers showing variation of the breeding types is carried out also in the second stage survey. The result of the survey is shown in Table 6-2-3.
As a result of the survey counting, 520 kg/ha of the present average yield (the matured tree) per ha is obtained. The gross production cost per ha is 25,150 COL$/ha, and the net production value per ha is 36,800 COL$/ha (Dec. 1983).

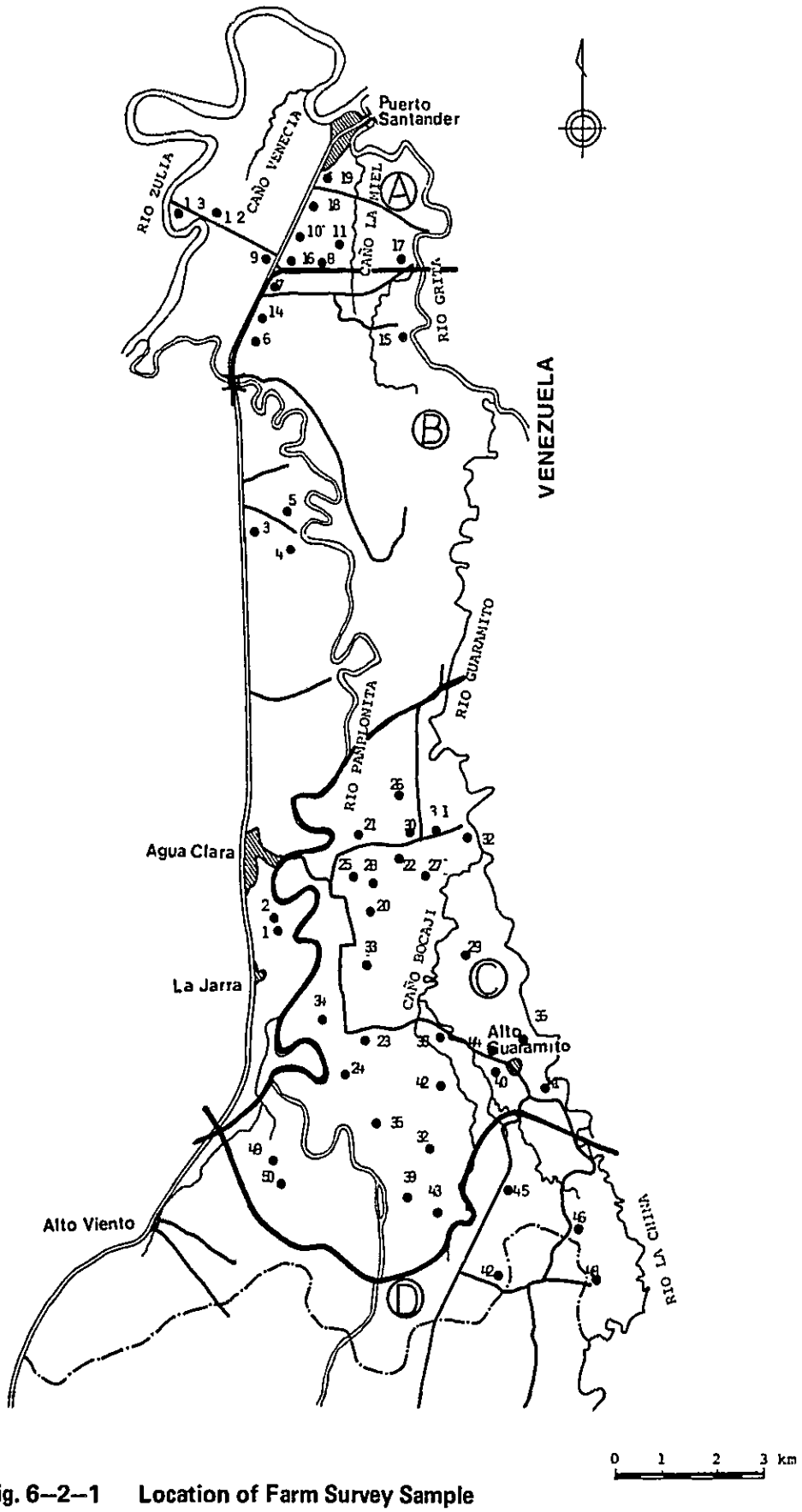


Fig. 6–2–1 Location of Farm Survey Sample

Table 6–2–1 Farm Household Survey

(1) Family Members, Land Use

(%: YES)

Item \ Zone	A	B	C	D	Total (Mean)
1. Information on HIVAT (%)	10	33	54	0	36
2. Land Ownership (%)	90	78	88	75	85
3. Owned Area (ha)	46	44	29	35	36
4. Family Members (No.)	5.4	8.2	6.8	7.5	6.9
5. Pasture Acreage (ha)	0.4	0.5	2.9	1.0	
6. Pasture Acreage (ha)	41.1	34.4	21.3	18.3	24.9
7. Natural Pasture (ha)	27.1	30.9	14.7	18.3	17.9
8. Artificial Pasture (ha)	14.0	3.5	6.0	0	7.0

(2) Farmers' Intentions

(%: YES)

Item \ Zone	A	B	C	D	Total (Mean)
9. New Crops	10	50	70	50	57
10. Expansion of Farm Land	40	73	86	33	72
11. Possessing Waste Land in Part	30	33	80	75	58
12. Land Reclamation	43	50	71	75	63
13. Land Purchase	70	56	62	33	60
14 Contacting with Extension Service	70	69	69	100	71
15. Drainage Improvement	70	67	69	0	66
16. Flooding by Rain Water	75	60	89	0	76

(3) Property, Source of Energy and Water

(COL$, %: YES)

Item \ Zone	A	B	C	D	Total (Mean)
17. Estimated Present Value of House (COL$)	490,000	399,000	308,000	218,000	315,000
18. Source of Light					
(a) Electricity	70	31	19	75	34
(b) Kerosene Lamp	20	54	61		48
(c) Candle		31	26	25	21
19. Source of Fuel					
(a) Firewood	40	85	84	100	82
(b) Gas or Kerosene	50	23	13	0	22
20. Source of Water					
(a) Waterworks	10	15	13	0	14
(b) Well	50	64	58	50	69

(4) Farm Implements

(COL$)

Item \ Zone	A	B	C	D	Total (Mean)
21. Tractor	(650,000)	(225,000)	- -	- -	- -
22. Attachment	(320,000)	(150,000)	- -	- -	- -
23. Shovel	3	4	3	3	5
24. Pickax	2	1	3	3	2
25. Farm Knife	6	5	5	3	5
26. Hoe	2	-	2	-	2
27. Shoulder Pump	6,800	4,500	4,500	1,100	4,200
28. Manual Pump	2,500	5,300	1,200	17,000	6,500
29. Motor Pump	13,900	5,300	6,700	1,500	6,900
30. Motor	24,600	1,600	4,400	0	7,700
31 Pumps & Motors (Total)	47,800	16,700	16,800	19,600	25,200

21, 22 . ..... Mean of only possessors (7 households)
23, 24, 25, 26 . .. Mean of numbers in each household
27, 28, 29, 30 Mean = Total estimate value ' Household numbers

Table 6–2–2 Cacao Production Survey

(5) Living Cost

(COL$)

Item \ Zone	A	B	C	D	Total (Mean)	%
32. Food Total	61,600	54,500	56,400	57,750	57,500	56
33. Light, Fuel & Water	1,300	7,400	5,300	7,500	5,400	5
34. Education	6,000	20,900	12,800	12,500	13,000	13
35. Welfare	16,700	5,000	13,400	9,000	11,000	11
36. Clothes	13,300	11,700	14,200	20,600	15,000	15
37. Non-Food Total	37,300	44,800	45,700	49,600	44,400	44
38. Living Cost Total	98,900	99,300	102,100	107,300	101,900	100
39. Engel Efficiency	62%	55%	55%	54%	56%	-

(1) Cacao Net Production Value

Sample No.	Land Possession (ha)	Planting Density (m)	Cacao Acreage (ha)	Unmatured Tree <5 yrs (ha)	Matured Tree ≥5 yrs (ha)	Production Quantity (kg)	Unit Price (COL$/kg)	Gross Prod. Value (COL$)	Production Cost (COL$)	Net Prod. Value (COL$)	Per ha N.P.V. (COL$)
32	40	4x4	8	3	5	3,500	150	525,000	198,000	327,000	40,880
22	11	4x4	3.5		3.5	2,000	150	300,000	87,000	213,000	60,860
34	40	4x4	2	1.75	0.25	100	150	15,000	48,000	-33,000	-16,500
30	25	4x4	9	0	9	5,000	150	750,000	219,000	531,000	59,000
31	31	-	4	0	4	800	150	120,000	105,000	15,000	3,750
26	18	4x4	4	0	4	2,200	150	330,000	124,000	206,000	51,500
33	11	3.5x3.5	8	0	8	5,000	150	750,000	203,000	547,000	68,370
25	17	3.5x3.5	5	3	2	300	150	45,000	120,000	-75,000	-15,000
27	12	3.6x3.6	5	3	2	100	150	15,000	118,000	-103,000	-20,600
24	12	3x3	3.5	0	3.5	2,500	150	375,000	86,000	289,000	82,570
Total	207		52	11.5	41.5	21,500	150	3,225,000	1,308,000	1,917,000	-
Mean	21	3.7x3.7	5.2	1.2	4.1	2,150	150	322,500	130,800	191,700	36,870

* Matured Tree Unit Yield = 520 kg/ha
G.P.V. = Matured Tree acreage (ha) x Unit Price
(3,225,000 ÷ 42 x 150 = 524)

Farm Labor Force (man-day) by Zone

Item \ Zone	A	B	C	D	Total
Beef Cattle	4,530	9,390	10,350	4,620	28,890
Cacao (Cashew nuts)	-	5,400	15,600	(3,150)	24,150
Cassava	340	1,020	340	-	1,700
Maize	-	255	510	255	1,020
Total	4,870	16,055	26,800	8,025	55,760
Per House Mean Labor Force (man-day)	128	158	196	187	174

(2) Production Cost and the Components

COL$

Sample No.	Cacao Area (ha)	Production Cost	Cost Components			Per ha			
			Labor Cost	Material Expences	Others	Gross Prod. Value	Production Cost	Net Prod. Value	Net Income *
32	8	198,000	150,000	40,000	8,000	65,630	24,750	40,880	59,630
22	3.5	87,000	66,000	18,000	3,000	85,720	24,860	60,860	79,720
34	2	48,000	37,000	10,000	1,000	7,500	24,000	-16,500	2,000
30	9	219,000	165,000	47,000	7,000	83,330	24,330	59,000	77,330
31	4	105,000	81,000	21,000	3,000	30,000	26,250	3,750	24,000
26	4	124,000	100,000	20,000	4,000	82,500	31,000	51,500	76,500
33	8	203,000	155,000	40,000	8,000	93,750	25,380	69,370	87,745
25	5	120,000	90,000	26,000	4,000	9,000	24,000	-15,000	3,000
27	5	118,000	85,000	28,000	5,000	3,000	23,600	-20,600	-3,600
24	3.5	86,000	65,000	21,000	-	207,140	24,570	82,570	101,141
Total	52	1,308,000	994,000	271,000	43,000	-	-	-	-
Mean	5.2	130,800	99,400	27,100	4,300	62,020	25,150	36,870	56,000

* Net Income = N.P.V. + Labour Cost (Family Labor)

Table 6–2–3 Beef Cattle Production Survey

Cattle feeding pattern	(1) Poor drainage area	Poor drainage area			Well drainage area		Remarks
	Breeding	Breeding, partly Fattening			Fattening	Fattening	
Farmer Type	Parceleros	Particu-lares	Parceleros	Particu-lares	Particu-lares	Parceleros	
Survey House No.	8.9.11. 12.	3.5	36.38.41 43.46.48	35.37 39.40	1	42.44 45	
Land Possession (min-max) ha	39 (33-47)	26 (23-30)	36 (20-75)	52 (40-68)	68	75 (70-80)	
Pasture area (ha)	35	75	29	47	68	23	
Natural Pasture ha (%)	24 (69)	13 (17)	13 (46)	12 (24)	13 (19)	2 (9)	
Artificial pasture ha (%)	11 (31)	62 (83)	16 (54)	36 (76)	55 (81)	21 (91)	
Cattle Heads per House	64	206	52	74	100	31	
Cattle Heads per ha	1.8	2.8	1.8	1.6	1.47	1.3	(2) 1.4 (mean)
Heads sold per House	9.3	46.0	11.0	16.0	100	28.6	
Heads sold per ha	0.27	0.61	0.38	0.34	1.47	1.22	
Unit sold price (COL$/Head)	19,758	39,132	22,545	22,328	36,000	31,790	
Cost per ha (COL$)	3,394	10,589	4,317	4,428	33,710	26,370	
Feeder Cattle Cost per ha					(26,125)	(8,860)	
Per ha (COL$) Gross Production Value	5,136	29,924	8,567	7,592	26,795	27,975	(4) 4,500COL$/ Head (mean)
(3) Production Cost	3,394	17,510	4,317	4,428	7,585	17,510	
Net Production Value	1,742	12,414	4,250	3,164	19,210	10,465	

(1) Inundation over 10 days of duration & 30cm depth
(2) Total Heads (Calf included) x 0.8
(3) Exclude Feeder Cattle Cost
(4) Calf Breeding Costs are adjusted to Standard Cattle

6.3 Products Reduction

6.3.1 Net Production Value per ha, Damaged Area and Farm Household

Net production value per ha in COL $ 7,960 of this project area is shown in Table 6-3-1 by area. According to this Table, Zone C shows the highest products and Zone A which has most expended poor drainage area shows the lowest products. As shown in Table 6-3-1 and 6-3-2, it is clear that the low net production value is caused by poor drainage or inundation.

Table 6–3–1 Poor Drainage & Flooding Area

(1) Zone Area ha (%)	(2) Mean N.P.V. per.ha (COL$)	(3) Poorer Drainage Area ha (%)	(4) Flooding Area ha (%)
A 1,930 (100)	5,890	840 (44)	1,570 (85)
B 4,750 (100)	7,070	1,170 (25)	1,760 (35)
C 4,860 (100)	9,690	660 (14)	880 (18)
D 1,960 (100)	7,700	- -	90 (5)
Total 13,500 (100)	7,960	2,670 (20)	4,300 (32)

(1) Land Total
(2) Agricultural Land
(3) Over 10 days of duration & 30cm depth by Inundation

Table 6–3–2 Damageable Household Proportion by Poor Drainage & Flooding

(1) Zone % (Houses)	(2) Poor Drainage (Houses, %)		(3) Flooded (Houses, %)		(4) (2) or/ and (3) %		(5) Mean N.P.V. per ha (COL$)
	over 80% of the farm	over 50% of the farm	over 80% of the farm	over 50% of the farm	over 80%	over 50%	
A 100 (38)	32	50	82	82	89	97	5,890
B 100(102)	12	25	16	26	27	51	7,070
C 100(137)	7	13	9	12	16	26	9,690
D 100 (43)	0	0	0	0	0	0	7,700
Total 100(320)	10	18	18	21	23	32	7,960

Source: Land Tenure Map, Poor Drainage Area Map, and Flooding Area Map.
(2) Poor Drainage Area; over 10 days of duration & 30cm depth by Inundation
Every Percentage is exclude the farms under 50% of Damage area.

6.3.2 Decrease of Pastural Yield by Poor Drainage and Inundation

Feeding capacity per ha is determined by pasture production, feedable pasture ratio, nutrients contain and pests and disease. Feeding capacity of the natural pasture is said only 25 percent of the artificial pasture feeding capacity. The artificial pasture is turned to the native plant land mainly by casual inundation or by poor drainage. These changes are clearly explained by the land ledger of IGAC and field survey. The artificial pasture land is registered 80 percent of the project area, but according to the field survey, it is reduced and counted only 30 percent. At casual inundated area, natural weed which has tolerance to swampy condition, was spreaded by the flood and prevent the growth of high productive pasture. Therefore, even low productivity and nutrient, strong grass spacies under bad conditions shall be selected and seeded. These evidences show the indirect damage of the poor drainage and inundation. Some example of poor drainage or inundation damages for pasture which is collected by the field survey, is tabulated below:

Table 6–3–3 Poor Drainage & Flooding Damage in Beef Cattle Production

COL$

Hearing in Farmer Survey	Sample No.	Artificial Pasture Proportion (%)	Per ha				
			* Weight Gain(kg)	** Gross Prod. Value	Production Cost	Net Production Value	(%)
Poor Drainage over 10days & 30cm depth by Inundation	8,9,39 11,12	11	64	5,136	3,394	1,742	14
Poor Drainage Damage(Yes)	3,5,35 38,46	32	107	8,567	4,317	4,250	34
Well Drainage No Damage	44,45	91	332	29,924	17,510	12,419	100

* Weight Gain is equal to the quantity sold per year.
** Farm Gate price: 80 - 90 COL$/kg
(Include Calf)

6.3.3 Decrease of Cacao Yield

As shown in Table 6-3-4 which is prepared by the field survey, the poor drained area shows low yield on matured cacao basis. Also comparing with standard farm of Caja Agraria, about 5 times of labour inputs (15 man day/ha) are provided to maintain the drainage canal in the cacao plantation of the project area. This number shows the importance of drainage and higher production cost requirement in the project area.

Table 6-3-4 Poor Drainage & Flooding Damage in Cacao Production

(COL$)

Hearing in Farmer Survey	Sample No.	Per ha Yield **			Per ha		
		Total	(Only Matured tree)	*Gross Prod. Value	Production Cost	Net Prod. Value	ditto (%)
Poor Drainage over 10days & 30cm depth by Inundation	22,31 26,25	345	(424)	51,810	26,530	25,280	50
Poor Drainage Damage(Yes)	33,27, 24	453	(563)	67,960	24,510	43,450	86
Well Drainage No Damage	30,32	500	(772)	75,000	24,529	50,471	100

Farm Gate Price is 150COL$/kg (Dec. 1983)

Matured Tree Yield = G.P.V ÷ Matured Tree Acreage ÷ 150

6.3.4 Expectable yield after completion of drainage system

After improving the drainage condition of the project area, the increase of yield of crop will be expected on pasture, cacao and other crops. The expansible yield of each crops are estimated as follows:

(1) Pasture

As mentioned before, the productivity of natural pasture is 25 percent of the artificial one. Existing natural pasture which covers 70 percent of pasture land of the project area can be improved to the artificial pasture by completing the drainage system. Under these assumptions, the incremental yield ratio of the pasture in the project area can be expected as follows:

$$\frac{\text{Expected yield ratio}}{\text{Present yield ratio}} = \frac{1.0 \times 1.0}{0.7 \times 0.25 + 0.3 \times 1.0} = 2.12 \text{ times}$$

Acording to Table 6-3-3, the net production value of heavy damaged area increases 7 times of present's. The weight gain increases to 300 kg/ha/year (140 kg w.g/ha/year x 2.12) after completion of drainage system. Therefore, the weight gain (w.g) can be expected 300 w.g/ha/year after the project.

(2) Cacao

As shown in Table 6-3-4, after completion of drainage system the net yield of cacao can be expected 700 to 800 kg/ha as a matured cacao basis.

(3) Other Crops

There is no data on incremental yield of maize and cassava after improvement of drainage system in the project area. Refering the field survey and information from colombian agronomist, the expectable yield of maize and cassava with drainage improvement are estimated as follows:

Table 6-3-5 Expected Yield with Well-Drainage in Cultivated Crops

(t/ha)

Crops	Present Yield (t/ha)	Expected Yield with Well-drainage
Maize	2	3
Cassava	6	10

1. Cassava

Statistical data in DNP indicates that the national average gross production of cassava between 1979 and 1983 is 1,917,500 tons.

The file in OPSA shows that the average gross production of cassava in the Department between 1979 and 1983 is 100,140 tons.

Cassava has difficulties in preservation and transport, therefore, almost cassava produced in Norte de Santander Department are consumed in the department.

As a result, the consumption of cassava in Cucuta city, where 43 percent of total population of the Department is concentrated, is estimated approximately 43,000 tons.

In Cucuta market chronic cassava shortage appears except for the harvest time of March and April.

Gross production of 3,200 t, 9,600 t and 4,200 t are proposed in the development plan I, II and III, respectively.

These gross production correspond to 7%, 20% and 10% of total consumption in Cucuta market, respectively.

In the production scheme, the harvest time of cassava in the project is planned not to coincide with the harvest time in the areas around the project and the proposed farm gate price is estimated to be COL $ 10/kg which is lower than existing price of COL $ 15 kg.

Cassava is one of the important carbohydrate foods and it is possible that the incremental production of cassava in the porject will be consumed in the market of Cucuta.

2. Maize

According to the publication of DNP, the annual average importation of maize between 1979 and 1983 reaches upto 101,000 t which is accounted for more than 10 percent of total domestic consumption.

In the development plan I, II and III, the proposed annual production of maize is 1.25, 1.50 and 133.38 times of existing production volume, respectively.

Although the production of maize in the development plan III will significantly increase, no marketing problems may rise because for the first reason that this is an import substitute crop, and secondly IDEMA has marketing system.

It can be said that the increase of maize production will contribute to increase in self sufficiency of maize in The Republic.

3. Sorghum

The information of DNP indicates that 60,400 t of sorghum which is accounted for more than 10 percent is imported.

In the development Plan III, 10,670 of annual production is proposed which amounts to 18 percent of total importation of sorghum.

No marketing problems may rise for the same reason of maize.

It can be also said that production of sorghum in the project area will contribute to saving foreign currency

4. Cacao

Cacao is one of the most prospective crops due to reasons stated below:

1. Being encorraged to extend cropping area by the Government,
2. Being easy handling and transportation of cacao beams, and
3. Existing shipping system of Cacao beans in the project area to processing factories in Bogota, Medellin, Manizales and so on through brokers in Bucaramanga. The following production are proposed in development plans.

Development Plan	I	800 t/year
"	II	1,746 t/year
"	III	1,746 t/year

The above proposed volume of production is accounted to 1.9, 4.1 and 4.1 percent of total average national production of 42,100 t/year (1983, DNP), respectively, therefore Cacao production in this project has no influence on the market price. A current slump of Cacao price will not be expected due to upholding the price by FEDECACAO.

Production of Cacao in this project will contribute to the saving of foreign currency holdings.

5. Watermelon, Papaya, Pineapple

It is proposed in the development plan III that cropping area of watermelon, papaya and pineapple are 100 ha, 50 ha and 50 ha, respectively. These cropping areas are comparatively large as vegetables and fruits.

Those crops stated above, however, are representative crops for planning purpose. Therefore in practice various kinds of vegetables and fruits will be cultivated according to the market demand.

Expected crops which can produce the same profits will be pumpkin, eggplant, bell peper, okura, chili, parsley and so on as vegetable and melon, cruva, passion fruits and so on as fruits.

Difference of the farm gate price and production cost between the proposed crop types and prospective crops may cause no significant

effect on economic aspect of the Development Plan III.

6. Beef Cattle

The file in Central Bank of Colombia indicates that the average slaughter number of beef cattle between 1977 and 1981 reaches upto 2,848,110/year. Statistics of DANE shows that the average slaughter number of beef cattle at Cucuta city between 1977 and 1981 reaches up to 58,256/year and 68,463 in 1981.

The number of slaughter at Cucuta city is accounted for 2 percent of total number of national slaughter number, and 60% of slaughtered cattle (41,550 heads) was exported to Venezuela. Large number of beef cattle had been collected from Llano and other regions along the Caribbean sea cost before the economic depression of Venezuela.

There is a higher market price tendency in Cucuta compering with that of other cities in Colombia due to the chronic shortage of beef.

Reasons of this tendency were analysed as follows;

1. Most beef cattle collected from outside of the Department have been exported to Venezuela.

2. The production volume around Cucuta city is lower than demand.

The data from Central Bank says that the annual domestic average beef consumption is 24.9 kg/man, however, the average beef consumption in Cucuta city is 14.4 kg/man according to the information of URPA. There is 10 kg/man difference in the average beef consumption.

The proposed number of beef cattle in development plan I, II and III are 18,526, 15,760 and 11,724, respectively.

In terms of beef meat tonnage, these beef cattle number will be equivalent to about 3,200 t, 2,900 t and 2,200 t respectively.

The increase in beef meat production in the development plan I, II and III are 2,500 t, 2,200 t and 1,500 t, respectively.

Therefore increased average annual consumption of beef meat by development plans are 5.8 kg/man, 5.1 kg/man and 3.5 kg/man respectively, which will be easily consumed in the Cucuta market. It can be said that the production of beef meat has potential for exporting to Venezuela when her economic recession will be recovered.

6.4 Livestock

6.4.1 Breeding Conditions

At present, the profitability of small scale feeding farm shows low value. Even though, improvement of the grass land will be completed, there still are many problems which shall be fundamentally solved. They are as follows:

1. Quantity of cattle for breeding (including seed bull),
2. Unskillness of farmers for the complicated breeding technique,
3. Social circumstances which are obstructing the take-off from extensive farming, and
4. Others.

Small-scale farmers intend to manage breeding farming by following main reasons:

1. Expecting the cash income by milk production,
2. Long suspension period after obtaining a breeding cattle, and
3. No necessity of intensive farming because of small head breeding.

In order to get higher cash income, they insist hard milking for their cattle, therefore, milk cows and colues decline their physical strength. And they cause the decrease of birth rate and the increase of death rate of calves. Also, the long usage of breeding cattle results the low productivity, because the continuation and accumul ation of undesirable gene. It needs extensive financial input and sublation of farmers consciousness to solve those problems fundamentally. Considering the present conditions, the conversion of farming type to the simple fattening type from the small scale feeding farm, which shows low productivity is recommendable for improving the livestock productivity in the project area. In Parallel with these conversions, the small scale feeding farm can raise the productivity by improving the pasture and selling the born calves to the fattening farmer or by introduction of integrated production system. The process of conversion to the fattening type farming management, the biggest problem is the capital introduction for the pruchasing of fattening cattle. farmer does not use these systems so much. Increasing of fattening farmer will face to the financial problems on purchasing more heads of breeding cattle and selling more heads for meat. It is indispensable to establish the organization of beef cattle producers for countermeasuring these financial problems.

Table 6–4–1 Farm Scale and Cattle Feeding Pattern

Scale	Large scale farm	Medium scale farm	Small scale farm
Land Possession (ha)	over 150 ha	150 - 70 ha	around 30 ha
Parceleros/ Particulares	Particulares	Mostly Particulares	Mostly Parceleros
Parceleros Proportion	0%	16%	75%
Artificial Pasture Proportion	100%	60%	30%
Pasture Management	Renewal	every 3-5 years	No Renewal
Cattle Feeding Pattern	Breeding & Fattening	Fattening	Breeding or Fattening
Grazing Capacity per ha	3 - 4 Heads	1.5 - 2 Heads	1.2 - 1.8 Heads
Grass Varieties	Braquiaria Angleton Aleman Elefante Kikuyu	Braquiaria Angleton Aleman Elefante Kikuyu	Braquiaria Angleton Grama Gramalote Paja Comino
Grass mat-formation	a little	partly	mostly
Bull Varieties	Cebu·Pardo Suizo Hornstein	Cebu·Pardo Suizo	Cebu·the cross-breed
Breeding Efficiency	70 - 85%	65 - 75%	50 - 65%
Milk Yield per day	4 - 6 ℓ	3 - 4 ℓ	2 ℓ
Milk sold price	19 COL$/ℓ	16 COL$/ℓ	16 COL$/ℓ
Sold Cattle Weight	400 - 450 kg	400 kg	350 - 400 kg
Growing period	30 - 40 Month	36 - 48 Month	36 - 54 Month
Market	Cucuta Market	Cucuta Market	Local Market
Tructor Possession	Mostly own	Own, Partly rental	No
Pasture System	Rotational Grazing	Rotational/ Continuous	Continuous Grazing
Pasture Fence	own	own	No
Proportion in the Project area	2 - 3%	8 - 9%	80 - 90%
Extension Service	ICA	ICA or INCORA	INCORA
Farmers Communication	With other large ranches	With other ranches	With only neighbours
Other Livestocks	horse, hog, chicken	horse,mule, hog, chicken, duck	mule, hog, goat chicken

Table 6–4–2 Estimated Present Cattle Breeding

Zone	A Zone	B Zone	C Zone	D Zone	Total
Pasture Acreage (ha)	1,510	3,130	3,450	1,540	9,630
House No.	38	102	137	43	320
Pasture per House (ha)	39.7 ha	30.7 ha	25.2 ha	35.8 ha	30.1 ha
Artificial (ha)	12.0	9.2	15.1	21.5	18.1
Natural (ha)	27.7	21.5	10.1	14.3	12.1
Cattle Heads per ha	1.2	1.2	1.6	1.6	1.4
Cattle Heads per House	48	37	40	57	42
Cattle Heads per Zone	1,800	3,750	5,520	2,460	13,530
* Cattle Age <1yr.	184	382	563	250	1,379
1 - 2yrs.	176	367	540	241	1,324
2 - 3yrs.	810	1,688	2,484	1,107	6,089
>3yrs.	630	1,313	1,932	862	4,738
Head sold per ha	0.3	0.3	0.45	0.45	0.38
Yearly Head sold Total per Zone	453	939	1,533	693	3,638

* Cattle Age is estimated on the basis of the INCORA Farm Survey 1982.

6.4.2 Introduction of Breed and Breeding Cattle

It is favourable and easy to introduce Cebu breed which has high resistancy against tropical pest and decease, parasitism, high temperature and physiological stress. These breeding cattle can be introduced to the breeding farm directly or through the cattle market. Considering the present cattle marketing system, the farmers' cooperative system shall be established on the purchasing breeding cattle. When these farmers' cooperative is established, it becomes possible to purchase directly from the calf producing area such as Arauca and Llanos.

6.4.3 Breeding Method

Except middle or large scale farmers, most of small scale farmers are adopting a continuous grazing method, and these method shows low effective use of pasture at present. The rotational grazing method shall be introduced after the improvement of pasture. Especially, the rotation grazing method shall be introduced to the Zone C and D, which the irrigation will be introduced under the project Plan III and will produce higher yield of pasture with fertilization. In addition to the introduction of the method, the beef production of the project area will be expandly increased by the improving the grazing fence, cattle trat and mineral feeder also by the simplification of feeding management.

6.4.4 Effect of Mixed Seeding

It is very effective to obtain higher productivity of forage by the mixed seeding of leguminous pasture and true grasses pasture. Hereinafter the effectiveness of the mixed seeding for the forage production is estimated by applying the mixed seeding of Leadcanaly Grass for true grasses pasture, and Pueratia Lobata (willid) Ohwi Kudzu for leguminous pasture. The nutrition contents of each crops are adopted the value mentioned in "Japanese Standard Forage Nutrition Content Table-1975". The calculation results are shown in following table. As shown in these tables, the increase of productivity is estimated 20, 23 and 14 percent of DM, DCP and TDN basis, respectively.

Grass	D.M. (%)	D.C.P. (%)	T.D.N. (%)
Leadcanaly Grass	21.0	2.1	12.1
Tropical Kudzu	35.0	3.7	17.8

Leadcanaly Grass (70%)·Kudzu (30%)

Grass	D.M. (%)	D.C.P. (%)	T.D.N. (%)
Leadcanaly Grass (70%) Tropical Kudzu (30%)	25.2	2.58	13.81

Source: Japan Standard Feed Content 1975

Table 6–4–3 Pasture Grass Standard Yield in Colombia

Grass	Applicable Height (m)	Yield (t/ha/year)
Angleton	0-2,000	100 - 150
Braquiaria	0-2,200	125
Tropical kudzu	0-2,000	55

Source: ICA (Curso de pastos y forrajes, Compendio No. 11, Primera reimpresion, Agosto de 1980)

Table 6–4–4 The Seeds Price of Major Pasture Grasses in Cucuta

Grass	Price (COL$/kg)
Angleton	600
Braquiaria	1,500
Tropical Kudzu	3,000
Puntero	600
Guinea	600
Carimagua	1,800

Source: Hearing at Stores in Cucuta

Table 6–4–5 Grass Yield Efficiency by Grazing Types

Grazing type	Yield Loss (%)
Continuous Grazing	70
Rotational Grazing	43
Tether Grazing	31
Well-managed Pasture	11

Source: Establecimiento y manejo de Pastos y Forrajes:Numero 134, Segunda Edicion 1983 :Tomas de orientacion agropecuaria.

Table 6–4–6 Grass Forage Grazing Capacity by Grazing Types

Grazing type	Breeding Heads per ha
Rotational Grazing	2.5
Tether Grazing	2.9
Soilage Feeding	4.1
Hay Feeding	5.0
Silage Feeding	5.0

Source: Ditto

Table 6–4–7 Weight Gain Efficiency by Managing Methods

Pasture Managing Methods	Heads/ha	Weight Gain kg/ha/year	Gain Index
Continuous Grazing	1.4	204	100
Continuous Grazing + Weeding	1.9	277	129
Alternate Grazing	2.5	475	266
Alternate Grazing + Applied Nitrogen	3.0	548	300
Rotational Grazing	3.4	609	340
Rotational Grazing + Applied Nitrogen	5.1	876	433

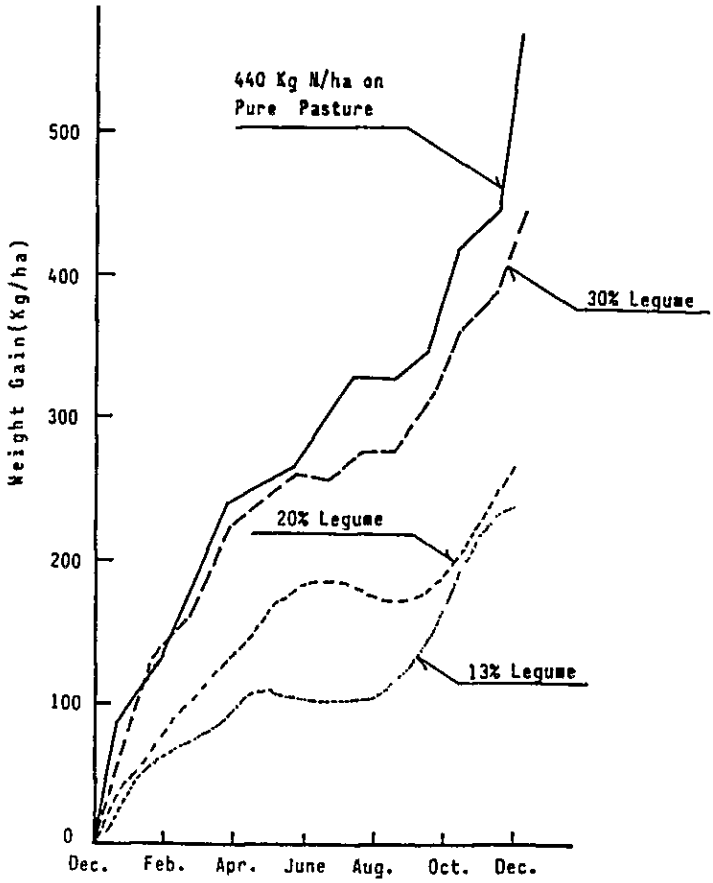
Source: Ditto

Table 6–4–8 Hay Yield by Nitrogen Fertilizer Application and Element's Content

Fertilizer Application (1)		Yield t/ha (2)	Elements' Content kg/ha			
			N	P	K	Ca
Angleton	N 0	3.4	36	8	38	12
	N 50	19.9	267	64	350	60
	N 100	27.6	415	75	435	88
Pangola	N 0	1.0	13	5	16	4
	N 50	9.6	164	49	186	45
	N 100	19.6	390	95	410	90
Paragrass	N 0	1.8	25	7	43	5
	N 50	10.7	175	46	244	35
	N 100	17.9	290	65	500	50

(1) Fertilizer Applied after every mowing
(2) Mowing every 7 weeks.

Source: ICA (Curso de Pastos y Forrajes, Compendio No. 11, Primera reimpresion - Agosto de 1980)



Source: Bryan 1970

Fig. 6–4–1 Proportion of Leguminous Pasture and Weight Gain

Table 6–4–9 Hay Yield by Nitrogen Fertilizer Application in Cauca Valley

Grass (1) (mowing times) Nitrogen (kg/ha)	Pangola (9)	Paragrass (9)	Angleton (9)	Braquiaria (12)	Puntero (14)
9	0.41	0.69	1.18	0.99	1.50
25	1.74	2.52	4.00	1.67	2.80
50	3.68	4.37	6.91	2.45	4.09
100	6.27	7.41	10.21	3.08	4.40
200	8.26	10.65	10.78	3.80	4.80

(1) Fertilizer Applied after every mowing.

Source: Curso de Pastos y Forrajes, Compendio No. 11, Primera reimpresion, Agostos 1980: ICA.

Table 6–4–10 Tropical Grass Land Productivity in Cattle Weight

Item	Daily average growth rate in weight (g)		Yearly total growth rate in weight (kg)	
	dry season	wet season	per Head	per ha
Natural Pasture with good management	- 167	449	90	22
Natural Pasture + Protein Bank 1	126	537	147	74
Braquiaria	- 50	506	118	147
Gamba grass + Stylosanthes capitate	303	656	201	330

1 Tropical kudzu.

Source: CIAT Report, 1981

Table 6-4-11 Weight Gain, Grass Yield and Feed Composition of the Project

Item	Present		Plan I		Plan II		Plan III	
Zone	A.B	C.D	A.B	C.D	A.B	C.D	A.B	C.D
Grazing Capacity (Heads/ha)	1.2	1.6	1.8	2.2	1.8	2.2	1.8	3.5
Weight Gain (kg/Head.yr)	100	100	150	150	170	170	170	170
Weight Gain (kg/ha.yr)	120	160	270	330	306	374	306	595
Grass Yield (t/ha.yr)	45	60	80	100	90	115	90	140
Pasture Grass Type	Artificial 30% Natural 70%		Artificial 100%		Artificial 100%		Artificial 100%	
Grass Varieties	Mostly natural grass		Grass forage		Grass forage & Tropical Kudzu (30%)			
Grazing Type	Continual Grazing		Continual Grazing		Continual Grazing			Rotational Grazing
Fertilizer	No application		No application		Standard application			Much application
Land condition	Poor drainage		Improved drainage		Much improved drainage			Irrigation
Grass Utilization Rate	50%		50%		50%			65%
Spindly growth Grass rate	10%		10%		10%			5%
Available grass intake (5/ha.yr)	18	24	32	40	36	46	36	84
- ditto - * Feed Composition per ha (kg) D.M.	3,780	5,040	6,720	8,400	9,072	11,592	9,072	21,168
D.C.P.	378	504	672	840	929	1,183	929	2,167
T.D.N.	2,178	2,904	3,872	4,840	4,972	6,352	4,972	11,600
- ditto - Feed Composition per Head (kg) D.M.	3,150	3,150	3,733	3,818	5,040	5,269	5,040	6,048
D.C.P.	315	315	373	381	516	539	516	619
T.D.N.	1,815	1,815	2,151	2,200	2,762	2,887	2,762	3,314
** Feed Requirement intake (grass) (t/Head)	15		15 - 18		15 - 21			- 24

* D.M. = Dry matter
D.C.P. = Digestible Crude Protain
T.D.N. = Total Digestible Nuturients

** Grass intake per day is estimated at 12% of the Cattle weight (350 kg).

Table 6–5–1 Monthly Shipping Quantity of Cacao in Norte de Santander (1982)

(t)

Month	Corregimento	Cucuta	Ocana	Sardinata	Total
1		43.6	75.3	88.1	207.0
2		27.6	85.4	72.5	185.5
3		64.9	53.0	91.7	209.6
4		53.7	53.2	50.3	157.1
5		79.5	62.7	50.2	192.4
6		102.9	49.0	40.3	192.1
7		21.3	24.2	26.2	71.6
8		8.1	6.8	9.0	23.8
9		4.4	2.8	7.6	14.8
10		14.7	1.8	1.2	17.8
11		17.6	15.1	17.4	50.0
12		31.3	29.5	39.9	100.6
Yr total		470 t	460 t	490 t	1,420 t

Source: FEDECACAO-Bogota, 1983

Table 6–5–2 Cacao Official Price & US$ Quotation (1970 – 83)

Year	National Production Total 1,000t	Official Price COL$/Kg	US$ Quotation yr mean	International Price	
				COL$	US$/Kg
1970	170	14.8	18.44	9.65	
1971	180	15.2	19.93	10.55	
1972	180	15.2	21.87	11.60	
1973	170	19.6	23.64	21.40	
1974	190	28.4	26.06	35.80	
1975	220	31.2	30.93	37.75	
1976	210	38.5	34.70	52.45	
1977	220	69.1	36.78	122.10	
1978	270	78.8	39.10	114.05	
1979	310	95.0	42.55	134.05	
1980	310	98.0	47.28	133.50	2,954
1981	350	114	54.49	124.43	2,285
1982	340	132	61.86	116.91	1,890
1983		162	80.00	169.68	2,121

Source: International Price: COL$
Official Price: FEDECACAO-Bogota
US$ Rate: Banco de la Republica, 1983
International Price: US$:FAO TRADE YEAR BOOK

Table 6–5–3 Marketing Price of Major Farm Products in Norte de Santander (1977 – 83)

Farm Gate Price (COL$)

Year	Cacao	Crude Sugar	Maize	Cassava	Plantain (Cooking Banana)	Tomato
1977	40	-	7	4	4	-
1978	72	6	7	4	4	20
1979	82	8	8	4	5	10
1980	101	13	10	6	7	20
1981	108	15	15	5	10	30
1982	120	-	19	6	9	-
1983*	116	20	16	10	11	15

Wholesale Price (COL$)

1977	61	14	8	5	7	17
1978	62	12	7	5	8	23
1979	78	11	11	10	9	24
1980	91	17	14	13	12	27
1981	108	21	16	11	14	33
1982	127	31	20	18	19	41
1983*	138	35	23	26	21	41

Consumer Price (COL$)

1977	67	16	11	7	9	24
1978	76	15	10	8	10	29
1979	88	14	14	13	12	37
1980	101	19	19	18	17	44
1981	128	31	22	17	19	57
1982	145	35	22	26	27	72
1983*	155	39	30	33	29	68

* estimated

Source: URPA, 1983

Table 6–5–4 Monthly Consumer Price of Major Farm Products in Cucuta

(COL$/500g)

	Rice	Maize (Grain)	Potato	Cassava	Plantain (Cooking banana)	Onion	Tomato	Beef (without bone)	Cocoa
1982 Jul.	24.60	19.60	12.00	13.50	13.50	46.00	25.00	115.00	62.20
Aug.	24.60	19.20	13.00	14.00	13.50	33.00	27.00	115.00	62.20
Sep.	24.40	19.20	15.50	15.00	14.50	30.00	36.00	115.00	62.20
Oct.	23.90	19.60	17.30	15.00	15.90	26.00	30.00	117.00	63.20
Nov.	24.40	19.60	18.00	15.00	14.90	37.00	21.00	122.00	63.20
Dec.	24.40	19.60	15.50	15.00	13.90	38.00	19.00	120.00	63.20
1983 Jan.	24.40	21.00	15.00	20.00	15.00	38.00	26.00	125.00	64.40
Feb.	(...)	21.00	15.00	(...)	15.00	40.00	19.00	125.00	65.00
Mar.	23.90	21.00	10.50	11.00	10.50	39.00	17.00	125.00	65.00
Apr.	24.40	21.50	15.00	13.00	11.00	52.00	20.00	125.00	65.00
May	24.60	21.50	19.00	14.50	13.50	56.00	23.00	126.00	69.00
Jun.	24.60	21.50	17.50	16.50	14.50	61.50	27.00	132.00	69.00

Source: Boletin Mensual de Estadistica, DANE, 1983

Table 6–5–5 IDEMA Official Price (June, 1983)

(COL$/t)

Sesame	42,020		Beans (A)		64,130
Rice (A)	22,600	IR-22 Blue Bonnet		(B)	54,510
(B)	14,850	IR-8		(C)	51,305
(C)	11,440	nameless	Sorghum		19,240
Maize (white)	25,180		Wheat		24,750
(yellow)	22,780		Barley		22,500
Soy Bean	35,475				

6.6 Proposed Unit Yield

6.6.1 Cassava

The national average yield of cassava in Colombia is recorded 9.6 t/ha during 1979 - 1983 (DNP, 1983).

Statistical differentiation with TOA (Tomas de Orientacion Agropecuaria) information states that the average yield of native breed cassava is recorded 8 t/ha.

It is said that the average yield of hybrid cassava will reach up to 22 t/ha by applying technical agricultural guidance (TOA: YUCA o Mandioca, 1982).

According to the ICA 7th office taking care of the study area, the yield of hybrid cassava listed as 22.2 - 26.3 t/ha (ICA; '81 Annual Report of 7th office, 1982).

In the document of Cucuta office of ICA recommended CMC-76 hybrid which is adaptable for high humid condition. CMC-76 hybrid cassava has been introduced around the study area and been extended in the part of the study area.

With the use of sufficient fertilizer the CMC-76 yield is expected to reach up to 30 to 50 t/ha. While the unit yield of native breed is expected to be Inly 6-10 t/ha.

Based on the estimated data stated above and field survey, it is estimated that the existing yield is 6 t/ha. Therefore, the proposed unit yield estimated based on the above data are as follows:

1) Plan I : The yield of 10 t/ha is expected from native breed cassava by using fertilizer and pesticides.

2) Plan II, III : The yield of 15 t/ha is expected from hybrid cassava by using of sufficient fertilizer and pesticides.

6.6.2 Maize

The national average yield of Maize is recorded 1.4 t/ha during 1979 - 1983 (DNP, 1983).

Statistical differentiation with Banco de Republica, 1982 information states 2.5 t/ha as the average yield of Maize in the Norte de Santander Department.

According to the ICA 7th office, ICA H-21 (white seed) and ICA V-101 (yellow seed) are recommended for the study area.

The unit yield of both species are expected to reach up to 3 to 5 t/ha.

Considering the buying price of IDEMA, ICA H-211 is recommended in this project.

According to ICA the average yield of ICA H-211 is adaptable to high humid condition and unit yields is recorded 9.1 t/ha at the Cauca Valley through 1980B to 1982A (ICA; '82 Annual Report, 1983).

According to ICA 7th office, the yield has been recorded 5.6 t/ha in their territory. The office stated that ICA H-211 has been grown on the commercial base (ICA; '81, '82 Annual Report of 7th office, 1982, 1983).

Based on the above-mentioned data and field survey, it is estimated that 2 t/ha is the existing average yields of maize. The proposed yield of maize is estimated to be as follows:

1) Plan I : The yield of 2.5 t/ha as the average yield of the Norte de Santander Department is expected fro the native breed by using fertilizer and pesticides.

2) Plan II & III: The yield of 3.5 t/ha is expected from hybrid ICA H-211 by using of sufficient fertilizer and pesticides in non-irrigated area where drainage condition are improved.

   In irrigated area, the yield of 4.0 t/ha is expected by using irrigation facilities, sufficient fertilizer, pesticides and mechanical cultivation.

6.6.3 Sorghum

The national average yield is recorded at 2.2 t/ha during 1979 - 1983 (DNP, 1983).

2.5 t/ha is estimated to be the average yield of sorghum in the Norte de Santander Department (Banco de Republica, 1982).

ICA Cucuta Office recommends hybrid pionner in the study area. The yield is expected to reach up to 2 to 4 t/ha.

According to ICA 7th office, the yield of pionner has been recorded at 5.4 t/ha in their territory. Pionner has been grown on the commercial base (ICA; '81, '82 Annual Report of 7th Office 1982, 1983).

In general, sorghum culture needs low cost and the yield is also small. The sorghum culture, however, by using irrigation in the Zulia district adjacent to the study area has a good performance record.

In this connection, the yield of 4 t/ha in the study area is expected by using irrigation facilities, sufficient fertilizer, pesticides and mechanical cultivation.

6.6.4 Cacao

Present cacao yield is 520 kg/ha on average through farm survey. Projected cacao yield is 800 kg/ha in the plan I and 900 kg/ha in the plan II & III. Those figures will be realized by the extension of hybrid varietes and much fertilizer application together with drainage improvement.

Average yield of cacao reaches 532 kg/ha (1979 - 83) in whole The Republic, and 480 kg/ha in the Norte de Santander Department (DNP 1983; Bancods la Republica 1982).

FEDECACAO informs that the average yield of hybrid variety is 800 - 1,000 kg/ha while that of local variety is 400 kg/ha. The unit yield of cacao increases its productivity with growing age as follows (FEDECACAO, 1982):

3 years old	100 kg/ha
4	300
5	700
6	900
7	1,000
8	1,200

ICA reports that two hybrids' yield is 1,010 - 1,290 kg/ha and four local varieties yield is 450 - 540 kg/ha.

Also ICA identifies the area along the Zulia, Pamplonita, and Grita River as a favorable land for cacao cultivation (ICA 1981).

TOA's publication also mentions that cacao is adaptable in the project area with the drainage improvement (TOA, 1982).

6.6.5 Watermelon

The national average yield is recorded 14 t/ha during 1976 - 1977 (OPSA, 1980).

It is proposed to change the native breed which is cultivated in the study area and in the vicinity for the hybrid Japanese watermelon.

Seeds of hybrid Japanese watermelon is easily obtained in Colombia. Compared with native breed, hybrid Japanese watermelon has more popurality in Colombia. Japanese watermelon has been cultivated in various countries in South America. Especially in San Juan Settlement in Bolivia where bears resembling meteorological condition to the study area, the yield of TOMIKEN (Japanese watermelon) has recorded more than 20 t/ha (JICA, 1983).

The yield of 15 t/ha is proposed in this project.

6.6.6 Papaya

The national average yield is recorded 39 t/ha during 1977 - 1979 (Ministry of Agriculture, 1979).

The yield of papaya has a tendency to show biggest production in first year and decreases then after.

Based on the data mentioned above and field survey the average yield of 15 t/ha is proposed in this project.

6.6.7 Pineapple

The national average yield of 40 t/ha is recorded during 1976 - 1979 (Ministry of Agriculture 1979).

The first harvesting is expected after 16 - 24 months of setting.

The yield of 20 t/ha is proposed in this project.

6.6.8 Cashew Nut

According to the farm survey, it is concluded that cashew fruit yield is almost 10 times the yield of nuts. However, at present only 5 tons of cashew fruit is harvested compared with harvesting of 1 ton of nuts due to difficulties in handling of cashew fruit. Proposed yield is 1.2 times higher than present yield in the Plan I, and 1.5 times higher in the Plan II.

6.7 Production Value and Production Cost

Table 6—7—1 Gross Production Value

[Present]

Zone & No. of Households	Crop Type	Area (ha)	Unit Yield (t/ha)	Yield (t)	Farm Gate Price (col$)	Gross Production Value 10³ (col$)	Unit G.P.V. (col$/ha)
Zone A	Beef Cattle	1,510	0.12	181.2	90,000	16,308	10,800
38	Cassava	10	6	60	15,000	900	90,000
	Cacao	-	-	-	-	-	-
	Sub Total	1,520	-	241.2	-	17,208	11,321
Zone B	Beef Cattle	3,130	0.12	375.6	90,000	33,804	10,800
102	Cassava	30	6	180	15,000	2,700	90,000
	Maize	10	2	20	17,000	340	34,000
	Cacao	90	0.52	46.8	125,000	5,850	65,000
	Sub Total	3,260	-	622.4	-	42,694	13,096
Zone C	Beef Cattle	3,450	0.16	552	90,000	49,680	14,400
137	Cassava	10	6	60	15,000	900	90,000
	Maize	20	2	40	17,000	680	34,000
	Cacao	260	0.52	135.2	125,000	16,900	65,000
	Sub Total	3,740	-	787.2	-	68,160	18,225
Zone D	Beef Cattle	1,540	0.16	246.4	90,000	22,176	14,400
43	Maize	10	2	20	17,000	340	34,000
	Cashew Nut	70	fruit 5 nut 1	350 70	4,000 42,000	1,400 2,940	20,000 42,000
	Sub Total	1,620	-	686.4	-	26,856	16,578
Total 320	Beef Cattle	9,630		1,355.2		121,968	12,663
	Cassava	50		300		4,500	90,000
	Maize	40		80		1,360	34,000
	Cacao	350		182		22,750	65,000
	Cashew Nut	70		fruit 350 nut 70		1,400 2,940	62,000
	Sub Total	10,140		2,337.2		154,918	15,278

[Plan I]

Zone & No. of Households	Crop Type	Area (ha)	Unit Yield (t/ha)	Yield (t)	Farm Gate Price (col$)	Gross Production Value 10³ (col$)	Unit G.P.V. (col$/ha)
Zone A	Beef Cattle	1,520	0.27	410	90,000	36,936	24,300
38	Cassava	40	10	400	15,000	6,000	150,000
	Sub Total	1,560	-	810	-	42,936	27,523
Zone B	Beef Cattle	3,000	0.27	810	90,000	72,900	24,300
102	Cassava	100	10	1,000	15,000	15,000	150,000
	Maize	10	2.5	30	17,000	425	42,500
	Cacao	430	0.8	344	125,000	43,000	100,000
	Sub Total	3,540	-	2,179	-	131,325	37,097
Zone C	Beef Cattle	3,070	0.33	1,013	90,000	91,179	29,700
137	Cassava	140	10	1,400	15,000	21,000	150,000
	Maize	20	2.5	50	17,000	850	42,500
	Cacao	570	0.8	456	125,000	57,000	100,000
	Sub Total	3,800	-	2,919	-	170,029	44,744
Zone D	Beef Cattle	1,530	0.33	505	90,000	45,441	29,700
43	Cassava	40	10	400	15,000	6,000	150,000
	Maize	10	2.5	25	17,000	425	42,500
	Cashew Nut	70	fruit 6 nut 1.2	420 84	4,000 42,000	1,680 3,528	24,000 50,400
	Sub Total	1,650		1,434		57,074	34,590
Total 320	Beef Cattle	9,120		2,738		246,456	27,024
	Cassava	320		3,200		48,000	150,000
	Maize	40		100		1,700	42,500
	Cacao	1,000		800		100,000	100,000
	Cashew Nut	70		fruit 420 84		1,680 3,528	74,400
	Sub Total	10,550		7,342		401,364	38,044

[Plan II]

Zone & No. of Households	Crop Type	Area (ha)	Unit Yield (t/ha)	Yield (t)	Farm Gate Price (col$)	Gross Production Value 10^3 (col$)	Unit G.P.V. (col$/ha)
Zone A	Beef Cattle	1,220	0.306	373	90,000	33,599	27,540
38	Cassava	80	15	1,200	10,000	12,000	150,000
	Cacao	260	0.9	234	125,000	29,250	112,500
	Sub Total	1,560		1,807		74,849	47,980
Zone B	Beef Cattle	2,610	0.306	799	90,000	71,879	27,540
102	Cassava	200	15	3,000	10,000	30,000	150,000
	Maize	10	3	30	17,000	150	51,000
	Cacao	720	0.9	648	125,000	81,000	112,500
	Sub Total	3,540		4,477		183,389	51,805
Zone C	Beef Cattle	2,550	0.374	954	90,000	85,833	33,660
137	Cassava	270	15	4,050	10,000	40,500	150,000
	Maize	20	3	60	17,000	1,020	51,000
	Cacao	960	0.9	864	125,000	108,000	112,500
	Sub Total	3,800		5,928		235,353	63,935
Zone D	Beef Cattle	1,480	0.374	554	90,000	49,817	33,660
43	Maize	90	15	1,350	10,000	13,500	150,000
	Cashew Nut	70	fruit 7.5 nut 1.5	525 105	4,000 42,000	2,100 4,410	30,000 63,000
	Sub Total	1,650		2,564		70,337	42,628
Total 320	Beef Cattle	7,860		2,680		241,128	30,678
	Cassava	640		9,600		96,000	150,000
	Maize	40		120		2,040	51,000
	Cacao	1,940		1,746		218,250	112,500
	Cashew Nut	70		fruit 525 nut 105		2,100 4,410	93,000
	Sub Total	10,550		14,776		563,928	53,453

[Plan III]

Zone & No. of Households	Crop Type	Area (ha)	Unit Yield (t/ha)	Yield (t)	Farm Gate Price (col$)	Gross Production Value 10^3 (col$)	Unit G.P.V. (col$/ha)
Zone A	Beef Cattle	1,220	0.306	373	90,000	33,599	27,540
38	Cassava	80	15	1,200	10,000	12,000	150,000
	Cacao	260	0.9	234	125,000	29,250	112,500
	Sub Total	1,560		1,807		74,849	47,980
Zone B	Beef Cattle	2,610	0.306	799	90,000	71,879	27,540
102	Cassava	200	15	3,000	10,000	30,000	150,000
	Maize	10	3	30	17,000	510	51,000
	Cacao	720	0.9	648	125,000	108,000	112,500
	Sub Total	3,540		4,477		183,389	51,805
Zone C	Beef Cattle	880	0.595	524	90,000	47,124	53,550
137	Maize	1,760	4	7,040	17,000	119,680	68,000
	Sorghum	(1,760)	4	7,040	15,000	105,600	60,000
	Cacao	960	0.9	864	125,000	108,000	112,500
	Sub Total	3,600	-	15,468		380,404	105,668
Zone D	Beef Cattle	500	0.595	298	90,000	26,775	53,550
43	Maize	900	4	3,600	17,000	61,200	68,000
	Sorghum	(900)	4	3,600	15,000	54,000	60,000
	Watermelon	100	15	1,500	10,000	15,000	150,000
	Papaya (pineapple)	100	17.5	1,750	10,000	17,500	175,000
	Sub Total	1,600		10,748		174,475	109,047
Total 320	Beef Cattle	5,210		1,994		179,377	34,429
	Cassava	280		4,200		42,000	150,000
	Maize	10		30		510	51,000
	Maize/sorghum	2,660		21,280		340,480	128,000
	Cacao	1,940		1,746		218,250	112,500
	Watermelon	100		1,500		15,000	150,000
	Papaya (pineapple)	100		1,750*		17,500	175,000
	Sub Total	10,300		32,500		813,117	78,943

( ) Double cropping with Maize

Note) Average unit yield of Papaya and Pine Apple is obtained by the following estimate;

Unit yield of papaya from the first to the fourth year	15 t/ha
Unit yield of pine apple in the first year	20 t/ha
Unit yield of pien apple in the second year	40 t/ha

17.5 t/ha is an average yield of 15 t/ha and 20 t/ha.

Table 6–7–2 Breakdown of Hourly Cost of Agricultural Machinery

Item	Tractor	Combine
Type	70 Hp	110 Hp
Price	1,550,000 col$	6,130,000 col$
Body	1,350,000 "	6,130,000
Attachment	200,000 "	-
Durable hours	7,000 hr	7,000 hr
Depreciation	221 col$	876 col$
Personnel Expenses	195 "	504 "
Operator	145 "	198 "
Assistant	-	115 "
Repair	50 "	191 "
Fuel Expenses	164 "	245 "
Oil Expenses	95 "	142 "
Expenses for goods	224 "	887 "
Total	899 ≒ 900 "	2,654 ≒ 2,700 "

Table 6–7–3 Unit Production Cost

Production Cost of Beef Cattle (Present) 5,400 col$/ha (Zone A and B)
7,200 col$/ha (Zone C and D)

Based on the field survey the production cost of beef cattle is estimated to be col$ 4,500/head. Accordingly production cost of beef cattle is estimated as below;

Zone A & B 4,500 col$ x 1.2 head/ha = 5,400 col$/ha
Zone C & D 4,500 col$ x 1.6 head/ha = 7,200 col$/ha

Production Cost of Beef Cattle (Plan I) 11,583 col$/ha(Zone AB)
12,148 col$/ha(Zone CD)

Item	Description	Quantity	Unit Cost (col$)	Total Cost (col$/yr)	Remarks
Improvement of pasture	Tractor	30 hr	900	540	3x900÷5=540 (once in 5 yrs.)
Improvement of pasture	Lime	1,000 kg	4.5	900	ton/ha (- do -)
Seeding & Land Preparation	Tractor	4.0 hr	900	720	4x900÷5=720 (- do -)
Seeds	Braquiaria	6 kg	1,500	1,800	6x1500÷5=1800 (- do -)
Weedicide		2 l	500	1,000	once in an yr.
Depreciation of Fence		400 m	34,800	2,320	per 400 m (15yrs depreciation)
Repair of Fence		40 m	3,480	232	34800÷15yr=2320
Depreciation of cattle trough	(Including salt & mineral)			251	18850/5ha=1pc. (15yrs depreciation)
Labour cost	Cow Boy	3.5 psns	350	1,225	weeding:1.5prsns repair:1.0 " transfer:1.0 "
Sub Total				8,988	

Zone AB (1.8head/ha)	Quantity	Unit Cost (col$)	Total Cost (col$)	Remarks
Ranch	1	8,988	8,988	
Medicine	1.8	1,092	1,965	
Labour	1.8	350	630	1 person/head
Sub Total			11,583	col$ 6,435/head

Zone CD (2.2head/ha)	Quantity	Unit Cost (col$)	Total Cost (col$)	Remarks
Ranch	1	8,988	8,988	
Medicine	2.2	1,086	2,390	
Labour	2.2	350	770	1 person/head
Sub Total			12,148	col$ 5,522/head

Production Cost of Beef Cattle (Plan II)

12,358 col$/ha (Zone AB)
12,852 col$/ha (Zone CD)

Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			(col$)	(col$/yr)	
Improvement of pasture	Tractor	30 hr	900	540	3x900÷5=540 (once in 5 yrs)
Improvement of pasture	Rime	1,000 kg	4.5	900	1ton/ha (- do -)
Seeding & Land Preparation	Tractor	4.0 hr	900	720	4x900÷5=720 (- do -)
Seeds	Kudzu	1 kg	3,000	600	1x3000÷5=600 (- do -)
Seeds	Angleton	6 kg	600	720	6x600÷5=720 (- do -)
Weedicide		2 l	500	1,000	once in an yr
Compound Fertilizer		50 kg	23	1,150	once in an yr
Depreciation of Fence		400 m	34,800	2,320	per 400 m 34,800÷15=2320 15yrs depreciation
Repair of Fence		40 m	3,480	232	
Depreciation of cattle trough	(Including solt & mineral)			251	18,850/5ha=1pc. 15yrs depreciation
Labour cost		3.5 prsns	350	1,225	weeding:1.5prsns repair:1.0 " Transfer:1.0 "
Sub Total				9,658	

Zone AB (1.8head/ha)	Quantity	Unit Cost	Total Cost	Remarks
			(col$)	(col$)
Ranch	1	8,988	8,988	
		(col$)	(col$/yr)	
Medicine	1.8	1,150	2,070	
Labour	1.8	350	630	1 person/head
Sub Total			12,358	col$ 6,866/head

Zone CD (2.2head/ha)	Quantity	Unit Cost	Total Cost	Remarks
			(col$)	(col$)
Ranch	1	9,658	9,658	
		(col$)	(col$/yr)	
Medicine	2.2	1,102	2,424	
Labour	2.2	350	770	1 person/head
Sub Total			12,852	col$ 5,842/head

Production Cost of Beef Cattle (Plan III)

12,358 col$/ha (Zone AB)
15,662 col$/ha (Zone CD)

Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			(col$)	(col$/yr)	
Improvement of pasture	Tractor	3.0 hr	900	540	3x900÷5=540 (once in 5 years)
Improvement of pasture	Rime	1,000 kg	4.5	900	1 ton/ha (- do -)
Seeding & Land Preparation	Tractor	4.0 hr	900	720	4x900÷5=720 (- do -)
Seeds	Kudzu	1 kg	3,000	600	1x3,000÷5=600 (- do -)
Seeds	Angleton	6 kg	600	720	6x600÷5=720
Weedicide		2 l	500	1,000	once in an year.
Compound Fertilizer		100 kg	23	2,300	once in an year
Depreciation of Fence		400 m	34,800	2,320	per 400 m 34,800÷15=2,320 15yrs depreciation
Repair of Fence		40 m	3,480	232	
Depreciation of cattle trough	(Including solt & mineral)			251	18,850/5ha=1pc. 15yrs depreciation
Labour cost		3.5 prsns	350	1,225	weeding.1.5prsns repair:1.0 " Transfer:1.0 "
Sub Total				10,808	

Zone AB (1.8head/ha)	Quantity	Unit Cost	Total Cost	Remarks
		(col$)	(col$)	
Ranch	1	8,988	8,988	
Medicine	1.8	1,092	1,965	
Labour	1.8	350	630	1 person/head
Sub Total			11,583	col$ 6,435/head

Zone CD (3.5head/ha)	Quantity	Unit Cost	Total Cost	Remarks
Ranch	1	10,808	10,808	
Medicine	3.5	1,037	3,629	
Labour	3.5	350	1,225	1 person/head
Sub Total			15,662	col$4,475/head

Production Cost of Cassava (Present) 10,180 col$/ha					
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
		persons	col$	col$	
Plowing, Harrowing	Labour	10	300	3,000	
Planting	"	14	300	4,200	
Weeding	"	2	300	600	
Harvest	"	7.9	300	2,380	
Sub Total				10,180	
Seeds			0	0	
Total				10,180	

Production Cost of Cassava (Plan II III) 54,350 col$/ha					
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	Tractor	3.0	900	2,700	Harrow
Planting	Labour	15	300	4,500	
Complementary Planting	Labour	4	300	1,200	
Weeding	Tractor	2.0 hr	900	1,800	
Weeding	Labour	5	300	1,500	
Fertilization	Tractor	1.0	900	900	
Prevention & Extermination of Plant Pest	Tractor	1.0	900	900	
Harvesting	Labour	30	300	9,000	
Selecting	Labour	5	300	1,500	
Sub Total				26,250	
Seedling		1,000pcs	0.36	3,600	
Fertilizer		350 kg	36	10,500	
Agricultural Chemical				2,000	
Bags		300	40	12,000	
Sub Total				28,100	
Total				54,350	

Production Cost of Cassava		(Plan I)		42,250 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	Tractor	3.0 hr	900	2,700	Harrow
Planting	Labour	15 prsns	300	4,500	
Complementary Planting	Labour		300	1,200	
Weeding	Tractor	2 hr	900	1,800	
" (labour)	Labour	5	300	1,500	
Fertilization	Tractor	1.0 hr	900	900	
Prevention & Extermination of Plant Pest	Tractor	1.0 hr	900	900	
Harvesting	Labour	20	300	6,000	
Selection	Labour	3	300	900	
Sub Total				22,650	
Seedling		10,000 pcs	0.36	3,600	
Fertilizer		200 kg	30	6,000	
Agricultural Chemical				2,000	
Bags		200 bags	40	8,000	
Sub Total				19,600	
Total				42,250	

Production Cost of Maize (Present)				10,160 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing, Harrowing	Labour	15	300	4,500	
Seeding	Labour	3	300	900	
Weeding	Labour	3	300	900	
Harvesting	Labour	4.5	300	1,360	
Sub Total				7,660	
Seeds		25 kg	100	2,500	
Sub Total				2,500	
Total				10,160	

Production Cost of Maize		(Plan I,II)		27,150 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	Tractor	3.0	900	2,700	Harrow
Planting	Tractor	1.0	900	900	
Weeding	Tractor	2.0	900	1,800	
Weeding	Labour	4	300	1,200	
Fertilization	Tractor	1	900	900	
Prevention & Extermination of Plant Pest	Tractor	1	900	900	
Harvesting	Tractor	3	900	2,700	Trailer
Harvesting	Labour	5	300	1,500	
Sub Total				14,850	
Seeds		25 kg	100	2,500	
Fertilizer		180 kg	30	5,400	
Agricultural Chemical				2,000	
Bags		60 bags	40	2,400	
Sub Total				12,300	
Total				27,150	

Production Cost of Maize		(Plan III)		32,300 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	Tractor	3.0	900	2,700	Harrow
Planting	Tractor	1.0	900	900	
Weeding	Tractor	2.0	900	1,800	
Weeding	Labour	4	300	1,200	
Fertilization	Tractor	1.0	900	900	
Prevention & Extermination of Plant Pest	Tractor	1.0	900	900	
Harvesting	Combine	1.5	2,700	4,050	
Sub Total				14,700	
Seeds		25 kg	100	2,500	
Fertilizer		330 kg	30	9,900	
Agricultural Chemical				2,000	
Bags		80 bags	40	3,200	
Sub Total				17,600	
Total				32,300	

Production Cost of Sorghum (Plan III)				30,700 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	Tractor	3.0	900	2,700	Harrow
Seeding	Tractor	1.0	900	900	
Weeding	Tractor	2.0	900	1,800	
Weeding	Labour	4	300	1,200	
Fertilization	Tractor	1.0	900	900	
Prevention & Extermination of Plant Pest	Tractor	1.0	900	900	
Harvesting	Combine	1.5	2,700	4,050	
Sub Total				14,700	
Seeds		20 kg	45	900	
Fertilizer		330 kg	30	9,900	
Agricultural Chemical				2,000	
Bags		80 bags	40	3,200	
Sub Total				16,000	
Total				30,700	

Production Cost of Cacao (Present)				26,000 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Weeding	Labour	5	300	1,500	
Drainage	Labour	15	300	4,500	
Pruning	Labour	6	300	1,800	
Shade Trees	Labour	4	300	1,200	
Fertilization	Labour	4	300	1,200	
Prevention & Extermination of Plant Pest	Labour	6	300	1,800	
Harvesting	Labour	8	300	2,400	
Drying	Labour	8	300	2,400	
Packing	Labour	4	300	1,200	
Sub Total				18,000	
Fertilizer		200 kg	30	6,000	
Box		20 pcs.	100	2,000	
Sub Total				8,000	
Total				26,000	

Production Cost of Cacao (First Year)				61,800 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Seedlings	Labour	8	300	2,400	
Plowing & Harrowing	"	15	300	4,500	
Setting	"	20	300	6,000	
Complementary Setting	"	5	300	1,500	
Drainage	"	25	300	7,500	
Fertilization	"	6	300	1,800	
Shade Trees	"	25	300	7,500	
Prevention & Extermination of Plant Pest	"	6	300	1,800	
Pruning	"	4	300	1,200	
Sub Total	"			37,200	
Seeds		1,110	5	5,550	
Fertilizer		350 kg	30	10,500	
Agricultural Chemicals				2,000	
Seeding of Cooking Bananas		1,110	5	5,550	
Seedling of Shade Trees		25	40	1,000	
Sub Total				24,600	
Total				61,800	

Production Cost of Cacao (from 2nd to 4th Year)				32,000 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Drainage	Labour	15	300	4,500	
Weeding	"	25	300	7,500	
Pruning	"	8	300	2,400	
Shade Trees	"	5	300	1,500	
Fertilization	"	6	300	1,800	
Prevention & Extermination of Plant Pest	"	6	300	1,800	
Sub Total				19,500	
Fertilizer		350 kg	30	10,500	
Agricultural Chemicals				2,000	
Sub Total				12,500	
Total				32,000	

Production Cost of Cacao (after 5th Year)				48,600 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Weeding	Labour	15	300	4,500	
Drainage	"	15	300	4,500	
Pruning	"	5	300	1,500	
Shade Trees	"	5	300	1,500	
Fertilization	"	6	300	1,800	
Prevention & Extermination of Plant Pest	"	9	300	2,700	
Harvesting	"	14	300	4,200	
Drying	"	14	300	4,200	
Packing	"	7	300	2,100	
Sub Total				27,000	
Fertilizer		350 kg	30	10,500	
Agricultural Chemicals				3,000	
Box		30 pcs	60	1,800	
Sub Total				15,300	
Total				42,300	
Depreciation for first four years				6,300	61,800 (first yr) +32,000 (2nd - 4th yr) x3=157,800 per yr: 157,800÷ 25=6312 ≒6,300
Grand Total				48,600	

Production Cost of Cashew Nut (First Year)				34,450 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	Tractor	3.0 hr	900	2,700	Harrow
Seedlings	Labour	10	300	3,000	
Setting	"	5	300	1,500	
Weeding	"	30	300	9,000	
Fertilization	"	5	300	1,500	
Prevention & Extermination of Plant Pest	"	5	300	1,500	
Sub Total				21,450	
Seeds		100	50	5,000	
Fertilizer		200 kg	30	6,000	
Agricultural Chemicals				2,000	
Sub Total				13,000	
Total				34,450	

Production Cost of Cashew Nut (2nd to 5th Year) 22,000 col$/ha

Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Weeding	Labour	30	300	9,000	
Fertilization	"	5	300	1,500	
Prevention & Extermination of Plant Pest	"	5	300	1,500	
Sub Total				12,000	
Fertilizer		200 kg	30	6,000	
Agricultural Chemicals				4,000	
Sub Total				10,000	
Total				22,000	

Production Cost of Cashew Nut (After 5th Year) 45,700 col$/ha

Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Weeding	Labour	20	300	6,000	
Fertilization	"	5	300	1,500	
Prevention & Extermination of Plant Pest		5	300	1,500	
Harvesting	"	15	300	4,500	
Sub Total				13,500	
Fertilizer		300 kg	30	9,000	
Agricultural Chemicals				6,000	
Bags		275	40	11,000	
Sub Total				26,000	
Total				39,500	
Depreciation upto matured stage				6,200	34,450 (First yr) +22,000 (2nd ~ 5th yr) x4=122,450 per year: 122,450÷20 =6122=6200
Grand Total				45,700	

Production Cost of Watermelon				91,250 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	"	3.0	900	2,700	Harrow
Seedling	Labour	20	300	6,000	
Setting	"	15	300	4,500	
Weeding	Tractor	2.0	900	1,800	
Weeding	Labour	50	300	15,000	
Fertilization	"	10	300	3,000	
Prevention & Extermination of Plant pest	"	20	300	6,000	
Harvesting	"	40	300	12,000	
Sub Total				53,250	
Seeds		1,000	10	10,000	Japanese Seeds
Fertilizer		800 kg	30	24,000	
Agricultural Chemicals				4,000	
Sub Total				38,000	
Total				91,250	

Production Cost of Papaya (First Year)				118,950 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	"	3.0	900	2,700	Harrow
Seedling	Labour	15	300	4,500	
Setting	"	15	300	4,500	
Weeding	"	40	300	12,000	
Fertilization	"	5	300	1,500	
Prevention & Extermination of Plant Pest		15	300	4,500	
Harvesting	"	30	300	9,000	
Sub Total				40,950	
Seeds		250 kg	40	10,000	
Fertilizer		500 kg	30	15,000	
Agricultural Chemicals				2,000	
Box		1,700	30	51,000	
Sub Total				78,000	
Total				118,950	

Production Cost of Papaya (2nd to 4th Year)				82,988 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
Weeding	Labour	40	300	12,000	
Fertilization	"	5	300	1,500	
Prevention & Extermination of Plant Pest	"	15	300	4,500	
Harvesting	"	18	300	5,400	
Sub Total				23,400	
Fertilizer		500 kg	30	15,000	
Agricultural Chemicals				2,000	
Box		1,020	30	30,600	
Sub Total				47,600	
Total				71,000	

* Unit Production Cost is an average costs for four years.
(118,950 + 71,000 x 3) ÷ 4 = 82,988

Production Cost of Pineapple				84,725 col$/ha	
Item	Description	Quantity	Unit Cost	Total Cost	Remarks
			col$	col$	
[First year]					
Plowing	Tractor	2.5 hr	900	2,250	Plow
Harrowing	"	3.0	900	2,700	Harrow
Seeding	Labour	20	300	6,000	
Fertilization	"	12	300	3,600	
Prevention & Extermination of Plant Pest	"	5	300	1,500	
Weeding	"	30	300	9,000	
Sub Total				25,050	
Seeds		42,000	0.4	16,800	
Fertilizer		500 kg	30	15,000	
Agricultural Chemicals				2,000	
Sub Total				33,800	
Total				58,850	
[2nd Year]					
Fertilization	Labour	12	300	3,600	
Weeding	"	30	300	9,000	
Prevention & Extermination of Plant Pest	"	5	300	1,500	
Harvesting	"	80	300	24,000	
Selecting & Packing	"	15	300	4,500	
Sub Total				42,600	
Fertilizer		500 kg	30	15,000	
Agricultural Chemicals				2,000	
Box		1,700	30	51,000	
Sub Total				68,000	
Total				110,600	

(First Year 58,850 + 2nd Year 110,600) ÷ 2 = 84,725

Table 6–7–4 Total Production Cost

[Present]

Zone & No. of Households	Crop Type	Area (ha)	Unit Production Cost (col$)	Production Cost (1,000 col$)
Zone A	Beef Cattle	1,510	5,400	8,154
38	Cassava	10	10,180	102
	Sub Total	1,520		8,256
Zone B	Beef Cattle	3,130	5,400	16,902
	Cassava	30	10,180	305
102	Maize	10	10,160	102
	Cacao	90	26,000	2,340
	Sub Total	3,260		19,649
Zone C	Beef Cattle	3,450	7,200	24,840
	Cassava	10	10,180	102
137	Maize	20	10,160	203
	Cacao	260	26,000	6,760
	Sub Total	3,740		31,905
Zone D	Beef Cattle	1,540	7,200	11,088
	Maize	10	10,160	102
43	Cashew Nut	70	45,700	3,199
	Sub Total	1,620		14,389
	Beef Cattle	9,630		60,984
	Cassava	50		509
Total 320	Maize	40		407
	Cacao	350		9,100
	Cashew Nut	70		3,199
	Sub Total	10,140		74,199

[Plan I]

Zone & No. of Households	Crop Type	Area (ha)	Unit Production Cost (col$)	Production Cost (1,000 col$)
Zone A	Beef Cattle	1,520	11,583	17,606
38	Cassava	40	42,250	1,690
	Sub Total	1,560		19,296
Zone B	Beef Cattle	3,000	11,583	34,749
	Cassava	100	42,250	4,225
102	Maize	10	27,150	272
	Cacao	430	48,600	20,898
	Sub Total	3,540		60,144
Zone C	Beef Cattle	3,070	12,148	37,294
	Cassava	140	42,250	5,915
137	Maize	20	27,150	543
	Cacao	570	48,600	27,702
	Sub Total	3,800		71,454
Zone D	Beef Cattle	1,530	12,148	18,586
	Cassava	40	42,250	1,690
	Maize	10	27,150	272
43	Cashew Nut	70	45,700	3,199
	Sub Total	1,650		23,747
	Beef Cattle	9,120		108,235
	Cassava	320		13,520
Total 320	Maize	40		1,087
	Cacao	1,000		48,600
	Cashew Nut	70		3,199
	Sub Total	10,550		174,641

[Plan II]

Zone & No. of Households	Crop Type	Area (ha)	Unit Production Cost (col$)	Production Cost (1,000 col$)
Zone A	Beef Cattle	1,220	12,358	15,077
38	Cassava	80	54,350	4,348
	Cacao	260	48,600	12,636
	Sub Total			32,061
Zone B	Beef Cattle	2,610	12,358	32,254
	Cassava	200	54,350	10,870
102	Maize	10	27,150	272
	Cacao	720	48,600	34,992
	Sub Total	3,540		78,388
Zone C	Beef Cattle	2,550	12,852	32,773
	Cassava	270	54,350	14,675
137	Maize	20	27,150	543
	Cacao	960	48,600	46,656
	Sub Total	3,800		94,647
Zone D	Beef Cattle	1,480	12,852	19,021
	Cassava	90	54,350	4,892
43	Maize	10	27,150	272
	Cashew Nut	70	45,700	3,199
	Sub Total	1,650		27,384
	Beef Cattle	7,860		99,125
	Cassava	640		34,785
Total 320	Maize	40		1,087
	Cacao	1,940		94,284
	Cashew Nut	70	3,199	
	Sub Total	10,550		232,480

[Plan III]

Zone & No. of Households	Crop Type	Area (ha)	Unit Production Cost (col$)	Production Cost (1,000 col$)
Zone A	Beef Cattle	1,220	12,358	15,077
38	Cassava	80	54,350	4,348
	Cacao	260	48,600	12,636
	Sub Total	1,560		32,061
Zone B	Beef Cattle	2,610	12,358	32,254
	Cassava	200	54,350	10,870
102	Maize	10	27,150	272
	Cacao	720	48,600	34,992
	Sub Total	3,540		78,388
Zone C	Beef Cattle	880	15,662	13,783
	Maize	1,760	32,300	56,848
137	Sorghum	1,760	30,700	54,032
	Cacao	960	48,600	46,656
	Sub Total	3,600		171,319
Zone D	Beef Cattle	500	15,662	7,831
	Maize	900	32,300	29,070
	Sorghum	900	30,700	27,630
43	Watermelon	100	91,250	9,125
	Papaya (pineapple)	100	83,856	8,386
	Sub Total	1,600		82,042
	Beef Cattle	5,210		68,945
	Cassava	280		15,218
	Maize	10		272
	Maize	2,660		85,918
Total 320	Sorghum	2,660		81,662
	Cacao	1,940		94,284
	Watermelon	100		9,125
	Papaya (pineapple)	100		8,386
	Sub Total	10,300		363,810

Table 6–7–5 Net Production Value

[Present] (Unit: 1,000 col$)

Zone & No. of Households	Crop Type	Area (ha)	Gross Production Value	Production Cost	Net Production Value	N.P.V./ha (col$)
Zone A	Beef Cattle	1,510	16,308	8,154	8.154	5,400
38	Cassava	10	900	102	798	79,800
	Sub Total	1,520	17,208	8,256	8,952	5,890
Zone B	Beef Cattle	3,130	33,804	16,902	16,902	5,400
	Cassava	30	2,700	305	2,395	79,800
102	Maize	10	340	102	238	23,800
	Cacao	90	5,850	2,340	3,510	39,000
	Sub Total	3,260	42,694	19,649	23,045	7,070
Zone C	Beef Cattle	3,450	49,680	24,840	24,840	7,200
	Cassava	10	900	102	798	79,800
137	Maize	20	680	203	477	23,800
	Cacao	260	16,900	6,760	10,140	39,000
	Sub Total	3,740	68,160	31,905	36,255	9,690
Zone D	Beef Cattle	1,540	22,176	11,088	11,088	7,200
	Maize	10	340	102	238	23,800
43	Cashew Nut	70	1,400 2,940	3,199	1,141	16,300
	Sub Total	1,620	26,856	14,389	12,467	7,700
	Beef Cattle	9,360	121,968	60,984	60,984	6,520
	Cassava	50	4,500	509	3,991	79,800
Total	Maize	40	1,360	407	953	23,830
320	Cacao	350	22,750	9,100	13,650	39,000
	Cashew Nut	70	1,400 2,940	3,199	1,141	16,300
	Total	10,140	154,918	74,199	80,719	7,960

[Plan I] (Unit: 1,000 col$)

Zone & No. of Households	Crop Type	Area (ha)	Gross Production Value	Production Cost	Net Production Value	N.P.V./ha (col$)
Zone A	Beef Cattle	1,520	36,936	17,606	19,330	12.717
38	Cassava	40	6,000	1,690	4,310	107,750
	Sub Total	1,560	42,936	19,296	23,640	15,154
Zone B	Beef Cattle	3,000	72,900	34,749	38,151	12,717
	Cassava	100	15,000	4,225	10,775	107,750
102	Maize	10	425	272	153	15,300
	Cacao	430	43,000	20,898	22,102	51,400
	Sub Total	3,540	131,325	60,144	71,181	20,108
Zone C	Beef Cattle	3,070	91,179	37,294	53,885	17,552
	Cassava	140	21,000	5,915	15,085	107,750
137	Maize	20	850	543	307	15,300
	Cacao	570	57,000	27,702	29,298	51,400
	Sub Total	3,800	170,029	71,454	98,575	25,941
Zone D	Beef Cattle	1,530	45,441	18,586	26,855	17,552
	Cassava	40	6,000	1,690	4,310	107,750
43	Maize	10	425	272	153	15,300
	Cashew Nut	70	1,680 3,528	3,199	2,009	28,700
	Sub Total	1,650	57,074	23,747	33,327	20,198
	Beef Cattle	9,120	246,456	108,235	138,235	15,156
	Cassava	320	48,000	13,520	34,480	107,750
Total	Maize	40	1,700	1,087	613	15,300
320	Cacao	1,000	100,000	48,600	51,400	51,400
	Cashew Nut	70	1,680 3,528	3,199	2,009	28,700
	Total	10,550	401,364	174,641	226,723	21,490

[Plan II]

(Unit: 1,000 col$)

Zone & No. of Households	Crop Type	Area (ha)	Gross Production Value	Production Cost	Net Production Value	N P.V./ha (col$)
Zone A	Beef Cattle	1,220	33,559	15,077	18,552	15,182
38	Cassava	80	12,000	4,348	7,652	95,650
	Cacao	260	29,250	12,636	16,614	63,900
	Sub Total	1,560	74,849	32,061	42,788	27,428
Zone B	Beef Cattle	2,610	71,879	32,254	39,625	15,182
102	Cassava	200	30,000	10,870	19,130	95,650
	Maize	10	510	272	238	23,800
	Cacao	720	81,000	34,992	46,008	63,900
	Sub Total	3,540	183,389	78,388	105,001	29,661
Zone C	Beef Cattle	2,550	85,833	32,773	53,060	20,808
137	Cassava	270	40,500	14,675	25,825	95,650
	Maize	20	1,020	543	477	23,800
	Cacao	960	108,000	46,656	61,344	63,900
	Sub Total	3,800	235,353	94,647	140,706	37,028
Zone D	Beef Cattle	1,480	49,817	19,021	30,796	20,808
43	Cassava	90	13,500	4,892	8,608	95,650
	Maize	10	510	272	238	23,800
	Cashew Nut	70	2,100	3,199	3,311	47,300
			4,410			
	Sub Total	1,650	70,337	27,384	42,953	26,032
Total	Beef Cattle	7,860	241,128	99,125	142,003	18,067
320	Cassava	640	96,000	34,785	61,125	95,650
	Maize	40	2,040	1,087	953	23,800
	Cacao	1,940	218,250	94,284	123,966	63,900
	Cashew Nut	70	2,100	3,199	3,311	47,300
			4,410			
	Total	10,550	563,928	232,480	331,448	31,417

[Plan III]

(Unit: 1,000 col$)

Zone & No. of Households	Crop Type	Area (ha)	Gross Production Value	Production Cost	Net Production Value	N.P.V./ha (col$)
Zone A	Beef Cattle	1,220	33,599	15,077	18,522	15,182
38	Cassava	80	12,000	4,348	7,652	95,650
	Cacao	260	29,250	12,636	16,614	63,900
	Sub Total	1,560	74,849	32,061	42,788	27,428
Zone B	Beef Cattle	2,610	71,879	32,254	39,625	15,182
102	Cassava	200	30,000	10,870	19,130	95,650
	Maize	10	510	272	238	23,800
	Cacao	720	81,000	34,992	46,008	63,900
	Sub Total	3,540	183,389	78,388	105,001	29,661
Zone C	Beef Cattle	880	47,124	13,783	33,341	37,888
137	Sorghum	1,760	105,600	54,032	51,568	29,300
	Maize	1,760	119,680	56,848	62,832	35,700
	Cacao	960	108,000	46,656	61,344	63,900
	Sub Total	3,600	380,404	171,319	209,085	58,079
Zone D	Beef Cattle	500	26,775	7,831	18,944	37,888
43	Maize	900	61,200	29,070	32,130	35,700
	Sorghum	(900)	54,000	27,630	26,370	29,300
	Watermelon	100	15,000	9,125	5,875	58,750
	Papaya (pineapple)	100	17,500	8,386	9,114	91,140
	Sub Total	1,600	174,475	82,042	92,433	57,711
Total	Beef Cattle	5,120	179,377	68,945	110,432	21,400
320	Cassava	280	42,000	15,218	26,782	95,650
	Maize	10	510	272	238	23,800
	Maize/ Sorghum	2,660 (2,660)	340,480 -)	167,580 -)	172,900	65,000
	Cacao	1,940	218,250	94,284	123,966	63,900
	Watermelon	100	15,000	9,125	5,875	58,750
	Papaya (pineapple)	100	17,500	8,386	9,114	91,140
	Total	10,300	813,117	363,810	449,307	43,622

( ) Double cropping with maize

6.8 Average Farmer's Income

(1) Average Cropping Area
(2) Production Cost
(3) Unit Labour Force
(4) Yearly Labour Force
(5) Labour Requirement
(6) Estimated Family Labour Price & Non-Agricultural Income
(7) Water Charge
(8) Agricultural Cost
(9) Agricultural Gross Production Value
(10) Agricultural Income
(11) Living Cost
(12) Farmers Income

(1) Average Cropping Area/Household (Cropping Area/No. of Households) Unit : ha

Zone & No. of Households	Present	Plan I	Plan II	Plan III
Zone A 38	Pasture 39.7 Cassava 0.3	Pasture 40.0 Cassava 1.0	Pasture 32.0 Cassava 2.0 Cacao 7.0	Pasture 32.0 Cassava 2.0 Cacao 7.0
	Sub Total 40.0	Sub Total 41.0	Sub Total 41.0	Sub Total 41.0
Zone B 102	Pasture 30.7 Cassava 0.3 Maize 0.1 Cacao 0.9	Pasture 29.4 Cassava 1.0 Maize 0.1 Cacao 4.2	Pasture 25.6 Cassava 2.0 Maize 0.1 Cacao 7.0	Pasture 25.6 Cassava 2.0 Maize 0.1 Cacao 7.0
	Sub Total 32.0	Sub Total 34.7	Sub Total 34.7	Sub Total 34.7
Zone C 137	Pasture 25.2 Cassava 0.1 Maize 0.1 Cacao 1.9	Pasture 22.4 Cassava 1.0 Maize 0.1 Cacao 4.2	Pasture 18.6 Cassava 2.0 Maize 0.1 Cacao 7.0	Pasture 6.4 Maize/ Sorghum 12.9 Cacao 7.0
	Sub Total 27.3	Sub Total 27.7	Sub Total 27.7	Sub Total 26.3
Zone D 43	Pasture 35.8 Maize 0.2 Cashew Nut 1.6	Pasture 35.5 Cassava 1.0 Maize 0.2 Cashew Nut 1.7	Pasture 34.5 Cassava 2.0 Maize 0.2 Cashew Nut 1.7	Pasture 11.6 Maize/ Sorghum 21.0 Watermelon 2.3 Papaya (Pineapple) 2.3
	Sub Total 37.7	Sub Total 38.4	Sub Total 38.4	Sub Total 37.2
Total 320	Pasture 30.1 Cassava 0.2 Maize 0.1 Cacao 1.1 Cashew Nut 0.2	Pasture 28.5 Cassava 1.0 Maize 0.1 Cacao 3.1 Cashew Nut 0.2	Pasture 24.5 Cassava 2.0 Maize 0.1 Cacao 6.1 Cashew Nut 0.2	Pasture 16.2 Cassava 0.9 Maize 0.0 Maize/ Sorghum 8.4 Cacao 6.1 Watermelon 0.3 Papaya (Pineapple) 0.3
	Total 31.7	Total 32.9	Total 32.9	Total 32.2

(2) Production Cost/Household(Unit Production Cost x Cropping Area) Unit : 1,000col$

Zone & No. of Households	Present	Plan I	Plan II	Plan III
Zone A 38	Pasture 214 Cassava 3	Pasture 463 Cassava 42	Pasture 395 Cassava 109 Cacao 340	Pasture 395 Cassava 109 Cacao 340
	Sub Total 217	Sub Total 505	Sub Total 844	Sub Total 844
Zone B 102	Pasture 166 Cassava 3 Maize 1 Cacao 23	Pasture 341 Cassava 42 Maize 3 Cacao 204	Pasture 316 Cassava 109 Maize 3 Cacao 340	Pasture 316 Cassava 109 Maize 3 Cacao 340
	Sub Total 193	Sub Total 590	Sub Total 768	Sub Total 768
Zone C 137	Pasture 181 Cassava 1 Maize 1 Cacao 49	Pasture 272 Cassava 42 Maize 3 Cacao 204	Pasture 239 Cassava 109 Maize 3 Cacao 340	Pasture 100 Maize/ Sorghum 813 Cacao 340
	Sub Total 232	Sub Total 521	Sub Total 691	Sub Total 1,253
Zone D 43	Pasture 258 Maize 2 Cashew Nut 73	Pasture 431 Cassava 42 Maize 5 Cashew Nut 78	Pasture 443 Cassava 109 Maize 5 Cashew Nut 78	Pasture 182 Maize/ Sorghum 1,323 Watermelon 210 Papaya (Pineapple) 193
	Sub Total 333	Sub Total 656	Sub Total 635	Sub Total 1,908

(3) Unit Labour Force/Household (Person/ha)

Zone & No. of Households	Present	Plan I	Plan II	Plan III
Zone A 38	Pasture 3.0	Pasture 5.3	Pasture 5.3	Pasture 5.3
	Cassava 33.9	Cassava 47.0	Cassava 59.0	Cassava 59.0
			Cacao 90.0	Cacao 90.0
	Sub Total 36.9	Sub Total 52.3	Sub Total 154.3	Sub Total 154.3
Zone B 102	Pasture 3.0	Pasture 5.3	Pasture 5.3	Pasture 5.3
	Cassava 33.9	Cassava 47.0	Cassava 59	Cassava 59
	Maize 25.5	Maize 9.0	Maize 9	Maize 9
	Cacao 60.0	Cacao 90.0	Cacao 90	Cacao 90
	Sub Total 122.4	Sub Total 151.3	Sub Total 151.3	Sub Total 151.3
Zone C 137	Pasture 3.0	Pasture 5.7	Pasture 5.7	Pasture 7.0
	Cassava 33.9	Cassava 47.0	Cassava 59.0	Maize/ Sorghum 8.0
	Maize 25.5	Maize 9.0	Maize 9.0	
	Cacao 60.0	Cacao 90.0	Cacao 90.0	Cacao 90.0
	Sub Total 122.4	Sub Total 151.7	Sub Total 151.7	Sub Total 105
Zone D 43	Pasture 3	Pasture 5.7	Pasture 5.7	Pasture 7.0
	Maize 25.5	Cassava 47	Cassava 59	Maize/ Sorghum 8.0
	Cashew Nut 45	Maize 9	Maize 9	Watermelon 155.0
		Cashew Nut 45	Cashew Nut 45	Papaya (Pineapple) 97,0
	Sub Total 73.5	Sub Total 106.7	Sub Total 118.7	Sub Total 267

Pasture: Including Cattle Breeding Labours.

(4)Yearly Labour Force/Household(Unit Labour Force x Cropping Area)(Person)

Zone & No. of Households	Present	Plan I	Plan II	Plan III
Zone A 38	Pasture 119.1	Pasture 212.0	Pasture 169.6	Pasture 169.6
	Cassava 10.2	Cassava 47.0	Cassava 118.0	Cassava 118.0
			Cacao 630.0	Cacao 630.0
	Sub Total 129.3	Sub Total 259.0	Sub Total 917.6	Sub Total 917.6
Zone B 102	Pasture 92.1	Pasture 155.8	Pasture 135.7	Pasture 135.7
	Cassava 10.2	Cassava 47.0	Cassava 118.0	Cassava 118.0
	Maize 2.6	Maize 0.9	Maize 0.9	Maize 0.9
	Cacao 54.0	Cacao 378.0	Cacao 630.0	Cacao 630.0
	Sub Total 158.9	Sub Total 581.7	Sub Total 884.6	Sub Total 884.6
Zone C 137	Pasture .75.6	Pasture 118.7	Pasture 98.6	Pasture 44.8
	Cassava 3.4	Cassava 47.0	Cassava 118.0	Maize/ Sorghum 103.2
	Maize 2.6	Maize 0.9	Maize 0.9	
	Cacao 114.0	Cacao 378.0	Cacao 630.0	Cacao 630.0
	Sub Total 195.0	Sub Total 544.0	Sub Total 847.5	Sub Total 778.0
Zone D 43	Pasture 107.4	Pasture 188.2	Pasture 182.9	Pasture 81.2
	Maize 5.1	Cassava 47.0	Cassava 118.0	Maize/ Sorghum 168.0
	Cashew Nut 72.0	Maize 1.8	Maize 1.8	Watermelon 356.5
		Cashew Nut 76.5	Cashew Nut 76.5	Papaya (Pineapple) 223.1
	Sub Total 184.5	Sub Total 313.5	Sub Total 379.2	Sub Total 828.8

Pasture: Including Cattle Breeding Labours.

(5) Labour Requirement/Household (Person · Day)

Zone & Item	Present	Plan I	Plan II	Plan III
Zone A				
Labour Requirement	129	259	918	918
Family Labour	129	259	540	540
Hired Labour	0	0	378	378
Surplus Labour	411	281	0	0
Zone B				
Labour Requirement	159	582	885	885
Family Labour	159	540	540	540
Hired Labour	0	42	345	345
Surplus Labour	381	0	0	0
Zone C				
Labour Requirement	196	545	848	778
Family Labour	196	540	540	540
Hired Labour	0	5	308	238
Surplus Labour	344	0	0	0
Zone D				
Labour Requirement	185	314	379	829
Family Labour	185	314	379	540
Hired Labour	0	0	0	286
Surplus Labour	355	226	161	0

(6) Estimated Family Labour Price and Non-Agricultural Income/Household Unit : 1,000col$

Zone & Item	Present	Plan I	Plan II	Plan III
Zone A				
Family Labour Price	39	78	162	162
Non-agricultural Income	62	42	0	0
Zone B				
Family Labour Price	48	162	162	162
Non-agricultural Income	57	0	0	0
Zone C				
Family Labour Price	59	162	162	162
Non-agricultural Income	52	0	0	0
Zone D				
Family Labour Price	56	94	114	162
Non-agricultural Income	53	34	24	0

Family Labour is estimated 300 COL$ per person-day.
Non agr-Income = Surplus Labour x 0.5 x 300 COL$ per person-day

(7) Water Charge/Household

Unit : 1,000col$

Zone & Item	Present	Plan I	Plan II	Plan III
Zone A				
Area (ha)	40.0	41.0	41.0	41.0
Water Charge	0	89	108	108
Zone B				
Area (ha)	32.0	34.7	34.7	34.7
Water Charge	0	76	91	91
Zone C				
Area (ha)	27.3	27.7	27.7	26.3 (19.3)
Water Charge	0	60	73	117
Zone D				
Area (ha)	37.7	38.4	38.4	37.2 (37.2)
Water Charge	0	84	101	190

( ) Irrigation Area

Water Charge: Plan I 2,182 COL$/ha
Plan II 2,624 COL$/ha
Plan III A,B 2,624 COL$/ha
C,D 5,097 COL$/ha

(8) Agricultural Cost/Household

Unit : 1,000col$

Zone & Item	Present	Plan I	Plan II	Plan III
Zone A				
Production Cost	217	505	844	844
Family Labour	-39	-78	-162	-162
Water Charge	0	89	108	108
Interest 1	21	51	82	82
Interest 2	0	52	41	41
Total Cost	199	619	913	913
Zone B				
Production Cost	193	590	768	768
Family Labour	-48	-162	-162	-162
Water Charge	0	76	91	91
Interest 1	17	51	73	73
Interest 2	0	38	33	33
Total Cost	162	593	803	803
Zone C				
Production Cost	232	521	691	1,253
Family Labour	-59	-162	-162	-162
Water Charge	0	60	73	117
Interest 1	21	43	63	131
Interest 2	0	29	24	26
Total Cost	194	491	689	1,365
Zone D				
Production Cost	333	556	635	1,908
Family Labour	-56	-94	-114	-162
Water Charge	0	84	101	190
Interest 1	33	55	63	210
Interest 2	0	46	45	48
Total Cost	310	647	730	2,194

Interest 1. Agriculture Credits' Interest
(Production Cost excluding Family Labour x 60% x 20%)

Interest 2. Cattle Purchasing Credits' Interest
((Proposed Heads - Present Heads) x ha x 18,000 x 60% x 20%)

(9) Agricultural Gross Production Value

Unit . 1,000col$

Zone & No. of Households	Present		Plan I		Plan II		Plan III	
Zone A	Pasture	429	Pasture	972	Pasture	881	Pasture	881
38	Cassava	27	Cassava	150	Cassava	300	Cassava	300
					Cacao	788	Cacao	788
	Sub Total	456	Sub Total	1,122	Sub Total	1,969	Sub Total	1,969
Zone B	Pasture	332	Pasture	996	Pasture	705	Pasture	705
102	Cassava	27	Cassava	150	Cassava	300	Cassava	300
	Maize	3	Maize	43	Maize	5	Maize	5
	Cacao	59	Cacao	10	Cacao	788	Cacao	788
	Sub Total	421	Sub Total	1,199	Sub Total	1,798	Sub Total	1,798
Zone C	Pasture	363	Pasture	665	Pasture	626	Pasture	343
137	Cassava	9	Cassava	150	Cassava	300	Maize/ Sorghum	1,651
	Maize	3	Maize	4	Maize	5		
	Cacao	124	Cacao	420	Cacao	788	Cacao	788
	Sub Total	499	Sub Total	1,239	Sub Total	1,719	Sub Total	2,782
Zone D	Pasture	516	Pasture	1,054	Pasture	1,161	Pasture	621
43	Maize	7	Cassava	150	Cassava	300	Maize/ Sorghum	2,688
	Cashew Nut	32 67	Maize	9	Maize	102		
			Cashew Nut	41 86	Cashew Nut	51 107	Watermelon	345
							Papaya (Pineapple)	403
	Sub Total	622	Sub Total	1,340	Sub Total	1,721	Sub Total	4,057

(10) Agricultural Income/Household

Unit . 1,000col$

	Present	Plan I	Plan II	Plan III
Zone A 38	40.0 ha 220	41.0 ha 426	41.0 ha 917	41.0 ha 917
Zone B 102	32.0 ha 217	34.7 ha 487	34.7 ha 856	34.7 ha 856
Zone C 137	27.3 ha 255	27.7 ha 626	27.7 ha 887	26.3 ha 1,274
Zone D 43	37.7 ha 263	38.4 ha 599	38.4 ha 875	37.2 ha 1,713
320	31.7 ha 240	32.9 ha 554	32.9 ha 879	32.2 ha 1,157

(1) Agricultural Income, Farmer's Income, Economic Surplus/Household

Unit : 1,000col$

Zone & NO. of Households	Present	Plan I	Plan II	Plan III
Zone A				
38	99	119	139	139
Zone B				
102	99	119	139	139
Zone C				
137	102	122	143	143
Zone D				
43	107	128	150	150

Plan I : Present x 1.2

Plan II & III . Present x 1.4

(2) Economic Surplus/Household

Unit : 1,000col$

Zone & Item	Present	Plan I	Plan II	Plan III
Zone A				
Agricultural G.P.V.	456	1,122	1,969	1,969
Agricultural Cost	199	619	913	913
Agricultural Income	257	503	1,056	1,056
Non-agricultural income	62	42	0	0
Farmer's Income	319	545	1,056	1,056
Household Living Cost	99	119	139	139
Economic Surplus	220	426	917	917
Zone B				
Agricultural G.P.V.	421	1,199	1,798	1,798
Agricultural Cost	162	593	803	803
Agricultural Income	259	606	995	995
Non-agricultural income	57	0	0	0
Farmer's Income	316	606	995	995
Household Living Cost	99	119	139	139
Economic Surplus	217	487	856	856
Zone C				
Agricultural G.P.V.	499	1,239	1,719	2,782
Agricultural Cost	194	491	689	1,365
Agricultural Income	305	748	1,030	1,417
Non-agricultural income	52	0	0	0
Farmer's Income	357	748	1,030	1,417
Household Living Cost	102	122	143	143
Economic Surplus	255	626	887	1,274
Zone D				
Agricultural G.P.V.	622	1,340	1,721	4,057
Agricultural Cost	310	647	730	2,194
Agricultural Income	312	693	991	1,863
Non-agricultural income	53	34	34	0
Farmer's Income	365	727	1,025	1,863
Household Living Cost	102	128	150	150
Economic Surplus	263	599	875	1,713

6.9 Agricultural Finance

An appropriate financing is indispensable to promote agriculture and livestock. Ratio of financed amount to the total production cost used for agriculture and livestock is increasing every year. The financing for the main agricultural products except coffee beans increased by 60 percent for the recent three years since 1980 to 1982 (OPSA, 1983). The financing for livestock in almost one half of that for agriculture, even though it is increasing little by little every year.

Ratio of the actual financing from respective financing organization in 1982 is as follows:

F.F.A.P. : 51.6%, Caja Agraria : 40.7%
INCORA : 1.2%, Banco Ganadero : 6.1%
PRODESARROLLO : 0.4%

The condition for financing (gualification of borrowers, kind of products, amount, term, interest, etc.) are different for respective organization (refer to Table 6-9-1). These financing condition are prepared by respective organizations every year for respective production and are finally decided by the Agriculture and Livestock Financing Committee. One of the members of the committee is sent from the Ministry of Agriculture.

The procedures for financing are as follows:

- Apprication to the turget organization by borrower
- Checking of the farm condition based on the apprication by the specialist who belongs to or temporarily employed by the organization
- Preparation of contract documents
- Financing
- Checking of effectiveness of financing and guidance by respective organization

The year interest presented by the financing organizations is practically minus interest judging from the ratio of inflation of about 25 percent in recent years. This means that the agricultural production is receiving very courteous treatment.

Table 6-9-1 Condition of Finances

Credit Organization	Capital Source	User	Credit Period (Year)	Annual Interest (%)	Maximum Credit Sum	Remarks
Caja Agraria	F.F.A.P.	All farmers	~ 2 (Short term) 2-1/12 ~ 8 (Middle term) (Middle term) 8-1/12 ~ 10 (Long term)	12 to 21	80% of total investment. Depend on agricultural term, ha and project. 2 mil. COL$ for middle and long term credit.	Required technical guidance for investment.
	Self-capital	All farmers	~ 1 (Short term) 1-1/12 ~ 6 (Middle term) 6 ~ (Long term)	18 to 29	4 mil. COL$	Annual interest (COL$): Crop (temporal culture) 18% (~300 x 10^3) 22% (300 x 10^3 ~ 1.8 mil.) 29% (>1.8 mil.) Others 18% (~100 x 10) 23% (100 x 10^3 ~ 1.2 mil.) 29% (>1.2 mil.)
Banco Ganadero	F.F.A.P.	All farmers	~ 2 (Short term) 2 ~ 8 (Middle term) 8 ~ 10 (Long term)	21 to 22	80% of total investment. Depend on agricultural term, ha and project. 2 mil. COL$ for middle and long term credit.	
	Self-capital	Large scale cattle producer	Max. 2	18	Depend on production scale.	
Banco Cafetero	F.F.A.P.	All farmer in coffee area	~ 2 (Short term) 2 ~ 8 (Middle term) 8 ~ 10 (Long term)	12 to 21	80% of total investment. Depend on agricultural term, ha and project. 2 mil. COL$ for middle and long term credit.	
	Federación Cafetero-Prodesarrollo	Coffee producer	~ 10	20 to 24	Depend on investment.	
	Self-capital	Large scale farmer	~ 1	32	Depend on investment.	
INCORA	F.F.A.P.	Parceleros of INCORA	~ 1 (Short term) 1-1/12 ~ 5 (Middle term) 5-1/12 ~ 13 (Long term)	18	Half mil. COL$ (Particular) Half mil. COL$ x number of member (Group farm)	
	Caja Agraria	Parceleros of INCORA	- ditto -	18	- ditto -	Building and rebuilding of houses
	Bco. Ganadero	Parceleros of INCORA	- ditto -	18	- ditto -	Small cattle farm
	Self-capital	Parceleros of INCORA	- ditto -	18	- ditto -	

APPENDIX 7. PROJECT IMPLEMENTATION

LIST OF TABLES

LIST OF FIGURES

7.1 Implementation Schedule

7.1.1 Implementation Program

The major work of the Project consists of following items:

(1) Pre-construction Work

(2) Civil Works

(3) Procurement of O/M Equipment

(4) Facilities of Supporting Services

(5) Engineering Services

The basic conception of the major work above-mentioned are stated hereinafter.

(1) Pre-construction work

Survey by aerial photograph and mapping for the whole Project area should be commenced in the first Project year. The detailed design (Engineering services) should be commenced after the accomplishment of mapping above-mentioned, in parallel with major irrigation and drainage canal, soil survey for major structure and preparing of tender documents. Tendering and part of Land Acquisition will be started after the detailed design. Total pre-construction period is considered about 18 months.

(2) Civil works

Civil works will be carried out on the contract basis by current governmental policy (international competitive-bid contract) and be commenced from the Second Project year after preparing basic condition for implementing of the construction works.

(3) Procurement of O/M Equipment

For the Post-Project, O/M Equipment will be procured under the Project. Procurement of O/M Equipment will be started from the beginning of fourth project year and inspection and inland transportation will be completed with in the fifth project year.

(4) Agricultural Supporting Service Facilities

Construction of supporting service facilities such as staff quarter for water management, motor pool for agricultural machines will be started from fourth project year.

(5) Engineering Services

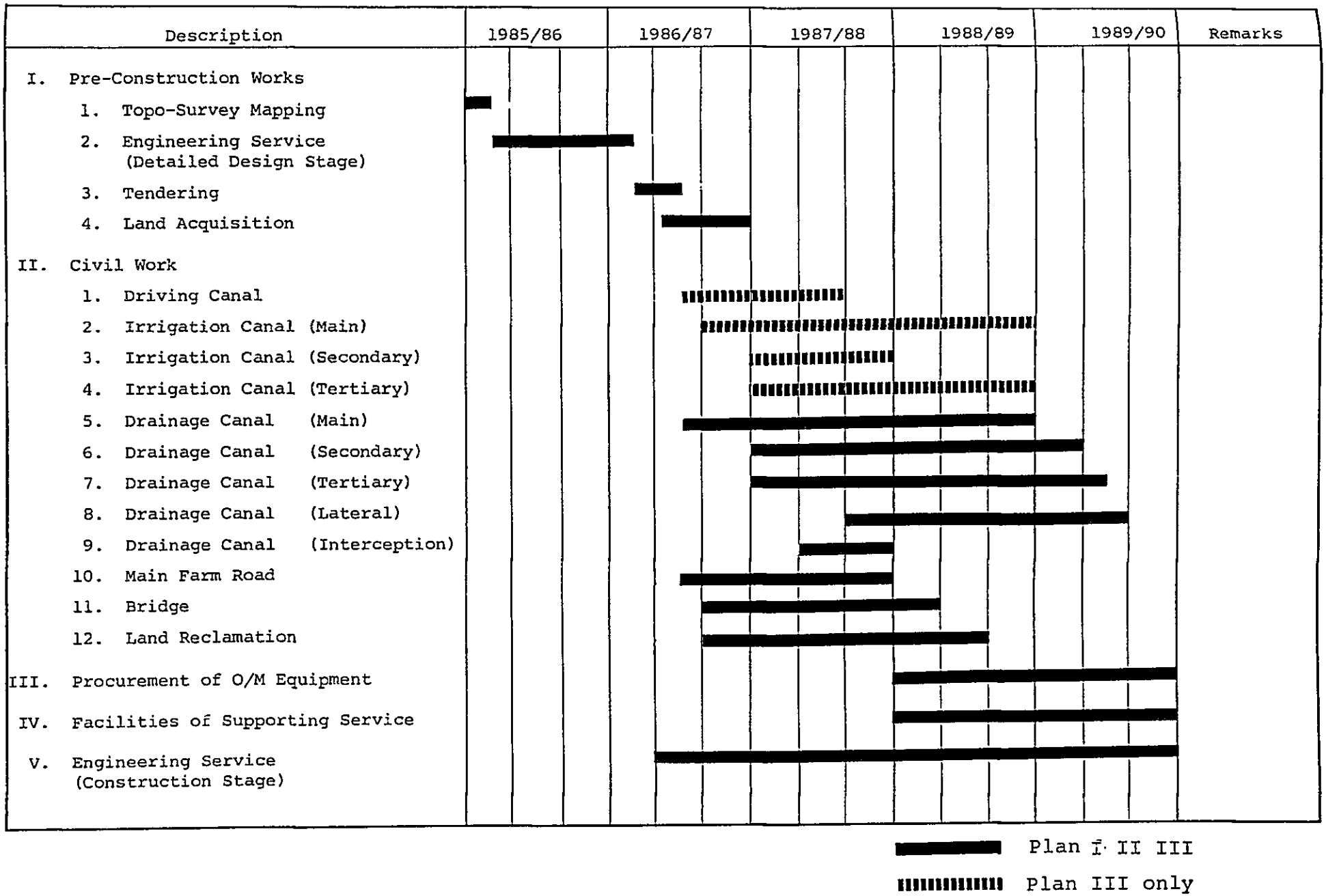
To assist the Colombian Officials concerned in design, preparation of tender documents, agricultural supporting services and supervision of the construction the consulting services are indispensable.

It should be commenced from the first project year. The consultants

personnel both foreign and local will render their services up to the completion of the project works.

The time schedule of respective work above-mentioned has been worked out based on the each basic conception, and proposed implementation program is shown in Fig. 7-1-1.

Fig. 7-1-1 Implementation Schedule



7.2 Cost Estimate

7.2.1 Construction Cost

(1) Condition

The construction cost is estimated based on the following condition:

1) Civil works are to be carried out on the contract basis following the current governmental policy.

2) Taxes on the construction materials to be imported from abroad are exempted from the estimate of construction cost.

3) The construction cost comprises foreign and local currency portions. The local currency portion is estimated based on the current prices in Colombia in July 1983 and the data collected from the on-going projects. The foreign currency portion is estimated based on the CIF prices at Barranquilla.

4) The classification of local and foreign currency portions is defined as follows:

1. Local currency portion
   - Labour
   - Reinforcement bar
   - Cement
   - 25% of fuel, oil, etc.
   - Inland transportation costs
   - Expenses of engineering services for local consultant, and
   - Minor works

2. Foreign currency portion
   - Depreciation costs for heavy equipment and cost of spare parts
   - Vehicles to be required for the construction supervision and O/M equipment for the project operation
   - 75% of fuel, oil, etc.
   - Expenses and fees of engineering services by foreign consultant.

5) In view of the preliminary stage for the cost estimate, 10% of direct costs as physical contingency is included in the construction costs. The price escalation; 8% per annum for the foreign currency portion (Table &-2-1) and 20% per annum for local currency portion, is also included in the construction costs.

6) The associated costs to be financed by the Government, such as the costs for strengthening the extention services, facilities of the water users' association, and improvement of the social infrastructures are not included in the estimate.

(2) Estimate of Construction Cost

Based on condition above-mentioned the total construction cost of the project by the plan are estimated as follows:

Construction Cost

(Unit : 10^3col$)

Item	Total	Foreign Currency	Local Currency	Remarks
Plan I	2,090,281	1,263,037	827,244	
Plan II	2,427,680	1,494,782	932,898	
Plan III	3,098,524	1,786,904	1,311,620	

The summary of construction cost, annual disbursement schedule and breakdown of the cost estimate are shown in Table 7-2-2 through Table 7-2-6.

7.2.2 Annual Operation and Maintenance Costs

The annual operation and maintenance costs include the materials and labor costs for repair and maintenance of project facilities, the costs for operation, repair and maintenance of O/M equipment. The summary of the annual operation and maintenance costs are shown in Table 7-2-13.

Table 7–2–1 Price Escalation for Foreign Currency

Country	Wholesale Price Escalation Rate (%)				Consumer Price Escalation Rate (%)			
	1980	1981	1982	Ave.	1980	1981	1982	Ave.
Japan	9.6	1.6	0.1	3.8	7.1	4.3	1.8	4.4
U.S.A.	12.3	5.6	1.6	6.5	12.4	8.9	3.9	8.4
W. Germany	6.9	8.1	3.6	6.2	5.4	6.3	4.6	5.4
France	7.7	13.4	8.2	9.8	13.7	14.0	9.7	12.5
England	12.7	11.5	8.0	10.7	15.1	12.0	5.4	10.8
Average	9.8	8.0	4.3	7.4	10.7	9.1	5.1	8.3
Price Escalation Rate	7.85 ≒ 8.0							

Source: Banco de Republica, July of 1983.

7.3 Terms of References

TERMS OF REFERENCES (Draft) for Engineering Services both Detailed Design and Construction stage are stated hereinafter. Fig. 7-3-1 through Fig. 7-3-4 show the assignment schedule and necessary Man-month of detailed design and construction supervision.

Table 7–2–2 Summary of Construction Cost (Plan I)

	Description	Foreign Currency 10^3 Col $	Local Currency 10^3 Col $	Total 10^3 Col $
I.	Preparatory Work	-	10,770	10,770
II.	Irrigation Canals	-	-	-
III.	Drainage Canals	423,289	176,922	600,211
IV.	Farm Road	18,415	64,588	83,003
V.	Bridge	72,674	82,942	155,616
VI.	Land Reclamation	55,620	12,955	68,575
	Sub-Total (I - VI)	569,998	348,177	918,175
VII.	O/M Equipment	57,184	-	57,184
VIII.	Supporting Service	-	750	750
IX.	Administration Cost	-	33,480	33,480
X.	Engineering Services	250,152	22,650	273,602
	Sub-Total (I - X)	878,134	405,057	1,283,191
XI.	Physical Contingency	87,813	40,505	128,318
	Sub-Total (I - XI)	965,947	445,562	1,411,509
XII.	Price Escalation	297,090	381,682	678,772
	Grand-Total	1,263,037	827,244	2,090,281

Table 7-2-3 Summary of Construction Cost (Plan II)

	Description	Foreign Currency 10^3 Col $	Local Currency 10^3 Col $	Total 10^3 Col $
I.	Preparatory Work	-	13,715	13,715
II.	Irrigation Canals	-	-	-
III.	Drainage Canals	570,082	224,805	794,887
IV.	Farm Road	18,415	64,588	83,003
V.	Bridge	72,674	82,942	155,616
VI.	Land Reclamation	55,620	12,955	68,575
	Sub-Total (I - VI)	716,791	399,005	1,115,796
VII.	O/M Equipment	70,320	-	70,320
VIII.	Supporting Service	-	750	750
IX.	Administration Cost	-	33,480	33,480
X.	Engineering Services	250,952	22,650	273,602
	Sub-Total (I - X)	1,038,063	455,885	1,493,948
XI.	Physical Contingency	103,806	45,588	149,394
	Sub-Total (I - XI)	1,141,869	501,473	1,643,342
XII.	Price Escalation	352,913	431,425	784,338
	Grand-Total	1,494,782	932,898	2,427,680

Table 7–2–4 Summary of Construction Cost (Plan III)

	Description	Foreign Currency 10^3 Col $	Local Currency 10^3 Col $	Total 10^3 Col $
I.	Preparatory Work	-	14,852	14,852
II.	Irrigation Canals	141,971	132,754	274,725
III.	Drainage Canals	597,675	273,432	871,107
IV.	Farm Road	18,415	64,588	83,003
V.	Bridge	72,674	82,942	155,616
VI.	Land Reclamation	55,620	12,955	68,575
	Sub-Total (I - VI)	886,355	581,523	1,467,878
VII.	O/M Equipment	91,768	-	91,768
VIII.	Supporting Service	-	6,000	6,000
IX.	Administration Cost	-	33,480	33,480
X.	Engineering Services	264,112	27,650	291,762
	Sub-Total (I - X)	1,242,235	648,653	1,890,888
XI.	Physical Contingency	124,223	64,865	189,088
	Sub-Total (I - XI)	1,366,458	713,518	2,079,976
XII.	Price Escalation	420,446	598,102	1,018,548
	Grand-Total	1,786,904	1,311,620	3,098,524

Table 7–2–5 Summary of Annual Disbursement Schedule

[10^3 COL$]

Project Year	Plan I				Plan II				Plan III			
	F/C	L/C	Total	Per-centage	F/C	L/C	Total	Per-centage	F/C	L/C	Total	Per-centage
1985/1986	49,407	11,479	60,886	2.9	49,407	11,479	60,886	2.5	49,407	11,479	60,886	2.0
1986/1987	147,426	94,068	241,494	11.6	163,209	104,234	267,443	11.0	208,931	190,179	399,110	12.9
1987/1988	390,458	337,993	728,451	34.8	488,916	380,658	869,574	35.8	596,031	525,820	1,121,851	36.2
1988/1989	439,763	259,882	699,645	33.5	517,960	296,142	814,102	33.5	620,150	408,880	1,029,030	33.2
1989/1990	235,983	123,822	359,805	17.2	275,290	140,385	415,675	17.2	312,385	175,262	487,647	15.7
Total	1,263,037	827,244	2,090,281	100.0	1,494,782	932,898	2,427,680	100.0	1,786,904	1,311,620	3,098,524	100.0

Description	Investment Cost			1st Year 1985/1986		2nd Year 1986/1987		3rd Year 1987/1988		4th Year 1988/1989		5th Year 1989/1990	
	F/C	L/C	Total	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
I. Preparatory Work		10,770	10,770				10,770						
II. Irrigation													
1. Driving Canal													
2. Main Canal													
3. Secondary Canal													
4. Tertiary Canal													
III. Drainage													
1. Main Canal	131,892	37,296	169,188			26,378	7,459	52,757	14,919	52,757	14,918		
2. Secondary Canal	48,706	38,920	87,626					21,917	17,514	21,918	17,514	4,871	3,892
3. Tertiary Canal	152,224	53,446	205,670					30,445	10,689	76,112	26,723	45,667	16,034
4. Lateral Canal	81,857	44,825	126,682					16,371	8,965	40,929	22,413	24,557	13,447
5. Interception Canal	8,610	2,435	11,045					8,610	2,435				
IV. Road													
1. Main Road	18,415	64,588	83,003			3,683	12,918	14,732	51,670				
V. Bridge	72,674	82,942	155,616			14,534	16,588	43,604	49,765	14,536	16,589		
VI. Land Reclamation	55,620	12,955	68,575			5,562	1,296	33,372	7,773	16,686	3,886		
Sub-Total (I - VI)	569,998	348,177	918,175			50,157	49,031	221,808	163,730	222,938	102,043	75,095	33,373
VII. O/M Equipment	57,184		57,184							28,592		28,592	
VIII. Supporting Service		750	750								375		375
IX. Administration Cost		33,480	33,480		6,696		6,696		6,696		6,696		6,696
X. Engineering Service	250,952	22,650	273,602	41,588	2,000	64,747	3,660	59,975	7,390	42,321	4,800	42,321	4,800
Sub-Total (I - X)	878,134	405,057	1,283,191	41,588	8,696	114,904	59,387	281,783	177,816	293,851	113,914	146,008	45,244
XI . Physical Contingency (10%)	87,813	40,505	128,318	4,159	870	11,490	5,938	28,178	17,782	29,385	11,391	14,601	4,524
Sub-Total (I - XI)	965,947	445,562	1,411,509	45,747	9,566	126,394	65,325	309,961	195,598	323,236	125,305	160,609	49,768
XII . Price Escalation	297,090	381,682	678,772	3,660	1,913	21,032	28,743	80,497	142,395	116,527	134,577	75,374	74,054
Grand Total	1,263,037	827,244	2,090,281	49,407	11,479	147,426	94,068	390,458	337,993	439,763	259,882	235,983	123,822
	60 %	40 %	100 %										

Table 7–2–7 Annual Disbursement Schedule (Plan II)

Unit: 10^3 Col$

Description	Investment Cost			1st Year 1985/1986		2nd Year 1986/1987		3rd Year 1987/1988		4th Year 1988/1989		5th Year 1989/1990	
	F/C	L/C	Total	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
I. Preparatory Work		13,715	13,715				13,715						
II. Irrigation													
1. Driving Canal													
2. Main Canal													
3. Secondary Canal													
4. Tertiary Canal													
III. Drainage													
1. Main Canal	217,143	61,361	278,504			38,678	10,931	110,614	31,253	67,851	19,177		
2. Secondary Canal	52,257	44,384	96,641					23,516	19,973	23,516	19,973	5,225	4,438
3. Tertiary Canal	199,007	66,653	265,660					39,801	13,331	99,504	33,327	59,702	19,995
4. Lateral Canal	93,065	49,972	143,037					18,613	9,995	46,533	24,986	27,919	14,991
5. Interception Canal	8,610	2,435	11,045					8,610	2,435				
IV. Road													
1. Main Road	18,415	64,588	83,003			3,683	12,918	14,732	51,670				
V. Bridge	72,674	82,942	155,616			14,535	16,589	43,605	49,765	14,534	16,588		
VI. Land Reclamation	55,620	12,955	68,575			5,562	1,296	33,372	7,773	16,686	3,886		
Sub-Total (I - VI)	716,791	399,005	1,115,796			62,458	55,449	292,863	186,195	268,624	117,937	92,846	39,424
VII. O/M Equipment	70,320		70,320							35,160		35,160	
VIII. Supporting Servuce		750	750								375		375
IX. Administration Cost		33,480	33,480		6,696		6,696		6,696		6,696		6,696
X. . Engineering Service	250,952	22,650	273,602	41,588	2,000	64,747	3,660	59,975	7,390	42,321	4,800	42,321	4,800
Sub-Total (I - X)	1,038,063	455,885	1,493,948	41,588	8,696	127,205	65,805	352,838	200,281	346,105	129,808	170,327	51,295
XI . Physical Contingency (10%)	103,806	45,588	149,394	4,159	870	12,720	6,580	35,283	20,028	34,610	12,980	17,034	5,130
Sub-Total (I - XI)	1,141,869	501,473	1,643,342	45,747	9,566	139,925	72,385	388,121	220,309	380,715	142,788	187,361	56,425
XII . Price Escalation	352,913	431,425	784,338	3,660	1,913	23,284	31,849	100,795	160,349	137,245	153,354	87,929	83,960
Grand Total	1,494,782	932,898	2,427,680	49,407	11,479	163,209	104,234	488,916	380,658	517,960	296,142	275,290	140,385
	62 %	38 %	100 %										

Description	Investment Cost			1st Year 1985/1986		2nd Year 1986/1987		3rd Year 1987/1988		4th Year 1988/1989		5th Year 1989/1990	
	F/C	L/C	Total	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
I. Preparatory Work		14,852	14,852				14,852						
II. Irrigation													
1. Driving Canal	33,185	53,823	87,008			26,548	43,058	6,637	10,765				
2. Main Canal	44,584	40,770	85,354			8,917	8,154	17,834	16,308	17,833	16,308		
3. Secondary Canal	20,202	25,361	45,563					20,202	25,361				
4. Tertiary Canal	44,000	12,800	56,800					22,000	6,400	22,000	6,400		
III. Drainage													
1. Main Canal	217,996	70,905	288,901			38,849	12,840	110,955	35,070	68,192	22,995		
2. Secondary Canal	50,956	59,918	110,874					22,930	26,963	22,931	26,963	5,095	5,992
3. Tertiary Canal	226,800	87,488	314,288					45,360	17,498	113,400	43,744	68,040	26,246
4. Lateral Canal	93,313	52,686	145,999					18,663	10,537	46,657	26,343	27,993	15,806
5. Interception Canal	8,610	2,435	11,045					8,610	2,435				
IV. Road													
1. Main Road	18,415	64,588	83,003			3,683	12,918	14,732	51,670				
V. Bridge	72,674	82,942	155,616			14,535	16,589	43,605	49,765	14,534	16,588		
VI. Land Reclamation	55,620	12,955	68,575			5,562	1,296	33,372	7,773	16,686	3,886		
Sub-Total (I - VI)	886,355	581,523	1,467,878			98,094	109,707	364,900	260,545	322,233	163,227	101,128	48,044
VII. O/M Equipment	91,768		91,768							45,884		45,884	
VIII. Supporting Service		6,000	6,000								3,000		3,000
IX. Administration Cost		33,480	33,480		6,696		6,696		6,696		6,696		6,696
X. Engineering Service	264,112	27,650	291,762	41,588	2,000	64,747	3,660	65,239	9,390	46,269	6,300	46,269	6,300
Sub-Total (I - X)	1,242,235	648,653	1,890,888	41,588	8,696	162,841	120,063	430,139	276,631	414,386	179,223	193,281	64,040
XI. Physical Contingency (10%)	124,223	64,865	189,088	4,159	870	16,284	12,006	43,014	27,663	41,439	17,923	19,327	6,403
Sub-Total (I - XI)	1,366,458	713,518	2,079,976	45,747	9,566	179,125	132,069	473,153	304,294	455,825	197,146	212,608	70,443
XII. Price Escalation	420,446	598,102	1,018,548	3,660	1,913	29,806	58,110	122,878	221,526	164,325	211,734	99,777	104,819
Grand Total	1,786,904	1,311,620	3,098,524	49,407	11,479	208,931	190,179	596,031	525,820	620,150	408,880	312.385	175,262
	58 %	42 %	100 %										

Table 7–2–9 Bill of Quantity (1)

Works	Description	Unit	QUANTITY		
			PLAN I	PLAN II	PLAN III
1. Preparatory Works					
1-1 Land Acquisition		ha	215.4	274.3	297.04
2. Irrigation Canal			---	---	
2-1 Driving Canal			---	---	
(1) Excavation		m^3	---	---	120,849.0
(2) Earthfill		m^3	---	---	84,139.0
2-1-1 Related Structures					
(1) Siphon (A)	ℓ = 180, ø2,000	Unit	---	---	1.0
(2) Siphon (B)	ℓ = 320, ø2,000	Unit	---	---	1.0
(3) Cross Culvert	ℓ = 8	Unit	---	---	1.0
2-2 Main Canal					
(1) Excavation		m^3	---	---	169,935.0
(2) Earthfill		m^3	---	---	150,826.0
2-2-1 Related Structures					
(1) Siphon (C)	ℓ = 250	Unit	---	---	1.0
(2) Diversion Works		Unit	---	---	1.0
(3) Shute		Unit	---	---	1.0
(4) Drop Structure		Unit	---	---	2.0
(5) Check gate		Unit	---	---	7.0
(6) Wasteway		Unit	---	---	1.0
2-3 Secondary Canal					
(1) Excavation		m^3	---	---	24,036.0
(2) Earthfill		m^3	---	---	135,945.0
2-3-1 Related Structures					
(1) Turnout		Unit	---	---	20.0
(2) Cross Culvert		Unit	---	---	196.0

Bill of Quantity (2)

Works	Description	Unit	QUANTITY		
			PLAN I	PLAN II	PLAN III
2-4 Tertiary Canal					
(1) Earthfill		m^3	---	---	433,740.0
2-4-1 Related Structures					
(1) Stop log		Unit	---	---	196
3. Drainage Canal					
3-1 Main					
(1) Excavation		m^3	819,040.0	1,082,273.0	1,082.273.0
(2) Earthfill		m^3	119,343.0	109,369.0	109,369.0
3-1-1 Related Structures					
(1) Drop Structure	TYPE V	Unit	---	---	7.0
(2) Culvert		Unit	---	---	2.0
3-2 Secondary					
(1) Excavation		m^3	253,650.0	274,806.0	274,806.0
(2) Earthfill		m^3	92,506.0	92,506.0	64,718.0
3-2-1 Related Structures					
(1) Drop Structure		Unit	40.0	49.0	49.0
(2) Culvert		Unit	---	---	7.0
3-3 Lateral					
(1) Excavation		m^3	455,904.8	530,817.5	530,817.5
(2) Earthfill		m^3	132,762.0	132,762.0	132,762.0
3-3-1 Related Structures					
(1) Drop Structure		Unit	13.0	13.0	13.0
(2) Culvert		Unit	130.0	130.0	150.0
3-4 Tertiary					
(1) Excavation		m^3	690,000.0	1,008,250.0	1,363,250.0
(2) Earthfill		m^3	517,500.0	517,500.0	251,250.0
3-4-1 Related Structures					
(1) Culvert		Unit	70.0	70.0	160.0

Bill of Quantity (3)

Works	Description	Unit	QUANTITY		
			PLAN I	PLAN II	PLAN III
3-5 Interception					
(1) Excavation		m^3	56,853.0	56,853.0	56,853.0
3-6 Catch Drain					
(1) Excavation		m^3	---	317,700.0	317,700.0
(2) Earthfill		m^3	---	3,563.0	3,563.0
4. Main Road	B = 6.5 km				
(1) Earthfill		m^3	135,400.0	135,400.0	135,400.0
(2) Basement		m^2	119,625.0	119,625.0	119,625.0
(3) Pavement	5.0 km	m^2	27,500.0	27,500.0	27,500.0
5. Bridge					
(1) Type I	ℓ=100, B=6.0	Unit	1.0	1.0	1.0
(2) Type II	ℓ=15, B=4.0	Unit	18.0	18.0	18.0
(3) Type III	ℓ=10, B=4.0	Unit	32.0	32.0	32.0
(4) Type IV	ℓ=7, B=4.0	Unit	46.0	46.0	46.0
6. Land Reclamation		ha	900.0	900.0	900.0
7. O/M Equipment		Unit			
(1) Bulldozer	15 t, 141 HP	Unit	1.0	1.0	1.0
(2) Back Hoe	0.6 m^3, 102 HP	Unit	1.0	1.0	2.0
(3) Motor Grade	3.7 m, 130 HP	Unit	1.0	1.0	1.0
(4) Drag Line	0.6-0.0 m^3 105 HP	Unit	1.0	2.0	2.0
(5) Damp Truck	8 t	Unit	2.0	2.0	4.0
8. Supporting Service					
(1) Staff Quarter		m^2	---	---	200.0
(2) Motor Pool		m^2	150.0	150.0	600.0

Table 7–2–10 Breakdown of Construction Costs for Plan I

Preparatory Works

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Land Acquisition								
(1) Drainage Canal	ha	202.1			50,000.0	10,105,000.0	10,105,000.0	
(2) Road	ha	13.30			50,000.0	665,000.0	665,000.0	
Total							10,770,000.0	

Main Drainage Canal

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	819,040	147.0	120,398,880.0	41.5	33,990,160.0	154,389,040.0	
2. Earthfill	m^3	119,343	96.3	11,442,730.9	27.7	3,305,801.1	14,798,532.0	
Sub-total				131,891,610.9		37,295,961.0	169,187,571.9	
Miscellaneous	L.S.			589.1		39.0	428.1	
Total				131,892,000.0		37,296,000.0	169,188,000.0	

Secondary Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	253,650.0	147.0	37,286,550.0	41.5	20,526,475.0	47,813,025.0	
2. Earthfill	m^3	92,506.0	96.3	8,908,327.8	27.7	2,562,416.2	11,470,744.0	
3. Drop Structure								49 Units
Reinforced Concrete	m^3	1,993.4	1,159.9	2,312,144.6	12,682.3	25,280,896.8	27,593,041.4	
Levelling Concrete	m^3	160.0	1,243.5	198,960.0	3,435.8	549,728.0	748,688.0	
Sub-total				48,705,982.4		38,919,516.0	87,625,498.4	
4. Miscellaneous	L.S.			17.6		484.0	501.6	
Total				48,706,000.0		38,920,000.0	87,626,000.0	

Tertiary Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	690,000.0	147.0	101,430,000.0	41.5	28,635,000.0	130,065,000.0	
2. Earthfill	m^3	517,500.0	96.3	49,835,250.0	27.7	14,334,750.0	64,170,000.0	
3. Box Culvert								
Reinforced Concrete	m^3	826.0		958,077.4	12,682.3	10,475,579.8	11,433,657.2	
Sub-total				152,223,327.4		53,445,329.8	205,668,657.2	
4. Miscellaneous	L.S.			672.6		670.2	1,342.8	
Total				152,224,000.0		53,446,000.0	205,670,000.0	

Lateral

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	455,904.8	147.0	67,018,005.6	41.5	18,920,049.2	85,938,054.8	
2. Earthfill	m^3	132,762.0	96.3	12,784,980.6	27.7	3,677,507.4	16,462,488.0	
3. Drop Structure								
Reinforced Concrete	m^3	355.5	1,159.9	412,344.4	12,682.3	4,508,557.6	4,920,902.0	
Levelling Concrete	m^3	22.5	1,243.5	27,978.7	3,435.8	77,305.5	105,284.2	13 Units
4. Culvert								
Reinforced Concrete	m^3	1,391.0	1,159.9	1,613,420.9	12,682.3	17,641,079.3	19,254,500.2	
Sub-total				81,856,730.2		44,824,499.0	126,681,229.2	
5. Miscellaneous	L.S.			269.8		501.0	770.8	
Total				81,857,000.0		44,825,000.0	126,682,000.0	

Interception Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	56,853.0	147.0	8,357,391.0	41.5	2,359,399.5	10,716,790.5	
2. O.H.	L.S.			250,721.7		70,781.9	321,503.6	3%
Sub-total				8,608,112.7		2,430,181.4	11,038,294.1	
3. Miscellaneous	L.S.			1,887.3		4,818.6	6,705.9	
Total				8,610,000.0		2,435,000.0	11,045,000.0	

Road Works

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Earthfill	m^3	135,400.0	110.2	14,922,182.0	27.6	3,737,316.0	18,659,498.0	
2 Subgrad Course	m^2	92,125.0	16.5	1,520,062.5	259.0	23,860,375.0	25,380,437.5	
Sub-total				16,442,244.5		27,597,691.0	44,039,935.5	
3 O.H.	L.S.			822,112.2		1,379,884.5	2,201,996.7	5%
Sub-total				17,264,356.7		28,977,575.5	46,241,932.2	
4 Miscellaneous	L.S.			643.3		424.5	1,067.8	
Total				17,265,000.0		28,978,000.0	46,243,000.0	

Asphalt Pavement (5.0 km)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1 Subgrad Course	m^2	27,500.0	16.5	453,750.0	259.5	7,136,250.0	7,590,000.0	t = 0.2
2 Pavement	m^2	27,500	23.3	640,750.0	973.7	26,776,750.0	27,417,500.0	
Sub-total				1,094,500.0		33,913,000.0	35,007,500.0	
3. O.H.	L.S.			54,725.0		1,695,650.0	1,750,375.0	
Sub-total				1,149,225.0		35,608,650.0	36,757,875.0	
4. Miscellaneous	L.S.			775.0		1,350.0	2,125.0	
Total				1,150,000.0		35,610,000.0	36,760,000.0	

Bridge Type I (1) ℓ= 100 m, B = 6.0 m

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
Reinforced Concrete	m^3	157.76	1,159.9	182,985.8	12,682.2	2,000,743.8	2,183.729.6	
Concrete for Pavement	m^3	29.92	1,159.9	34,704.2	7,270.3	217,527.3	252,231.5	
Structural Steel	t	136.14	74,800.0	10,183,272.0		-----	10,183,272.0	
Painting	m^2	1,290.42		-----	25.0	32,260.5	32,260.5	
Guard Rail	t	5.02	233,100.0	1,170,162.0		-----	1,170,162.0	
2. Substructure								
Reinforced Concrete	m^3	258.4	1,159.9	299,718.1	12,682.1	3,277,080.4	3,576,798.5	
Levelling Concrete	m^3	16.16	1,243.5	10,094.9	3,435.8	55,522.5	75,617.4	
Cobble Stone	m^3	32.34		-----	2,200.0	71,148.0	71,148.0	
Excavation	m^3	846.24	141.8	119,996.8	61.9	52,382.2	172,379.0	
Surplus Soil	m^3	206.72	154.6	31,958.9	57.3	11,845.0	43,803.9	
Gabion	m^3	450.0		-----	3,500.0	1,575,000.0	1,575,000.0	
Sub-total				12,042,892.7		7,261,249.2	19,336,402.4	

Bridge Type I (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
3. Temporary Works	L.S.			4,817,157.0				40%
Sub-total				16,860,049.7		7,261,249.2	24,121,298.9	
4. O.H.	L.S.			1,686,004.9		726,124.9	2,412,129.3	10%
Sub-total				18,546,054.6		7,987,374.1	26,533,428.7	
5. Miscellaneous	L.S.			3,945.4		12,625.9	16,571.3	
Total				18,550,000.0		8,000,000.0	26,550,000.0	

Bridge Type II (1) ℓ = 15 m, B = 4.0

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Reinforced Concrete	m^3	16.73	1,159.9	19,405.1	12,682.2	212,173.2	231,578.3	
(2) Concrete for Pavement	m^3	2.96	1,159.9	3,433.3	7,270.3	21,520.0	24,953.3	
(3) Structural Steel	t	7.10	74,800.0	538,180.0	---	---	538,180.0	
(4) Guard Rail	t	0.50	233,100.0	116,550.0	---	---	116,550.0	
(5) Painting	m^2	89.80			25.0	2,245.0	2,245.0	
2. Substructure								
(1) Reinforced Concrete	m^3	56.40	1,159.9	65,418.3	12,682.2	715,276.0	780,694.3	
(2) Levelling Concrete	m^3	4.74	1,243.5	5,894.1	3,435.8	16,285.6	22,179.7	
(3) Cobble Stone	m^3	9.48			2,200.0	20,856.0	20,856.0	
(4) Excavation	m^3	257.34	141.8	36,490.8	61.9	15,929.3	52,420.1	
(5) Surplus Soil	m^3	56.64	154.6	8,756.5	57.3	3,245.4	12,001.9	
Sub-total				794,128.1		1,007,530.5	1,801,658.6	
3. O.H.	L.S.			79,412.8		100,753.0	180,165.8	10%
Sub-total				873,540.9		1,108,283.5	1,981,824.4	

Bridge Type II (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
(4) Miscellaneous	L.S.			1,459.1		1,716.5	3,175.6	
Total				875,000.0		1,110,000.0	1,985,000.0	
18 units				15,750,000.0		19,980,000.0	35,730,000.0	

Bridge Type III (1) ℓ = 10, B = 4

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Reinforced Concrete	m^3	11.04	1,159.9	12,805.2	12,682.2	140,011.4	152,816.6	
(2) Concrete for Pavement	m^3	1.95	1,159.9	2,261.8	7,270.3	14,177.0	16,438.8	
(3) Structural Steel	t	4.68	74,800.0	350,064.0		---	350,064.0	
(4) Guard Rail	t	0.33	233,100.0	76,923.0		---	76,923.0	
2. Substructure								
(1) Reinforced Concrete	m^3	37.20	1,159.9	43,148.2	12,682.2	471,777.8	514,926.0	
(2) Levelling Concrete	m^3	3.13	1,243.5	3,892.1	3,435.8	10,754.0	14,646.1	
(3) Cobble Stone	m^3	6.25			2,200.0	13,750.0	13,750.0	
(4) Excavation	m^3	169.80	141.8	24,077.6	61.9	10,510.6	34,588.2	
(5) Surplus Soil	m^3	37.40	154.6	5,782.0	57.3	2,143.0	7,925.0	
Sub-total				518,953.9		663,123.8	1,182,077.7	
3. O.H.	L.S.			51,895.3		66,312.3	118,207.6	10%
Sub-total				570,849.2		729,436.1	1,300,285.3	

Bridge Type III (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous	L.S.			150.8		536.9	714.7	
Total				571,000.0		730,000.0	1,301,000.0	
32 Units				18,272,000.0		23,360,000.0	41,632,000.0	

Bridge Type IV (1) ℓ = 7, B = 4

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1 Superstructure								
(1) Reinforced Concrete	m^3	8.30	1,159.9	9,627.1	12,682.2	105,262.2	114,889.3	
(2) Concrete for Pavement	m^3	1.40	1,159.9	1,623.8	7,270.3	10,178.4	11,802.2	
(3) Structural Steel	t	3.50	74,800.0	261,800.0			261,800.0	
(4) Guard Rail	t	0.20	233,100.0	46,620.0			46,620.0	
2. Substructure				76,899.9		508,935.4	585,835.3	
(1) Reinforced Concrete	m^3	37.20	1,159.9	43,148.2	12,682.2	471,777.8	514,926.0	
(2) Levelling Concrete	m^3	3.13	1,243.5	3,892.1	3,345.8	10,754.0	14,646.1	
(3) Cobble Stone	m^3	6.25			2,200.0	13,750.0	13,750.0	
(4) Excavation	m^3	169.80	141.8	24,077.6	61.9	10,510.6	34,588.2	
(5) Surplus Soil	m^3	37.40	154.6	5,782.0	57.3	2,143.0	7,925.0	
Sub-total				396,570.8		624,376.0	585,835.3	
3. O.H.				39,657.0		62,437.6	102,094.6	10%
Sub-total				436,227.8		686,813.6	1,123,041.4	

Bridge Type IV (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous				772.2		186.4	958.6	
Total				437,000.0		687,000.0	1,124,000.0	
46 Units				20,102,000.0		31,602,000.0	51,704,000.0	

Land Reclamation

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Land Reclamation	ha	900.0	59,999.3	53,999,370.0	13,975.0	12,577,500.0	66,576,870.0	
2. O.H.	L.S.			1,619,981.1		377,325.0	1,997,306.1	
Sub-total				55,619,351.1		12,954,825.0	68,574,176.1	
3. Miscellaneous	L.S.			648.9		175.0	823.9	
Total				55,620,000.0		12,955,000.0	68,575,000.0	

O/M Equipment

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Bulldozer	Unit	1	13,128,000.0	13,128,000.0			13,128,000.0	15 t, 141 HP
2. Back Hoe	Unit	1	10,008,000.0	10,008,000.0			10,008,000.0	0.6 m^3, 102 HP
3. Motor Grader	Unit	1	9,472,000.0	9,472,000.0			9,472,000.0	3.7 m^3 130 HP
4. Drag Line	Unit	1	13,136,000.0	13,136,000.0			13,136,000.0	0.6-0.8m^3 105 HP
5. Damp Truck	Unit	2	5,720,000.0	11,440,000.0			11,440,000.0	8 t
Total				57,184,000.0			57,184,000.0	

Supporting Service

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Motor Pool	m^2	150			5,000.0	750,000.0	750,000.0	

Administration Cost

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Project Director	M/M	60.0			60,000.0	3,600,000.0	3,600,000 0	1 man x 60 M
2. Staff	M/M	600.0			45,000.0	27,000,000.0	27,000,000.0	10 men x 60 M
3. Driver	M/M	180.0			15,000.0	2,700,000.0	2,700,000.0	3 men x 60 M
4. Postage	L.S.					180,000.0	180,000.0	
Total						33,480,000.0	33,480,000.0	

Engineering Service

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Survey	km^2	100	200,000.0	20,000,000.0			20,000,000.0	
2. Detailed Design	L.S.			83,930,000.0		5,525,000.0	89,755,000.0	
3. Supervision	L.S.			147,022,000.0		16,825,000.0	163,847,000.0	
Total				250,952,000.0		22,650,000.0	273,602,000.0	

Table 7–2–11 Breakdown of Construction Costs for Plan II

Preparatory Works

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Land Acquisition								
(1) Drainage Canal	ha	261.00			50,000.0	13,050,000.0	13,050,000.0	
(2) Road	ha	13.30			50,000.0	665,000.0	665,000.0	
Total							13,715,000.0	

Main Drainage Canal

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	1,399,973	147.0	205,796,031.0	41.5	58,098,879.5	263,894,910.5	
2. Earthfill	m^3	112,932	96.3	10,875,351.6	27.7	3,128,216.4	14,003,568.0	
Sub-total				216,671,382.6		61,227,095.9	277,898,478.5	
3. Miscellaneous	L.S.			471,617.4		133,904.1	605,521.5	
Total				217,143,000.0		61,361,000.0	278,504,000.0	

Secondary Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	274,806.0	147.0	40,396,482.0	41.5	11,404,449.0	51,800,931.0	
2. Earthfill	m^3	92,506.0	96.3	8,908,327.8	27.7	2,562,416.2	11,470,744.0	
3. Drop Structure								49 Units
(1) Reinforced Concrete	m^3	2,348.9	1,159.9	2,724,489.1	12,682.3	29,789,454.4	32,513,943.5	
(2) Levelling Concrete	m^3	182.5	1,243.5	226,938.7	3,435.8	627,033.5	853,972.2	
Sub-total				52,256,237.6		44,383,353.1	96,639,590.7	
4. Miscellaneous	L.S.			762.4		646.9	1,409.3	
Total				52,257,000.0		44,384,000.0	96,641,000.0	

Tertiary Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	1,008,250	147.0	148,212,750.0	41.5	41,842,375.0	190,055,125.0	
2. Earthfill	m^3	517,500	96.3	49,835,250.0	27.7	14,334,750.0	64,170,000.0	
3. Box Culvert								
Reinforced Concrete	m^3	826	1,159.9	958,077.4	12,682.3	10,475,579.8	11,433,657.2	
Sub-total				199,006,077.4		66,652,704.8	265,658,782.2	
4. Miscellaneous	L.S.			922.6		295.2	1,217.8	
Total				199,007,000.0		66,653,000.0	265,660,000.0	

Lateral Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	530,817.5	147.0	78,030,172.5	41.5	22,028,926.2	100,059,098.7	
2. Earthfill	m^3	132,762.0	96.3	12,784,980.6	27.7	3,677,507.4	16,462,488.0	
3. Drop Structure								13 Units
(1) Reinforced Concrete	m^3	513.5	1,159.9	595,608.6	12,682.3	6,512,361.0	7,107,969.6	
(2) Levelling Concrete	m^3	32.5	1,243.5	40,413.7	3,435.8	111,663.5	152,077.2	
4. Culvert								
(1) Reinforced Concrete	m^3	1,391.0	1,159.9	1,613,420.9	12,682.3	17,641,079.3	19,254,500.2	
Sub-total				93,064,596.3		49,971,537.4	143,036,133.7	
5. Miscellaneous	L.S.			403.7		462.6	866.3	
Total				93,065,000.0		49,972,000.0	143,037,000.0	

Interception Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	56,853.0	147.0	8,357,391.0	41.5	2,359,399.5	10,716,790.5	
2. O.H.	L.S.			250,721.7		70,781.9	321,503.6	3%
Sub-total				8,608,112.7		2,430,181.4	11,038,294.1	
3. Miscellaneous	L.S.			1,887.3		4,818.6	6,705.9	
Total				8,610,000.0		2,435,000.0	11,045,000.0	

Main Farm Road

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Earthfill	m^3	135,400.0	110.2	14,922,182.0	27.6	3,737,316.0	18,659,498.0	
2. Subgrade Course	m^2	92,125.0	16.5	1,520,062.5	259.0	23,860,375.0	25,380,437.5	
Sub-total				16,442,244.5		27,597,691.0	44,039,935.5	
3. O.H.	L.S.			822,112.2		1,379,884.5	2,201,996.7	5%
Sub-total				17,264,356.7		28,977,575.5	46,241,932.2	
4. Miscellaneous	L.S.			643.3		424.5	1,067.8	
Total				17,265,000.0		28,978,000.0	46,243,000.0	

Asphalt Pavement (5.0 km)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Subgrade Course	m^2	27,500.0	16.5	453,750.0	259.5	7,136,250.0	7,590,000.0	0.2 thick
2. Pavement	m^2	27,500.0	23.3	640,750.0	973.7	26,776,750.0	27,417,500.0	
Sub-total				1,094,500.0		33,913,000.0	35,007,500.0	
3. O.H.	L.S.			54,725.0		1,695,650.0	1,750,375.0	
Sub-total				1,149,225.0		35,608,650.0	36,757,875.0	
4. Miscellaneous	L.S.			775.0		1,350.0	2,125.0	
Total				1,150,000.0		35,610,000.0	36,760,000.0	

Bridge Type I (1) ℓ = 100 m, B = 6.0 m

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
Reinforced Concrete	m^3	157.76	1,159.9	182,985.8	12,682.2	2,000,743.8	2,183,729.6	
Concrete for Pavement	m^3	29.92	1,159.9	34,704.2	7,270.3	217,527.3	252,231.5	
Structural Steel	t	136.14	74,800.0	10,183,272.0			10,183,272.0	
Printing	m^2	1,290.42			25.0	32,260.5	32,260.5	
Guard Rail	t	5.02	233,100.0	1,170,162.0			1,170,162.0	
2. Substructure								
Reinforced Concrete	m^3	258.40	1,159.9	299,718.1	12,682.2	3,277,080.4	3,576,798.5	
Levelling Concrete	m^3	16.16	1,243.5	20,094.9	3,435.8	55,522.5	75,617.4	
Cobble Stone	m^3	32.34			2,200.0	71,148.0	71,148.0	
Excavation	m^3	846.24	141.8	119,996.8	61.9	52,382.2	172,379.0	
Surplus Soil	m^3	206.72	154.6	31,958.9	57.3	11,845.0	43,803.9	
Gabion	m^3	450.00			3,500.0	1,575,000.0	1,575,000.0	
Sub-total				12,042,892.7		7,261,249.2	19,336,402.4	
3. Temporary Works	L.S.			4,817,157.0				40%
Sub-total				16,860,049.7		7,261,249.2	24,121,298.9	

Bridge Type I (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. O.H.	L.S.			1,686,004.9		726,124.9	2,412,129.8	10%
Sub-total				18,546,054.6		7,987,374.1	26,533,428.7	
5. Miscellaneous	L.S.							
Total				18,550,000.0		8,000,000.0	26,550,000.0	

Bridge Type II (1) ℓ = 15 m, B = 4.0

(Unit. COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Concrete (Reinforced)	m^3	16.73	1,159.9	19,405.1	12,682.2	212,173.2	231,578.3	
(2) Concrete for Pavement	m^3	2.96	1,159.9	3,433.3	7,270.3	21,520.0	24,953.3	
(3) Structural Steel	t	7.10	74,800.0	528,180.0			538,180.0	
(4) Guard Rail	t	0.50	233,100.0	116,550.0			116,550.0	
(5) Printing	m^2	89.80			25.0	2,245.0	2,245.0	
2. Substructure								
(1) Concrete (Reinforced)	m^3	56.40	1,159.9	65,418.3	12,682.2	715,276.0	780,694.3	
(2) Levelling Concrete	m^3	4.74	1,243.5	5,894.1	3,435.8	16,285.6	22,179.7	
(3) Cobble Stone	m^3	9.48			2,200.0	20,856.0	20,856.0	
(4) Excavation	m^3	257.34	141.3	36,480.8	61.9	15,929.3	52,420.1	
(5) Surplus Soil	m^3	56.64	154.6	8,756.5	57.3	3,245.4	12,001.9	
Sub-total				794,128.1		1,007,530.5	1,801,658.6	
3. O.H.	L.S.			79,412.8		100,753.0	180,165.8	10%
Sub-total				873,540.9		1,108,283.5	1,981,824.4	

Bridge Type II (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous	L.S.			1,459.1		1,716.5	3,175.6	
Total				875,000.0		1,110,000.0	1,985,000.0	
18 Units				15,750,000.0		19,980,000.0	35,730,000.0	

Bridge Type III (1) ℓ = 10, B = 4

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Reinforced Concrete	m^3	11.04	1,159.9	12,805.2	12,682.2	140,011.4	125,816.6	
(2) Concrete for Pavement	m^3	1.95	1,159.9	2,261.8	7,270.3	14,177.0	16,438.8	
(3) Structural Steel	t	4.68	74,800.0	350,064.0			350,064.0	
(4) Guard Rail	t	0.33	233,100.0	76,923.0			76,923.0	
2. Substructure								
(1) Reinforced Concrete	m^3	37.20	1,159.9	43,148.2	12,682.2	471,777.8	514,926.0	
(2) Levelling Concrete	m^3	3.13	1,243.5	3,892.1	3,435.8	10,754.0	14,646.1	
(3) Cobble Stone	m^3	6.25			2,200.0	13,750.0	13,750.0	
(4) Excavation	m^3	169.80	141.8	24,077.6	61.9	10,510.6	34,588.2	
(5) Surplus Soil	m^3	37.40	154.6	5,782.0	57.3	2,143.0	7,925.0	
Sub-total				518,953.9		663,123.8	1,182,077.7	
3. O.H.	L.S.			51,895.3		66,312.3	118,207.6	10%
Sub-total				570,849.2		729,436.1	1,300,285.3	
Substructure Total				76,899.9		508,935.4	585,835.3	

Bridge Type III (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous	L.S.			150.8		536.9	714.7	
Total				571,000.0		730,000.0	1,301,000.0	
32 Units				18,272,000.0		23,360,000.0	41,632,000.0	

Bridge Type IV (1) ℓ = 7, B = 4

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Reinforced Concrete	m^3	8.30	1,159.9	9,627.1	12,682.2	105,262.2	114,889.3	
(2) Concrete for Pavement	m^3	1.40	1,159.9	1,623.8	7,270.3	10,178.4	11,802.2	
(3) Structural Steel	t	3.50	74,800.0	261,800.0			261,800.0	
(4) Guard Rail	t	0.20	233,100.0	46,620.0			46,620.0	
2. Substructure								
(1) Reinforced Concrete	m^3	37.20	1,159.9	43,148.2	12,682.2	471,777.8	514,926.0	
(2) Levelling Concrete	m^3	3.13	1,243.5	3,892.1	3,435.8	10,754.0	14,646.1	
(3) Cobble Stone	m^3	6.25			2,200.0	13,750.0	13,750.0	
(4) Excavation	m^3	169.80	141.8	24,077.6	61.9	10,510.6	34,588.2	
(5) Surplus Soil	m^3	37.40	154.6	5,782.0	57.3	2,143.0	7,925.0	
Sub-total				396,570.8		624,376.0	1,123,041.4	
3. O.H.				39,657.0		62,437.6	102,094.6	10%
Sub-total				436,227.8		686,813.6	1,123,041.4	

Bridge Type IV (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous				772.2		186.4	958.6	
Total				437,000.0		687,000.0	1,124,000.0	
46 Units				20,102,000.0		31,602,000.0	51,704,000.0	

Land Reclamation

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Land Reclamation	ha	900.0	59,993.3	53,999,370.0	13,975.0	12,577,500.0	66,576,870.0	
2. O.H.	L.S.			1,619,981.1		377,325.0	1,997,306.1	
Sub-total				55,619,351.1		12,954,825.0	68,574,176.1	
3. Miscellaneous	L.S.			648.9		175.0	823.9	
Total				55,620,000.0		12,955,000.0	68,575,000.0	

O/M Equipment

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Bulldozer	Unit	1	13,128,000	13,128,000.0		---	13,128,000.0	15 t, 141 HP
2. Back Hoe	Unit	1	10,008,000	10,008,000.0		---	10,008,000.0	0.6 m^3, 102 HP
3. Motor Grader	Unit	1	9,472,000	9,472,000.0		---	9,472,000.0	3.7 m, 130 HP
4. Drag Line	Unit	2	13,136,000	26,272,000.0		---	26,272,000.0	0.6-0.8m^3 105 HP
5. Damp Truck	Unit	2	5,720,000	11,440,000.0		---	11,440,000.0	8 t
Total				70,320,000.0		---	70,320,000.0	

Supporting Service

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
Motor Pool	m^2	150		---	5,000.0	750,000.0	750,000.0	

Administration Cost

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Project Director	M/M	60.0		---	60,000.0	3,600,000.0	3,600,000.0	1 man x 60 M
2. Staff	M/M	600.0		---	45,000.0	27,000,000.0	27,000,000.0	10 men x 60 M
3. Driver	M/M	180.0		---	15,000.0	2,700,000.0	2,700,000.0	3 men x 60 M
4. Postage	L.S.			---		180,000.0	180,000.0	
Total						33,480,000.0	33,480,000.0	

Engineering Service

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Survey	km^2	100	200,000.0	20,000,000.0			20,000,000.0	
2. Detailed Design	L.S.			83,930,000.0		5,825,000.0	89,755,000.0	
3. Supervision	L.S.			147,022,000.0		16,825,000.0	163,847,000.0	
Total				250,952,000.0		22,650,000.0	273,602,000.0	

Table 7–2–12 Breakdown of Construction Costs for Plan III

Preparatory Work

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Land Acquisition								
(1) Irrigation Canal	ha	37.04			50,000.0	1,852,000.0	1,852,000.0	
(2) Drainage Canal	ha	246.70			50,000.0	12,335,000.0	12,335,000.0	
(3) Road	ha	13.30			50,000.0	665,000.0	665,000.0	
Total						14,852,000.0	14,852,000.0	

Driving Canal (1)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	120,849.00	141.8	17,136,388.2	61.9	7,480,553.1	24,616,941.3	
2. Earthfill	m^3	84,139.00	110.2	9,272,117.8	27.6	2,332,236.4	11,594,354.2	
3. Related Structure								
(1) Shiphon (A)								
Concrete Pipe	m	180.00			20,100.0	3,618,000.0	3,618,000.0	ℓ=180.0
Levelling Concrete	m^3	556.20	1,243.5	69,163.4	3,435.8	191,099.1	260,262.5	Class F
Reinforced Concrete	m^3	814.03	1,159.9	944,193.3	12,682.3	10,323,772.6	11,267,965.9	Class C
Concrete	m^3							
(2) Siphon (B)		59.40	1,159.9	68,898.0	7,270.3	431,855.8	500,753.8	
Concrete Pipe	m	320.00			20,100.0	6,432,000.0	6,432,000.0	ℓ=320.0
Levelling Concrete	m^3	98.88	1,243.5	122,957.2	3,435.8	339,731.9	462,689.1	Class F
Reinforced Concrete	m^3	1,447.16	1,159.9	1,678,560.8	12,682.3	18,353,317.2	20,031,878.0	Class C
Concrete	m^3	59.40	1,159.9	68,898.0	2,270.3	431,855.8	500,753.8	
Sub-total				31,357,780.7		49,590,630.3	80,948,411.0	

Driving Canal (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
(3) Cross Culvert								ℓ = 8.0 m
Levelling Concrete	m^3	4.44	1,243.5	5,521.1	3,435.8	15,254.9	20,776.0	Class F
Reinforced Concrete	m^3	28.20	1,159.9	32,709.1	16,682.3	357,640.8	390,349.9	Class C
Concrete	m^3	59.4	1,159.9	68,898.0	7,270.3	431,855.8	500,753.8	
Sub-total				31,602,704.9		51,259,093.4	82,861,798.3	
4. O.H.	L.S.			1,580,135.2		2,562,954.6	4,143,089.8	5%
Sub-total				33,182,840.1		53,822,048.0	87,004,888.1	
5. Miscellaneous				2,159.9		952.0	3,111.9	
Total	L.S.			33,185,000.0		53,823,000.0	87,008,000.0	

Main Canal (1)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	169,935.00	141.8	24,096,783.0	61.9	10,518,976.5	34,615,759.5	
2. Earthfill	m^3	150,826.00	96.3	14,524,543.8	27.7	4,177,880.2	18,702,424.0	
3. Related Structure								
(1) Siphon (C)								
Concrete Pipe	m	250.00			18,090.0	4,522,500.0	4,522,500.0	
Reinforced Concrete	m^3	1,184.47	1,159.9	1,373,866.7	12,682.3	15,021,803.8	16,395,670.5	
Concrete	m^3	59.40	1,159.9	68,898.0	7,270.3	431,855.8	500,753.8	
Levelling Concrete	m^3	74.50	1,243.5	92,640.7	3,435.8	255,967.1	348,607.8	
(2) Diversion Works								
Reinforced Concrete	m^3	68.50	1,159.9	79,453.1	12,682.3	968,737.5	948,190.6	
Levelling Concrete	m^3	12.0	1,243.5	14,922.0	3,435.8	41,229.6	56,151.6	
Gate (1.2 x 1.8)	L.S.			---		70,000.0	70,000.0	
Gate (0.9 x 0.9)	L.S.			---		40,000.0	40,000.0	
Sub-total				45,344,591.3		37,256,106.5	82,600,697.8	

Main Canal (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
(3) Gabion	m^3	140.00		---	3,500.0	490,000.0	490,000.0	2x1x1 m
(4) Check Gate								
Reinforced Concrete	m^3	120.75	1,159.9	140,057.9	12,682.3	1,531,387.7	1,671,445.6	7 Units
Levelling Concrete	m^3	18.90	1,243.5	23,502.1	3,435.8	64,936.6	88,438.7	
Gate	Unit	7.00		---	12,000.0	84,000.0	84,000.0	
(5) Shute								
Reinforced Concrete	m^3	75.60	1,159.9	87,688.4	12,682.3	958,781.9	1,046,470.3	
Levelling Concrete	m^3	11.30	1,243.5	14,051.5	3,435.8	38,824.5	52,876.0	
(6) Drop Structure								
Reinforced Concrete	m^3	48.20	1,159.9	55,907.2	12,682.3	611,288.8	667,194.0	
Levelling Concrete	m^3	3.40	1,243.5	4,227.9	3,435.8	11,681.7	15,909.6	
Gabion	m^3	10.00		---	3,500.0	35,000.0	35,000.0	
Sub-total				44,583,762.3		40,769,549.7	85,353,312.0	
4. Miscellaneous								
Total	L.S.			44,584,000.0		40,770,000.0	85,354,000.0	

Secondary Canal

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	24,036.0	141.8	3,408,304.8	61.9	1,487,828.4	4,896,133.2	
2. Earthfill	m^3	135,945.0	96.3	13,091,503.5	27.7	3,765,676.5	16,857,130.0	
3. Related Structure								
(1) Turnout								
Reinforced Concrete	m^3	124.0	1,159.9	143,827.6	12,682.3	1,572,605.2	1,716,432.8	20 Units
Levelling Concrete	m^3	70.0	1,243.5	87,045.0	3,435.8	240,506.0	327,551.0	
Gate	Unit	20.0			11,000.0	220,000.0	220,000.0	ø500
(2) Cross Culvert								196 Units
Reinforced Concrete	m^3	1,215.2	1,159.9	1,409,510.4	12,682.3	15,411,530.9	16,821,041.3	
Concrete Pipe	m	588.0			1,500.0	882,000.0	882,000.0	ø500
Sub-total				18,140,191.3		23,580,147.0	41,720,338.3	
4. O.H.				1,360,514.3		1,768,511.0	3,129,025.3	7.5%
Sub-total				19,500,705.6		25,348,658.0	44,849,363.6	
5. Miscellaneous	L.S.			701,294.4		12,342.0	713,636.4	
Total				20,202,000.0		25,361,000.0	45,563,000.0	

Tertiary Canal

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Earthfill	m^3	433,740.0	96.3	41,769,162.0	27.7	12,014,598.0	53,783,760.0	
2. Stop Log								196 Units
(1) Reinforced Concrete	m^3	29.4	1,159.6	34,092.2	12,682.3	372,859.6	506,951.8	
Sub-total				41,803,254.2		12,387,457.6	54,190,711.8	
3. O.H.	L.S.			1,254,097.6		371,623.7	1,625,721.3	3%
Sub-total				43,057,351.8		12,759,081.3	55,816,433.1	
4. Miscellaneous				942,648.2		40,918.7	983,566.9	
Total				44,000,000.0		12,800,000.0	56,800,000.0	

Main Drainage Canal

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	1,399,973.0	147.0	205,796,031.0	41.5	58,098,879.5	263,894,910.5	
2. Earthfill	m^3	112,927.0	96.3	10,874,870.1	27.7	3,128,077.9	14,002,948.0	
3. Drop Structure								7 Units
Reinforced Concrete	m^3	276.5	1,159.9	320,712.3	12,682.3	3,506,665.9	3,827,378.2	
Levelling Concrete	m^3	17.5	1,243.5	21,761.2	3,435.8	60,126.5	81,887.7	
4. Culvert (Interception)								
Reinforced Concrete	m^3	412.2	1,159.9	478,110.7	12,682.3	5,227,644.0	5,705,754.7	
Levelling Concrete	m^3	22.4	1,243.5	27,854.4	3,435.8	76,961.9	104,816.3	
Gabion	m^3	192.0		---	3,500.0	672,000.0	672,000.0	
Sub-total				217,519,339.7		70,770,355.7	288,289,695.4	
5. Miscellaneous	L.S.			476,660.3		134,644.3	611,304.6	
Total				217,996,000.0		70,905,000.0	288,901,000.0	

Secondary Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	274,806.0	147.0	40,396,482.0	41.5	11,404,449.0	51,800,931.0	
2. Earthfill	m^3	64,718.0	96.3	6,232,343.4	27.7	1,792,688.6	8,025,032.0	
3. Drop Structure								49 Units
Reinforced Concrete	m^3	2,348.9	1,159.9	2,724,489.1	12,682.3	29,789,454.4	32,513,943.5	
Levelling Concrete	m^3	182.5	1,243.5	226,938.7	3,435.8	627,033.5	853.972.2	
4. Culvert								
Reinforced Concrete	m^3	1,101.3	1,159.9	1,277,397.8	12,682.3	13,967.016.9	15,244,414.7	
Levelling Concrete	m^3	79.0	1,243.5	98,236.5	3,435.8	271,428.2	369,664.7	
Gabion	m^3	590.0			3,500.0	2,065,000.0	2,065,000.0	
Sub-total				50,955,887.5		59,717,070.6	110,125,958.1	
5. Miscellaneous	L.S.			112.5		926.4	1,041.9	
Total				50,956,000.0		59,918,000.0	110,874,000.0	

Tertiary Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	1,363,250.0	147.0	200,397,750.0	41.5	56,574,875.0	256,972,625.0	
2. Earthfill	m^3	251,417.5	96.3	24,211,505.5	27.7	6,964,264.7	31,175,769.9	
3. Culvert								
Reinforced Concrete	m^3	1,888.0	1,159.9	2,189,891.2	12,682.3	23,948,182.4	26,134,073.6	
Sub-total				226,799,164.4		87,487,322.1	314,282,468.5	
4. Miscellaneous				835.6		677.9	1,513.5	
Total				226,800,000.0		87,488,000.0	314,288,000.0	

Lateral Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	530,817.5	147.0	78,030,172.5	41.5	22,028,926.2	100,059,098.7	
2. Earthfill	m^3	132,762.0	96.3	12,784,980.6	27.7	3,677,507.4	16,462,488.0	
3. Drop Structure								13 Units
Reinforced Concrete	m^3	513.5	1,159.9	595,608.6	12,682.3	6,512,361.0	7,107,969.6	
Levelling Concrete	m^3	32.5	1,243.5	40,413.7	3,435.8	111,663.5	152,077.2	
4. Culvert								
Reinforced Concrete	m^3	1,605.0	1,159.9	1,861,639.5	12,632.3	20,355,091.5	22,216,731.0	
Sub-total				93,312,814.9		52,685,549.6	145,998,364.5	
5. Miscellaneous	L.S.			185.1		450.4	635.5	
Total				93,313,000.0		52,686,000.0	145,999,000.0	

Interception Drainage

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation	m^3	56,853.0	147.0	8,357,391.0	41.5	2,359,399.5	10,716,790.5	
2. O.H.	L.S.			250,721.7		70,781.9	321,503.6	3%
Sub-total				8,608,112.7		2,430,181.4	11,038,294.1	
3. Miscellaneous	L.S.			1,987.3		4,818.6	6,705.9	
Total				8,610,000.0		2,435,000.0	11,045,000.0	

Road Works

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Earthfill	m^3	135,400.0	110.2	14,922,182.0	27.6	3,737,316.0	18,659,498.0	
2. Subgrade Course	m^2	92,125.0	16.5	1,520,062.5	259.0	23,860,375.0	25,380,437.5	
Sub-total				16,422,244.5		27,597,691.0	44,039,935.5	
3. O.H.	L.S.			822,112.2		1,379,884.5	2,201,996.7	5%
Sub-total				17,264,356.7		28,977,575.5	46,241,932.2	
4. Miscellaneous	L.S.			643.3				
Total				17,265,000.0		28,978,000.0	46,243,000.0	

Asphalt Pavement (5.0 km)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Subgrade Course	m^2	27,500.0	16.5	453,750.0	259.5	7,136,250.0	7,590,000.0	t = 0.2
2. Pavement	m^2	27,500.0	23.3	640,750.0	973.7	26,776,750.0	27,417,500.0	
Sub-total				1,094,500.0		33,913,000.0	35,007,500.0	
3. O.H.	L.S.			54,725.0		1,695,650.0	1,750,375.0	
Sub-total				1,149,225.0			36,757,875.0	
4. Miscellaneous	L.S.			775.0		1,350.0	2,125.0	
Total				1,150,000.0		35,610,000.0	36,760,000.0	

Bridge Type I (1) ℓ = 100 m, B = 6.0 m

(Unit. COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
Reinforced Concrete	m^3	157 76	1,159.9	182,985.8	12,682.2	2,000,743.8	2,183,729.6	
Concrete for Pavement	m^3	29.92	1,159.9	34,704.2	7,270.3	217,527.3	252,231.5	
Structural Steel	t	136.14	74,800.0	10,183,272.0			10,183,272.0	
Printing	m^2	1,290.42			25.0	32,260.5	32,260.5	
Guard Rail	t	5.02	233,100.0	1,170,162.0			1,170,162.0	
2. Substructure								
Reinforced Concrete	m^3	258.40	1,159.9	299,718.1	12,682.2	3,277,080.4	3,576,798.5	
Levelling Concrete	m^3	16.16	1,243.5	20,094.9	3,435.8	55,522.5	75,617.4	
Cobble Stone	m^3	32.34			2,200.0	71,148.0	71,148.0	
Excavation	m^3	846.24	141.8	119,996.8	61.9	52,382.2	172,379.0	
Surplus Soil	m^3	206.72	154.6	31,958.9	57.3	11,845.0	43,803.9	
Gabion	m^3	450.00			3,500.0	1,575,000.0	1,575,000.0	
Sub-total				12,042,892.7		7,261,249.2	19,336,402.4	

Bridge Type I (2)

(Unit. COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
3. Temporary Works	L.S.			4,817,157.0				40%
Sub-total				16,860,049.7		7,261,249.2	24,121,298.9	
4. O.H.	L.S.			1,686,004.9		726,124.9	2,412,129.3	10%
Sub-total				18,546,054.6		7,987,374.1	26,533,428 7	
5. Miscellaneous	L.S.			3,945.4		12,625.9	16,571.3	
Total				18,550,000.0		8,000,000.0	26,550,000.0	

Bridge Type II (1) ℓ = 15 m, B = 4.0 m

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Reinforced Concrete	m^3	16.73	1,159.9	19,405.1	12,682.2	212,173.2	231,788.3	
(2) Concrete for Pavement	m^3	2.96	1,159.9	3,433.3	7,270.3	21,520.0	24,953.3	
(3) Structural Steel	t	7.10	74,800.0	538,180.0			538,180.0	
(4) Guard Rail	t	0.50	233,100.0	116,550.0			116,550.0	
(5) Printing	m^2	89.80			25.0	2,245.0	2,245.0	
2. Substructure								
(1) Reinforced Concrete	m^3	56.40	1,159.9	65,418.3	12,682.2	715,276.0	780,694.3	
(2) Levelling Concrete	m^3	4.74	1,243.5	5,894.1	3,435.8	16,285.6	22,179.7	
(3) Cobble Stone	m^3	9.48			2,200.0	20,856.0	20,856.0	
(4) Excavation	m^3	257.34	141.8	36,490.8	61.9	15,929.3	52.420.1	
(5) Surplus Soil	m^3	56.64	154.6	8,756.5	57.3	3,745.4	12,001.9	
Sub-total				794,128.1		1,007,530.5	1,801,658.6	
3. O.H.	L.S.			79,412.8		100,753.0	180,165.8	10%
Sub-total				873,540.9		1,108.283.5	1,981,824.4	

Bridge Type II (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous	L.S.			1,459.1		1,716.5	3,175.6	
Total				875,000.0		1,110,000.0	1,985,000.0	
18 Units				15,750,000.0		19,980,000.0	35,730,000.0	

Bridge Type III (1) ℓ = 10 m, B = 4 m

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Reinforced Concrete	m^3	11.04	1,159.9	12,805.2	12,682.2	140,011.4	152,816.6	
(2) Concrete for Pavement	m^3	1.95	1,159.9	2,261.8	7,270.3	14,177.0	16,438.8	
(3) Structural Steel	t	4.68	74,800.0	350,064.0			350,064.0	
(4) Guard Rail	t	0.33	233,100.0	76,923.0			76,923.0	
2. Substructure								
(1) Reinforced Concrete	m^3	37.20	1,159.9	43,148.2	12,682.2	471,777.8	514,926.0	
(2) Levelling Concrete	m^3	3.13	1,243.5	3,892.1	3,435.8	10,754.0	14,646.1	
(3) Cobble Stone	m^3	6.25			2,200.0	13,750.0	13,750.0	
(4) Excavation	m^3	169.80	141.8	24,077.6	61.9	10,510.6	34,588.2	
(5) Surplus Soil	m^3	37.4	154.6	5,782.0	57.3	2,143.0	7,925.0	
Sub-total				518,943.9		663,123.8	1,182,077.7	
3 O.H.	L.S.			51,895.3		66,312.3	118,207.6	10%
Sub-total				570,849.2		729,436.1	1,300,285.3	
Substructure Total				76,899.9		508,935.4	585,835.3	

Bridge Type III (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous	L S.			150.8		536.9	714.7	
Total				571,000.0		730,000.0	1,301,000.0	
32 Units				18,272,000.0		23,360,000.0	41,632,000.0	

Bridge Type IV (1) ℓ = 7 m, B = 4 m

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Superstructure								
(1) Reinforced Concrete	m^3	8.30	1,159.9	9,627.1	12,682.2	205,262.2	114,889.3	
(2) Concrete for Pavement	m^3	1.40	1,159.9	1,623.8	7,270.3	10,178.4	11,802.2	
(3) Structural Steel	t	3.50	74,800.0	261,800.0			261,800.0	
(4) Guard Rail	t	0.20	233,100.0	46,620.0			46,620.0	
2. Substructure				76,899.9		508,935.4	585,835.3	
(1) Reinforced Concrete	m^3	37.20	1,159.9	43,148.2	12,682.2	471,777.8	514,926.0	
(2) Levelling Concrete	m^3	3.13	1,243.5	3,892.1	3,435.8	10,754.0	14,646.1	
(3) Cobble Stone	m^3	6.25			2,200.0	13,750.0	13,750.0	
(4) Excavation	m^3	169.80	141.8	24,077.6	61.9	10,510.6	34,588.2	
(5) Surplus Soil	m^3	37.4	154.6	5,782.0	57.3	2,143.0	7,925.0	
Sub-total				396,570.8		624,376.0	585,835.3	
3. O.H.				39,657.0		62,437.6	102,094.6	10%
Sub-total				436,227.8		686,813.6	1,123,041.4	

Bridge Type IV (2)

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
4. Miscellaneous				772.2		186.4	958.6	
Total				437.000.0		687,000.0	1,124,000.0	
46 Units				20,102,000.0		31,602,000.0	51,704,000.0	

Land Reclamation

(Unit. COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Land Reclamation	ha	900.0	59,999.3	53,999,370.0	13,975.0	12,577,500.0	66,576,870.0	
2. O.H.	L.S.			1,619,981.1		377,325.0	1,997,306.1	
Sub-total				55,619,351.1		12,954,825.0	68,574,176.1	
3. Miscellaneous	L.S.			648.9		175.0	823.9	
Total				55,620,000.0		12,955,000.0	68,575,000.0	

O/M Equipment

(Unit. COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Bulldozer	Unit	1	13,128,000	13,128,000.0			13,128,000.0	15 t, 141 HP
2. Back Hoe	Unit	2	10,008,000	20,016,000.0			20,016,000.0	0.6 m^3, 102 HP
3. Motor Grader	Unit	1	9,472,000	9,472,000.0			9,472,000.0	3.7 m, 130 HP
4. Drag Line	Unit	2	13,136,000	26,272,000.0			26,272,000.0	0.6-0.8m 105 HP
5. Damp Truck	Unit	4	5,720,000	22,880,000.0			22,880,000.0	8 t
Total				91,768,000.0			91,768,000.0	

Supporting Service

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. House	Unit	2			1,500,000.0	3,000,000.0	3,000,000.0	100 m^2 x 15,000.0
2. Motor Pool	m^2	600			5,000.0	3,000,000.0	3,000,000.0	
Total						6,000,000.0	6,000,000.0	

Administration Cost

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Project Director	M/M	60.0			60,000.0	3,600,000.0	3,600,000.0	1 man x 60 M
2. Staff	M/M	600.0			45,000.0	27,000,000.0	27,000,000.0	10 men x 60 M
3. Driver	M/M	180.0			15,000.0	2,700,000.0	2,700,000.0	3 men x 60 M
4. Postage	L.S.					180,000.0	180,000.0	
Total						33,480,000.0	33,480,000.0	

Engineering Service

(Unit: COL$)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Survey	km^2	100	200,000.0	20,000,000.0			20,000,000.0	
2. Detailed Design	L.S.			92,090,000.0		5,825,000.0	97,915,000.0	
3. Supervision	L.S.			152,022,000.0		21,825,000.0	173,847,000.0	
Total				264,112,000.0		27,650,000.0	291,762,000.0	

Table 7–2–13 Annual Operation & Maintenance Cost

Unit : col$

Item	Plan I	Plan II	Plan III
1. Operation & Maintenance cost of Equipment	17,883,000	21,507,000	29,146,000
2. Maintenance Cost for Civil work	1,788,000	2,151,000	2,915,000
3. Administration Cost			150m/m@18,000
(1) Labour wages 100 M/M @ 18,000	1,800,000	1,800,000	2,700,000
(2) Office expenses	1,300,000	1,800,000	2,300,000
4. Miscellaneous	244,000	422,000	450,000
TOTAL	23,015,000	27,680,000	37,511,000

TERM OF REFERENCE (Draft)

Detailed design Stage

1. Detailed Design

The scope of work for the detailed design of the Project is as follows.

(1) Scope of Work and Objectives

The main consultancy services for the Pamplonita River Basin Agricultural Development Project are as follows:

1) Review of Feasibility Study and Plan
2) Addition of Hydrology, Topographical Survey and Soil Tests and Collection and Analysis of Data
3) Execution of the Detailed Design
4) Drawing up of an Administration and Management Manual
5) Cost Estimation of the Project
6) Drawing up of Documents Related to the Project
7) Other Related Services

2. Details of the Work

The main work are as follows.

(1) As already mentioned above, the following studies shall be carried out.

1) Review of the irrigation and/or drainage
2) Project facilities and civil works

Review of the planned layout for roads, water-works and the capacity of the planned facilities.

3) Financing plan

Investigation of the loan investment plan, repayment schedule of several other similar projects.

4) Crops

Review of the cropping pattern and anticipated production.

5) Farm management

Extension of production organization and review of land use plan.

(2) The items below should also be included in the topographical survey, and collection and analysis of additional data.

1) Topographical survey

- Topographical survey, profile and sectional leveling for

main irrigation and/or drainage canal, bridge and other major structure.

- Profile and sectional leveling for roads.

2) Boring

- Boring in the location of the major structures

3) Other related items

- Study of prices of materials and machinery.
- Study of the level of experience and competence of local civil engineers.
- Also an outline survey of similar projects.

(3) The detailed design and civil work specifications shall cover the following items.

1) Field irrigation and drainage facilities
2) Roads
3) Bridge

(4) Administration and Management Manuals shall include the following points.

1) Irrigation and/or drainage facilities
   - Canal
   - Syphon
   - Other facilities
2) Roads
   - Main roads
   - Secondary roads
   - Bridge

(5) Estimate of the Project cost shall be based on the detailed design.

(6) Drawing up of Project Documents

1) Instruction to Tender
2) Form of Tender
3) Conditions of Contract
4) General Specifications
5) Technical Specifications
6) Tender Drawing
7) Form of Agreement and Form of Performance Bond

(7) Duties to be included in the Project are as follows:

1) Transfer of Technology

The Consultant should cooperate in the transfer of technology to the counterparts and local consultant engineers.

2) Duties of the Consultant

The Consultant shall have the following duties during the implementation of the Project.

a. Total man-months shall not exceed 135 months (Foreign 95, Local 40).

b. Assignment of Experts

The following team of experts will be required for implementation of the Project.

- Project Director
- Team Leader
- Irrigation & Drainage Engineer
- Design Engineer
- Hydraulic Engineer
- Hydrologist
- Geologist
- Soil Mechanical Engineer
- Construction Engineer
- Topographic Surveyer
- Agronomist
- Economist
- Specification Writer

3) Equipment

The equipment listed below will be required for implementation of the Project.

- Survey equipment
- Soil test equipment
- Copy machine
- Calculators, Drafting equipment
- Personal computer

(8) Reports

The Consultant shall prepare reports as listed below. Reports are to be drawn up using the M.G.S. method. The Consultant shall submit all reports, documents, etc. in the English language.

- Inception Report
- Implementation Report
- Quarterly Progress Report
- Monthly Report
- Design Report
- Design Note

Fig. 7–3–1 Assignment Schedule of Engineering Services (Detailed Design)

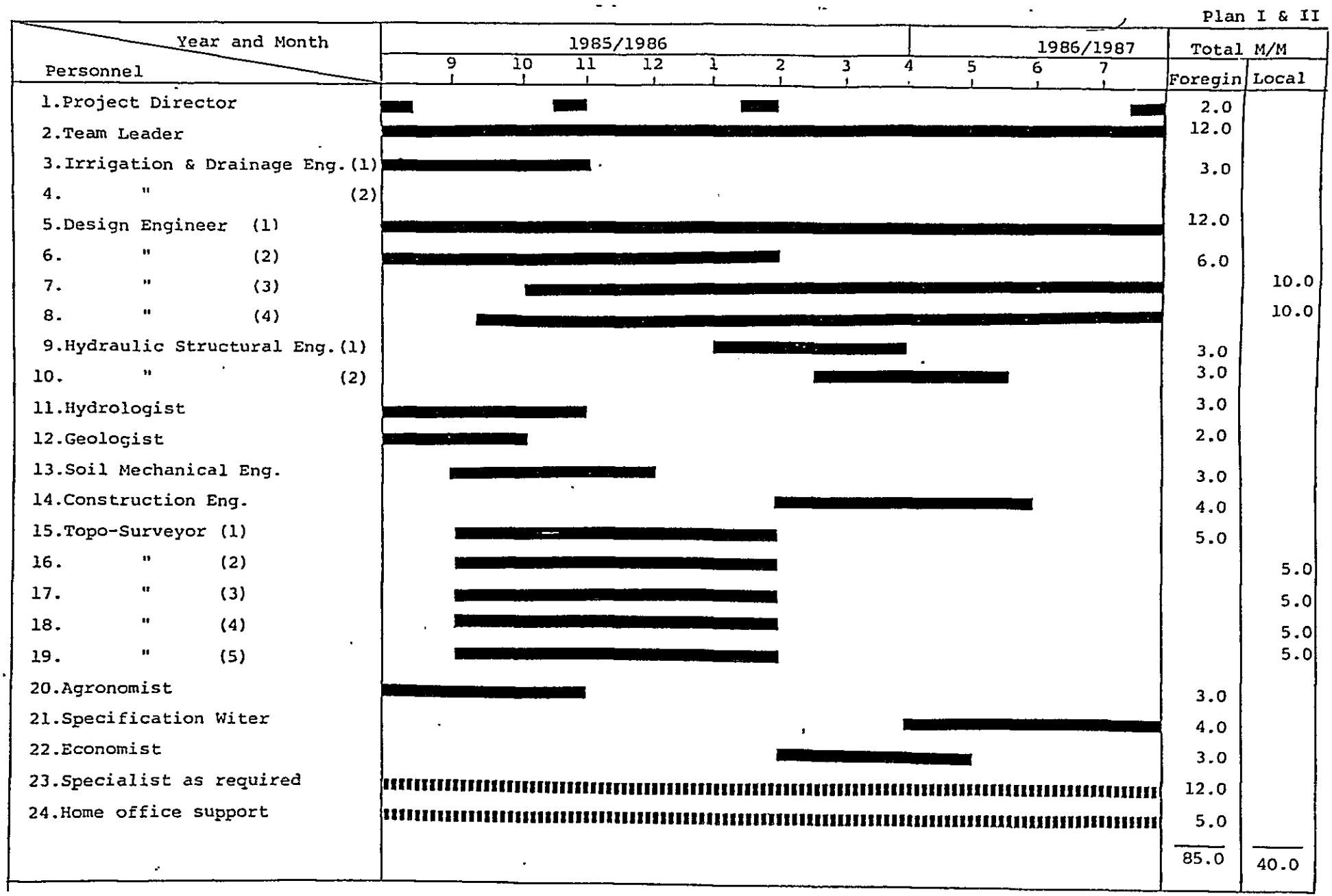
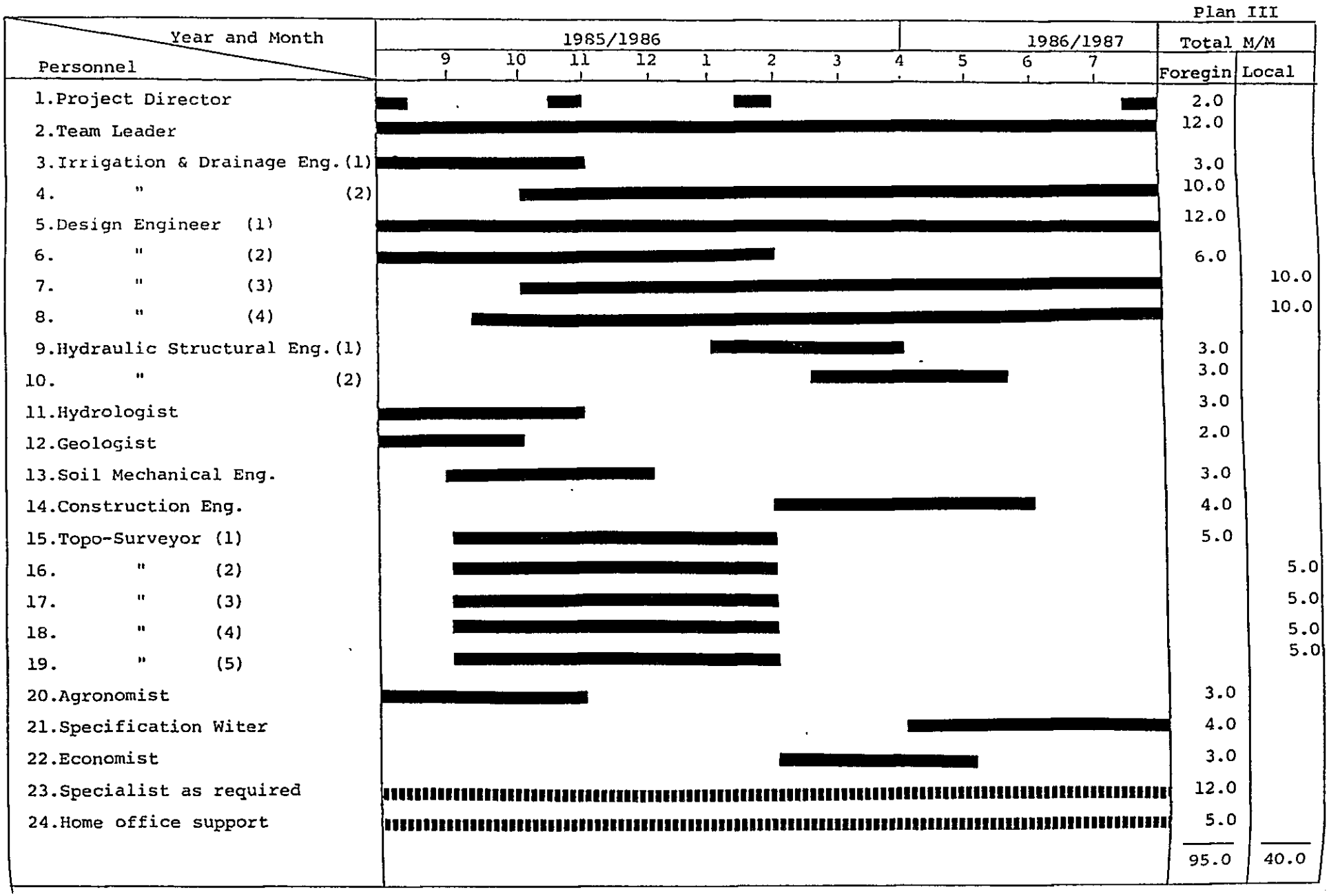


Fig. 7–3–2 Assignment Schedule of Engineering Services (Detailed Design)



TERM OF REFERENCE (Draft)

Construction Stage

Terms of reference for engineering consulting services for the Pamplonita River Basin Agricultural Development Project on the construction stage is hereunder:

1. Objectives

Consultant Engineering servicds, needed for construction of the Pamplonita River Basin Agricultural Development Project consists of the following objectives:

(1) Assistance of supervision of the construction

(2) Assistance of operation and maintenance works

2. Scope of the Service

The scope of the services for the Consultant is to cover the following items.

2.1. Assistance of Supervision of Construction Works

The Consultants shall perform the following services through the period from the stage of preparation to the completion of all the construction works of the project.

(1) Tasks Concepts

- Familiarize the data collected and documents prepared by the consulting firms which have completed the previous studies and final design.
- Review of previous studies
- Consider all possibilities of reduction the cost of works by making such adjustment to the design which are technically acceptable within the approved design and constract specifications for the works.
- Check the detailed working drawings for the construction of all the structures and facilities prepared by contractors.
- Execute the revision of the design if it deemed necessary in the course of construction.
- Check the shop works and test of contractors/suppliers in their factories before shipment and issue necessary certificates of inspection, if requested by The Government.
- Check the working and shop drawing, construction program and

schedule to be furnished by contractors/suppliers if requested by The Government.

- Review and supervise additional surveying/investigation if it is deemed necessary in the course of construction.

- Prepare completion reports for all the construction works of the Project including "as built" drawing of the structures.

(2) Assistance Concept

- Carrying out inspection and supervision of the works during the construction.

- Assist The Government in evaluation of bids awarding the contractor/supplier for procurement of equipment and materials.

- Assist The Government to keep the progress of the work according to the schedule of prepare the modified working schedule in response to change of situation.

- Assist The Government to evaluate the progress of the work and to certify the payment to contractors, if requested by The Government.

- Assist The Government in final inspection of completed works.

3. Expertise of Consultant's Engineering Service

In carrying out the scope of works a multidisciplineary team of the Consultants will be organized as follows:

(1) Project Director
(2) Team Leader
(3) Construction Eng. (1)
(4) Construction Eng. (2)
(5) Construction Eng. (3)
(6) Irrigation & Drainage Eng. (1)
(7) Irrigation & Drainage Eng. (2)
(8) Structural Engineer (1)
(9) Structural Engineer (2)
(10) Structural Engineer (3)
(11) Soil/Foundation Engineer
(12) Bridge Engineer
(13) Hydraulic Engineer (1)
(14) Hydraulic Engineer (2)
(15) O/M Expert
(16) Unlocated
(17) Home Office Support

4. Assignment of Consultants for Engineering Services

(a) Duration of the engineering services is about 42 months

(b) The total man-months for the engineering services should not exceed 175 man-months of foreign consultants and 200 man-months of local consultants.

5. Reporting

The Consultants shall prepare and submit the following reports to the Ministry. The metric system shall be used in all design works, drawings and calculations. The reports and drawings shall be editted in English.

(1) Monthly Progress Report

At the end of each calendar month, report shall be prepared with a summary of progress of the works, and the Consultants activities during reporting period including the work schedule in next period.

(2) Annual Report

At the end of the Colombian fiscal year, annual report shall be prepared, which comprised the program and schedule of the next twelve months including the budgetary schedule.

(3) Inspection Report

Inspection report which comprises the detail of shop inspection and test at suppliers' factories before shipment shall be prepared.

(4) Completion Report

At the completion of the project, the completion report and drawings comprising all the aspects of the project shall be prepared.

(5) Other Necessary Reports

If necessary, technical document and technical specifications for the construction shall be prepared.

6. General Remarks

The Consultants should also take into account the followings.

(1) The Consultants' Project Personnel should organize their own facilities for translation of existing reports and data relevant to the project.

(2) The Consultants' Project Personnel shall adopt themselves as quickly as possible to the Colombian situations and conditions, especially the local living and working condition at the job site.

(3) The Consultants should purchase on behalf of The Government such

equipment needed for survey and investigation, drawing and reproduction, necessary for the successful performance of his assignment. The Government will bear the purchase cost of such equipment, which shall be the property of The Government.

(4) The Consultants should commence the works within thirty (30) days after the effective date of the Contract.

(5) Execution of the works will require close contact and good cooperation with the Instituto Colombiano de Hidrologia, Meteorologiay, Adecuacion de Tierras and its Execution Body.

(6) The Consultants should pay full attention to transfer of knowledge and technical know-how to the Government's engineers, technicians and other counterparts. At least, the followings should be conducted by the Consultants.

- To execute in country and abroad, on-the-job training in every related field works to Colombian engineers, technicians and other counterparts.

- To hold periodical discussion meetings with the Government's engineers, technicians and other counterparts.

Fig. 7–3–3 Assignment Schedule of Engineering Services (Construction Stage)

Plan I & II

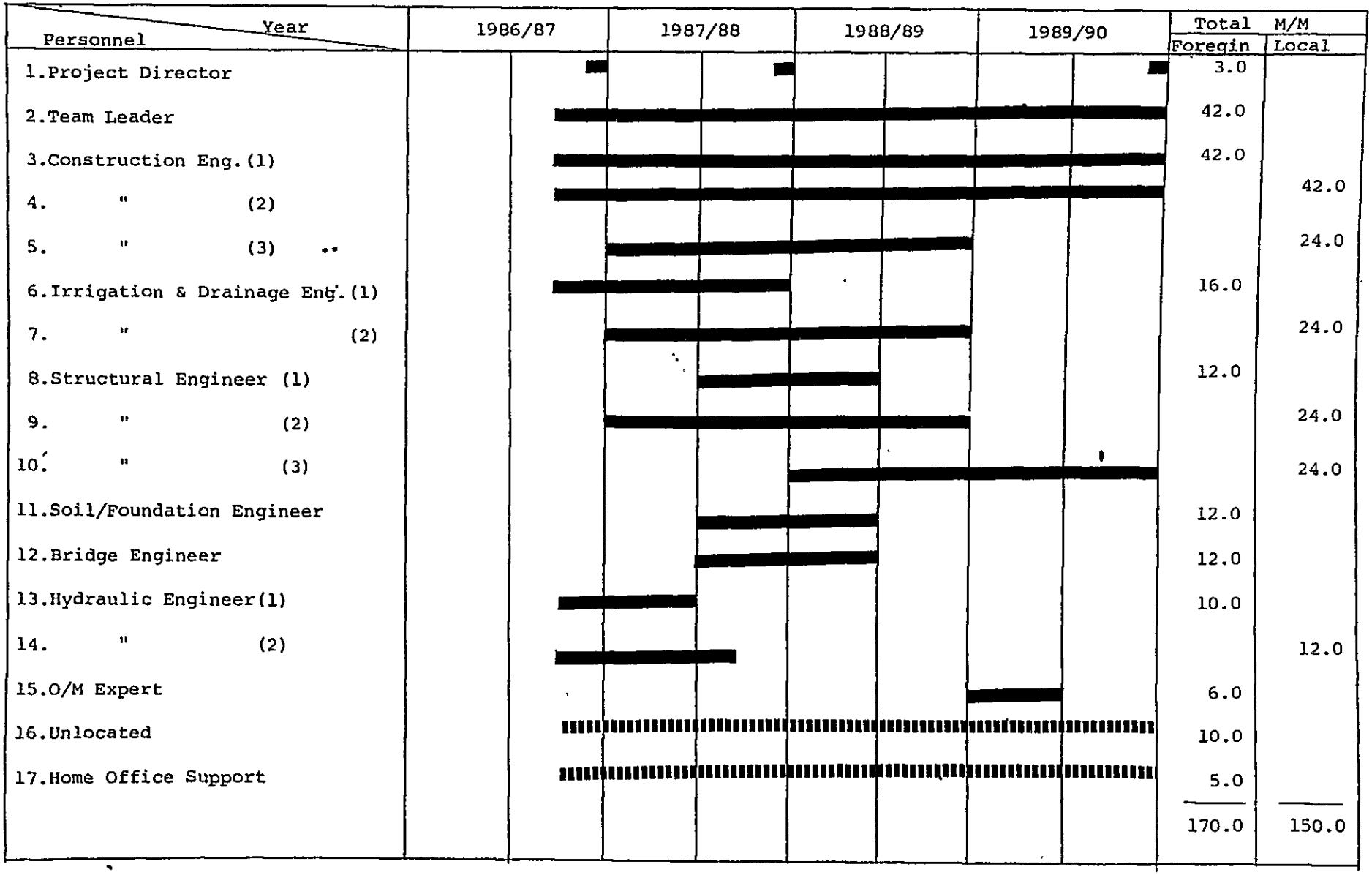
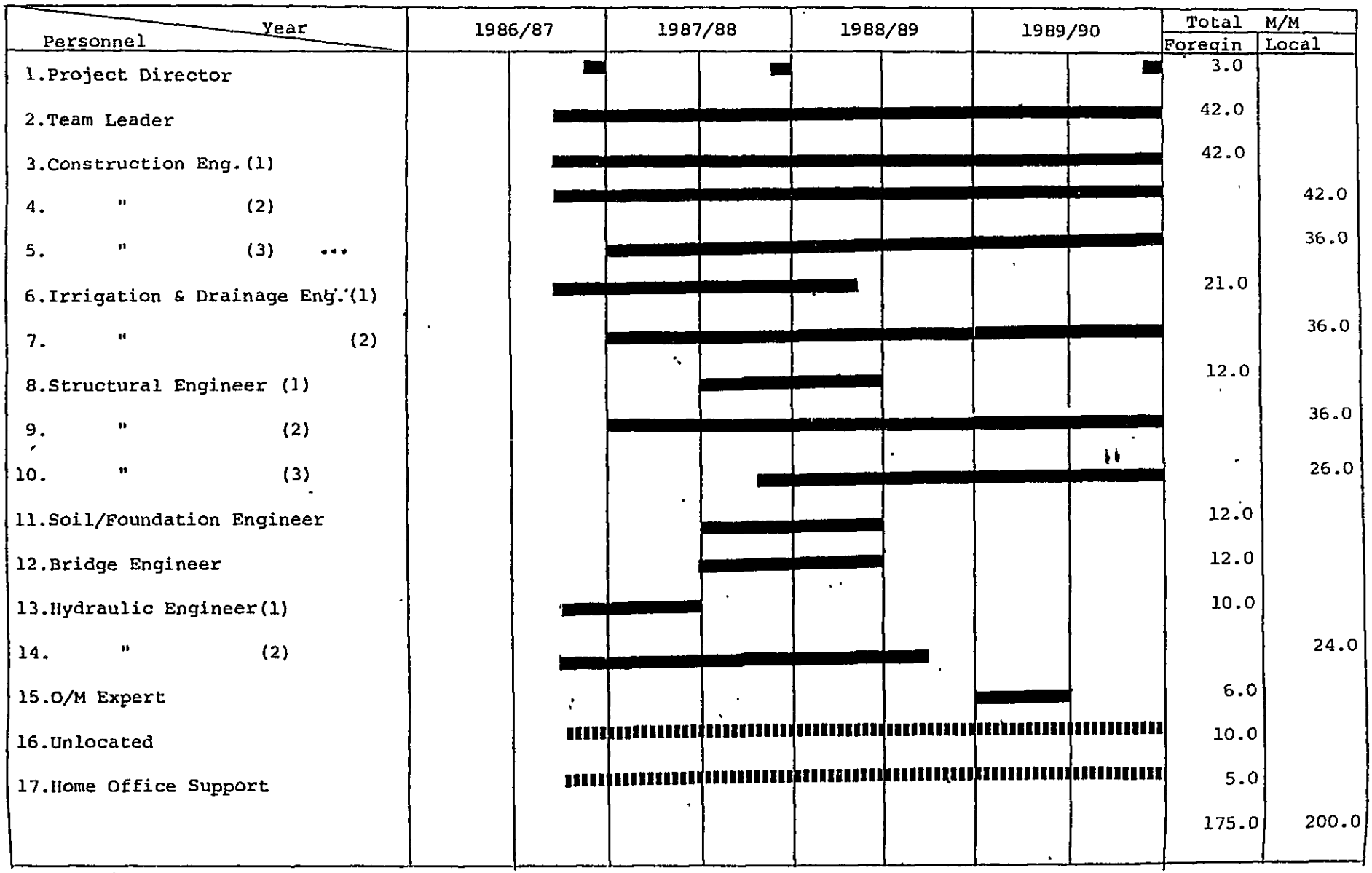


Fig. 7—3—4 Assignment Schedule of Engineering Services (Construction Stage)

Plan III



APPENDIX 8. PROJECT EVALUATIONS

LIST OF TABLES

LIST OF FIGURES

8.1 General

The project evaluation is carried out in order to ascertain the feasibility of the project in view of economic, financial and socio-economic aspects.

The economic feasibility for the project is firstly evaluated by calculating the economic internal rate of return (EIRR). Further, sensitivity analysis of EIRR is also made with respect to change in the economic construction cost, production price and production cost.

Secondary, the financial aspect is evaluated by calculating the capacity to pay and by preparing the repayment schedule of project construction cost. The calculation of capacity to pay is to confirm the soundness of the project from the farmers' viewpoint.

Finally, intangible socio-economic impacts of the project are briefly studied in due consideration of the effect of the project on the regional development.

8.2 Economic Evaluation

8.2.1 Basic Assumptions

For the economic evaluation of the project, the following basic assumptions are established.

1) The project life is taken as 50 years from 1985 to 2034.

2) The project construction period is five years from 1985 to 1989 of the fiscal year.

3) The current prices of July of 1983 are used in the evaluation.

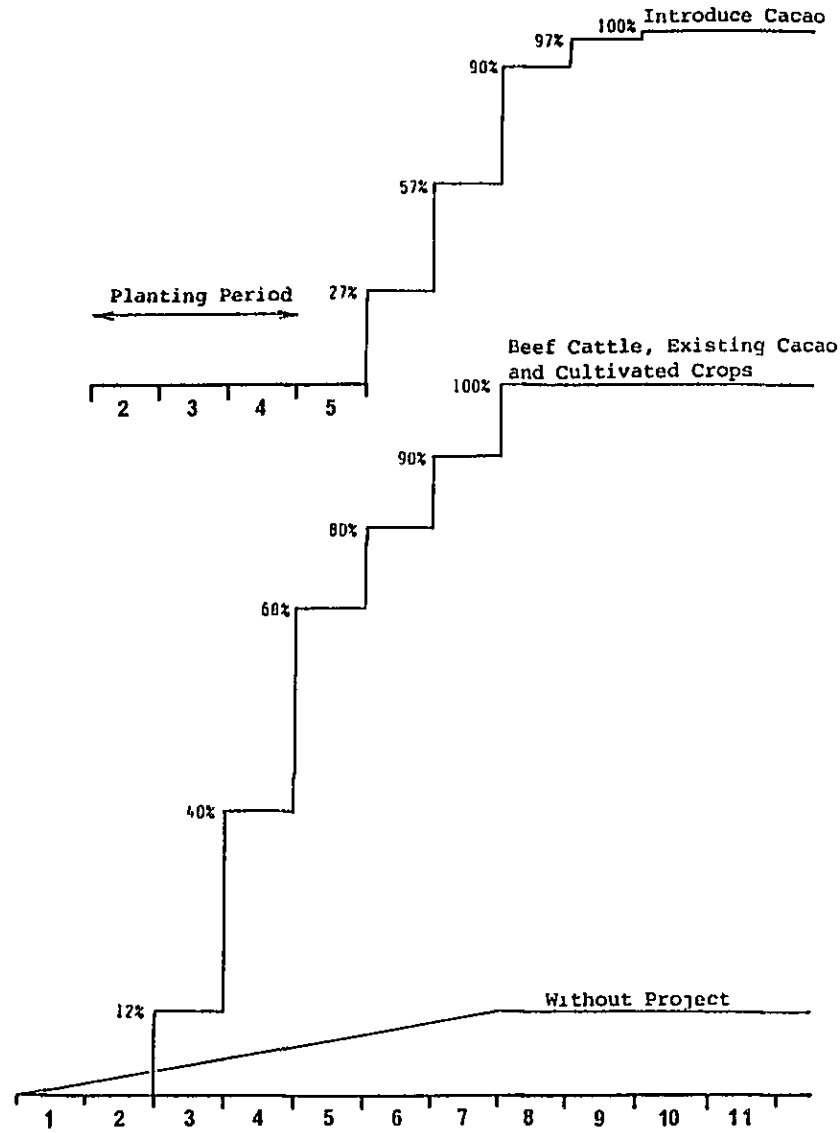
4) Only direct benefit is counted in the evaluation and any indirect or intangible benefits are not taken into account.

8.2.2 Project Cost

(1) Economic Construction Cost

The construction cost broadly comprises the cost for:

1) Preparatory work,
2) Civil work,
3) Land reclamation,
4) O & M equipment (first procurement only),
5) Supporting service,
6) Administration cost,
7) Engineering service,



Development Area (%)		15	50	85	100						
Increase of Net Production Value Beef Cattle, Existing Cacao and Cultivated Crops (%)			12	40	68	80	90	100			
Increase of Net Production Value Introduce Cacao (%)						27	57	90	97	100	
Net Production Value of Without Project (Magnification)	1.025	1.05	1.075	1.1	1.125	1.15	1.175	1.20			

Fig. 8–2–1 Increase of Net Production Value

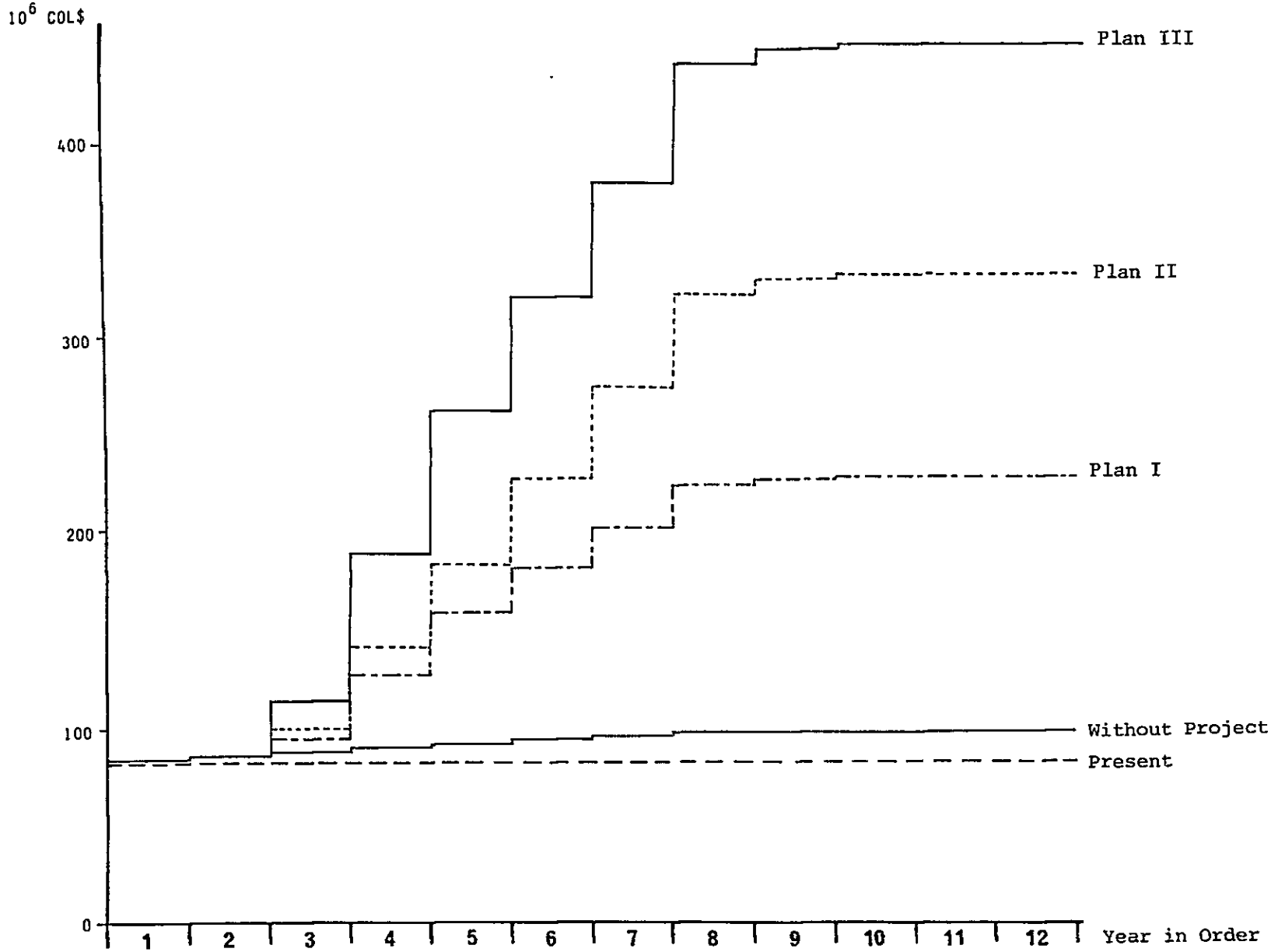


Fig. 8—2—2 Increase of Net Production Value of Each Development Plan

8) Physical contingency, and

9) Price escalation.

Among the costs mentioned above, all the costs except administration cost and price escalation are counted as the economic cost. The total economic construction cost is shown in Table 8-2-1.

(2) Economic Annual Operation and Maintenance Cost

The annual operation and maintenance cost comprises for:

1) O & M cost of equipment,

2) Maintenance cost for civil work,

3) Administration cost, and

4) Miscellaneous.

Among the costs mentioned above, the O & M cost of equipment and the maintenance cost for civil work are counted as the economic cost. The total economic annual operation and maintenance cost is shown in Table 8-2-2.

Table 8-2-1 Economic Construction Cost

(Unit: 10^3 COL$)

	Description	Plan I	Plan II	Plan III
I.	Preparatory Work	10,770	13,715	14,852
II.	Irrigation			
	1. Driving Canal			87,008
	2. Main Canal			85,354
	3. Secondary Canal			45,563
	4. Tertiary Canal			56,800
III.	Drainage			
	1. Main Canal	169,188	278,504	288,901
	2. Secondary Canal	87,626	96,541	110,874
	3. Tertiary Canal	205,670	265,660	314,288
	4. Lateral Canal	126,682	143,037	145,999
	5. Interception Canal	11,045	11,045	11,045
IV.	Road			
	1. Main Road	83,003	83,003	83,003
V.	Bridge	155,616	155,616	155,616
VI.	Land Reclamation	68,575	68,575	68,575
	Sub-Total (I - VI)	918,175	1,115,796	1,467,878
VII.	O/M Equipment	57,184	70,320	91,768
VIII.	Supporting Service	750	750	6,000
IX.	Engineering Service	273,602	273,602	291,762
	Sub-Total (I - IX)	1,249,711	1,460,467	1,857,408
X.	Physical Contingency (10%)	124,971	146,047	185,741
	Total (I - X)	1,374,682	1,606,514	2,043,149

Table 8–2–2 Economic Annual Operation and Maintenance Cost

(Unit : 10^3 COL$)

Item	Plan I	Plan II	Plan III
1. Operation & Maintenance Cost of Equipment	17,883	21,507	29,146
2. Maintenance Cost for Civil Work	1,788	2,151	2,915
Total	19,671	23,658	32,061

8.2.3 Project Benefit

The direct project benefit is evaluated as the difference of net production value from crops in future between without project and with project.

The basic conception of the project benefit during the construction period is stated hereinafter. Incremental net production value of beef cattle, existing cacao and cultivated crops will be in proportion for development area.

1) Net production value will reach up to 80% of proposed net production value at the termination of the construction, (5th project year) and reach the proposed net production value after 8 years (8th project year).

2) Newly introduced cacao will be planted one-third of proposed cacao area every year from the second project year.
The net production value will reach upto 80% of proposed net production value after 4 years (6th project year) and reach the proposed net production value after 10 years.

3) The incremental net production value of without project is estimated at 1.2 times of the present after 8 years and will be constant in the future. Relation between the increment of net production value and project year are shown in Fig. 8-2-1 and 8-2-2. The project benefit stream of each development plan are tabulated through Table 8-2-3 to 8-2-5.

The annual project benefit and total project benefit of each development plan are shown in Table 8-2-6.

Table 8–2–6 Annual and Total Project Benefit

(Unit : 10^3 COL$)

Item	Plan I	Plan II	Plan III
Annual Project Benefit	129,860	234,585	352,444
Total Project Benefit	5,883,775	10,541,312	15,951,041

Table 8—2—3 Project Benefit Stream (Plan I)

(Unit: 10^3 COL$)

Year in Order	1	2	3	4	5	6	7	8	9	10	11
Present Net Production Value	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719
Increase of Net Production Value Beef Cattle, Existing Cacao and Culvivated Crops			13,511	45,038	76,564	90,075	101,335	112,594	112,594	112,594	112,594
Increase of Net Production Value Introduce Cacao						9,021	19,044	30,069	32,408	33,410	33,410
Total Net Production Value	80,719	80,719	94,230	125,757	157,283	179,815	201,098	223,382	225,721	226,723	226,723
Proportion of Total Net Production (%) Value	36 (36)	36 (37)	42	55	69	79	89	99	100	100	100
Net Production Value Without Project	82,737	84,755	86,773	88,791	90,809	92,827	94,845	96,863	96,863	96,863	96,863
Project Benefit	0	0	7,457	36,966	66,474	86,988	106,253	126,519	128,858	129,860	129,860

( ): in case of Without Project.

Table 8–2–4 Project Benefit Stream (Plan II)

(Unit: 10^3 COL$)

Year in Order	1	2	3	4	5	6	7	8	9	10	11
Present Net Production Value	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719
Increase of Net Production Value Beef Cattle, Existing Cacao and Culvivated Crops			17,895	59,651	101,407	119,302	134,215	149,128	149,128	149,128	149,128
Increase of Net Production Value Introduce Cacao						27,432	57,913	91,441	98,553	101,601	101,601
Total Net Production Value	80,719	80,719	98,614	140,370	182,126	227,453	272,847	321,288	328,400	331,448	331,448
Proportion of Total Net Production (%) Value	24 (25)	24 (26)	30	42	55	67	82	97	99	100	100
Net Production Value Without Project	82,737	84,755	86,773	88,791	90,809	92,827	94,845	96,863	96,863	96,863	96,863
Project Benefit	0	0	11,841	51,579	91,317	134,626	178,002	224,425	231,537	234,585	234,585

( ): in case of Without Project.

Table 8–2–5 Project Benefit Stream (Plan III)

(Unit: 10^3 COL$)

Year in Order	1	2	3	4	5	6	7	8	9	10	11
Present Net Production Value	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719	80,719
Increase of Net Production Value Beef Cattle, Existing Cacao and Cultivated Crops			32,038	106,795	181,551	213,590	240,288	266,987	266,987	266,987	266,987
Increase of Net Production Value Introduce Cacao						27,432	57,913	91,441	98,553	101,601	101,601
Total Net Production Value	80,719	80,719	112,757	187,514	262,270	321,741	378,920	439,147	446,259	449,307	449,307
Proportion of Total Net Production (%) Value	18 (18)	18 (19)	25	42	58	72	84	98	99	100	100
Net Production Value Without Project	82,737	84,755	86,773	88,791	90,809	92,827	94,845	96,863	96,863	96,863	96,863
Project Benefit	0	0	25,984	98,723	171,461	228,914	284,075	342,284	349,396	352,444	352,444

( ): in case of Without Project.

Table 8–2–7 Cost and Benefit Stream (Plan I)

(Unit : 10^5 COL$)

Year in Order	Cost			Benefit	Present Value (7%)			Present Value (8%)		
	Const.	M/O	Total		Discount Rate	Cost	Benefit	Discount Rate	Cost	Benefit
1	479.47	0.0	479.47	0.0	1.0000	479.47	0.0	1.0000	479.47	0.0
2	1843.54	0.0	1843.54	0.0	0.9345	1722.95	0.0	0.9259	1706.98	0.0
3	4981.93	0.0	4981.93	74.57	0.8734	4351.41	65.13	0.8573	4271.20	63.93
4	4411.76	0.0	4411.76	369.66	0.8162	3601.31	301.75	0.7938	3502.19	293.44
5	2050.12	0.0	2050.12	864.74	0.7628	1563.76	659.76	0.7350	1442.19	488.60
6	0.0	196.71	196.71	869.38	0.7129	140.25	620.21	0.6806	133.87	592.02
7	0.0	196.71	196.71	1062.53	0.6663	131.07	708.00	0.6301	122.96	669.57
8	0.0	196.71	196.71	1265.19	0.6227	122.50	787.89	0.5834	114.77	738.22
9	0.0	196.71	196.71	1298.58	0.5820	114.48	749.96	0.5402	106.27	696.17
10	0.0	196.71	196.71	1298.60	0.5439	106.99	706.35	0.5002	98.40	649.62
11	0.0	196.71	196.71	1298.60	0.5083	99.99	660.14	0.4631	91.11	601.50
12	0.0	196.71	196.71	1298.60	0.4750	93.45	616.95	0.4288	84.36	556.94
13	0.0	196.71	196.71	1298.60	0.4440	87.34	576.59	0.3971	78.11	515.69
14	0.0	196.71	196.71	1298.60	0.4149	81.62	538.87	0.3676	72.32	477.49
15	0.0	196.71	196.71	1298.60	0.3878	76.28	503.61	0.3404	66.97	442.12
16	0.0	196.71	196.71	1298.60	0.3624	71.29	470.67	0.3152	62.01	409.37
17	0.0	196.71	196.71	1298.60	0.3387	66.63	439.88	0.2918	57.41	379.04
18	0.0	196.71	196.71	1298.60	0.3165	62.27	411.10	0.2702	53.16	350.97
19	0.0	196.71	196.71	1298.60	0.2958	58.19	384.20	0.2502	49.22	324.97
20	0.0	196.71	196.71	1298.60	0.2765	54.39	359.07	0.2317	45.58	300.98
21	0.0	196.71	196.71	1298.60	0.2584	50.83	335.58	0.2145	42.20	278.61
22	0.0	196.71	196.71	1298.60	0.2415	47.50	313.62	0.1986	39.07	257.97
23	0.0	196.71	196.71	1298.60	0.2257	44.40	293.11	0.1839	36.18	238.86
24	0.0	196.71	196.71	1298.60	0.2109	41.49	273.93	0.1703	33.50	221.17
25	0.0	196.71	196.71	1298.60	0.1971	38.78	256.01	0.1576	31.02	204.78
26	0.0	196.71	196.71	1298.60	0.1842	36.24	239.26	0.1460	28.72	189.61
27	0.0	196.71	196.71	1298.60	0.1721	33.87	223.61	0.1352	26.59	175.57
28	0.0	196.71	196.71	1298.60	0.1609	31.65	208.98	0.1251	24.62	162.56
29	0.0	196.71	196.71	1298.60	0.1504	29.58	195.31	0.1159	22.80	150.52
30	0.0	196.71	196.71	1298.60	0.1405	27.65	182.53	0.1073	21.11	139.37
31	0.0	196.71	196.71	1298.60	0.1313	25.84	170.59	0.0995	19.54	129.05
32	0.0	196.71	196.71	1298.60	0.1227	24.15	159.43	0.0920	18.10	119.49
33	0.0	196.71	196.71	1298.60	0.1147	22.57	149.00	0.0852	16.75	110.64
34	0.0	196.71	196.71	1299.60	0.1072	21.09	139.25	0.0788	15.51	102.44
35	0.0	196.71	196.71	1298.60	0.1002	19.71	130.14	0.0730	14.36	94.85
36	0.0	196.71	196.71	1298.60	0.0936	18.42	121.63	0.0676	13.30	87.83
37	0.0	196.71	196.71	1298.60	0.0875	17.21	113.67	0.0626	12.31	81.32
38	0.0	196.71	196.71	1298.60	0.0818	16.09	106.23	0.0579	11.40	75.30
39	0.0	196.71	196.71	1298.60	0.0764	15.03	99.28	0.0536	10.56	69.72
40	0.0	196.71	196.71	1298.60	0.0714	14.05	92.79	0.0497	9.77	64.55
41	0.0	196.71	196.71	1298.60	0.0667	13.13	86.72	0.0460	9.05	59.77
42	0.0	196.71	196.71	1298.60	0.0624	12.27	81.04	0.0426	8.38	55.34
43	0.0	196.71	196.71	1298.60	0.0583	11.47	75.74	0.0394	7.76	51.24
44	0.0	196.71	196.71	1298.60	0.0545	10.72	70.79	0.0365	7.18	47.45
45	0.0	196.71	196.71	1298.60	0.0509	10.02	66.15	0.0338	6.65	43.93
46	0.0	196.71	196.71	1298.60	0.0476	9.36	61.83	0.0313	6.16	40.68
47	0.0	196.71	196.71	1298.60	0.0444	8.75	57.78	0.0290	5.70	37.66
48	0.0	196.71	196.71	1298.60	0.0415	8.18	54.00	0.0268	5.29	34.87
49	0.0	196.71	196.71	1298.60	0.0388	7.64	50.47	0.0248	4.89	32.29
50	0.0	196.71	196.71	1298.60	0.0363	7.14	47.17	0.0230	4.52	29.90
	13746.82	9851.95	22598.77	58877.75		15745.66	13865.33		15202.77	11938.11

Table 8–2–8 Cost and Benefit Stream (Plan II)

(Unit : 10^5 COL$)

Year in Order	Cost			Benefit	Present Value (11%)			Present Value (12%)		
	Const.	M/O	Total		Discount Rate	Cost	Benefit	Discount Rate	Cost	Benefit
1	479.47	0.0	479.47	0.0	1.0000	479.47	0.0	1.0000	479.47	0.0
2	2049.45	0.0	2049.45	0.0	0.9009	1846.35	0.0	0.8928	1829.86	0.0
3	6010.64	0.0	6010.64	118.41	0.8116	4878.37	96.10	0.7971	4791.64	94.39
4	5161.38	0.0	5161.38	515.79	0.7311	3773.95	377.14	0.7117	3673.76	367.12
5	2364.20	0.0	2364.20	913.17	0.6587	1557.37	601.53	0.6355	1502.49	580.33
6	0.0	236.58	236.58	1346.26	0.5934	140.39	798.93	0.5674	134.24	763.90
7	0.0	236.58	236.58	1780.02	0.5346	126.48	951.67	0.5066	119.85	901.81
8	0.0	236.58	236.58	2244.25	0.4816	113.95	1080.96	0.4523	107.01	1015.18
9	0.0	236.58	236.58	2315.37	0.4339	102.65	1004.70	0.4038	95.55	935.13
10	0.0	236.58	236.58	2345.85	0.3909	92.48	917.05	0.3606	85.31	845.93
11	0.0	236.58	236.58	2345.85	0.3521	83.31	826.17	0.3219	76.17	755.30
12	0.0	236.58	236.58	2345.85	0.3172	75.06	744.29	0.2874	68.01	674.37
13	0.0	236.58	236.58	2345.85	0.2858	67.62	670.53	0.2566	60.72	602.12
14	0.0	236.58	236.58	2345.85	0.2575	60.92	604.08	0.2291	54.21	537.60
15	0.0	236.58	236.58	2345.85	0.2319	54.88	544.22	0.2046	48.40	480.00
16	0.0	236.58	236.58	2345.85	0.2090	49.44	490.29	0.1826	43.22	428.57
17	0.0	236.58	236.58	2345.85	0.1882	44.54	441.70	0.1631	38.59	382.65
18	0.0	236.58	236.58	2345.85	0.1696	40.13	397.93	0.1456	34.45	341.65
19	0.0	236.58	236.58	2345.85	0.1528	36.15	358.49	0.1300	30.76	305.05
20	0.0	236.58	236.58	2345.85	0.1376	32.57	322.97	0.1161	27.46	272.36
21	0.0	236.58	236.58	2345.85	0.1240	29.34	290.96	0.1036	24.52	243.18
22	0.0	236.58	236.58	2345.85	0.1117	26.43	262.13	0.0925	21.89	217.13
23	0.0	236.58	236.58	2345.85	0.1006	23.81	236.15	0.0826	19.55	193.86
24	0.0	236.58	236.58	2345.85	0.0906	21.45	212.75	0.0737	17.45	173.09
25	0.0	236.58	236.58	2345.85	0.0817	19.32	191.66	0.0658	15.58	154.54
26	0.0	236.58	236.58	2345.85	0.0736	17.41	172.67	0.0588	13.91	137.99
27	0.0	236.58	236.58	2345.85	0.0663	15.68	155.56	0.0525	12.42	123.20
28	0.0	236.58	236.58	2345.85	0.0597	14.13	140.14	0.0468	11.09	110.00
29	0.0	236.58	236.58	2345.85	0.0538	12.73	126.25	0.0418	9.90	98.21
30	0.0	236.58	236.58	2345.85	0.0484	11.47	113.74	0.0373	8.84	87.69
31	0.0	236.58	236.58	2345.85	0.0436	10.33	102.47	0.0333	7.89	78.29
32	0.0	236.58	236.58	2345.85	0.0393	9.31	92.31	0.0298	7.05	69.91
33	0.0	236.58	236.58	2345.85	0.0354	8.38	83.16	0.0266	6.29	62.41
34	0.0	236.58	236.58	2345.85	0.0319	7.55	74.92	0.0237	5.62	55.73
35	0.0	236.58	236.58	2345.85	0.0287	6.80	67.50	0.0212	5.01	49.76
36	0.0	236.58	236.58	2345.85	0.0259	6.13	60.81	0.0189	4.48	44.42
37	0.0	236.58	236.58	2345.85	0.0233	5.52	54.78	0.0169	4.00	39.66
38	0.0	236.58	236.58	2345.85	0.0210	4.97	49.35	0.0150	3.57	35.41
39	0.0	236.58	236.58	2345.85	0.0189	4.48	44.46	0.0134	3.18	31.62
40	0.0	236.58	236.58	2345.85	0.0170	4.04	40.05	0.0120	2.84	28.23
41	0.0	236.58	236.58	2345.85	0.0153	3.63	36.08	0.0107	2.54	25.21
42	0.0	236.58	236.58	2345.85	0.0138	3.27	32.51	0.0095	2.27	22.50
43	0.0	236.58	236.58	2345.85	0.0124	2.95	29.29	0.0085	2.02	20.09
44	0.0	236.58	236.58	2345.85	0.0112	2.66	26.38	0.0076	1.80	17.94
45	0.0	236.58	236.58	2345.85	0.0101	2.39	23.77	0.0068	1.61	16.02
46	0.0	236.58	236.58	2345.85	0.0 91	2.15	21.41	0.0060	1.44	14.30
47	0.0	236.58	236.58	2345.85	0.0082	1.94	19.29	0.0054	1.28	12.77
48	0.0	236.58	236.58	2345.85	0.0074	1.75	17.38	0.0048	1.15	11.40
49	0.0	236.58	236.58	2345.85	0.0066	1.57	15.66	0.0043	1.02	10.18
50		236.58	236.58	2345.85	0.0060	1.42	14.10	0.0038	0.91	9.09
	16865 14	10646.10	26711.24	105415.12		13939.33	14936.07		13522.52	12477.55

EIRR = 11.1 %

Table 8–2–9 Cost and Benefit Stream (Plan III)

(Unit : 10^5 COL$)

Year in Order	Cost			Benefit	Present Value (13%)			Present Value (14%)		
	Const.	M/O	Total		Discount Rate	Cost	Benefit	Discount Rate	Cost	Benefit
1	479.47	0.0	479.47	0.0	1.0000	479.47	0.0	1.0000	479.47	0.0
2	3038.29	0.0	3038.29	0.0	0.8849	2688.75	0.0	0.8771	2665.16	0.0
3	7700.82	0.0	7700.82	259.84	0.7831	6030.87	203.49	0.7694	5925.55	199.93
4	6456.05	0.0	6456.05	987.25	0.6930	4474.36	684.19	0.6749	4357.64	666.35
5	2756.86	0.0	2756.86	1714.61	0.6133	1690.83	1051.60	0.5920	1632.28	1015.18
6	0.0	320.61	320.61	2289.14	0.5427	174.01	1242.45	0.5193	166.51	1188.90
7	0.0	320.61	320.61	2840.75	0.4803	153.99	1364.46	0.4555	146.06	1294.20
8	0.0	320.61	320.61	3422.84	0.4250	136.27	1454.91	0.3996	128.12	1367.89
9	0.0	320.61	320.61	3493.96	0.3761	120.60	1314.28	0.3505	112.39	1224.83
10	0.0	320.61	320.61	3524.44	0.3328	106.72	1173.23	0.3075	98.59	1083.79
11	0.0	320.61	320.61	3524.44	0.2945	94.44	1038.25	0.2697	86.48	950.69
12	0.0	320.61	320.61	3524.44	0.2606	83.58	918.81	0.2366	75.86	833.94
13	0.0	320.61	320.61	3524.44	0.2307	73.96	813.10	0.2075	66.54	731.52
14	0.0	320.61	320.61	3524.44	0.2041	65.45	719.56	0.1820	58.37	641.69
15	0.0	320.61	320.61	3524.44	0.1806	57.92	636.78	0.1597	51.20	562.88
16	0.0	320.61	320.61	3524.44	0.1598	51.26	563.52	0.1400	44.91	493.76
17	0.0	320.61	320.61	3524.44	0.1414	45.36	498.69	0.1228	39.40	433.12
18	0.0	320.61	320.61	3524.44	0.1252	40.14	441.32	0.1077	34.56	379.93
19	0.0	320.61	320.61	3524.44	0.1108	35.52	390.55	0.0945	30.31	333.27
20	0.0	320.61	320.61	3524.44	0.0980	31.44	345.62	0.0829	26.59	292.34
21	0.0	320.61	320.61	3524.44	0.0867	27.82	305.85	0.0727	23.32	256.44
22	0.0	320.61	320.61	3524.44	0.0767	24.62	270.67	0.0638	20.46	224.95
23	0.0	320.61	320.61	3524.44	0.0679	21.78	239.55	0.0559	17.95	197.32
24	0.0	320.61	320.61	3524.44	0.0601	19.28	211.97	0.0491	15.74	173.09
25	0.0	320.61	320.61	3524.44	0.0532	17.06	187.59	0.0430	13.81	151.83
26	0.0	320.61	320.61	3524.44	0.0471	15.10	166.00	0.0377	12.11	133.18
27	0.0	320.61	320.61	3524.44	0.0416	13.36	146.90	0.0331	10.62	116.83
28	0.0	320.61	320.61	3524.44	0.0368	11.82	130.00	0.0290	9.32	102.48
29	0.0	320.61	320.61	3524.44	0.0326	10.46	115.05	0.0255	8.17	89.99
30	0.0	320.61	320.61	3524.44	0.0288	9.26	101.81	0.0223	7.17	78.85
31	0.0	320.61	320.61	3524.44	0.0255	8.19	90.10	0.0196	6.29	69.17
32	0.0	320.61	320.61	3524.44	0.0226	7.25	79.73	0.0172	5.51	60.67
33	0.0	320.61	320.61	3524.44	0.0200	6.41	70.56	0.0151	4.84	53.22
34	0.0	320.61	320.61	3524.44	0.0177	5.68	62.44	0.0132	4.24	46.69
35	0.0	320.61	320.61	3524.44	0.0156	5.02	55.26	0.0115	3.72	40.95
36	0.0	320.61	320.61	3524.44	0.0138	4.44	48.90	0.0101	3.26	35.92
37	0.0	320.61	320.61	3524.44	0.0122	3.93	43.27	0.0089	2.86	31.51
38	0.0	320.61	320.61	3524.44	0.0108	3.48	38.29	0.0078	2.51	27.64
39	0.0	320.61	320.61	3524.44	0.0096	3.08	33.89	0.0068	2.20	24.24
40	0.0	320.61	320.61	3524.44	0.0085	2.72	29.99	0.0060	1.93	21.27
41	0.0	320.61	320.61	3524.44	0.0075	2.41	26.54	0.0052	1.69	18.65
42	0.0	320.61	320.61	3524.44	0.0066	2.13	23.48	0.0046	1.48	16.36
43	0.0	320.61	320.61	3524.44	0.0058	1.89	20.78	0.0040	1.30	14.35
44	0.0	320.61	320.61	3524.44	0.0052	1.67	18.39	0.0035	1.14	12.59
45	0.0	320.61	320.61	3524.44	0.0046	1.48	16.27	0.0031	1.00	11.04
46	0.0	320.61	320.61	3524.44	0.0040	1.31	14.40	0.0027	0.88	9.69
47	0.0	320.61	320.61	3524.44	0.0036	1.15	12.74	0.0024	0.77	8.50
48	0.0	320.61	320.61	3524.44	0.0032	1.02	11.28	0.0021	0.67	7.45
49	0.0	320.61	320.61	3524.44	0.0028	0.90	9.98	0.0018	0.59	6.54
50	0.0	320.61	320.61	3524.44	0.0025	0.80	8.83	0.0016	0.52	5.73
	20451.49	14427.45	34878.94	159510.41		16870.09	17445.54		16412.27	15741.51

EIRR = 13.4 %

8.2.4 Economic Internal Rate of Return (EIRR)

Using the costs and benefit estimated in the above, the cost and benefit streams are firstly prepared as shown through Table 8-2-7 to 8-2-9, then the EIRR is calculated by electronic computer. The calculated EIRR are as follows:

Plan I	7.1%
Plan II	11.1%
Plan III	13.4%

Only the EIRR of Plan III indicates the economic soundness of the project.

8.2.5 Sensitivity Analysis (Only Plan III)

In order to evaluate further the soundness of the project to the possible changes of economic condition in future, the sensitivity analysis is made for the following critical condition in terms of economic internal rate of return.

1) Increase of construction cost
2) Decrease of production price
3) Increase of production cost

The calculated result of EIRR for each condition is shown in Table 8-2-10.

Table 8–2–10 Sensitivity Analysis

Condition	EIRR (%)
Construction Cost + 10%	12.3
Production Price - 10%	11.0
Production Cost + 10%	12.4

4) In addition, another sensitivity analysis which has the following critical condition is made. The construction cost include initial investment cost for farm machinery. Number of farm machine is as follows:

a. Tractor

Plowing, stamping and seeding by tractor concentrated in March for Sorghum and in September for Maize. Considering proposed plant area of cassava, watermelon and papaya is small and the time lag of cultivation from above-mentioned crops, same tractors will be used.

Tractors for improvement of pasture will be utilized in vacant hours. Estimate of required number of tractor is as follows:

Working hour in March and September;

Plowing	2.5 hours/ha
Stamping	3.0 hours/ha
Seeding	1.0 hours/ha
Total	6.5 hours/ha

Proposed plant area 2,670 ha (include 10 ha of non-irrigated area)

Daily working hour 12 hours

Monthly working day 30 days

Required number of tractor;

2,760 ha x 6.5 hour/ha ÷ (12 hour x 30 days)
= 48.2 ≒ 49 units.

b. Combine

Harvest of Maize and Sorghum in February and June, respectively. Estimated harvest time is 1.5 hour/ha.
Required number of combine is as follows:

Proposed plant area 2,660 ha (Irrigated area only)

2,660 ha x 1.5 hour/ha ÷ 360 hour = 11.1 ≒ 12 units

c. Estimated purchase cost for machine

Purchase cost for farm machines used for economic analysis are based on the price list of agency in Cucuta. Price list of farm machinery are shown in Table 8-2-11.

Table 8–2–11 Price List of Farm Machine

Machine and Attachment	Spec. of Machine	Cost (COL$)
Tractor	70 Hp	1,350,000
Plow	4 disk	180,000
Harrow	32 disk	190,000
Seeder	4 lines	180,000
Fertilizer Applicator		100,000
Cultivator		150,000
Sub Total		2,300,000
Combine	110 Hp	6,130,000

d. Purchase of Farm Machinery

Farm machinery will be phased in proportion to the development area. The purchase scheme of farm machinery is shown in Table 8-2-12.

Table 8–2–12 Number and Purchase Cost of Farm Machinery

Year in Order		2	3	4	5	Total
Number	Tractor	8	17	17	7	49
	Combine	2	4	5	1	12
Purchase Cost (10^3 COL$)		30,660	63,620	69,750	22,230	186,260

The calculated result of EIRR is 12.4%.

8.3 Financial Evaluation

8.3.1 General

The financial feasibility of the project is evaluated from the viewpoint of farmer's economy.

8.3.2 Construction Cost

The total construction cost and its annual disbursement thus estimated are shown in Table 8-3-2.

Table 8–3–1 Annual Disbursement Schedule of Construction Cost

(Unit: 10^3 COL$)

Plan	Year	1	2	3	4	5	Total
I	Foreign Portion	49,407	147,426	390,458	439,763	235,983	1,263,037
	Local Portion	11,479	94,068	337,993	259,882	123,822	827,244
	Total	60,886	241,494	728,451	699,645	359,805	2,090,281
II	Foreign Portion	49,407	163,209	488,916	517,960	275,290	1,494,782
	Local Portion	11,479	104,234	380,658	296,142	140,385	932,898
	Total	60,886	267,443	869,574	814,102	415,675	2,427,680
III	Foreign Portion	49,407	208,931	596,031	620,150	312,385	1,786,904
	Local Portion	11,479	190,179	525,820	408,880	175,262	1,311,620
	Total	60,886	399,110	1,121,851	1,029,030	487,647	3,098,524

8.3.3 Repayment of Construction Cost

The financial evaluation of the project is made by examining the repayment capability for the construction cost of the project. The capital required for the project implementation will be arranged under the following condition:

1) For the foreign currency portion, the capital is financed by bilateral or international organizations with

Interest	8 or 4.5%
Price Escalation	8%
per annum.	

2) For the local currency portion, the capital is financed with

Interest	20 or 18 %
Price Escalation	20%
per annum.	

3) The annual repayment of farmer is made with

Interest	20 or 18%
Repayment Period	20 years including 5 year grace period
per annum	

Under the condition stated above, the repayment of average farm are summarized through Table 8-3-2 to 8-3-5. Also, repayment analysis by each zone is made and result obtained are tabulated in Table 8-3-6.

Table 8-3-2 Calculation of Repayment (Plan I)

Foreign Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 8%)	Interest (8%)	Total
1	49,407	1.08^5	72,595
2	147,426	1.08^4	200,571
3	390,458	$1,08^3$	491,865
4	439,763	1.08^2	512,940
5	235,983	1.08	254,862
Total	1,263,037		1,532,832

Local Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 20%)	Interest (20%)	Total
1	11,479	1.2^5	28,563
2	94,068	1.2^4	195,059
3	337,993	1.2^3	584,052
4	259,882	1.2^2	374,230
5	123,822	1.2	148,586
Total	827,244		1,330,491

F/C + L/C = 2,863,323(10^3 COL$)

Interest: 20%
Repayment Period: 15 years

2,863,323 x 0.2139 = 612,465 (10^3 COL$)

Annual Repayment of the Average Farm
(Total Project Area: 10,550 ha, Average Farm Area: 32.9 ha)

612,465 ÷ 10,550 x 32.9 = 1,910(10^3 COL$)

Table 8–3–3 Calculation of Repayment (Plan II)

Foreign Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 8%)	Interest (8%)	Total
1	49,407	1.08^5	72,595
2	163,209	1.08^4	222,044
3	488,916	1.08^3	615,893
4	517,960	1.08^2	604,149
5	275,290	1.08	297,313
Total	1,494,782		1,811,994

Local Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 20%)	Interest (20%)	Total
1	11,479	1.2^5	28,563
2	104,234	1.2^4	216,140
3	380,658	1.2^3	657,777
4	296,142	1.2^2	426,444
5	140,385	1.2	168,462
Total	932,898		1,497,387

F/C + l/C = 3,309,381(10^3 COL$)

Interest: 20%
Repayment Period: 15 years

3,309,381 x 0.2139 = 707,877(10^3 COL$)

Annual Repayment of the Average Farm
(Total Project Area: 10,550 ha, Average Farm Area: 32.9 ha)

707,877 ÷ 10,550 x 32.9 = 2.208(10^3 COL$)

Table 8-3-4 Calculation of Repayment (Plan III)

Foreign Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 8%)	Interest (8%)	Total
1	49,407	1.08^5	72,595
2	208,931	1.08^4	284,248
3	596,031	1.08^3	750,827
4	620,150	1.08^2	723,343
5	312,385	1.08	337,376
Total	1,786,904		2,168,390

Local Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 20%)	Interest (20%)	Total
1	11,479	1.2^5	28,563
2	190,179	1.2^4	394,355
3	525,820	1.2^3	908,617
4	408,880	1.2^2	588,787
5	175,262	1.2	210,314
Total	1,311,620		2,130,637

F/C + L/C = 4,299,027(10^3 COL$)

Interest: 20%
Repayment Period: 15 years

$$4,299,027 \times 0.2139 = 919,562(10^3 \text{ COL\$})$$

Annual Repayment of the Average Farm
(Total Project Area: 10,300 ha, Average Farm Area: 32.2 ha)

$$919,562 \div 10,300 \times 32.2 = 2,875(10^3 \text{ COL\$})$$

Table 8-3-5 Calculation of Repayment (Plan I)

Foreign Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 8%)	Interest (4.5%)	Total
1	49,407	1.045^5	61,570
2	147,426	$1,045^4$	175,808
3	390,458	$1,045^3$	445,577
4	439,763	1.045^2	480,232
5	235,983	1,045	246,602
Total	1,263,037		1,409,790

Local Currency Portion (Unit: 10^3 COL$)

Year in Order	Construction Cost (Include Price Escalation 20%)	Interest (18%)	Total
1	11,479	1.18^5	26,261
2	94,068	1.18^4	182,377
3	337,993	1.18^3	555,333
4	259,882	1.18^2	361,860
5	123,822	1.18	146,110
Total	827,244		1,271,941

F/C + L/C = 2,681,731 (10^3 COL$)

Interest: 18%
Repayment Period: 15 years

2,681,731 x 0.1964 = 526,692 (10^3 COL$)

Annual Repayment of the Average Farm
(Total Project Area: 10,550 ha, Average Farm Area: 32.9 ha)

526,692 ÷ 10,550 x 32.9 = 1,642 (10^3 COL$)

Table 8–3–6 Annual Repayment of Each Zone

	Plan I	Plan II	Plan III
A Zone			
Average Farm Area (ha)	41.0	41.0	41.0
Average Economic Surplus (10^3 COL$)	426	917	917
Annual Repayment (10^3 COL$)	1,263	2,303	2,279
B Zone			
Average Farm Area (ha)	34.7	34.7	34.0
Average Economic Surplus (10^3 COL$)	487	856	856
Annual Repayment (10^3 COL$)	1,443	2,150	2,127
C Zone			
Average Farm Area (ha)	27.7	27.1	26.3
Average Economic Surplus (10^3 COL$)	626	887	1,274
Annual Repayment (10^3 COL$)	1,855	2,228	3,166
D Zone			
Average Farm Area (ha)	38.4	38.4	37.2
Average Economic Surplus (10^3 COL$)	599	875	1,713
Annual Repayment (10^3 COL$)	1,775	2,198	4,257
Total Area			
Average Farm Area (ha)	32.9	32.9	32.2
Average Economic Surplus (10^3 COL$)	554	879	1,157
Annual Repayment (10^3 COL$)	1,642	2,208	2,875

Plan I: F/C; Interest 4.5% Price Escalation 8%
L/C; Interest 18% Price Escalation 20%
Repayment; Interest 18%
Period 15 Years (5-year Grace Period)

Plan II, III: F/C; Interest 8% Price Escalation 8%
L/C; Interest 20% Price Escalation 20%
Repayment; Interest 20%
Period 15 Years (5-year Grace Period)

Repayment of Zone = Economic Surplus of Zone ÷ Economic Surplus of Total Average x Repayment of Total Average

8.3.4 Capacity to Pay

For evaluating the project feasibility from the financial aspect of farm, economic surplus of the average farm analysis are made under the future with project. The capacity to pay expected under the future with project condition is shown in Table 8-3-7.

Table 8–3–7 Annual Economic Surplus

(Unit : 10^3 COL$)

Year in Order	Plan I	Plan II	Plan III
1	239	264	250
2	295	329	317
3	402	456	499
4	632	766	1,008
5	952	1,203	1,670
6	1,307	1,759	2,487
7	1,767	2,583	3,483
8	2,358	3,667	4,876
9	2,859	4,490	5,908
10	3,430	5,543	7,164

* include price escalation

The repayment schedule of the average farm is prepared as shown in Table 8-3-8.

Table 8-3-8 Repayment Schedule of the Average Farm

Interest: 20%
Repayment Period: 20 Years
(5-year Grace Period)

(Unit: 10^3 COL$)

Year in Order	Economic Surplus*	Repayment
1	250	
2	317	
3	499	
4	1,008	
5	1,670	
6	2,487	2,487
7	3,483	3,341
8	4,876	2,875
9	5,908	2,875
10	7,164	2,875
11	8,597	2,875
12	10,316	2,875
13	12,379	2,875
14	14,855	2,875
15	17,826	2,875
16	21,391	2,875
17	25,669	2,875
18	30,803	2,875
19	36,964	2,875
20	44,357	2,875
21	53,228	0
22		

* including price escalation.

8.3.5 Repayment Program (Only Plan III)

In the examination of repayment capability, it is assumed that the foreign currency portion of the construction cost will be arranged under the following condition:

1) The interest is 8 or 4.5% per annum.
2) The repayment period is 20 or 25 years including 5 year grace period

Based on the above condition, the repayment programs for the foreign currency portion are prepared as shown through Table 8-3-9 to 8-3-11.

Table 8–3–9 Repayment Program of Foreign Loan Case 1

Interest: 8%
Repayment Period: 20 Years
(5-year Grace Period)

(Unit: 10^3 COL$)

Year in Order	Foreign Loan	Accumulated Foreign Loan	Interest Payment	Capital Payment	Total Payment
1	49,407	49,407	3,950		3,953
2	208,931	258,338	20,667		20,667
3	596,031	854,369	68,350		68,350
4	620,150	1,474,519	117,962		117,962
5	312,385	1,786,904	142,952		142,952
6		1,786,904	142,952	119,127	262,079
7		1,667,777	133,422	119,127	252,549
8		1,548,650	123,892	119,127	243,019
9		1,429,523	114,362	119,127	233,489
10		1,310,396	104,832	119,127	223,959
11		1,191,269	95,302	119,127	214,429
12		1,072,142	85,771	119,127	204,898
13		953,015	76,241	119,127	195,368
14		833,888	66,711	119,127	185,838
15		714,761	57,181	119,127	176,308
16		595,634	47,651	119,127	166,778
17		476,507	38,121	119,127	157,248
18		357,380	28,590	119,127	147,717
19		238,253	19,060	119,127	138,187
20		119,126	9,530	119,126	128,657
21		0	0	0	0
22					

Table 8–3–10 Repayment Program of Foreign Loan Case 2

Interest: 8%
Repayment Period: 25 Years
(5-year Grace Period)

(Unit: 10^3 COL$)

Year in Order	Foreign Loan	Accumulated Foreign Loan	Interest Payment	Capital Payment	Total Payment
1	49,407	49,407	3,953		3,950
2	208,931	258,338	20,667		20,667
3	596,031	854,369	68,350		68,350
4	620,150	1,474,519	117,962		117,962
5	312,385	1,786,904	142,952		142,952
6		1,786,904	142,952	89,346	232,298
7		1,697,558	135,805	89,346	225,151
8		1,608,212	128,657	89,346	218,003
9		1,518,866	121,509	89,346	210,855
10		1,429,520	114,362	89,346	203,708
11		1,340,174	107,214	89,346	196,560
12		1,250,828	100,066	89,346	189,412
13		1,161,482	92,919	89,346	182,265
14		1,072,136	85,771	89,346	175,117
15		982,790	78,623	89,346	167,969
16		893,444	71,476	89,346	160,822
17		804,098	64,328	89,346	153,674
18		714,752	57,180	89,346	146,526
19		625,406	50,032	89,346	139,378
20		536,060	42,885	89,346	132,231
21		446,714	35,737	89,346	125,083
22		357,368	28,589	89,346	117,935
23		268,022	21,442	89,346	110,788
24		178,676	14,294	89,346	103,640
25		89,330	7,146	89,330	96,492
26		0	0	0	0

Table 8–3–11 Repayment Program of Foreign Loan Case 3

Interest: 4.5%
Repayment Period: 25 Years
(5-year Grade Period)

(Unit: 10^3 COL$)

Year in Order	Foreign Loan	Accumulated Foreign Loan	Interest Payment	Capital Payment	Total Payment
1	49,407	49,407	2,223		2,223
2	208,931	258,338	11,625		11,625
3	596,031	854,369	38,447		38,447
4	620,150	1,474,519	66,353		66,353
5	312,385	1,786,904	80,411		80,411
6		1,786,904	80,411	89,346	169,757
7		1,697,558	76,390	89,346	165,736
8		1,608,212	72,370	89,346	161,716
9		1,518,866	68,349	89,346	157,695
10		1,429,520	64,328	89,346	153,674
11		1,340,174	60,308	89,346	149,654
12		1,250,828	56,287	89,346	145,633
13		1,161,482	52,267	89,346	141,613
14		1,072,136	48,246	89,346	137,592
15		982,790	44,226	89,346	133,572
16		893,444	40,205	89,346	129,551
17		804,098	36,184	89,346	125,530
18		714,752	32,164	89,346	121,510
19		625,406	28,143	89,346	117,489
20		536,060	24,123	89,346	113,469
21		446,714	20,102	89,346	109,448
22		357,368	16,082	89,346	105,428
23		268,022	12,061	89,346	101,407
24		178,676	8,040	89,346	97,386
25		89,330	4,020	89,330	93,366
26		0	0	0	0

8.4 Socio-Economic Impact

In addition to the direct benefits stipulated in the econimic evaluation, favourable but intangible socio-economic impacts are expected from the implementation of the project.

8.4.1 Improvement of Environmental Sanitation

The construction of the project works would have a positive effect on the ecology of the project area. The health and sanitary conditions would become better with drainage improvement as well as supply of fresh water through the irrigation canals.

8.4.2 Improvement of Local Transportation

The local transportation will be improved much by the construction of the operation and maintenance roads along the drainage and the irrigation canals. The expanded road system will not only enhance the economic activity in and around the project area but also contribute to inter-regional accessibility and communications.

8.4.3 Increase of Employment Opportunity to Local People

Employment opportunity to the local people will be increased by the project implementation, and a favourable impact will be given to the national economy. Furthermore, the employee will be able to gain more experience, technical know-how, skillfulness in the various working fields. These accumulations would be applied to the future development in the Norte de Santander Department.

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