Tables

Table 2. 1 CENSUS POPULATION OF EL SALVADOR, REGION AND DEPARTMENT

(1950, 1961, 1971 AND 1992)

Department	Area (km2)	1950 (June 13)			1961 (May 2)			1971 (June 28)			1992 (September 27)			Population Density (Persons/km2)			
		Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	1950	1961	1971	1992
El Salvador	21,040.2	677,167	,178,750	1,855,917	966,899	1,544,085	2,510,984	,405,532	2,149,116	3,554,648	2,581,834	2,536,765	5,118,599	88	119	169	243
Region I	4,488.0	148,680	268,748	417,428	197,509	359,288	556,797	271,428	479,956	751,384	404,826	675,132	1,079,958	93	124	167	241
1 Ahuachapan	1,239.6	28,107	66,539	94,646	34,135	96,575	130,710	41,009	137,463	178,472	58,983	202,205	261,188	76	105	144	211
2 Santa Ana	2,023.2	74,181	128,274	202,455	103,178	155,977	259,155	143,865	191,988	335,853	205,214	253,373	458,587	100	128	166	227
3 Sonsonate	1,225.2	46,392	73,935	120,327	60,196	106,736	166,932	86,554	150,505	237,059	140,629	219,554	360,183	98	136	193	294
Region II	5,311.9	311,824	324,590	636,414	482,615	427,032	909,647	748,444	596,246	1,344,690	1,571,100	810,713	2,381,813	120	171	253	448
4 Chalatenango	2,016.6	27,152	78,707	105,859	35,501	94,396	129,897	47,516	125,329	172,845	60,233	117,087	177,320	52	64	86	88
5 La Libertad	1,652.9	49,560	94,444	144,004	70,974	132,506	203,480	98,522	187,053	285,575	220,065	293,801	513,866	87	123	173	311
6 San Salvador	886.2	212,933	83,519	296,452	349,374	113,854	463,228	561,521	171,924	733,445	,223,472	288,653	1,512,125	335	523	828	1706
7 Cuscatlan	756.2	22,179	67,920	90,099	26,766	86,276	113,042	40,885	111,940	152,825	67,330	111,172	178,502	119	149	202	236
Region III	3,511.1	72,601	189,447	262,048	91,896	246,273	338,169	119,146	347,262	466,408	194,433	332,911	527,344	75	96	133	150
8 La Paz	1,223.6	34,430	62,413	96,843	41,906	88,753	130,659	53,041	128,888	181,929	91,693	154,222	245,915	79	107	149	201
9 Cabanas	1,103.5	11,403	66,225	77,628	15,171	79,419	94,590	22,309	108,772	131,081	42,550	95,876	138,426	70	86	119	125
10 San Vicente	1,184.0	26,768	60,809	87,577	34,819	78,101	112,920	43,796	109,602	153,398	60,190	82,813	143,003	74	95	130	121
Region IV	7,729.2	144,062	395,965	540,027	194,879	511,492	706,371	266,514	725,652	992,166	411,475	718,009	1,129,484	70	91	128	146
11 Usulutan	2,130.4	48,631	113,718	162,349	58,428	148,633	207,061	79,686	214,811	294,497	123,397	186,965	310,362	76	97	138	146
12 San Miguel	2,077.1	54,131	117,103	171,234	77,654	154,167	231,821	108,754	211,848	320,602	186,207	217,204	403,411	82	112	154	194
13 Morazan	1,447.4	16,495	80,234	96,729	23,560	95,821	119,381	29,011	127,041	156,052	42,664	117,482	160,146	67	82	108	111
14 La Union	2,074.3	24,805	84,910	109,715	35,237	112,871	148,108	49,063	171,952	221,015	59,207	196,358	255,565	53	71	107	123

Source : Censos Nacionales de Poblacion y Vivienda, 1961, 1971 y 1992

Table 2.2 AREA, POPULATION AND NUMBER OF HOUSEHOLDS IN THE STUDY AREA BY DEPARTMENT

1) Area and Population

Department	Area (km2)			No. of Administratiopn Unit			1971 Population				1992 Population				Average Annual Growth Growth Rate(%),1971-1992		
	Dep. (A)	S. Area (B)	Ratio (%) (B)/(A)	Muni-cipios	Cantons	Caserios	Urban	Rural	Total	Density (P/km2)	Urban	Rural	Total	Density (P/km2)	Urban	Rural	Total
San Miguel	2,077.1	1,265.5	60.9	15	99	302	92,039	139,474	231,513	182.9	165,509	148,986	314,495	248.5	2.80	0.31	1.45
Usultan	2,130.4	328.4	15.4	9	33	98	16,014	44,891	60,905	185.5	24,047	41,317	65,364	199.0	1.93	-0.39	0.33
Morazan	1,447.4	523.8	36.2	13	49	146	18,144	52,165	70,309	134.2	27,793	50,334	78,127	149.2	2.03	-0.17	0.50
La Union	2,074.3	129.1	6.2	4	11	32	2,857	11,040	13,897	107.6	2,643	13,326	15,969	123.7	-0.37	0.89	0.66
Total	7,729.2	2,246.8	29.1	41	192	578	129,054	247,569	376,623	167.6	219,992	253,964	473,956	210.9	2.54	0.12	1.09

2) Households

Department	No.of Households			Family Size in 1992 (Persons/hh)		
	Urban	Rural	Total	Urban	Rural	Total
San Miguel	42,232	32,231	74,463	3.9	4.6	4.2
Usultan	6,016	9,124	15,140	4.0	4.5	4.3
Morazan	5,999	10,978	16,977	4.6	4.6	4.6
La Union	646	3,061	3,707	4.1	4.4	4.3
Total	54,893	55,394	110,287	4.0	4.6	4.3

Source: Censos Nacionales de Pobacion y Vivienda 1971 and 1992

Table 2.3 POPULATION PROJECTION OF EL SALVADOR AND DEPARTMENTS

Department	Area (km2)	Census Population('000)		Projected Population('000)			Density (Persons/km2)				Average Annual Growth Rate (%)					
		1971	1992	2000	2010	2020	1992	2000	2010	2020	1971-1992	1992-2000	2000-2010	2010-2020	1992-2010	1992-2020
El Salvador	**21,040.2**	**3,554.6**	**5,118.6**	**6,276.0**	**7,440.7**	**8,533.7**	**243**	**298**	**354**	**406**	**1.73**	**2.58**	**1.72**	**1.38**	**2.10**	**1.84**
Region I	**4,488.0**	**751.4**	**1,080.0**	**1,321.2**	**1,628.6**	**1,926.4**	**241**	**294**	**363**	**429**	**1.72**	**2.55**	**2.11**	**1.69**	**2.31**	**2.09**
1 Ahuachapan	1,239.6	178.5	261.2	319.8	392.4	462.5	211	258	317	373	1.81	2.56	2.07	1.66	2.29	2.06
2 Santa Ana	2,023.2	335.9	458.6	551.3	667.4	777.9	227	272	330	384	1.48	2.33	1.93	1.54	2.11	1.91
3 Sonsonate	1,225.2	237.1	360.2	450.1	568.7	686.0	294	367	464	560	1.99	2.83	2.37	1.89	2.57	2.33
Region II	**5,311.9**	**1,344.7**	**2,381.8**	**3,066.9**	**3,667.0**	**4,240.4**	**448**	**577**	**690**	**798**	**2.73**	**3.21**	**1.80**	**1.46**	**2.43**	**2.08**
4 Chalatenango	2,016.6	172.8	177.3	196.6	206.9	215.5	88	97	103	107	0.12	1.30	0.51	0.41	0.86	0.70
5 La Libertad	1,652.9	285.6	513.9	682.1	880.1	1,079.7	311	413	532	653	2.80	3.60	2.58	2.07	3.03	2.69
6 San Salvador	886.2	733.4	1,512.1	1,985.3	2,357.8	2,706.1	1,706	2,240	2,661	3,054	3.46	3.46	1.73	1.39	2.50	2.10
7 Cuscatlan	756.2	152.8	178.5	203.0	222.3	239.1	236	268	294	316	0.73	1.62	0.91	0.73	1.23	1.05
Region III	**3,511.1**	**466.4**	**527.3**	**606.8**	**686.5**	**758.9**	**150**	**173**	**196**	**216**	**0.58**	**1.77**	**1.24**	**1.01**	**1.48**	**1.31**
8 La Paz	1,223.6	181.9	245.9	292.9	344.8	393.0	201	239	282	321	1.43	2.21	1.65	1.32	1.90	1.69
9 Cabanas	1,103.5	131.1	138.4	152.8	160.9	167.6	125	139	146	152	0.26	1.25	0.51	0.41	0.84	0.68
10 San Vicente	1,184.0	153.4	143.0	161.1	180.8	198.3	121	136	153	167	-0.33	1.50	1.16	0.93	1.31	1.17
Region IV	**7,729.2**	**992.2**	**1,129.5**	**1,281.1**	**1,458.6**	**1,625.0**	**146**	**166**	**189**	**210**	**0.61**	**1.59**	**1.31**	**1.09**	**1.43**	**1.31**
11 Usulutan	2,130.4	294.5	310.4	338.3	357.9	374.5	146	159	168	176	0.25	1.08	0.57	0.45	0.80	0.67
12 San Miguel	2,077.1	320.6	403.4	480.3	599.2	715.4	194	231	288	344	1.09	2.20	2.24	1.79	2.22	2.07
13 Morazan	1,447.4	156.1	160.1	173.5	184.8	194.3	111	120	128	134	0.12	1.01	0.63	0.50	0.80	0.69
14 La Union	2,074.3	221.0	255.6	289.0	316.7	340.8	123	139	153	164	0.69	1.55	0.92	0.74	1.20	1.03

Source : Censos Nacionales de Poblacion y Vivienda, 1971 y 1992
Proyeccion de la Poblacion de El Salvador 1995-2025, DIGESTYC

Table 2.4(1/2) POPULATION PROJECTION OF DEPARTMENTS AND MUNICIPALITIES IN THE STUDY AREA

1) DEPARTMENT OF SAN MIGUEL

No	Municipality (Municipio)	Study Area		Census Population		Projected Population			Population Density (Persons/km²)				Average Annual Growth Rate (%			
		Ratio to Dept. (%)	Area (km2)	1971	1992	2000	2010	2020	1992	2000	2010	2020	1971-1992	1992-2000	2000-2010	2010-2020
I	**Department of San Miguel**	**100**	**2,077**	**320,602**	**403,411**	**480,276**	**599,173**	**715,436**	**194**	**231**	**288**	**344**	**1.09**	**2.20**	**2.24**	**1.79**
II	**Study Area in the Department**	**61**	**1,266**	**231,513**	**314,495**	**446,901**	**561,314**	**677,313**	**249**	**353**	**444**	**535**	**1.45**	**4.49**	**2.31**	**1.84**
1	San Miguel	100	594	120,640	191,116	239,038	317,190	397,995	322	402	534	670	2.19	2.84	2.87	2.30
2	Ciudad Barrios	20	14	2,974	4,961	31,610	42,974	54,984	365	2,324	3,160	4,043	2.44	26.05	3.12	2.50
3	Comacaran	100	35	4,063	3,523	3,832	4,148	4,420	102	111	120	128	-0.67	1.06	0.80	0.64
4	Chapeltique	80	83	8,029	8,356	11,208	12,205	13,067	101	135	147	158	0.19	3.74	0.86	0.68
5	Chinameca	80	62	18,841	16,620	22,554	24,416	26,017	268	364	394	420	-0.59	3.89	0.80	0.64
6	Chirilagua	60	124	12,679	13,033	23,202	25,118	26,765	105	187	202	216	0.13	7.48	0.80	0.64
7	El Transito	100	44	15,232	16,455	17,899	19,836	21,537	377	410	454	493	0.36	1.06	1.03	0.83
8	Lolotique	20	19	2,488	2,777	15,280	17,194	18,899	147	808	910	1,000	0.52	23.76	1.19	0.95
9	Moncagua	100	103	14,214	20,931	25,491	32,682	39,890	203	247	317	387	1.84	2.49	2.52	2.01
10	Nueva Guadalupe	30	7	1,538	1,970	7,600	9,125	10,565	290	1,118	1,342	1,554	1.17	18.38	1.85	1.48
11	Quelepa	100	22	3,652	4,859	5,703	6,971	8,188	219	257	314	369	1.35	2.02	2.03	1.62
12	San Jorge	100	38	8,899	8,903	9,417	10,065	10,616	236	250	267	282	0.00	0.70	0.67	0.53
13	San Rafael Oriente	100	45	11,325	15,110	17,751	21,727	25,548	336	394	483	568	1.37	2.03	2.04	1.63
14	Sesori	20	41	3,166	2,228	12,389	13,412	14,292	55	304	330	351	-1.64	23.92	0.80	0.64
15	Uluazapa	100	36	3,773	3,653	3,927	4,251	4,530	100	108	117	124	-0.15	0.91	0.80	0.64

2) DEPARTMENT OF USULUTAN

No	Municipality (Municipio)	Study Area		Census Population		Projected Population			Population Density (Persons/km²)				Average Annual Growth Rate (%			
		Ratio to Dept. (%)	Area (km2)	1971	1992	2000	2010	2020	1992	2000	2010	2020	1971-1992	1992-2000	2000-2010	2010-2020
I	**Department of Usulutan**	**100**	**2,130**	**294,497**	**310,362**	**338,332**	**357,942**	**374,455**	**146**	**159**	**168**	**176**	**0.25**	**1.08**	**0.57**	**0.45**
II	**Study Area in the Department**	**15**	**328**	**60,905**	**65,364**	**165,110**	**174,220**	**182,248**	**199**	**503**	**531**	**555**	**0.33**	**12.28**	**0.54**	**0.43**
16	Usulutan	20	28	9,284	12,865	69,099	73,341	76,924	459	2,468	2,619	2,747	1.55	23.38	0.60	0.48
17	California	30	7	648	690	2,544	2,703	2,837	95	348	370	389	0.30	17.72	0.61	0.49
18	Concepcion Batres	90	107	10,804	10,582	12,376	12,408	12,434	99	115	116	116	-0.10	1.98	0.03	0.02
19	Ereguaiquin	100	29	5,888	7,069	7,521	7,788	8,008	244	259	269	276	0.86	0.78	0.35	0.28
20	Jucuapa	40	14	7,582	6,226	16,498	16,881	17,194	432	1,146	1,172	1,194	-0.92	12.95	0.23	0.18
21	Jucuaran	30	72	5,729	3,359	12,743	13,085	13,365	47	177	182	186	-2.48	18.14	0.27	0.21
22	Santa Maria	100	12	4,383	8,043	9,989	12,629	15,242	676	839	1,061	1,281	2.90	2.75	2.37	1.90
23	Santa Elena	100	55	15,133	14,801	16,007	16,487	16,881	270	292	300	307	-0.10	0.98	0.30	0.24
24	Santiago de Maria	10	4	1,454	1,729	18,333	18,898	19,363	455	4,824	4,973	5,095	0.82	34.33	0.30	0.24

Source : Censos Nacionales de Pobacion y Vivienda, 1971 y 1992
Proyeccion de la Poblacion de El Salvador 2025, DIGESTYC

Table 2.4(2/2) POPULATION PROJECTION OF DEPARTMENTS AND MUNICIPALITIES IN THE STUDY AREA

3) DEPARTMENT OF MORAZAN

No	Municipality (Municipio)	Study Area		Census Population		Projected Population			Population Density (Persons/km²)				Average Annual Growth Rate (%			
		Ratio to Dept. (%)	Area (km2)	1971	1992	2000	2010	2020	1992	2000	2010	2020	1971-1992	1992-2000	2000-2010	2010-2020
I	**Department of Morazan**	100	1,447	156,052	160,146	173,499	184,757	194,293	111	120	128	134	0.12	1.01	0.63	0.50
II	**Study Area in the Department**	36	524	70,309	78,127	105,886	111,784	116,847	149	202	213	223	0.50	3.87	0.54	0.43
25	San Francisco (Gotera)	100	60	14,208	19,887	21,181	23,558	25,653	333	354	394	429	1.59	0.79	1.07	0.86
26	Cacaopera	20	27	2,869	1,870	10,452	10,836	11,153	69	385	399	411	-1.99	24.00	0.36	0.29
27	Chilanga	100	34	7,549	8,358	8,972	9,448	9,847	243	261	275	287	0.48	0.89	0.52	0.41
28	Delicias de Concepcion	60	12	2,476	2,849	4,946	5,074	5,179	235	408	418	427	0.66	7.14	0.26	0.20
29	El Divisadero	100	61	7,275	7,480	7,974	8,276	8,526	122	130	135	139	0.13	0.80	0.37	0.30
30	Guatajiagua	100	71	9,380	10,278	10,815	11,152	11,429	145	153	158	161	0.43	0.64	0.31	0.25
31	Jocoro	50	32	5,134	4,853	10,435	10,825	11,148	153	328	341	351	-0.26	10.04	0.37	0.29
32	Lolotiquillo	100	23	3,950	4,609	4,824	4,982	5,112	204	213	220	226	0.73	0.57	0.32	0.26
33	San Carlos	100	37	2,137	3,220	3,700	4,309	4,869	87	100	117	132	1.95	1.75	1.54	1.23
34	Sensembra	100	22	3,040	3,127	3,325	3,442	3,539	142	151	156	161	0.13	0.77	0.35	0.28
35	Sociedad	40	47	5,271	4,202	11,483	11,894	12,233	89	243	251	258	-1.06	13.39	0.35	0.28
36	Yamabal	100	84	3,758	3,623	3,845	3,944	4,025	43	46	47	48	-0.17	0.75	0.25	0.20
37	Yoloaiquin	100	14	3,262	3,771	3,934	4,044	4,134	279	291	299	306	0.68	0.53	0.28	0.22

4) DEPARTMENT OF LA UNION

No	Municipality (Municipio)	Study Area		Census Population		Projected Population			Population Density (Persons/km²)				Average Annual Growth Rate (%			
		Ratio to Dept. (%)	Area (km2)	1971	1992	2000	2010	2020	1992	2000	2010	2020	1971-1992	1992-2000	2000-2010	2010-2020
I	**Department of La Union**	100	2,074	221,015	255,565	289,021	316,715	340,792	123	139	153	164	0.69	1.55	0.92	0.74
II	**Study Area in the Department**	6	129	13,897	15,969	58,051	61,819	65,070	124	450	479	504	0.66	17.51	0.63	0.50
38	San Alejo	20	50	4,333	4,559	24,560	25,214	25,750	91	488	501	512	0.24	23.43	0.26	0.21
39	Yucuaiquin	30	17	2,157	2,608	9,856	10,803	11,626	158	595	653	702	0.90	18.08	0.92	0.74
40	El Carmen	40	42	5,012	6,205	17,737	19,659	21,347	147	421	466	506	1.01	14.03	1.03	0.83
41	Yayantique	48	20	2,394	2,598	5,898	6,143	6,346	129	294	306	316	0.38	10.79	0.41	0.33
	Grand Total	29	2,247	376,623	473,956	775,948	909,137	1,041,477	211	345	405	464	1.09	6.36	1.60	1.28

Source : Censos Nacionales de Pobacion y Vivienda, 1971 y 1992
Proyeccion de la Poblacion de El Salvador 2025, DIGESTYC

Table 2.5 GROSS DOMESTIC PRODUCT (GDP), 1990 - 1995

Item	1990	1991	1992	1993	1994	1995	Average Annual Growth Rate (%)
(1) At Current Prices							
1) GDP (Million Colones)	36,487	42,594	49,841	60,522	70,612	83,688	-
Annual Growth Rate (%)	-	16.7	17.0	21.4	16.7	18.5	18.1
2) Per Capita GDP (Colon	6,948	7,925	9,048	10,714	12,185	14,081	-
Annual Growth Rate (%)	-	14.1	14.2	18.4	13.7	15.6	15.2
(2) At 1990 Constant Prices							
1) GDP (Million Colones)	36,487	37,791	40,643	43,643	46,251	49,145	-
Annual Growth Rate (%)	-	3.6	7.5	7.4	6.0	6.3	6.1
2) Per Capita GDP (Colon	6,948	7,031	7,378	7,726	7,981	8,269	-
Annual Growth Rate (%)	-	1.2	4.9	4.7	3.3	3.6	3.6

Source : Revista Trimestral, Oct./Dic., 1995, & Jul./Sep., 1996, Banco Central de Reserva

Table 2.6 OTHER ECONOMIC INDICATORS

Item	1990	1991	1992	1993	1994	1995	1996	Average
I. Exchange Rate (Cols./US$)	8.03	8.08	9.17	8.67	8.75	8.75	8.75	8.60
Annual Variation of Exchange Rate (%	-	0.62	13.49	-5.45	0.92	0.00	0.00	1.60
II. Prices (1990=100)								
1. Wholesale Prices	100.0	106.9	109.3	117.5	126.7	140.0	146.1	-
2. Consumer Prices	100.0	114.4	127.2	150.9	166.8	183.6	200.1	-
III. Inflation Rate (%)								
1. Wholesale Prices	-	6.9	2.2	7.5	7.8	10.5	4.3	6.6
2. Consumer Prices	-	14.4	11.2	18.6	10.5	10.1	9.0	12.3
3. Average	-	10.7	6.7	13.1	9.2	10.3	6.7	9.4
IV. Annual Rate of Bank Interest (%)								
1. Deposit	18.0	16.1	11.5	15.3	13.6	14.4	14.5	14.8
2. Lending	21.2	19.7	16.4	19.4	19.0	19.1	19.1	19.1
3. Average	19.6	17.9	14.0	17.3	16.3	16.7	16.8	16.9
V. Diff. between Lending Interest Rate & Inflation Rate (%) (=II-IV)								
1. Wholesale Prices	-	12.8	14.2	11.9	11.2	8.6	14.8	12.2
2. Consumer Prices	-	5.3	5.2	0.8	8.5	9.0	10.1	6.5
3. Average	-	9.0	9.7	6.4	9.8	8.8	12.5	9.4

Source : International Financial Statistics, January 1997, IMF

Table 2.7 FUTURE LAND USE PLAN

Area	Recommended Activity	Remarks	Class	Area (ha)
Intensive Agriculture-(1)	Annual crop, Improved pasture	The area has no or minor limitation for crop cultivation and the soil is inherently high in fertility. Therefore, the area can be used for any agricultural activity.	I,IIe,s,es,hs,IIe,s,es,hs	41,913
Intensive Agriculture-(2)	Annual crop, Improved pasture	The area is expected to increase land productivity by flood or drainage control because it has minor or severe limitation of impermeability. Therefore, the area can use any agricultural activity.	IIh,IIIh,IVh	6,502
Intensive Agriculture with Erosion Control	Annual crop, Improved pasture, Permanent crop	The area is prone to erosion because of slope and soil texture conditions. Therefore, it needs some countermeasure for annual crop production.	IVe,s,es,hs	36,534
Water Tolerant Crop	Rice etc.	The area has severe limitations of flood, impermeability and fine texture. However, the area has potential to grow rice.	Vh,s	5,856
Agroforestry	Tree crop	The area has severe limitation of slope and soil layer for annual crop cultivation. However, the area is suited for agroforestry.	VIe,s,es	20,703
Production Forest	Afforestation	The area has severe limitations, steep slope(56-70%) and shallow soil layer. The area is covered by poor vegetation because of deforestation and development of grazing land. The area should be changes from erosion prone land use to erosion free land use.	VIIe,s,es	86,229
Protection Area	Protection	The area prohibit from any production activity because it has very severe limitation such as steep slope (70%<) and thin soil layer (15cm>).	VIIIe,s,es	20,908
River & Wet Area			VIIh,VIIIh	1,654
Urban				1,252
Lake				2,815
Total				224,354

Table 3.1 AVAILABILITY OF METEO-HYDROLOGICAL RECORDS

Meteorological Observation Stations

No	Code	Station Name	Coordinate		Elevation	Observation		Year in 19- (H Hourly Data, D Daily Data, C Chart)																																								
			Lat	Long	(m.MSL)	Start	End	Before 57	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1	M6	Hcda. El Papalon	13.27	88.07	80	1960							HC	HC	HC	HC	HC	HC	HC	HC	HC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	DC	HDC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	
2	Z2	San Francisco Gotera	13.41.8	88.05.4	250	1970	1987	D*56	D	D	D	D	D	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	DC	DC	C	DC	DC	DC	DC	DC	DC	DC	DC	DC	
3	U13	Jucuaran	13.15.5	88.14.8	764	1970																HC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HC															

Rainfall Gauge Stations

No	Code	Station Name	Coordinate		Elevation	Observation		Year in 19- (H Hourly Data, D Daily Data, C Chart)																																								
			Lat	Long	(m.MSL)	Start	End	Before 57	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1	M02	San Miguel-Fenadesal	13.29	88.10	105	1931	1987																							D	D	D	D	D	D												D	
2	M04	Lolotique	13.33.4	88.21.2	675	1970	1987	D*53-56	D	D	D	D	D	D			D			D	D	D	D	D	D	D	D	D	D	D	D	D	D	D													D	
3	M05	Ciudad Barrios	13.45.9	88.16.3	860	1970	1987	D*56	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D		D		D												D	
4	M06	Beneficio El Papalon	13.27	88.07	80	1960							HC	HC	HC	HC	HC	HC	HC	HC	HC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	DC	HDC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	DC	
5	M07	San Jorge	13.25	88.21	330	1962									D	D	D	D	D	D	D	D	D	D		D	D																				D	
6	M12	Canton La Lava	13.21.3	88.14.9	40	1964																		D	D	D	D	D	D	D																		
7	M14	Hacienda San Jose	13.12	88.11	45	1966												HC	HC	HC	HDC	HC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HC																	
8	M15	Beneficio El Sitio	13.3	88.12	140	1959		D:45-50,52-56	D	D	D	D	D	D	D	D	D	D		D	D	D	D	D	D	D	D	D	D	D	D	D	D														D	
9	M16	Chapeltique	13.38	88.16	190	1968															D	D	D	D	D	D	D	D	D	D	D				D	D											D	
10	M17	Hacienda El Canal	13.19	88.18	30	1970																	D	D	D	D	D	D	D	D		D																
11	M18	Sesori	13.43	88.22	195	1970																	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC															D	
12	N01	Olomega	13.18.7	88.01.7	70 or 80	1931	1987	D*27-56	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D		D	D	D													
13	N11	Yucuaiquin	13.33	88.00	460	1967															D	D	D		D	D	D	D	D	D	D	D															D	
14	N14	El Carmen	13.21	88.00	105	1969																		D	D	D		D	D	D	D																	
15	N16	San Alejo	13.26	87.58	170	1970																		D	D	D	D		D	D	D	D															D	
16	U04	Usulutan	13.20.4	88.26.3	75	1931	1987	D:20,29,31-56	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D			D	D	D					D	
17	U06	Santiago de Maria	13.29	88.22	920	1959			HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	DC	DC	C	DC	DC	DC	DC	DC	C	C	C	DC	
18	U08	Beneficio San Mauricio	13.26	88.29	550	1959		D*10-56	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D			D														
19	U13	Jucuaran	13.15.5	88.14.8	764	1970																HC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HC														D	
20	U14	Puerto Parada	13.15.2	88.26.6	2	1970	1987								D		D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D							
21	202	San Francisco Gotera	13.41.8	88.05.4	250	1970	1987	D*56	D	D	D	D	D	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	DC	DC	C	DC	DC	DC	DC	DC	DC	DC	DC	DC	
22	205	Corinto	13.48	87.58	820									D	D	D	D	D	D	HD	HD	D	D	D	D	D	D	D	D	D	D	D	D														D	
23	206	Jocoro	13.37	88.02	250	1969	1995														D		D	D	D	D	D	D	D	D	D					D												
24	208	Osicala	13.48	88.09	560	1962	1995	D*55-56	D	D	D	D	D	D	D	D	D	D	D	D		D	D	D	D	D	D		D		D																D	

Stream Gauge Stations

No	Code	Station Name	Coordinate		Elevation	Observation		Year in 19- (H Hourly Data, D Daily Data, C Chart)																																								
			Lat	Long	(m.MSL)	Start	End	Before 57	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1	42-01-01	Moscoso/San Miguel	13.26	88.09	76.02	Jul-58	-			HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	C	C	C	C	C	HDC	HDC	HDC	HDC	HDC	HDC	HDC																		
2	42-01-02	Vado Marin/San Miguel	13.18	88.17	18.78	May-59	-			-	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	HDC	HDC	HDC	HDC												HDC	HDC	HDC	HDC
3	42-01-03	La Canoa/San Miguel	13.20	88.09	-	May-62	Jan-73			-	-	-	-	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC														
4	42-01-04	Las Conchas/San Miguel	13.17	88.23	15.23	Jul-63	-			-	-	-	-	-	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC														
5	42-01-05	San Miguel en Villerias	13.31	88.11	27.43	Jul-65	-			-	-	-	-	-	-	-	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC															HDC	HDC
6	42-02-01	La Reforma/San Esteban	13.32	88.13	206.57	Jul-65	-			-	-	-	-	-	-	-	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC																		
7	42-03-01	Puerto Viejo/L.Olomega	13.18	88.03	63.58	Sep-66	-			-	-	-	-	-	-	-	-	C	C	C	C	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HD	HD	HD	HD														
8	42-04-01	Hato Nuevo/Tasihuat	13.29	88.09	92.87	Mar-67	May-77			-	-	-	-	-	-	-	-	-	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC	HDC																			

Table 3.2 EXISTING DIKE LENGTH AND HEIGHT ALONG SAN MIGUEL RIVER

	Distance	Average	Left Bank		Right Bank	
No.	m	Distance (m)	Height	Length	Height	Length
0	100		(m)	(m)	(m)	(m)
1	700	400				
2	400	550				
3	400	400				
4	400	400				
5	800	600	0.7	600		
6	500	650	0.7	650		
7	200	350	1.2	350	2.4	350
8	600	400	1.6	400	2.4	400
9	400	500			2.4	500
10	400	400			2.8	400
11	400	400			2.4	400
12	900	650			2.8	650
13	600	750			3.0	750
14	500	550	2.8	550	4.0	550
15	400	450	2.4	450	3.6	450
16	700	550	3.2	550	3.6	550
17	500	600	1.6	600	3.2	600
18	400	450	2.8	450	1.2	450
19	400	400			2.8	400
20	500	450				
103	500	400				
104	500	500				
105	600	550				
106	500	550				
107	600	550			3.2	550
108	500	550			2.8	550
109	500	500				
110	700	600	2.0	600	2.8	600
111	800	750	2.4	750		
112	600	700	3.2	700		
113	500	550	1.6	550		
114	500	500	2.6	500		
115	400	450				
116	500	450				
117	700	600				
118	600	650				
119	900	750			1.2	750
120	500	700	2.4	700		
121	700	600	2.4	600		
122	700	700	2.8	700		
123	700	700				
124	800	750	2.8	750	2.0	750
125	600	700	2.8	700	1.2	700
126	600	600	2.4	600	2.4	600
127	600	600	2.8	600	1.2	600
128	300	450	1.6	450		
129	700	500	1.2	500		
130	800	750				
131	600	700				
132	500	550				
133	500	500				
Total	137,000			13,300		11,550
Ratio (%)	100			9.7		8.4

DIKE LENGTH AND HEIGHT ALONG PELOTA RIVER

	Distance	Average	Left Bank		Right Bank	
No.	m	Distance (m)	Height	Length	Height	Length
1	0	500	-		1.50	500
2	1,000	500	-		1.50	500
3	1,500	1,250	0.75	1,250	1.25	1,250
4	1,400	1,450	2.00	1,450	2.00	1,450
5	1,200	1,300	4.00	1,300	3.00	1,300
Total	5,100			4,000		3,700

Table 3.3(1/2) ANNUAL MAXIMUM WATER LEVEL AND DISCHARGE

Station: Villerias
Period: May 1970-December 1978

Year	Month	Date	Hmax (m)	Qmax (m^3/s)	Ranking	Remarks
1970	9	4	5.66	866.00	2	
1971	9	2	5.12	734.00	3	
1972	-	-	-	-	-	No data
1973	10	8	4.01	490.00	5	
1974	p	20	5.41	685.00	4	
1975	9	24	6.83	1079.12	1	
1976	-	-	-	-	-	Data incomplete
1977	-	-	-	-	-	Data incomplete
1978	-	-	-	-	-	Data incomplete

Station: Moscoso
Period:January 1964-December 1981

Year	Month	Date	Hmax (m)	Qmax (m^3/s)	Ranking	Remarks
1963	-	-	-	-	-	Data incomplete
1964	-	-	-	-	-	Data incomplete
1965	9	8	3.72	494.70	11	
1966	6	22	6.36	917.10	3	
1967	10	5	5.15	719.50	8	
1968	9	24	4.02	538.70	10	
1969	9	4	8.30	1982.00	1	revised from 2784.88m3/s
1970	9	4	5.61	880.00	4	
1971	9	3	5.48	841.50	5	
1972	10	8	4.08	777.39	6	
1973	9	16	8.48	921.00	2	
1974	9	8	3.26	218.32	15	
1975	9	24	6.90	709.84	9	
1976	6	5	7.27	760.87	7	
1977	6	16	4.96	405.09	12	
1978	9	21	5.34	382.11	14	
1979	8	31	6.19	395.33	13	
1980	-	-	-	-	-	Data incomplete

Station: El Delirio/La Canoa
Period: January 1963-April 1981

Year	Month	Date	Hmax (m)	Qmax (m^3/s)	Ranking	Remarks
1963	11	9	4.52	631.60	1	
1964	9	2	3.52	280.60	2	
1965	-	-	-	-	-	Data incomplete
1966	6	22	4.58	187.00	4	
1967	-	-	-	-	-	Data incomplete
1968-1976		-	-	-	-	No data
1977	6	16	4.76	109.34	6	
1978	8	28	5.49	115.00	5	
1979	10	9	5.52	189.41	3	
1980	-	-	-	-	-	Data incomplete

Remark: Until 1967 measured at El Delirio and after 1977 measured at La Canoa

Table 3.3(2/2) ANNUAL MAXIMUM WATER LEVEL AND DISCHARGE

Station: Vado Marin						
Period: May 1959-March 1981						
Year	Month	Date	Hmax (m)	Qmax (m^3/s)	Ranking	Remarks
1959	10	20	2.16	57.9	20	
1960	-	-	-	-	-	Data incomplete
1961	10	9	2.44	188.8	10	
1962	9	27	2.59	156.0	11	
1963	11	11	3.22	248.1	5	
1964	9	4	2.56	134.4	15	
1965	10	1	2.74	218.9	8	
1966	7	15	2.84	289.8	3	
1967	10	14	2.1	96.0	18	
1968	9	26	2.4	155.0	12	
1969	9	6	3.84	296.0	2	
1970	10	5	3.13	230.9	7	
1971	9	5	2.42	131.5	17	
1972	10	10	2.03	82.0	19	
1973	10	26	3.65	237.5	6	
1974	9	22	4.22	307.9	1	
1975	9	13	2.72	135.8	14	
1976	6	14	3.9	286.7	4	
1977	10	1	1.83	48.0	21	
1978	9	22	2.62	133.6	16	
1979	9	15	2.68	143.7	13	
1980	6	25	3.14	215.2	9	

Station: Las Conchas						
Period: May 1970-April 1981						
Year	Month	Date	Hmax (m)	Qmax (m^3/s)	Ranking	Remarks
1970	8	4	2.80	274.00	4	
1971	10	21	2.00	148.00	7	
1972	10	20	2.69	203.00	6	
1973	10	24	4.10	287.00	3	
1974	5	23	2.04	90.00	10	
1975	-	-	-	-	-	Data incomplete
1976	10	10	2.72	111.33	9	
1977	6	8	3.18	136.51	8	
1978	9	20	3.75	389.56	1	
1979	6	14	4.22	222.40	5	revised from 659.28m2/s
1980	6	23	4.90	302.40	2	revised from 1471.22m3/s

Table 3.4 FLOW DURATION AT VILLERIAS

N-day Discharge

Year	Discharge(m^3/s)				
	Min.	355-day	275-day	185-day	95-day
1971	1.34	1.97	2.62	4.66	14.90
1972	0.90	1.29	2.60	3.66	8.11
1973	1.36	1.53	2.06	7.27	29.20
1974	1.44	1.62	2.23	3.42	7.35
1975	0.73	1.07	1.59	3.90	22.92
1976	0.61	1.63	2.30	4.31	8.98
1977	1.00	1.03	1.41	2.65	5.74
1978	1.03	1.05	1.31	3.26	13.61
1979	1.08	1.17	1.53	5.41	19.35
1980	1.50	1.84	2.42	7.02	20.22
Average	1.10	1.42	2.01	4.56	15.04
q($m^3/s/km^2$)	0.00121	0.00156	0.00221	0.00501	0.01653

Notes:

1) n-day discharge: The discharge which is available for n days in a year.
2) The values of 1979 and 1980 are estimated from the data at Moscoso point by the ratio of catchment areas.
3) Catchment area at villerias = 910 km^2

Non-Exceedance Probability of 355-Day Discharge at Villerias

Return period		Thomas plot		Hazen plot	
(years)	(%)	Xi/X0	Q(m3/s)	Xi/X0	Q(m3/s)
200	0.5	0.45	0.62	0.50	0.69
100	1	0.48	0.67	0.53	0.74
50	2	0.53	0.73	0.58	0.80
20	5	0.60	0.83	0.64	0.89
10	10	0.67	0.93	0.71	0.98
5	20	0.77	1.06	0.80	1.10
2	50	1.00	1.38	1.00	1.38

Table 3.5 HIGH AND LOW TIDES AT EL TRIUNFO PORT

(Period 1994 - 1996)

High water spring tide(m.MSL)				
Year	Mon	Day	Time	Tide
1994	1	2	18	1.39
1994	1	12	3	1.30
1994	1	31	18	1.47
1994	2	12	16	1.22
1994	2	28	17	1.58
1994	3	13	16	1.19
1994	3	29	16	1.65
1994	4	12	16	1.19
1994	4	27	16	1.65
1994	5	12	16	1.19
1994	5	26	15	1.63
1994	6	10	15	1.22
1994	6	24	15	1.53
1994	7	11	16	1.30
1994	7	23	15	1.42
1994	8	11	5	1.42
1994	8	21	15	1.30
1994	9	9	5	1.55
1994	9	21	3	1.25
1994	10	7	4	1.63
1994	10	20	3	1.19
1994	11	5	3	1.65
1994	11	20	4	1.17
1994	11	29	23	1.17
1994	12	4	3	1.60
1994	12	20	4	1.17
1994	12	31	1	1.35
Average(1994)				1.38
1995	1	3	4	1.53
1995	1	21	18	1.25
1995	2	2	17	1.40
1995	2	19	18	1.40
1995	3	3	16	1.35
1995	3	20	17	1.59
1995	3	31	15	1.27
1995	4	17	16	1.58
1995	4	30	15	1.22
1995	5	16	16	1.63
1995	5	30	15	1.19
1995	6	14	15	1.63
1995	6	29	16	1.19
1995	7	13	15	1.60
1995	7	29	16	1.22
1995	8	11	15	1.50
1995	8	30	5	1.35
1995	9	11	4	1.42
1995	9	27	4	1.45
1995	10	9	3	1.35
1995	10	27	4	1.55
1995	11	7	2	1.25
1995	11	24	3	1.58
1995	12	8	3	1.17
1995	12	24	4	1.58
Average(1995)				1.41
1996	1	8	4	1.14
1996	1	22	4	1.55
1996	2	8	17	1.19
1996	2	20	16	1.53
1996	3	8	17	1.30
1996	3	20	16	1.47
1996	4	6	16	1.40
1996	4	18	15	1.40
1996	5	5	16	1.50
1996	5	17	15	1.30
1996	6	3	16	1.58
1996	6	16	15	1.22
1996	7	3	16	1.63
1996	7	17	16	1.19
1996	8	1	16	1.63
1996	8	16	16	1.19
1996	8	31	4	1.60
1996	9	16	5	1.27
1996	9	29	4	1.55
1996	10	15	4	1.35
1996	10	28	3	1.47
1996	11	13	4	1.42
1996	11	26	3	1.35
1996	12	13	4	1.50
1996	12	25	3	1.19
Average(1996)				1.40
Average(1994-1996)				1.39

Low water spring tide(m.MSL)				
Year	Mon	Day	Time	Tide
1994	1	1	11	-1.42
1994	1	13	9	-1.40
1994	1	30	10	-1.55
1994	2	12	10	-1.32
1994	2	28	22	-1.66
1994	3	14	22	-1.27
1994	3	29	22	-1.74
1994	4	12	22	-1.25
1994	4	27	22	-1.71
1994	5	12	22	-1.19
1994	5	26	21	-1.61
1994	6	12	23	-1.22
1994	6	24	21	-1.47
1994	7	12	23	1.39
1994	7	24	22	-1.37
1994	8	10	23	-1.42
1994	8	22	21	-1.27
1994	9	9	11	-1.53
1994	9	21	9	-1.25
1994	10	7	10	-1.66
1994	10	21	9	-1.22
1994	11	5	9	-1.69
1994	11	20	10	-1.19
1994	12	4	8	-1.66
1994	12	21	10	-1.22
Average(1994)				-1.42
1995	1	3	10	-1.81
1995	1	20	11	-1.35
1995	2	1	9	-1.53
1995	2	19	11	-1.47
1995	3	3	10	-1.45
1995	3	19	22	-1.59
1995	4	1	22	-1.35
1995	4	17	22	-1.65
1995	5	1	22	-1.25
1995	5	16	22	-1.65
1995	5	31	22	-1.17
1995	6	15	22	-1.65
1995	6	30	22	-1.14
1995	7	13	21	-1.55
1995	7	31	23	-1.22
1995	8	12	22	-1.50
1995	8	29	23	1.32
1995	9	11	10	-1.42
1995	9	27	10	-1.47
1995	10	10	9	-1.37
1995	10	26	10	-1.59
1995	11	8	9	-1.27
1995	11	25	10	-1.66
1995	12	9	10	-1.22
1995	12	24	10	-1.69
Average(1995)				-1.45
1996	1	8	10	-1.22
1996	1	22	10	-1.71
1996	2	7	10	-1.27
1996	2	20	9	-1.66
1996	3	8	23	-1.37
1996	3	20	21	-1.55
1996	4	6	22	-1.47
1996	4	18	21	-1.42
1996	5	5	22	-1.55
1996	5	18	21	-1.30
1996	6	3	22	-1.59
1996	6	17	22	-1.17
1996	7	3	22	-1.61
1996	7	17	22	-1.12
1996	8	1	22	-1.64
1996	8	16	22	-1.14
1996	8	30	22	-1.61
1996	9	16	10	-1.25
1996	9	29	10	-1.59
1996	10	15	10	-1.37
1996	10	28	9	-1.50
1996	11	14	10	-1.50
1996	11	26	9	-1.37
1996	12	13	10	-1.59
1996	12	26	9	-1.27
Average(1996)				-1.43
Average(1994-1996)				-1.43

Table 3.6 SEDIMENTATION DATA

OBSERVED SUSPENDED SOLID

YEAR	VILLERIAS	MOSCOSO
	(1000T/YEAR)	(1000T/YEAR)
1970/71	200	986
1971/72	171	511
1972/73	321	446
1973/74	207	463
1974/75	2.504	1.841
1775/76	-	455
1976/77	12	-
1977/78	-	115
1978/79	-	474
1979/80	-	331
AVERAGE	569	625
CALCULATED V.		
(m^3)	358	393

SPECIFIC GRAVITY = 2.65
VOID RATIO = 0.4

SEDIMENTATION VOLUME SURVEY IN EXISTING RESERVOIRS ON LEMPA RIVER

RESERVOIR NAME	CATCHMENT	RESIDUAL CATCHMENT	INITIAL YEAR	INITIAL VOLUME	VOLUME IN 1994	ANNUAL SED.	SPECIFIC SED.
	(km^2)	(km^2)		(M.C.M.)	(M.C.M.)	(M.C.M.)	(m^3/year/km^2)
GUIJA	2.768	2,768	1963	560	508.7	1.65	598
CERRON GRANDE	8.584	5.816	1976	2.180	2.026.2		1.469
5 DE NOVIEMBRE	9.863	1.279	1974	65	40.7	1.19	930
15 DE SEPTIEMBRE	17.524	7.661	1983	393	335.5	5.23	682
WEIGHTED AVERAGE							948

Table 4.1 INFORMATION ABOUT INUNDATION RELATED WITH STUDY AREA

Date of Flood	Affected Area	Causes of flood	Flood Damage	Source
1961	Acajutla **San Miguel** San Salvador	No information	No information	CEPRODE[1]
Sep.4, 1969	Rio Lempa **South-West Coast**	Hurricane "Francelia"	4,600 people affected Death 2 Damage US$1,600	CRED
1969	Rio Lempa and Paz Jaltepeque **Rio Grande de San Miguel**	No information	No information	CEPRODE
1966	Rio Lempa **Lake Olomega**	No information	No information	CEPRODE
1974	Usulutan **Rio Grande de San Miguel** Ahuachapan	No information	No information	CEPRODE
Aug. 24,1988	La Paz **Usulutan** **San Miguel** La Union	Flooding due to heavy seasonal rainfall	39,060 people affected. Destroyed homes and up to 95 Km2 of crop. Death 33.	CRED[2]
1989	**Rio Grande de San Miguel**	No information	No information	CEPRODE
Sep. 28, 1992	La Union **San Miguel** **Usulutan** San Vincente La Paz	Flooding due to rainfall since Sep. 28	Over 8,000 people evacuated. Death 2. 1,500 people isolated.	CRED
Sep. 28, 1995	**Usulutan**	No Information	1,500 people affected, 800 families evacuated, 2500 acres of corn, rice and sesame fields destroyed Death 8.	CRED
Sep. 1995	**San Miguel-Olomega-El Jocotal-The Mouth of Rio Grande De San Miguel**			JICA Preliminary Study

[1] Centro De Proteccion para Desastres Ceprode

[2] Information of Centre for Research on the Epidemiology of Disasters(CRED) during Jan. 1 ,1965-Dec. 31,1995

Table 4.2 RESULTS OF INUNDATION SURVEY

The numbers of the houses which had inundation in 1995 among the interviewed houses

Month in 1995	San Miguel	Olomega	Jocotal	Usulutan
June	0	4	0	0
July	0	0	1	0
August	4	6.33	7.5	2
September	4.5	26.33	10.5	9
October	1.5	11.33	7	1
November	1	0	0	0
No Remember	*6*	*6*	*1*	*4*
Total	17	48	27	16

Inundation depth and duration of 1995 flood

Flood Peak Time	San Miguel	Olomega	Jocotal	Usulutan
June	-	0.15m / 1.7day	-	-
July	-	-	0.05m / 0 day	-
August	0.05m / 4 day	0.17 m / 6.5 day	0.50 m / 8 day	0.20 m / 30 day
September	0.50m / 1.8day	0.09m / 7.3day	0.87m / 9.7 day	0.50 m / 46day
October	0.05m / 0 day	0.10m / 8 day	1.5m / 11.6 day	0.90m / 25day
November	-	-	-	-

The number of houses which had the maximum flood in 1988, 1989, 1991 and 1992 among the interviewed houses.

	San Miguel	Olomega	Jocotal	Usulutan	Total
1988	5 (Sep. 14 or 15)	15 (Aug.-Oct.)	4 (Aug.-Sep.)	8	32
1989	4 (Sep. 12)	8 (Aug.-Sep.)	1	13 (Aug.-Sep.)	26
1991	3 (Sep.)	7 (Sep.)	5 (Jul.-Sep.)	4 (Sep.)	19
1992	10 (Sep. 15-Oct.)	16 (Aug.-Sep.)	9 (Sep.-Oct.)	6 (Jun and Sep.)	41

Depth / Duration of the maximum floods

	San Miguel	Olomega	Jocotal	Usulutan
1988	1.2m / 0.8 day	1.0m / 22.9 day	2.1m / 19 day	2.7 m / 27.0 day
1989	0.8m / 3 day	0.9m / 28.2 day	- / 90 day(*)	1.1m / 16.7 day
1991	1.5m / 0.7 day	0.8 m / 27 day	1.4m / 75 day	0.9 m / 20 day
1992	1.2m / 5 day	0.7m / 7.6 day	0.93m / 6.2 day	0.4 m / 9.8 day

note: (*) is the data of only 1 sample.

Table 4.3 BASIN AREAS AND SLOPES

Subbasin No.	Location	Tributary	Basin area		Stream length	Elevation		basin slope
			Subbasin (Km^2)	cumulati (Km^2)	(Km)	Highest (m.MSL)	Lowest (m.MSL)	(1/I)
Upper Basin								
1		San Francisco R.	112.6	112.6	29.3	1100	160	31
2		Seco R.	153.6	266.2	25.6	700	140	46
3		Yamabal/San Diego R.	128.5	394.7	27.4	1000	140	32
4		Canas R.	57.8	452.5	18.4	300	100	92
5		Villerias R.	121.2	573.7	27.4	1200	100	25
6		Guayabal R.	227.1	800.9	29.9	1200	100	27
7			24.2	825.0	6.7	300	100	34
8	Villerias	San Esteban R.	85.0	910.0	20.5	1100	95	20
Middle Basin								
9		Taisihuat R.	54.0	964.0	15.2	2000	95	8
10			97.2	1061.2	26.9	400	95	88
11	Moscoso		12.8	1074.0	7.9	200	90	72
12	Aramuaca		136.8	1210.8	20.8	2000	80	11
13		Lake Olomega	207.0	1417.8	26.4	610	65	48
14	El Delirio		219.2	1637.0	40.6	2000	55	21
Lower Basin								
15	Vado Marin	Lake Jocotal	263.0	1900.0	38.3	2000	30	19
16			137.7	2037.7	26.2	2000	20	13
17	Las Conchas		199.9	2237.6	27.9	1600	15	18
18			9.2	2246.8	5.8	270	5	22

Table Basin and channel constants forf Storage function for the Design

Basin Constants

Basin No.	Area(km2)	K0	a	K=a*K0	P	Tl(hour)	Fl	Rsa(mm)	Base flow(m3/s)
1	112.6	78.7	0.15	11.8	0.6	0.82	0.31	2000	5.07
2	153.6	79.6	0.15	11.9	0.6	0.64	0.31	2000	4.24
3	128.5	74.9	0.15	11.2	0.6	0.73	0.31	2000	1.91
4	57.8	82.3	0.15	12.3	0.6	0.30	0.31	2000	4.00
5	121.2	70.7	0.15	10.6	0.6	0.73	0.31	2000	7.49
6	227.1	84.6	0.15	12.7	0.6	0.85	0.31	2000	0.80
7	24.2	32.7	0.15	4.9	0.6	0.00	0.31	2000	2.80
8	85.0	57.4	0.15	8.6	0.6	0.40	0.31	2000	1.78
9	54.0	34.1	0.23	7.8	0.6	0.15	0.28	2000	3.21
10	97.2	103.5	0.23	23.8	0.6	0.70	0.28	2000	0.42
11	12.8	38.6	0.23	8.9	0.6	0.00	0.28	2000	4.51
12	136.8	49.2	0.23	11.3	0.6	0.42	0.28	2000	6.82
13	207.0	122.2	0.23	28.1	0.6	0.68	0.28	2000	7.23
14	219.2	100.0	0.23	23.0	0.6	1.35	0.28	2000	8.67
15	263.0	110.3	0.23	25.4	0.6	1.24	0.22	2000	4.54
16	137.7	63.1	0.20	12.6	0.6	0.67	0.22	2000	6.59
17	199.9	66.1	0.20	13.2	0.6	0.75	0.22	2000	0.30
18	9.2	41.1	0.20	8.2	0.6	0.00	0.22	2000	0.10

Channel Constant

Channel No	K	P	Tl(hr)
19-20			0.60
21-22			4.18
24-25			0.56
27-28			0.45
29-30	25000	0.65	0.13
32-33	15848	0.65	0.08
34-35	63095	0.65	0.35
36-37	79432	0.65	0.26
40-41	79432	0.65	0.30
42-43	79432	0.65	0.40
44-45	125892	0.65	0.61
46-47	50118	0.65	0.24

Table Basin and channel constants for Storage function for exsiting condition(1995)

Basin Constants

Basin No.	Area(km2)	K0	a	K=a*K0	P	Tl(hour)	Fl	Rsa(mm)	Base flow(m3/s)
1	112.6	78.9	0.15	11.8	0.6	0.82	0.35	2000	1.24
2	153.6	79.6	0.15	11.9	0.6	0.64	0.35	2000	1.69
3	128.5	74.9	0.15	11.2	0.6	0.73	0.35	2000	1.41
4	57.8	82.3	0.15	12.3	0.6	0.30	0.35	2000	0.64
5	121.2	70.8	0.15	10.6	0.6	0.73	0.35	2000	1.33
6	227.1	84.8	0.15	12.7	0.6	0.85	0.35	2000	2.50
7	24.2	32.7	0.15	4.9	0.6	0.00	0.35	2000	0.27
8	85.0	57.2	0.15	8.6	0.6	0.40	0.35	2000	0.93
9	54.0	33.1	0.23	7.6	0.6	0.15	0.28	2000	0.59
10	97.2	103.4	0.23	23.8	0.6	0.70	0.28	2000	1.07
11	12.8	42.6	0.23	9.8	0.6	0.00	0.28	2000	0.14
12	136.8	50.0	0.23	11.5	0.6	0.42	0.28	2000	1.50
13	207.0	122.2	0.23	28.1	0.6	0.68	0.28	2000	2.27
14	219.2	100.1	0.23	23.0	0.6	1.35	0.28	2000	2.41
15	263.0	110.2	0.23	25.3	0.6	1.24	0.22	2000	2.89
16	137.7	63.3	0.20	12.7	0.6	0.67	0.22	2000	1.51
17	199.9	66.3	0.20	13.3	0.6	0.75	0.22	2000	2.20
18	9.2	41.1	0.20	8.2	0.6	0.00	0.22	2000	0.10

Channel Constants

Channel No	K	P	Tl(hour)
19-20			0.60
21-22			4.18
24-25			0.56
27-28			0.45
29-30	25000	0.65	0.13
32-33	15848	0.65	0.08
34-35	63095	0.65	0.35
36-37	79432	0.65	0.26
40-41	79432	0.65	0.30
42-43	79432	0.65	0.40
44-45	125892	0.65	0.61
46-47	50118	0.65	0.24

Table 4.4 BASIN AND CHANNEL CONSTANTS FOR STORAGE FUNCTION

Table 4.5 LAND CLASSIFICATION AND LAND USE OF INUNDATED AREA

LAND CLASSIFICATION

Class		Sn.Miguel	Olomega	Jocotal	Total
I	(ha)	0	0	17	17
	(%)	0	0	0	0
II	(ha)	0	252	520	772
	(%)	0	3	12	5
III	(ha)	249	3,889	965	5,103
	(%)	36	40	22	34
IV	(ha)	304	2,866	965	4,135
	(%)	43	29	22	28
V	(ha)	147	1,773	948	2,869
	(%)	21	18	21	19
VI	(ha)	0	96	25	121
	(%)	0	1	1	1
VII	(ha)	0	539	269	807
	(%)	0	5	6	5
VII	(ha)	0	0	25	25
	(%)	0	0	1	0
Other	(ha)	0	426	703	1,129
	(%)	0	4	16	8
Total		700	9,840	4,438	14,978

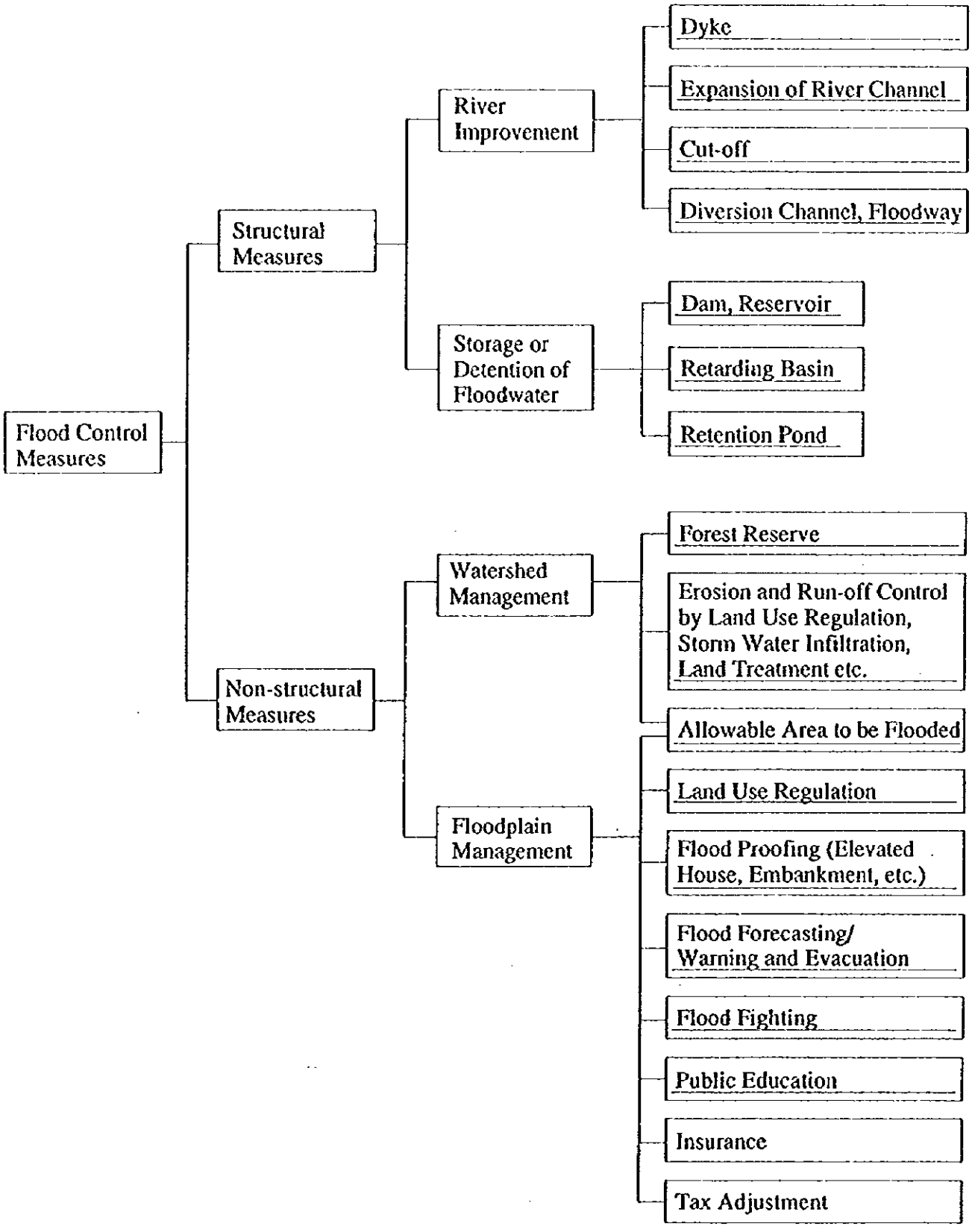
Source: MAG Note: Usulutan Area is not included due to lack of data

Table 4.6 EXISTING LAND USE IN THE INUNDATION AREA

Land use Area		Annual Crop	Sugar-cane	Grazing	Bush & Forest	Urban	Other	Total
San Miguel	(ha	22.9	169.3	251.6	41.2	164.7	50.4	700.0
	(%)	3.3	24.2	35.9	5.9	23.5	7.2	100.0
Olomega	(ha	896.7	1,687.0	6,095.8	109.5	0.0	1,050.9	9,840.0
	(%)	9.1	17.1	61.9	1.1	0.0	10.7	100.0
Jocotal	(ha	479.7	701.6	2,446.7	36.0	0.0	774.1	4,438.0
	(%)	10.8	15.8	55.1	0.8	0.0	17.4	100.0
Usulutan	(ha	465.3	325.6	1,522.7	417.8	0.0	398.6	3,130.0
	(%)	14.9	10.4	48.6	13.3	0.0	12.7	100.0
Total	(ha	1,864.6	2,883.4	10,316.8	604.5	164.7	2,274.0	18,108.0
	(%)	9.3	17.1	58.7	1.2	1.1	12.5	100.0

Source: Study Team

Table 5.1 FLOOD CONTROL MEASURES IN GENERAL



Note:
Underlined Measures are applicable to the Rio Grande de Sam Miguel

Table 5.2 CONCEPT OF CHANNEL IMPROVEMENT(MASTER PLAN)

Stretch			Concept of improvement for Master Plan
Code	From	To	
SAN MIGUEL RIVER			
L1-1	Santa Rita R. (SR21+0.20k)	End of farm land (SM1)	PL: Conservation of mangrove WK: None
L1-2	End of farm land (SM1)	Cerro El Encantado (SM7)	PL: Q10yr, DHWL>GH WK: Channel excavation, No dike.
L1-3	Cerro El Encantado (SM7)	Limon R. (SM13)	PL: Q10yr, DHWL>GH WK: Channel excavation, Dike
L2-1	Limon R. (SM13)	El Angel (SM24)	
L2-2	El Angel (SM24)	Ereguatquin R. (SM30-0.05k)	PL: Q10yr, DHWL>GH WK: Channel excavation, Dike(locally).
L3	Ereguatquin R. (SM30-0.05k)	Vado Marin Br. (SM58-0.02k)	
L4-1	Vado Marin Br. (SM58-0.02k)	Jocotal Drainage (SM64-0.03k)	PL: Q10yr, DHWL<GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike.
L4-2	Jocotal Drainage (SM64-0.03k)	Brazo de S.M. (SM80-0.06k)	PL: Q10yr, DHWL>GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike.
L4-3	Brazo de S.M. (SM80-0.06k)	Chilaguera R. (SM92-0.25k)	PL: Q10yr, DHWL<GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike.
L4-4	Chilaguera R. (SM92-0.25k)	La Canoa (SM96)	
L4-5	La Canoa (SM96)	El Delirio (SM103)	PL: Existing capacity>Q10yr WK: None
M1	El Delirio (SM103)	Olomega Dr. (SM104+0.14k)	PL: Q10yr, DHWL<GH WK: Channel excavation, Cut-off-channel, No dike.
O1-1	Olomega D/SM (SM104+0.14k)	End of COC (OL1+0.80k)	
COC	End of COC (OL1+0.80k)	Start of COC/SM (SM113)	PL: Q10yr, DHWL<GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike.
M2-2	Start of COC/SM (SM113)	Ground sill (SM117)	PL: Q10yr, DHWL<GH WK: Channel excavation, Cut-off-channel, No dike.
M2-3	Ground sill (SM117)	Pelota R. (SM119+0.09k)	PL: Q10yr, DHWL>GH WK: Channel excavation, Dike
M3	Pelota R. (SM119+0.09k)	L. Aramuaca (SM135)	
M4	L. Aramuaca (SM135)	Moscoso Br. (SM157)	PL: Q10yr, DHWL>GH WK: Channel excavation(locally), No dike
M5	Moscoso Br. (SM157)	Taisihuat R. (SM165+0.17k)	
M6-1	Taisihuat R. (SM165+0.17k)	Urbina Br. (SM170-0.06k)	
OLOMEGA DRANAGE			
O1-2	End of FW (OL1+0.80k)	Pelota R. (OL6+0.10k)	PL: Q10yr, DHWL<GH WK: Channel excavation, No dike
O2	Pelota R. (OL6+0.10k)	Olomega Outlet. (OL6+0.30k)	
Wo	Olomega Outlet. (OL6+0.30k)	Lake Olomega	
OLOMEGA DIVERSION CHANNEL			
Wi	Lake Olomega	Pelota R. (PL2+0.44k)	PL: Q10yr, DHWL>GH, Realignment of river course WK: Channel excavation, Dike
P2	Pelota R. (PL2+0.44k)	S.Miguel R. (SM120-0.26k)	

REMARKS:

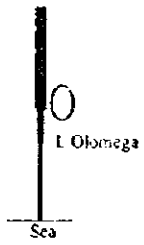
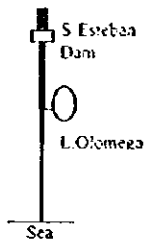
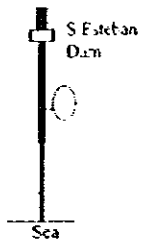
1) PL: Concept of planning 2) WK: Concept of improvement works
3) Q10yr (or Q2yr): 10 year (or 2 year) probable discharge
4) Q'10yr: 10 year probable discharge with inundation upstream
5) Qex: Existing channel capacity
6) DHWL>GH (or DHWL<GH): Design high water level is higher than (or lower) than surrounding ground height.

Table 5.3 QUANTITIES AND COSTS FOR ALTERNATIVES(COMBINATION OF MEASURES)

Items	Unit	Cost(Col.)	Alternative 1 Quantity	Alternative 1 Amount (10^6 ¢)	Alternative 1 L.C. (106 ¢)	Alternative 1 F.C. (106 ¢)	Alternative 2 Quantity	Alternative 2 Amount (10^6 ¢)	Alternative 2 L.C. (106 ¢)	Alternative 2 F.C. (106 ¢)	Alternative 3 Quantity	Alternative 3 Amount (10^6 ¢)	Alternative 3 L.C. (106 ¢)	Alternative 3 F.C. (106 ¢)	Alternative 4 Quantity	Alternative 4 Amount (10^6 ¢)	Alternative 4 L.C. (106 ¢)	Alternative 4 F.C. (106 ¢)
1. Construction works																		
1.1 Channel works				1,191.8	131.2	1,060.6		820.2	100.9	719.3		435.8	58.4	377.4		506.3	58.6	447.8
Excavation	m^3	44	13,876,500	610.6	61.1	549.5	9,405,100	413.8	41.4	372.4	3,009,200	132.4	13.2	119.2	3,909,500	172.0	17.2	154.8
Excavation(Jocotal	m^3	27	15,754,800	425.4	42.5	382.9	7,501,400	202.5	20.3	182.3	4,436,300	119.8	12.0	107.8	7,364,500	198.8	19.9	178.9
Embankment	m^3	50	1,917,000	95.9	9.6	86.3	2,187,000	109.4	10.9	98.5	2,187,000	109.4	10.9	98.5	1,917,000	95.9	9.6	86.3
Revetment	m	4,500	6,600	29.7	8.9	20.8	8,400	37.8	11.3	26.5	8,400	37.8	11.5	26.5	6,600	29.7	8.9	20.8
Weir	l.s.			20.3	6.1	14.2		20.3	6.1	14.2		0.0	0.0	0.0		0.0	0.0	0.0
Sluice, etc.	l.s.			9.9	3.0	6.9		9.9	3.0	6.9		9.9	3.0	6.9		9.9	3.0	6.9
Bridge	nos.	13,240,000		0.0	0.0	0.0	2	26.5	8.0	18.6	2	26.5	8.0	18.6		0.0	0.0	0.0
1.2 Dam works				0.0				0.0				507.3	80.4	426.9		507.3	80.4	426.9
Dam body	l.s.											358.8	35.9	322.9		358.8	35.9	322.9
Spillway, etc.	l.s.											148.5	44.6	104.0		148.5	44.6	104.0
(Sub-total)				1,191.8	131.2	1,060.6		820.2	100.9	719.3		943.1	138.9	804.3		1,015.6	139.0	874.6
2. Land	l.s.			7.6	7.6			10.3	10.3			56.8	56.8			54.1	54.1	
3. Administration	l.s.			60.0	60.0			41.5	41.5			50.0	50.0			53.4	53.4	
4. Engineering	l.s.			119.9	13.2	106.7		83.1	10.2	72.9		100.0	14.7	85.3		106.8	14.6	92.2
5. Contingency	l.s.			137.9	21.2	116.7		95.5	16.3	79.2		115.0	26.0	89.0		122.8	26.1	96.7
Total				1,517.2	233.2	1,284.0		1,050.6	179.2	871.4		1,264.9	286.4	978.5		1,350.7	287.2	1,063.5

(NOTE) Above unit costs and work quantities are those estimated for alternative study in the first phase of study.

Table 5.4 COMPARISON OF ALTERNATIVES(COMBINATION OF MEASURES)

Descriptions	Case1	Case2	Case3	Case4
SCHEMATIC DESCRIPTION OF ALTERNATIVE SCHEMES				
	Channel improvement only	Channel improvement + L.Olomega	Channel improvement + L.Olomega + San Esteban dam	Channel improvement + San Esteban dam
TECHNICAL ASPECTS				
• Difficulty	• Easier: Mainly channel improvement works	• Easier: Mainly channel improvement works	• More difficult: Dam construction and channel improvement works	• More difficult: Dam construction and channel improvement works
• Construction period	• Approx. 5 years	• Approx. 5 years	• Approx. 10 years	• Approx. 10 years
• Ranking (Wt=0.15)	• 1	• 1	• 3	• 3
FINANCIAL ASPECTS				
• Project cost(Ratio to Case-1)	• 1.00	• 0.69	• 0.83(multi-purpose)	• 0.89(multi-purpose)
• Ranking (Wt=0.40)	• 4	• 1	• 2	• 3
ECONOMIC ASPECTS				
• Benefit	• Reduction of flood damage • Enhancement of production	• Reduction of flood damage • Enhancement of production • Stable fishery in Lake Olomega	• Reduction of flood damage • Enhancement of production • Stable fishery in Lake Olomega	• Reduction of flood damage • Enhancement of production
• Ranking (Wt=0.15)	• 1	• 1	• 1	• 1
SOCIAL IMPACT				
• Land acquisition	• 3.7 km^2	• 4.5 km^2	• 35.5 km^2	• 34.7 km^2
• Re-settlement	• 18 houses	• 20 houses	• 1,301 houses	• 1,299 houses
• Ranking (Wt=0.15)	• 1	• 1	• 3	• 3
ENVIRONMENTAL ASPECTS				
• Positive effects	• Stabilization of water level in Lake Jocotal	• Stabilization of water level in Lake Jocotal and Lake Olomega	• Stabilization of water level in Lake Jocotal and Lake Olomega	• Stabilization of water level in Lake Jocotal
• Negative effects			• Ecological changes in reservoir area	• Ecological changes in reservoir area
• Ranking (Wt=0.15)	• 2	• 1	• 3	• 4
OVERALL EVALUATION				
• Summary of ranking	• 1x0.15+4x0.4+1x0.15+1x0.15+2x0.15=2.35	• 1x0.15+1x0.4+1x0.15+1x0.15+1x0.15=1.00	• 3x0.15+2x0.4+1x0.15+3x0.15+3x0.15=2.30	• 3x0.15+3x0.4+1x0.15+3x0.15+4x0.15=2.85
• Overall ranking	• 3	• 1	• 2	• 4

REMARKS:

1) Quantities presented in this table are for the facility plan based on 10-year provable flood.
2) Wt: Weight for overall evaluation
3) F.C: Flood control

Table 5.5 DESIGN PROFILE AND SECTION(MASTER PLAN)

Location	Sta No	Stretch code	Distance(km) dX	Distance(km) X	Elevation(m,MSL) R Bed	Elevation(m,MSL) DHWL	Elevation(m,MSL) D.Dike	Slope 1/I R bed	Slope 1/I DHWL	Width(m) B0	Width(m) b1	Width(m) b2	Width(m) B	Depth(m) H	Depth(m) h1	Q3 (m³/s)
LOWER REACHES																
River mouth	SR0	-	-	0 00	-	-	-	-	-	-	-	-	-	-	-	-
Santa Rita R	SR21+0 20k		10 00	10 00	-0 50	4 00	-	1,249	1,249	64	0	50	135	4 50	2 96	
End of farm land	SM1	L1-1	0 86	10 86	0 19	4 69		1,249	1,249	64	0	50	135	4 50	2 96	970
End of farm land	SM1		0 00	10 86	0 19	4 69	5 89	1,249	1,249	64	0	50	135	4 50	2 96	
Cerro El Encantado	SM7	L1-2	2 65	13 51	2 31	6 81	8 01	1,249	1,249	64	0	50	135	4 50	2 96	970
Cerro El Encantado	SM7		0 00	13.51	2 31	6 81	8 01	1,249	1,249	64	0	50	135	4 50	2 70	
Limon R	SM13	L1-3	3 36	16 87	5 00	9 50	10 70	1,249	1,249	64	0	50	135	4 50	2 70	970
Limon R.	SM13		0 00	16 87	5 00	9 50	10 70	1,228	1,025	62	0	50	130	4 50	1 93	
Ereguatquin R	SM30+0 05k	L2	9 33	26 20	12 60	18 60	19 80	1,228	1,025	62	6	44	140	6 00	3 40	970
Ereguatquin R.	SM30+0 05k		0 00	26 20	12 60	18 60	19 80	2,872	2,872	56	6	44	130	6 00	3 00	
Vado Marin Br (old	SM58	L3	15 51	41.71	18 00	24 00	25 20	2,872	2,872	56	6	44	130	6 00	3 00	830
Vado Marin Br (old	SM58		0 00	41.71	18 00	24 00	25 20	2,932	2,932	56	6	44	130	6 00	3 00	
Jocotal Drainage	SM63	L4-1	2 17	43 88	18 74	24 74		2,932	2,932	56	6	44	130	6 00	3 00	750
Jocotal Drainage	SM63		0 00	43 88	18 74	24 74	-	2,788	2,788	56	20	30	130	6 00	3 00	
Brazo de S M.	SM79+0 15k	L4-2	6 30	50 18	21 00	27 00	-	2,788	2,788	56	20	30	130	6 00	3 00	890
Brazo de S M.	SM79+0 15k		0 00	50.18	21 80	27 00	-	1,457	1,457	56	20	30	130	5 20	2 20	
Chilanguera R	SM91+0 32k	L4-3	4.37	54 55	24 80	30 00	-	1,457	1,457	56	20	30	130	5 20	2 20	890
Chilanguera R	SM91+0 32k		0.00	54 55	25.70	30 00	-	968	968	56	20	30	125	4 30	1 30	
La Canoa	SM95+0 38k	L4-4	2.42	56 97	28 20	32 50	-	968	968	56	20	30	125	4 30	1 30	770
La Canoa	SM95+0 38k		0 00	56 97				-	-		-	-		-	-	-
El Delirio	SM103	L4-5	6 74	61 29				-	-		-	-		-	-	-
MIDDLE REACHES																
El Delirio	SM103		0 00	61 29	56 07	61 07		1,637	1,637	53	20	30	125	5 00	2 00	
Olomega Dr /S M R	SM103+0 14k	M1	0 71	62 00	56 50	61 50		1,637	1,637	53	20	30	125	5 00	2 00	770
Olomega Dr /S M R	SM103+0.14k		0.00	62 00	56 50	61 50		1,637	1,637	52	20	30	125	5 00	2 00	
End of COC	OL1+0 80k	O1-1	0 85	62 85	57 02	62 02		1,637	1,637	52	20	30	125	5 00	2 00	760
End of COC	OL1+0 80k		0 00	62 85	57 02	62 02		1,637	1,637	52	20	30	125	5 00	2 00	
Start of COC/G sill	SM113	COC	2 10	64 95	58 30	63 30		1,637	1,637	52	20	30	125	5 00	2 00	760
Start of COC/G sill	SM113		0 00	64 95	59.30	65.30		1,637	1,637	29	6	44	105	6 00	3 00	
WL drop	SM117	M2-2	2 39	67 34	60.76	66 76		1,637	1,637	29	6	44	105	6 00	3 00	660
WL drop	SM117		0 00	67.34	61.75	68 75	69 95	1,637	1,637	16	6	44	95	7 00	4 00	
Pelota R	SM120-0 26k	M2-3	2 05	69 39	63.00	70 00	71 20	1,637	1,637	16	6	44	95	7 00	4 00	660
Pelota R	SM120-0 26k		0 00	69.39	63.00	70 00	71 20	1,637	1,637	40	6	44	120	7 00	4 00	
L. Aramuaca	SM135	M3	10 47	79.86	69.40	76.40	77.60	1,637	1,637	40	6	44	120	7.00	4 00	1 150
L. Aramuaca	SM135		0 00	79.86	69.40	76.40		1,637	1,637	40	6	44	120	7 00	4 00	
Moscoso Br.	SM157	M4	13.10	92.96	77.40	84.40		1,637	1,637	40	6	44	120	7 00	4 00	1,150
Moscoso Br	SM157		0.00	92.96	77.40	84.40		1,440	1,440	32	6	44	110	7 00	4 00	
Taisihuat R	SM165+0.17k	M5	4 25	97 21	80 35	87 35		1,440	1,440	32	6	44	110	7 00	4 00	1 050
Taisihuat R	SM165+0.17k		0.00	97 21	80 35	89 85		1,440	2,124	7	6	44	95	9 50	6 50	
Urbina Br	SM170-0.06k	M6-1	2 23	99.44	81.90	90 90		1,440	2,124	12	6	44	100	9 00	6 00	960
OLOMEGA DRAINAGE CHANNEL																
End of Drainage	OL1+0 80k		0 00	0 00	59 02	62 02	-	1,657	1,657	29	0	50	95	3 00	0 01	
Olomega Outlet	OL6+0.10k	O1-2	4 11	4.11	61 50	64 50	-	1,657	1,657	29	0	50	95	3 00	0 01	150
Olomega Outlet	Wo+0k		0 00	4.11	63 50	65 50	-	0	0	200	0	0	210	2 00	0 00	
Wo+0 95k	Wo+0.95k	Wo	1.15	5 26	63 50	65 50	-	0	0	200	0	0	210	2 00	0 00	
DIVERSION CHANNEL																
Wi-1.10k	Wi-1.10k		0 00	-4 31	63 50	65 50	66 70	-	2,140	62	0	0	75	2 00	0 00	
Wi+0/PL2+0.44k	Wi-0 00k	Wi	1.10	-3 21	63 50	65 50	66 70	0	2,140	62	0	0	75	2 00	0 00	
Wi+0/PL2+0.44k	PL2+0 44k		0.00	-3 21	63 50	67.50	68 70	6,420	2,140	62	0	30	105	4 00	1 29	
San Miguel R	SM120-0 26k	P2	3 21	0 00	64 00	69 00	70 20	6,420	2,140	38	6	44	105	5 00	2 00	320

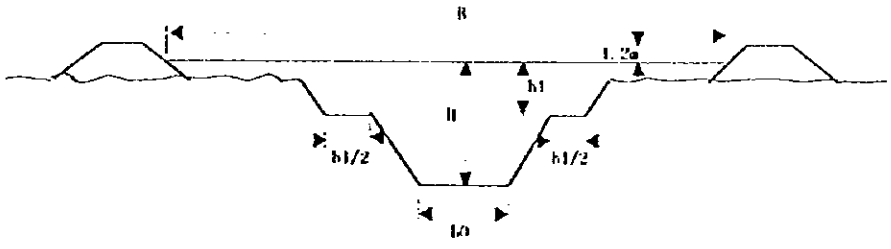


Table 5.6 PROJECT COST FOR MASTER PLAN

Items	Unit	Cost(Col.)	Quantity	Amount(million colons) Total	L.C.	F.C.
1. Construction works						
1.1 Channel works				705.1	306.2	398.9
Earth excavation(1)	m^3	45	8,087,000	363.9	149.2	214.7
Earth excavation(2)	m^3	20	6,266,000	125.3	51.4	73.9
Rock excavation	m^3	173	603,000	104.3	42.8	61.5
Embankment	m^3	42	1,843,000	77.4	31.7	45.7
Revetment	m	5,700	6,000	34.2	31.1	3.1
1.2 Structure works				34.7	25.6	9.1
Diversion weir	l.s.			10.9	9.4	1.5
Control gate	l.s.			9.4	5.8	3.6
Drainage sluice				8.0	5.0	3.0
Type-A	nos	426,000	7	3.0	1.9	1.1
Type-B	nos	586,000	6	3.5	2.2	1.3
Type-C	nos	754,000	2	1.5	0.9	0.6
Ground sill	m	18,300	348	6.4	5.4	1.0
1.3 Appurtenant works				67.7	37.5	30.2
Intake gate(Type-B)	nos	586,000	1	0.6	0.4	0.2
Bridge				58.2	30.3	27.9
Bridge(105m)	nos	13,400,000	1	13.4	7.0	6.4
Bridge(90m)	nos	12,600,000	3	37.8	19.7	18.1
Bridge(40m)	nos	7,000,000	1	7.0	3.6	3.4
Rural road	m	160	5,140	0.8	0.8	0.0
Telemetering system	l.s.			8.1	6.1	2.0
(Sub-total : 1.1+1.2+1.3)				807.5	369.3	438.2
2. Land and house				23.8	23.8	0.0
Land acquisit.(1)	10^3m^2	2,150	728	1.6	1.6	0.0
Land acquisit.(2)	10^3m^2	5,720	845	4.8	4.8	0.0
Land acquisit.(3)	10^3m^2	2,570	1,067	2.7	2.7	0.0
Land acquisit.(4)	10^3m^2	720	1,695	1.2	1.2	0.0
Land acquisit.(5)	10^3m^2	3,580	3,181	11.4	11.4	0.0
Land acquisit.(6)	10^3m^2	7,150	270	1.9	1.9	0.0
House compensat.	house	12,000	20	0.2	0.2	0.0
3. Administration	l.s.	-		41.6	41.6	0.0
4. Engineering service	l.s.	-		124.7	46.1	78.6
5. Physical contingency	l.s.	-		99.8	48.1	51.7
Total (1+2+3+4+5)				1,097.4	528.9	568.5

Note: The above costs are presented on the fixed price basis as of Dec.,1996
and price contingency is not included.

Table 5.7 ANNUAL DISBURSEMENT SCHEDULE(MASTER PLAN)

		Total cost	Annual Disbursment (million colons)												
			1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1. Construction Cost	Total	807.5	0.00	0.00	86.74	86.74	86.74	86.74	86.74	74.76	74.76	74.76	74.76	74.76	0.00
	L.C.	369.3	0.00	0.00	42.06	42.06	42.06	42.06	42.06	31.80	31.80	31.80	31.80	31.80	0
	F.C.	438.2	0.00	0.00	44.68	44.68	44.68	44.68	44.68	42.96	42.96	42.96	42.96	42.96	0
2. Land Acquisition	Total	23.8	0.00	4.80	4.80	4.80	4.80	0.00	2.30	2.30	0.00	0.00	0.00	0.00	0
	L.C.	23.8	0.00	4.80	4.80	4.80	4.80	0.00	2.30	2.30	0.00	0.00	0.00	0.00	0
	F.C.	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3. Administration	Total	41.6	0.00	0.24	4.58	4.58	4.58	4.34	4.45	3.85	3.74	3.74	3.74	3.77	0
	L.C.	41.6	0.00	0.24	4.58	4.58	4.58	4.34	4.45	3.85	3.74	3.74	3.74	3.77	0
	F.C.	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
4. Engineering Cost	Total	124.7	20.37	5.43	8.42	8.42	8.42	25.55	12.99	7.02	7.02	7.02	7.02	7.02	0.00
	L.C.	46.1	7.53	2.01	3.11	3.11	3.11	9.41	4.79	2.60	2.60	2.60	2.60	2.60	0
	F.C.	78.6	12.84	3.42	5.31	5.31	5.31	16.14	8.20	4.42	4.42	4.42	4.42	4.42	0
5. Physical Contingency	Total	99.8	2.04	1.05	10.45	10.45	10.45	11.66	10.65	8.79	8.55	8.55	8.55	8.59	0
	L.C.	48.1	0.75	0.71	5.46	5.46	5.46	5.58	5.36	4.06	3.81	3.81	3.81	3.84	0
	F.C.	51.7	1.28	0.34	5.00	5.00	5.00	6.08	5.29	4.74	4.74	4.74	4.74	4.76	0
6. (Sub-total) (1+2+3+4+5)	Total	1,097.4	22.41	11.52	114.99	114.99	114.99	128.29	117.13	96.73	94.07	94.07	94.07	94.15	0
	L.C.	528.9	8.28	7.75	60.00	60.00	60.00	61.39	58.97	44.61	41.96	41.96	41.96	42.01	0
	F.C.	568.5	14.12	3.77	54.99	54.99	54.99	66.90	58.16	52.11	52.11	52.11	52.11	52.13	0
7. Price Contingency	Total	480.2	1.88	1.83	22.65	29.05	35.78	46.30	50.53	46.64	51.10	57.71	64.66	72.02	0
	L.C.	321.3	1.02	1.48	15.75	20.30	25.11	30.92	35.02	30.76	33.18	37.69	42.47	47.60	0
	F.C.	158.9	0.86	0.35	6.90	8.76	10.67	15.38	15.52	15.88	17.92	20.02	22.19	24.43	0
8. (Total) (1+2+3+4+5+7)	Total	1,577.6	24.29	13.35	137.64	144.04	150.77	174.59	167.66	143.37	145.17	151.78	158.73	166.17	0
	L.C.	850.2	9.31	9.23	75.75	80.30	85.12	92.31	93.98	75.37	75.14	79.65	84.42	89.61	0
	F.C.	727.4	14.98	4.12	61.89	63.74	65.66	82.28	73.68	68.00	70.04	72.14	74.30	76.56	0

O & M cost	L.C.		0	0.00	0.00	0.48	0.95	1.43	1.91	2.39	2.80	3.21	3.62	4.03	4.44
Price Contingency	L.C.		0	0.00	0.00	0.16	0.40	0.72	1.13	1.64	2.21	2.88	3.66	4.57	5.60
Total	L.C.		0	0.00	0.00	0.64	1.35	2.15	3.04	4.03	5.01	6.09	7.28	8.60	10.04

Table 5.8 PROJECT COST FOR NON-STRUCTURAL MEASURES

(1) Floodplain Management

1)	Offices Cost (Olomega Site Office, 320 m^2)	¢	1,100,000
2)	Equipment	¢	5,400,000
	Automatic water level ganging station with telemeter:		
	5 units x ¢1,050,000	= ¢	5,250,000
	Office (Master Station) Equipment:	= ¢	1,750,000
	Total 1) + 2)	¢	7,000,000
3)	Operation/Maintenance Cost	¢	720,000/year
	Project Office: 5 x ¢5,000 x 12 months	= ¢	300,000
	Site Office: 5 x ¢5,000 x 12 months	= ¢	300,000
	Miscellaneous Cost ¢10,000 x 12 months	= ¢	120,000
(2)	Watershed Management	¢	208,000,000
1)	Reforestation: 30,000 ha x ¢3,000	= ¢	90,000,000
2)	Erosion Control: 20,000 ha x 45,000	= ¢	100,000,000
3)	Ground Sill: 30 places x ¢600,000	= ¢	18,000,000

Table 5.9 REDUCTION IN NUMBER AND AREA OF INUNDATION ASSETS EXPECTED BY IMPLEMENTING THE PROJECT

1. M/P
(1) 1.05-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	113	264	120	497	10	507	142	200	882	1,224
2	0.25-0.5	131	307	139	577	12	589	50	59	303	412
3	0.5-1.0	173	404	183	760	15	775	91	159	692	942
4	1.0-1.5	49	114	52	215	4	219	9	71	288	368
5	over 1.5	126	294	133	553	11	564	13	113	482	608
	Total	592	1,383	627	2,602	52	2,654	305	602	2,647	3,554

1. M/P
(2) 2-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores, Etc.	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	324	757	344	1,425	29	1,454	185	227	1,009	1,421
2	0.25-0.5	239	557	253	1,049	21	1,070	143	183	814	1,140
3	0.5-1.0	342	799	363	1,504	30	1,534	212	266	1,227	1,705
4	1.0-1.5	125	293	133	551	11	562	73	138	586	797
5	1.5-2.0	171	398	181	750	15	765	39	150	650	839
	Total	1,201	2,804	1,274	5,279	106	5,385	652	964	4,286	5,902

1. M/P
(3) 5-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores, Etc.	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	353	825	374	1,552	31	1,583	194	229	1,012	1,435
2	0.25-0.5	300	699	317	1,316	26	1,342	153	190	841	1,184
3	0.5-1.0	444	1,037	471	1,952	39	1,991	246	328	1,446	2,020
4	1.0-1.5	189	441	200	830	17	847	102	156	749	1,007
5	1.5-2.0	235	549	249	1,033	21	1,054	58	183	824	1,065
	Total	1,521	3,551	1,611	6,683	134	6,817	753	1,086	4,872	6,711

1. M/P
(4) 10-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores, Etc.	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	405	944	428	1,777	36	1,813	188	193	855	1,236
2	0.25-0.5	336	785	356	1,477	30	1,507	171	208	913	1,292
3	0.5-1.0	520	1,214	551	2,285	46	2,331	273	354	1,555	2,182
4	1.0-1.5	240	559	254	1,053	21	1,074	126	203	900	1,229
5	1.5-2.0	281	655	297	1,233	25	1,258	76	189	939	1,204
	Total	1,782	4,157	1,886	7,825	157	7,982	834	1,147	5,162	7,143

1. M/P
(5) 20-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores, Etc.	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	372	868	394	1,634	33	1,667	182	159	732	1,073
2	0.25-0.5	374	872	396	1,642	33	1,675	177	199	860	1,236
3	0.5-1.0	598	1,396	634	2,628	53	2,681	320	419	1,820	2,559
4	1.0-1.5	304	710	322	1,336	27	1,363	168	263	1,145	1,576
5	1.5-2.0	325	759	344	1,428	29	1,457	106	235	1,174	1,515
	Total	1,973	4,605	2,090	8,668	173	8,841	953	1,275	5,731	7,959

1. M/P
(6) 50-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores, Etc.	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	129	301	137	567	11	578	103	0	63	166
2	0.25-0.5	227	529	240	996	20	1,016	104	37	270	411
3	0.5-1.0	462	1,077	489	2,028	41	2,069	232	238	1,101	1,571
4	1.0-1.5	356	831	377	1,564	31	1,595	188	282	1,246	1,716
5	1.5-2.0	383	894	406	1,683	34	1,717	147	301	1,495	1,943
	Total	1,557	3,632	1,649	6,838	137	6,975	774	858	4,175	5,807

1. M/P
(7) 100-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores, Etc.	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	31	72	33	136	3	139	44	0	8	52
2	0.25-0.5	148	346	157	651	13	664	43	0	0	43
3	0.5-1.0	384	896	406	1,686	34	1,720	168	115	594	877
4	1.0-1.5	345	806	366	1,517	30	1,547	203	258	1,165	1,626
5	1.5-2.0	112	262	119	493	10	503	0	203	920	1,123
	Total	1,020	2,382	1,081	4,483	90	4,573	458	576	2,687	3,721

Table 5.10 AVERAGE APPRAISAL VALUES OF ASSETS IN FLOOD PRONE AREA (AT THE 1996 PRICES)

1. Buildings, Household Effects & Livestock

Unit : Colones/household

No.	Kind of Buildings	Buildings	House-hold Effects*	livestock**
1	Residence			
	(1) Medium Class	53,755	31,087	1,417
	(2) Low Class	27,405	12,338	1,417
	(3) Poor Class	9,905	3,845	1,417
2	Store & Others***	52,333	139,498	-

2. Agricultural Field Crops

No.	Crops	Production (Tons/ha)	Unit Price (Cols/ton)	Unit Price (Cols/ha)
1	Sugar cane	96.43	193.54	18,663
2	Maize	2.09	2,577.65	5,387
3	Pasture****			
	(1) Natural	-	-	6,790
	(2) Improved	-	-	8,570
	(3) Average			7,680

Source : MAG data and interview survey in field.

Note : * Household effects include equipment and materials.

** Livestock is pig and chicken.

*** Store & others give an average price of store and other buildings and these equipment and materials.

**** Price of pasture is estimated based on production of meat and milk of cattle raised in pasture.

Table 5.11 INUNDATION DAMAGE RATE OF ASSETS

No.	Inundation Depth (cm.)	Damage Rate: General Assets: Buildings	General Assets: Household Effects	Livestock	Agricultural Field Crops: Sugar cane	Agricultural Field Crops: Maize	Agricultural Field Crops: Pasture
1	0 - 25	0.140	0.111	0.069	0.548	0.214	0.181
2	25 - 50	0.198	0.127	0.206	0.642	0.457	0.280
3	50 - 100	0.355	0.254	1.000	0.926	0.696	0.561
4	100 - 150	0.452	0.325	1.000	0.973	0.910	0.841
5	150 - 200	0.453	0.343	1.000	1.000	1.000	1.000

Source : Results of interview survey in field.

Table 5.12 REDUCTION IN FLOOD DAMAGE TO ASSETS BY RETURN PERIOD

Unit : Colones Million

No.	Return Period (Year)	Flood Damage: Buildings	Household Effects	Livestock	Agricultural Crops	Public Facilities	Business Activities	Total
1	1	30.046	12.441	2.919	10.098	14.445	2.549	72.498
2	2	44.884	18.647	4.277	15.751	21.602	3.812	108.973
3	5	55.706	23.110	5.411	21.543	26.797	4.729	137.296
4	10	68.452	28.388	6.653	26.292	32.926	5.810	168.521
5	20	27.192	11.447	2.623	10.047	13.137	2.318	66.764
6	50	31.680	13.096	3.277	18.978	15.224	2.687	84.942
7	100	30.049	12.445	3.086	23.189	14.447	2.550	85.766

Table 5.13 (1/2) ESTIMATE OF ECONOMIC COST

I. M/P

(1) Financial Cost

1999 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	0.00	0.00	0.00	
4	Engineering Fee	7.53	12.84	20.37	
5	Physical Contingency	0.75	1.28	2.04	
	Sub-total	8.28	14.12	22.41	
6	Price Contingency	1.02	0.86	1.88	
	Total	9.30	14.98	24.29	OM Cost 0.00

2000 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	0.24	0.00	0.24	
4	Engineering Fee	2.01	3.42	5.43	
5	Physical Contingency	0.71	0.34	1.05	
	Sub-total	7.76	3.76	11.52	
6	Price Contingency	1.48	0.35	1.83	
	Total	9.24	4.11	13.35	OM Cost 0.00

2001 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	4.58	0.00	4.58	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	5.46	5.00	10.45	
	Sub-total	60.01	54.99	114.99	
6	Price Contingency	15.75	6.90	22.65	
	Total	75.76	61.89	137.64	OM Cost 0.00

2002 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	4.58	0.00	4.58	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	5.46	5.00	10.45	
	Sub-total	60.01	54.99	114.99	
6	Price Contingency	20.30	8.76	29.06	
	Total	80.31	63.75	144.05	OM Cost 0.64

2003 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	4.58	0.00	4.58	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	5.46	5.00	10.45	
	Sub-total	60.01	54.99	114.99	
6	Price Contingency	25.11	10.68	35.79	
	Total	85.12	65.67	150.78	OM Cost 1.35

2004 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	4.34	0.00	4.34	
4	Engineering Fee	9.41	16.14	25.55	
5	Physical Contingency	5.58	6.08	11.66	
	Sub-total	61.39	66.90	128.29	
6	Price Contingency	30.92	15.38	46.30	
	Total	92.31	82.28	174.59	OM Cost 2.15

2005 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	2.30	0.00	2.30	
3	Administration Cost	4.45	0.00	4.45	
4	Engineering Fee	4.79	8.20	12.99	
5	Physical Contingency	5.36	5.29	10.65	
	Sub-total	58.96	58.17	117.13	
6	Price Contingency	35.02	15.52	50.54	
	Total	93.98	73.69	167.67	OM Cost 3.04

(2) Economic Cost

1999 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	0.00	0.00	0.00	
4	Engineering Fee	6.66	12.84	19.50	
5	Physical Contingency	0.67	1.28	1.95	
	Sub-total	7.33	14.12	21.45	
6	Price Contingency	0.00	0.00	0.00	
	Total	7.33	14.12	21.45	OM Cost 0.00

2000 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	0.21	0.00	0.21	
4	Engineering Fee	1.78	3.42	5.20	
5	Physical Contingency	0.57	0.34	0.91	
	Sub-total	6.23	3.76	9.99	
6	Price Contingency	0.00	0.00	0.00	
	Total	6.23	3.76	9.99	OM Cost 0.00

2001 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	4.05	0.00	4.05	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.41	5.00	9.41	
	Sub-total	48.47	54.99	103.46	
6	Price Contingency	0.00	0.00	0.00	
	Total	48.47	54.99	103.46	OM Cost 0.00

2002 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	4.05	0.00	4.05	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.41	5.00	9.41	
	Sub-total	48.47	54.99	103.46	
6	Price Contingency	0.00	0.00	0.00	
	Total	48.47	54.99	103.46	OM Cost 0.43

2003 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	4.05	0.00	4.05	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.41	5.00	9.41	
	Sub-total	48.47	54.99	103.46	
6	Price Contingency	0.00	0.00	0.00	
	Total	48.47	54.99	103.46	OM Cost 0.86

2004 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.84	0.00	3.84	
4	Engineering Fee	8.33	16.14	24.47	
5	Physical Contingency	4.58	6.08	10.66	
	Sub-total	50.33	66.90	117.23	
6	Price Contingency	0.00	0.00	0.00	
	Total	50.33	66.90	117.23	OM Cost 1.29

2005 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	1.76	0.00	1.76	
3	Administration Cost	3.94	0.00	3.94	
4	Engineering Fee	4.24	8.20	12.44	
5	Physical Contingency	4.35	5.29	9.64	
	Sub-total	47.88	58.17	106.04	
6	Price Contingency	0.00	0.00	0.00	
	Total	47.88	58.17	106.04	OM Cost 1.72

Table 5.13 (2/2) ESTIMATE OF ECONOMIC COST

I. M/P

(1) Financial Cost

2006 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	31.80	42.96	74.76	
2	Land Acquisition	2.30	0.00	2.30	
3	Administration Cost	3.85	0.00	3.85	
4	Engineering Fee	2.60	4.42	7.02	
5	Physical Contingency	4.06	4.74	8.79	
	Sub-total	44.61	52.12	96.72	
6	Price Contingency	30.76	15.88	46.64	
	Total	75.37	68.00	143.36	OM Cost 4.03

2007 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	31.80	42.96	74.76	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.74	0.00	3.74	
4	Engineering Fee	2.60	4.42	7.02	
5	Physical Contingency	3.81	4.74	8.55	
	Sub-total	41.95	52.12	94.07	
6	Price Contingency	33.18	17.92	51.10	
	Total	75.13	70.04	145.17	OM Cost 5.01

2008 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	31.80	42.95	74.76	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.74	0.00	3.74	
4	Engineering Fee	2.60	4.42	7.02	
5	Physical Contingency	3.81	4.74	8.55	
	Sub-total	41.95	52.12	94.07	
6	Price Contingency	37.69	20.02	57.71	
	Total	79.64	72.14	151.78	OM Cost 6.09

2009 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	31.80	42.96	74.76	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.74	0.00	3.74	
4	Engineering Fee	2.60	4.42	7.02	
5	Physical Contingency	3.81	4.74	8.55	
	Sub-total	41.95	52.12	94.07	
6	Price Contingency	42.47	22.19	64.66	
	Total	84.42	74.31	158.73	OM Cost 7.28

2010 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	31.80	42.96	74.76	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.77	0.00	3.77	
4	Engineering Fee	2.60	4.42	7.02	
5	Physical Contingency	3.82	4.74	8.56	
	Sub-total	41.99	52.12	94.11	
6	Price Contingency	47.60	24.43	72.03	
	Total	89.59	76.55	166.14	OM Cost 8.60

Total — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	369.30	438.20	807.50	
2	Land Acquisition	23.80	0.00	23.80	
3	Administration Cost	41.61	0.00	41.61	
4	Engineering Fee	46.07	78.63	124.70	
5	Physical Contingency	48.08	51.68	99.76	
	Sub-total	528.86	568.51	1,097.37	
6	Price Contingency	321.30	158.89	480.19	
	Total	850.16	727.40	1,577.56	OM Cost 10.04

(2) Economic Cost

2006 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	25.39	42.96	68.35	
2	Land Acquisition	1.76	0.00	1.76	
3	Administration Cost	3.41	0.00	3.41	
4	Engineering Fee	2.30	4.42	6.72	
5	Physical Contingency	3.29	4.74	8.02	
	Sub-total	36.15	52.12	88.27	
6	Price Contingency	0.00	0.00	0.00	
	Total	36.15	52.12	88.27	OM Cost 2.15

2007 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	25.39	42.96	68.35	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.31	0.00	3.31	
4	Engineering Fee	2.30	4.42	6.72	
5	Physical Contingency	3.10	4.74	7.84	
	Sub-total	34.11	52.12	86.22	
6	Price Contingency	0.00	0.00	0.00	
	Total	34.11	52.12	86.22	OM Cost 2.53

2008 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	25.39	42.96	68.35	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.31	0.00	3.31	
4	Engineering Fee	2.30	4.42	6.72	
5	Physical Contingency	3.10	4.74	7.84	
	Sub-total	34.11	52.12	86.22	
6	Price Contingency	0.00	0.00	0.00	
	Total	34.11	52.12	86.22	OM Cost 2.90

2009 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	25.39	42.96	68.35	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.31	0.00	3.31	
4	Engineering Fee	2.30	4.42	6.72	
5	Physical Contingency	3.10	4.74	7.84	
	Sub-total	34.11	52.12	86.22	
6	Price Contingency	0.00	0.00	0.00	
	Total	34.11	52.12	86.22	OM Cost 3.28

2010 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	25.39	42.96	68.35	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.34	0.00	3.34	
4	Engineering Fee	2.30	4.42	6.72	
5	Physical Contingency	3.10	4.74	7.84	
	Sub-total	34.14	52.12	86.25	
6	Price Contingency	0.00	0.00	0.00	
	Total	34.14	52.12	86.25	OM Cost 3.66

Total — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	294.92	438.20	733.12	
2	Land Acquisition	18.20	0.00	18.20	
3	Administration Cost	36.82	0.00	36.82	
4	Engineering Fee	40.77	78.63	119.40	
5	Physical Contingency	39.07	51.68	90.75	
	Sub-total	429.78	568.51	998.29	
6	Price Contingency	0.00	0.00	0.00	
	Total	429.78	568.51	998.29	OM Cost 4.03

Table 5.14 ECONOMIC ANALYSIS

I. M/P

Unit : Cols. Million

	Year	Economic Cost			Economic Benefit (B)	Net Benefit (B)-(C)
		Construction	OM	Total (C)		
1	1999	21.45	0.00	21.45	0.00	-21.45
2	2000	9.99	0.00	9.99	0.00	-9.99
3	2001	103.46	0.00	103.46	0.00	-103.46
4	2002	103.46	0.43	103.89	16.74	-87.15
5	2003	103.46	0.86	104.32	33.48	-70.84
6	2004	117.23	1.29	118.52	50.21	-68.31
7	2005	106.04	1.72	107.76	66.95	-40.81
8	2006	88.27	2.15	90.42	83.69	-6.73
9	2007	86.22	2.53	88.75	98.48	9.73
10	2008	86.22	2.90	89.12	112.88	23.76
11	2009	86.22	3.28	89.50	127.68	38.18
12	2010	86.25	3.66	89.91	142.47	52.56
13	2011	0.00	4.03	4.03	156.87	152.84
14	2012	0.00	4.03	4.03	156.87	152.84
15	2013	0.00	4.03	4.03	156.87	152.84
16	2014	0.00	4.03	4.03	156.87	152.84
17	2015	0.00	4.03	4.03	156.87	152.84
18	2016	0.00	4.03	4.03	156.87	152.84
19	2017	0.00	4.03	4.03	156.87	152.84
20	2018	0.00	4.03	4.03	156.87	152.84
21	2019	0.00	4.03	4.03	156.87	152.84
22	2020	0.00	4.03	4.03	156.87	152.84
23	2021	0.00	4.03	4.03	156.87	152.84
24	2022	0.00	4.03	4.03	156.87	152.84
25	2023	0.00	4.03	4.03	156.87	152.84
26	2024	0.00	4.03	4.03	156.87	152.84
27	2025	0.00	4.03	4.03	156.87	152.84
28	2026	0.00	4.03	4.03	156.87	152.84
29	2027	0.00	4.03	4.03	156.87	152.84
30	2028	0.00	4.03	4.03	156.87	152.84
31	2029	0.00	4.03	4.03	156.87	152.84
32	2030	0.00	4.03	4.03	156.87	152.84
33	2031	0.00	4.03	4.03	156.87	152.84
34	2032	0.00	4.03	4.03	156.87	152.84
35	2033	0.00	4.03	4.03	156.87	152.84
36	2034	0.00	4.03	4.03	156.87	152.84
37	2035	0.00	4.03	4.03	156.87	152.84
38	2036	0.00	4.03	4.03	156.87	152.84
39	2037	0.00	4.03	4.03	156.87	152.84
40	2038	0.00	4.03	4.03	156.87	152.84
41	2039	0.00	4.03	4.03	156.87	152.84
42	2040	0.00	4.03	4.03	156.87	152.84
	Total	998.27	139.72	1,137.99	5,438.68	4,300.69

EIRR (%) 14.56

Discount Rate (%)	B/C	PV(Cols. Million)		NPV (Cols.Million)
		Cost	Benefit	
20	0.73	323.48	234.57	-88.91
15	0.97	415.05	402.93	-12.12
12	1.20	489.12	588.63	99.51
10	1.42	549.72	780.58	230.86
5	2.38	761.11	1,811.26	1,050.15

Table 5.15 FINANCIAL CASH FLOW AND LOAN REPAYMENT

Project Cost Unit : Million US$

Year in Order	Loan Disbursement			Repayment		
	Capital Cost	Interest	Cummurative Dept	Principal	Interest	Total
1	1.428	0.043	1.471		0.043	0.043
2	8.201	0.289	9.918		0.289	0.289
3	15.044	0.740	25.414		0.740	0.740
4	15.578	1.208	41.459		1.208	1.208
5	16.133	1.692	58.076		1.692	1.692
6	16.710	2.193	75.287		2.193	2.193
7	17.309	2.712	93.115		2.712	2.712
8	17.933	3.250	111.586		3.250	3.250
9	18.581	3.808	130.725		3.808	3.808
10	19.120	4.381	150.418		4.381	4.381
11			146.037	7.302	4.381	11.683
12			138.735	7.302	4.162	11.464
13			131.433	7.302	3.943	11.245
14			124.132	7.302	3.724	11.026
15			116.830	7.302	3.505	10.807
16			109.528	7.302	3.286	10.588
17			102.226	7.302	3.067	10.369
18			94.924	7.302	2.848	10.150
19			87.622	7.302	2.629	9.931
20			80.320	7.302	2.410	9.711
21			73.019	7.302	2.191	9.492
22			65.717	7.302	1.972	9.273
23			58.415	7.302	1.752	9.054
24			51.113	7.302	1.533	8.835
25			43.811	7.302	1.314	8.616
26			36.509	7.302	1.095	8.397
27			29.207	7.302	0.876	8.178
28			21.906	7.302	0.657	7.959
29			14.604	7.302	0.438	7.740
30			7.302	7.302	0.219	7.521
31			0.000			
Total	146.037	20.315	-	146.037	66.316	212.353

2. Foreign Currency Portion (F.C.) Unit : Million US$

Year in Order	Loan Disbursement			Repayment		
	Capital Cost	Interest	Cummurative Dept	Principal	Interest	Total
1	0.915	0.027	0.943		0.027	0.027
2	6.443	0.221	7.579		0.221	0.221
3	12.290	0.589	20.238		0.589	0.589
4	12.659	0.969	33.276		0.969	0.969
5	13.039	1.360	46.706		1.360	1.360
6	13.430	1.763	60.539		1.763	1.763
7	13.833	2.178	74.786		2.178	2.178
8	14.248	2.606	89.461		2.606	2.606
9	14.675	3.046	104.577		3.046	3.046
10	15.115	3.499	120.145		3.499	3.499
11			116.646	5.832	3.499	9.332
12			110.814	5.832	3.324	9.157
13			104.981	5.832	3.149	8.982
14			99.149	5.832	2.974	8.807
15			93.317	5.832	2.800	8.632
16			87.484	5.832	2.625	8.457
17			81.652	5.832	2.450	8.282
18			75.820	5.832	2.275	8.107
19			69.988	5.832	2.100	7.932
20			64.155	5.832	1.925	7.757
21			58.323	5.832	1.750	7.582
22			52.491	5.832	1.575	7.407
23			46.658	5.832	1.400	7.232
24			40.826	5.832	1.225	7.057
25			34.994	5.832	1.050	6.882
26			29.161	5.832	0.875	6.707
27			23.329	5.832	0.700	6.532
28			17.497	5.832	0.525	6.357
29			11.665	5.832	0.350	6.182
30			5.832	5.832	0.175	6.007
31			0.000			
Total	116.646	16.260	-	116.646	53.003	169.649

Table 5.16 (1/3) SCREENING

1.Social Environment

No.	Environmental Item	Discretion	Evaluation		Remarks
			1	2	
a	Resettlement	Resettlement by land occupation (Transfer of rights of residence, land ownership)	B	B	1), 2) Land acquisition area for the river improvement is 450 ha. 2) Resettlement of 20 houses.
b	Economic Activities	Loss of production base (land , etc.) and change of economic structure.	D	D	Most of land aquisition area is severe flood area and idle land.
c	Traffic and Public Facilities	Impacts on existing traffic, schools, hospitals, etc. (e.g., traffic jam, accidents)	D	D	
d	Split of Communities	Separation of regional communities by hindrance of regional traffic	D	D	
e	Cultural Property	Loss or deterioration of cultural properties, such as temples, shrines, archaeological assets, etc.	D	D	
f	Water Rights and Right of Common	Obstruction of fishing rights, irrigation and water rights	B	D	1) Fishing rights of about 2,000 fishermen
g	Public Health Condition	Worsening of health and sanitary condition due to generation of garbage and appearance of harmful insects, increasing of agricultural chemicals	D	D	
h	Waste	Generation of construction waste, surplus soil, sludge, domestic waste, etc.	B	B	1), 2) Generation of debris and soil
i	Hazards(Risk)	Increase in risk of cave-ins, ground failure and accident	D	D	

Table 5.16 (2/3) SCREENING

2. Natural Environment

No.	Environmental Item	Discretion	Evaluation		Remarks
			1	2	
a	Topography and Geology	Change of valuable topography and geology due to excavation and earthfill	D	D	
b	Soil and land	Topsoil erosion by raintall after land reclamation or deforestation, salt accumulation by irrigation, degradation of soil fertility	C	C	1), 2) Soil erosion be dike construction.
c	Groundwater	Lowering of groundwater table due to overdraft and turbid water caused by construction work	D	D	
d	Hydrological Situation	Change of discharge and water quality due to reclamation and drainage	B	B	1), 2) Impact on fishery and change of channel form.
e	Coastal Zone	Coastal erosion and change of vegetation due to coastal reclamation and coastal changes	B	B	1), 2) Increase of turbidity in the marine zone.
f	Fauna and Flora	Interruption of reproduction or extinction of species due to change of habitat condition	B	C	1), 2) Impact of the water level and the water quality.
g	Meteorology	Change of micro-climate, such as temperature, wind, etc., due to large scale reclamation, and construction	D	D	
h	Landscape	Deterioration of aesthetic harmony by structures and topographic change by reclamation	B	B	1), 2) Impact on landscape due to the construction of dike.

Table 5.16 (3/3) SCREENING

3. Pollution

No.	Environmental Item	Discretion	Evaluation		Remarks
			1	2	
a	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	D	D	
b	Water Pollution	Water pollution of river and groundwater caused by drilling mud and oil	D	D	
c	Soil Contamination	Contamination caused by discharge or diffusion of sewage or toxic substances	D	D	
d	Noise and Vibration	Generation of noise and vibration due to drilling and operation of pumping machines	D	D	
e	Land Subsidence	Deformation of the land and land subsidence due to lowering of groundwater table	D	D	
f	Offensive Odor	Generation of offensive odor and exhaust gases	D	D	

Mark classification : A: Important Impact, B: Some impact, C: Unknown , D: No Impact

Table 6.1 PRIORITY COMPARISON OF THE PROJECTS

Project Name	Cost (₤ Million)	Reduction of Flood Area by 10-year Flood (Population Saved)	Socio-economic Impact		Environmental Impact		Project Execution and Management		Financial Aspect		Selection
San Miguel River Improvement, Lower Reach 1 (to cope with 2-year flood)	376	37.3 km² (9,700 in 1996/17,100 in 2020)	(+) Increase in land development potential (+) Flood damage reduction (-) Land acquisition/compensation	high high low	(+) Improvement of Ecology in Lake Jocotal	high	F/S is required for project implementation and urgent	high	Project cost is medium size and possible to implement	high	Yes
San Miguel River Improvement, Lower Reach 2 (rest of M/P projects)	141	17.1 km² (700 / 1,300)	(+) Increase in land development potential (+) Flood damage reduction	medium medium	(+) Improvement of Ecology in Lake Jocotal	medium	F/S is required Construction of Phase 1 and 2 will take long period	medium low	Cost of Phase 1 and 2 is high	low	No
San Miguel River Improvement, Middle Reach 1 incl. Storage in Olomega (2 years flood)	314	42.7 km² (8,500 / 15,100)	(+) Increase in land development potential (-) Effects on flooding in the downstream (-) Land acquisition/compensation	high medium low	(+) Stabilization of fishery in Olomega	high	F/S is required and urgent	high	Project cost is medium size and possible to implement	high	Yes
San Miguel River Improvement, Middle Reach 2 (rest of M/P projects)	157	2.7 km² (5,000 / 7,000)	(+) Increase in land development potential (-) Effects on flooding in the downstream	low low	(+) Stabilization of fishery in Olomega	medium	F/S is required	medium	Cost of Phase 1 and 2 is high	low	No
San Miguel River Improvement, Upper Reach	63	6.0 km² (1,300 / 2,400)	(+) Smooth urban development (-) Effects on flooding in the downstream (-) Land acquisition/compensation	medium low low	-		F/S is required	low	Cost is high compared with the effect	low	No
Floodplain Management, Near San Miguel City	-	-	(+) Smooth urban development (+) Flood damage reduction	high high	-		Study is urgently needed because of rapid development	high	Low cost	high	Yes
Floodplain Management, Olomega Area and Jocotal Area	5.6	-	(+) Flood damage reduction (+) Contribution to solution of lake problem	high high	(+) Improvement of Ecology in the lakes	medium	Closely related with the river improvement	high	Low cost	high	Yes
Floodplain Management, Estuary Area	-	-	(+) Smooth development (-) Flood damage reduction	medium medium	-		Can be executed without F/S	low	Low cost	high	No
Watershed Management, Upper Basin	68	Small	(+) Effects on flood control and water resources (+) Increase in forestry production	high high	(+) Improvement of river water environment	high	Land owners are related Can be studied and executed by MAG Not pure flood control	low low low	Cost is moderate size Project cost would be the government an land owners	medium low	No
Watershed Management, Middle Basin	50	Small	(+) Effects on flood control and water resources (+) Increase in forestry and agricultural production	medium high	(+) Improvement of river water environment	high	Land owners are related Can be studied and executed by MAG Not pure flood control	low low low	Cost is moderate size Project cost would be the government an land owners	medium low	No
Watershed Management, Lower Basin	90	Small	(+) Effects on flood control and water resources (+) Increase in forestry and agricultural production	medium high	(+) Improvement of river water environment	high	Land owners are related Can be studied and executed by MAG Not pure flood control	low low low	Cost is moderate size Project cost would be the government an land owners	medium low	No

Note: high, medium, low in colums means priority

Table 6.2 COMPARISON OF ALTERNATIVES OF DIVERSION WEIR

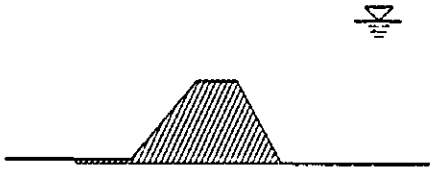
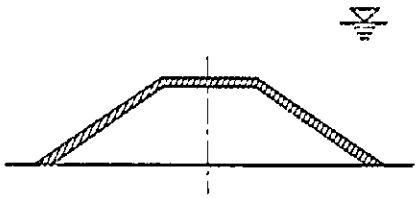
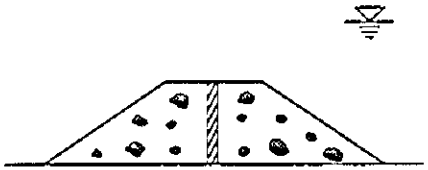
	a	b	c
	Concrete Monolith	Concrete Faced Fill	Rock Fill with Core
Structure			
Description	Concrete Monolith Structure	Embankment Paved by Concrete	Gabion or Rock Fill with Impermeable Core
Simplicity	○	×	×
Resitance Against Flow	○	△	△
Easy Maintenance	○	×	×
Easy Reconstruction	○	×	○
Natural Appearance	△	△	○
Cost	×	△	○
Total Evaluation	A	C	B

Table 6.3 COMPARISON OF ALTERNATIVES (LOWER END OF IMPROVEMENT)

Descriptions	Alternative-1	Alternative-2	Alternative-3
Description of Alternative	Improvement works: Excavation: up to SM1 Embankment: up to SM7	Improvement works: Excavation: up to SM1 Embankment: up to SM1	Improvement works: Excavation: up to SR21+0 20k Embankment: up to SM1
Technical Aspects:			
Work quantity			
Earth excavation	482,800 m³	482,800 m³	526,500 m³
Embankment	381,900 m³	680,300 m³	680,300 m³
Revetment	300 m	300 m	300 m
Drainage sluice	1 place	3 place	3 place
Rural road	1,740 m	1,740 m	1,740 m
Water level in stretch L1-2	Low due to flooding	High confined by dike	Little difference from Alt 2
Financial Aspects: Project cost	55.6 million colons	73.8 million colons	76.7 million colons
Economic Aspects: Flood in areas along stretch L1-2	Flooding still remain	Protected from 10 year flood.	Protected from 10 year flood.
Social Aspects: Land / house	728,000 m²/ 0 house	728,000 m²/ 1 house	834,000 m²/ 1 house
Environmental Aspects:	No significant impact	Flow concentrates to section SM1.	Flow concentrates to section SM1 and mangrove forest in stretch L1-1 to be cut 860 m long and 150 m wide.
Overall Evaluation:	**Selected:** Least cost and less social and environmental impact	Not selected:	Not selected: Little hydraulic effects and damage to mangrove forest.

(Note) Stretch of comparison: From river mouth to SM13

Stretch L1-1: From the upper end of mangrove forest(section SM1) to Cerro El Encantado(section SM7)

Table 6.4 COMPARISON OF ALTERNATIVES (RIVER COURSE IN OLOMEGA AREA)

Descriptions	Alternative-1	Alternative-2	Alternative-3
Description of alternative	Route of San Miguel R: Existing channel route	Route of San Miguel R: Existing channel route with cut-off channel below section SM113	Route of San Miguel R: Existing route of Pelota River and Olomega drainage
Technical Aspects:			
Work quantity			
Earth excavation	4,086,000 m³	3,050,000 m³	3,905,000 m³
Rock excavation	34,000 m³	66,000m³	49,000 m³
Embankment	286,800 m³	239,600 m³	384,300 m³
Revetment	1,400 m	2,300 m	1,400 m
Side weir and outlet gate	1 each	1 each	1 each
Ground sill	59 m	151 m	73 m
Intake gate	none	1 place	1 place
Bridge(new)	2 places	3 places	2 places
Rural road	1,050 m	1,050 m	1,050 m
Financial Aspects: Project cost	349.0 million colons	321.1 million colons	349.1 million colons
Economic Aspects:	Mitigation of flood damages	Same benefit as Alt.1	Same benefit as Alt.1
Social Aspects:			
Land / house	1,925,000 m²/ 2 houses	1,771,000 m²/ 2 houses	1,473,000 m²/ 2 houses
Social impact	No significant impact	New cut-off channel	Route change of San Miguel R.
Environmental Aspects:	No significant impact Sediment inflow: less than ever	No significant problem Sediment inflow: less than ever	No significant problem Sediment inflow: less than ever
Overall Evaluation:	Not selected:	**Selected:** Least cost and less social/environmental impact.	Not selected:

(Note) Stretch of comparison: From SM103 to SM120-0.26K

Table 6.5 CONCEPT OF CHANNEL IMPROVEMENT

Stretch			Concept of improvement for Master Plan
Code	From	To	
SAN MIGUEL RIVER			
L1-1	Santa Rita R. (SR21+0.20k)	End of farm land (SM1)	PL: Conservation of mangrove WK: None
L1-2	End of farm land (SM1)	Cerro El Encantado (SM7)	PL: Q10yr, DHWL>GH WK: Channel excavation, No dike,
L1-3	Cerro El Encantado (SM7)	Limon R. (SM13)	PL: Q10yr, DHWL>GH WK: Channel excavation, Dike
L2-1	Limon R. (SM13)	El Angel (SM24)	
L2-2	El Angel (SM24)	Ereguatquin R. (SM30-0.05k)	PL: Q10yr, DHWL>GH WK: Channel excavation, Dike(locally),
L3	Ereguatquin R. (SM30-0.05k)	Vado Marin Br. (SM58-0.02k)	
L4-1	Vado Marin Br. (SM58-0.02k)	Jocotal Drainage (SM64-0.03k)	PL: Q10yr, DHWL<GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike,
L4-2	Jocotal Drainage (SM64-0.03k)	Brazo de S.M. (SM80-0.06k)	PL: Q10yr, DHWL>GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike,
L4-3	Brazo de S.M. (SM80-0.06k)	Chilaguera R. (SM92-0.25k)	PL: Q10yr, DHWL<GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike.
L4-4	Chilaguera R. (SM92-0.25k)	La Canoa (SM96)	
L4-5	La Canoa (SM96)	El Delirio (SM103)	PL: Existing capacity>Q10yr WK: None
M1	El Delirio (SM103)	Olomega Dr. (SM104+0.14k)	PL: Q10yr, DHWL<GH WK: Channel excavation, Cut-off-channel, No dike.
O1-1	Olomega D/SM (SM104+0.14k)	End of COC (OL1+0.80k)	
COC	End of COC (OL1+0.80k)	Start of COC/SM (SM113)	PL: Q10yr, DHWL<GH, Realignment of river course WK: Channel excavation, Cut-off-channel, No dike,
M2-2	Start of COC/SM (SM113)	Ground sill (SM117)	PL: Q10yr, DHWL<GH WK: Channel excavation, Cut-off-channel, No dike,
M2-3	Ground sill (SM117)	Pelota R. (SM119+0.09k)	PL: Q10yr, DHWL>GH WK: Channel excavation, Dike
M3	Pelota R. (SM119+0.09k)	L. Aramuaca (SM135)	
M4	L. Aramuaca (SM135)	Moscoso Br. (SM157)	PL: Q10yr, DHWL>GH WK: Channel excavation(locally), No dike
M5	Moscoso Br. (SM157)	Taisihuat R. (SM165+0.17k)	
M6-1	Taisihuat R. (SM165+0.17k)	Urbina Br. (SM170-0.06k)	
OLOMEGA DRANAGE			
O1-2	End of FW (OL1+0.80k)	Pelota R. (OL6+0.10k)	PL: Q10yr, DHWL<GH WK: Channel excavation, No dike
O2	Pelota R. (OL6+0.10k)	Olomega Outlet. (OL6+0.30k)	
Wo	Olomega Outlet. (OL6+0.30k)	Lake Olomega	
OLOMEGA DIVERSION CHANNEL			
Wi	Lake Olomega	Pelota R. (PL2+0.44k)	PL: Q10yr, DHWL>GH, Realignment of river course WK: Channel excavation, Dike
P2	Pelota R. (PL2+0.44k)	S.Miguel R. (SM120-0.26k)	

REMARKS:

1) PL: Concept of planning 2) WK: Concept of improvement works
3) Q10yr (or Q2yr): 10 year (or 2 year) probable discharge
4) Q'10yr: 10 year probable discharge with inundation upstream
5) Qex: Existing channel capacity
6) DHWL>GH (or DHWL<GH): Design high water level is higher than (or lower) than surrounding ground height.

Table 6.6 QUANTITY OF WORKS FOR PRIORITY PROJECT

From		To		Stretch	Length	Excavation	Embank-	Land	House
Location	Station	Location	Station	code	dX(km)	(m^3)	ment(m^3)	(1,000m^2)	(nos)
LOWER REACHES									
River mouth	SR0	Santa Rita R.	SR21+0.20k		10.00				
Santa Rita R.	SR21+0.20k	End of farm land	SM1	L1-1	0.86	0	0	0	0
End of farm land	SM1	Cerro El Encantado	SM7	L1-2	2.65	146,900	0	299	1
Cerro El Encantado	SM7	Limon R.	SM13	L1-3	3.36	77,600	239,300	429	0
Limon R.	SM13	Ereguatquin R.	SM30+0.05k	L2	9.33	207,300	266,200	845	3
Ereguatquin R.	SM30+0.05k	Vado Marin Br.(old)	SM58	L3	15.51	213,000	0	1,067	11
Vado Marin Br.(old)	SM58	Jocotal Drainage	SM63	L4-1	2.17	824,100	0	191	0
Jocotal Drainage	SM63	Brazo de S.M.	SM79+0.15k	L4-2	6.30	1,597,600	0	711	0
Brazo de S.M.	SM79+0.15k	Chilanguera R.	SM91+0.32k	L4-3	4.37	1,220,900	0	526	0
Chilanguera R.	SM91+0.32k	La Canoa	SM95+0.38k	L4-4	2.42	263,100	0	267	0
La Canoa	SM95+0.38k	El Delirio	SM103	L4-5	6.74	0	0	0	0
				Sub-total	63.71	4,550,500	505,500	4,335	15
MIDDLE REACHES									
El Delirio	SM103	Olomega D./S.M.R.	SM104+0.14k	M1	0.71	80,800	0	62	0
Olomega D./S.M.R.	SM104+0.14k	Start of COC/G.Sill	SM113	M2-1	5.36	0	0	0	0
Olomega D./S.M.R.	SM104+0.14k	End of COC	OL1+0.80k	O1-1	0.85	167,900	0	96	0
End of COC	OL1+0.80k	Start of COC/G.Sill	SM113	COC	2.10	556,500	0	289	0
Start of COC/G.Sill	SM113	WL drop	SM117	M2-2	2.39	320,100	0	184	0
WL drop	SM117	Pelota R.	SM120-0.26k	M2-3	2.05	216,700	103,400	171	0
Pelota R.	SM120-0.26k	L. Aramuaca	SM135	M3	10.47	775,000	427,400	654	3
L. Aramuaca	SM135	Moscoso Br.	SM157	M4	13.10	0	0	0	0
Moscoso Br.	SM157	Taisihuat R.	SM165+0.17k	M5	4.25	0	0	0	0
Taisihuat R.	SM165+0.17k	Urbina Br.	SM170-0.06k	M6-1	2.23	0	0	0	0
				Sub-total	43.51	2,117,000	530,800	1,456	3
OLOMEGA DRAINAGE									
End of Drainage	OL1+0.80k	Pelota R.	OL6+0.10k	O1-2	4.11	468,700	0	351	0
Pelota R.	OL6+0.10k	Olomega Outlet	OL6+0.30k	O2	0.20	91,700	0	18	0
Olomega Outlet	OL6+0.30k	Lake Olomega	Wo+0.95k	Wo	0.95	30,400	0	50	0
				Sub-total	5.26	590,800	0	419	0
OLOMEGA DIVERSION CHANNEL									
Olomega D.	OL6+0.10k	Diversion weir	PL2+0.44k	P1	1.53	0	0	0	0
Diversion weir	Wi+0/PL2+0.4	San Miguel R.	SM120-0.26k	P2	3.21	688,900	98,600	126	0
Lake Olomega	Wi-1.10k	Wi+0/PL2+0.44k	Wi-0.00k	Wi	1.10	88,000	37,600	423	2
				Sub-total	5.84	776,900	136,200	549	2
				Grand total	**118.32**	**8,035,200**	**1,172,500**	**6,759**	**20**

Table 6.7 PROJECT COST

Items	Unit		Quantity	Amount(¢ million)		
	Unit	Cost(¢)		Total	L.C.	F.C.
1. Construction works						
1.1 Channel works				366.9	167.5	199.4
Earth excavation(1)	m^3	45	3,977,000	179.0	73.4	105.6
Earth excavation(2)	m^3	20	3,906,000	78.1	32.0	46.1
Rock excavation	m^3	173	152,000	26.3	10.8	15.5
Embankment	m^3	42	1,173,000	49.3	20.2	29.1
Revetment	m	5,700	6,000	34.2	31.1	3.1
1.2 Structure works				24.7	18.8	5.9
Diversion weir	l.s.			10.5	9.0	1.5
Control gate	l.s.			9.4	5.8	3.6
Drainage sluice				0.6	0.4	0.2
Type-A	nos	426,000	0	0.0	0.0	0.0
Type-B	nos	586,000	1	0.6	0.4	0.2
Type-C	nos	754,000	0	0.0	0.0	0.0
Ground sill	m	18,269	229	4.2	3.6	0.6
1.3 Appurtenant works				42.1	24.0	18.1
Intake gate(Type-B)	nos	586,000	1	0.6	0.4	0.2
Bridge				33.0	17.2	15.8
Bridge(105m)	nos	13,400,000	1	13.4	7.0	6.4
Bridge(90m)	nos	12,600,000	1	12.6	6.6	6.0
Bridge(40m)	nos	7,000,000	1	7.0	3.6	3.4
Rural road	m	160	2,640	0.4	0.4	0.0
Telemetering system	l.s.			8.1	6.1	2.0
(Sub-total : 1.1+1.2+1.3)				433.7	210.3	223.4
2. Land and house				19.2	19.2	0.0
Land acquisit.(1)	10^3m^2	2,150	728	1.6	1.6	0.0
Land acquisit.(2)	10^3m^2	5,720	845	4.8	4.8	0.0
Land acquisit.(3)	10^3m^2	2,570	1,067	2.7	2.7	0.0
Land acquisit.(4)	10^3m^2	720	1,695	1.2	1.2	0.0
Land acquisit.(5)	10^3m^2	3,580	2,424	8.7	8.7	0.0
Land acquisit.(6)	10^3m^2	7,150	0	0.0	0.0	0.0
House compensat.	house	12,000	20	0.2	0.2	0.0
3. Administration	l.s.	-		22.6	22.6	0.0
4. Engineering service	l.s.	-		67.9	25.1	42.8
5. Physical contingency	l.s.	-		54.3	27.7	26.6
(Sub-total : 1+2+3+4+5)				597.7	304.9	292.8
6. Price contingency	l.s.	-		178.2	123.4	54.8
Total				775.9	428.3	347.6

Table 6.8 ANNUAL DISBURSEMENT SCHEDULE(PRIORITY PROJECT)

		Total cost	Annual Disbursment (million colons)							
			1999	2000	2001	2002	2003	2004	2005	2006
1. Construction Cost	Total	433.7	0	0.00	86.74	86.74	86.74	86.74	86.74	0
	L.C.	210.3	0	0.00	42.06	42.06	42.06	42.06	42.06	0
	F.C.	223.4	0	0.00	44.68	44.68	44.68	44.68	44.68	0
2. Land Acquisition	Total	19.2	0	4.80	4.80	4.80	4.80	0.00	0.00	0
	L.C.	19.2	0	4.80	4.80	4.80	4.80	0.00	0.00	0
	F.C.	0.0	0	0.00	0.00	0.00	0.00	0.00	0.00	0
3. Administration	Total	22.6	0	0.24	4.58	4.58	4.58	4.34	4.29	0
	L.C.	22.6	0	0.24	4.58	4.58	4.58	4.34	4.29	0
	F.C.	0.0	0	0.00	0.00	0.00	0.00	0.00	0.00	0
4. Engineering Cost	Total	67.9	20.37	5.43	8.42	8.42	8.42	8.42	8.42	0
	L.C.	25.1	7.53	2.01	3.11	3.11	3.11	3.11	3.11	0
	F.C.	42.8	12.84	3.42	5.31	5.31	5.31	5.31	5.31	0
5. Physical Contingency	Total	54.3	2.04	1.05	10.45	10.45	10.45	9.95	9.90	0
	L.C.	27.7	0.75	0.71	5.46	5.46	5.46	4.95	4.93	0
	F.C.	26.6	1.28	0.34	5.00	5.00	5.00	5.00	4.98	0
6. (Sub-total) (1+2+3+4+5)	Total	597.7	22.41	11.52	114.99	114.99	114.99	109.45	109.36	0
	L.C.	304.9	8.28	7.75	60.00	60.00	60.00	54.46	54.39	0
	F.C.	292.8	14.12	3.77	54.99	54.99	54.99	54.99	54.97	0
7. Price Contingency	Total	178.2	1.88	1.83	22.65	29.05	35.78	40.07	46.96	0
	L.C.	123.4	1.02	1.48	15.75	20.30	25.11	27.43	32.30	0
	F.C.	54.8	0.86	0.35	6.90	8.76	10.67	12.64	14.66	0
8. (Total) (1+2+3+4+5+7)	Total	775.9	24.29	13.35	137.64	144.04	150.77	149.51	156.32	0
	L.C.	428.3	9.31	9.23	75.75	80.30	85.12	81.89	86.69	0
	F.C.	347.6	14.98	4.12	61.89	63.74	65.66	67.63	69.63	0

O & M cost	L.C.		0	0.00	0.00	0.48	0.95	1.43	1.91	2.39
Price Contingency	L.C.		0	0.00	0.00	0.16	0.40	0.72	1.13	1.64
Total	L.C.		0	0.00	0.00	0.64	1.35	2.15	3.04	4.03

Table 6.9 REDUCTION IN NUMBER AND AREA OF INUNDATION ASSETS EXPECTED BY IMPLEMENTING THE PROJECT

2. Alt. I(O+J+U)-2-year Flood Control Plan
(1) 1.05-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	61	142	64	267	5	273	139	210	876	1,225
2	0.25-0.5	81	189	86	356	7	363	39	57	242	338
3	0.5-1.0	114	267	121	502	10	512	76	155	643	874
4	1.0-1.5	56	132	60	247	5	252	17	75	309	401
5	1.5-2.0	109	255	116	480	10	489	52	127	572	751
	Total	421	984	447	1,852	37	1,889	323	624	2,642	3,589

2. Alt. I(O+J+U)-2-year Flood Control Plan
(2) 2-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	167	390	177	734	15	749	137	144	633	914
2	0.25-0.5	134	314	143	592	12	603	111	134	573	818
3	0.5-1.0	198	462	210	870	17	888	166	223	949	1,338
4	1.0-1.5	95	221	100	415	8	423	64	115	486	665
5	1.5-2.0	138	322	146	606	12	618	73	160	719	952
	Total	732	1,709	776	3,217	64	3,282	551	776	3,360	4,687

2. Alt. I(O+J+U)-2-year Flood Control Plan
(3) 5-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	195	454	206	855	17	872	160	170	750	1,080
2	0.25-0.5	155	361	164	679	14	693	133	159	684	976
3	0.5-1.0	201	468	213	882	18	900	198	261	1,095	1,554
4	1.0-1.5	41	97	44	183	4	186	60	94	377	531
5	1.5-2.0	90	211	96	398	8	406	39	98	425	562
	Total	682	1,592	722	2,996	60	3,056	590	782	3,331	4,703

2. Alt. I(O+J+U)-2-year Flood Control Plan
(4) 10-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	237	552	251	1,040	21	1,060	173	174	780	1,127
2	0.25-0.5	208	484	220	912	18	930	156	186	801	1,143
3	0.5-1.0	288	673	305	1,266	25	1,292	253	336	1,410	1,999
4	1.0-1.5	81	190	86	357	7	364	92	143	580	815
5	1.5-2.0	102	239	109	449	9	458	44	110	470	624
	Total	916	2,138	970	4,024	80	4,105	718	949	4,041	5,708

2. Alt. I(O+J+U)-2-year Flood Control Plan
(5) 20-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	244	568	258	1,070	21	1,092	159	126	596	881
2	0.25-0.5	247	577	262	1,086	22	1,107	173	200	866	1,239
3	0.5-1.0	353	847	384	1,594	32	1,626	309	415	1,740	2,464
4	1.0-1.5	129	300	136	564	11	575	136	209	861	1,206
5	1.5-2.0	119	277	126	522	10	533	58	146	614	818
	Total	1,101	2,569	1,166	4,836	97	4,933	835	1,096	4,677	6,608

2. Alt. I(O+J+U)-2-year Flood Control Plan
(6) 50-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	0	0	0	0	0	0	37	0	0	37
2	0.25-0.5	244	570	258	1,072	21	1,094	73	0	22	95
3	0.5-1.0	375	874	397	1,645	33	1,678	330	428	1,796	2,554
4	1.0-1.5	168	392	178	738	15	753	166	242	1,008	1,416
5	1.5-2.0	147	344	156	647	13	660	85	203	841	1,129
	Total	934	2,179	989	4,102	82	4,184	691	873	3,667	5,231

2. Alt. I(O+J+U)-2-year Flood Control Plan
(7) 100-Year Return Period

No.	Water Depth (m)	Number of Buildings: Residence: Medium	Low	Poor	Total	Stores & others	Total	Agricultural Crops (ha): Maize	Sugar cane	Pasture	Total
1	0.0-0.25	0	0	0	0	0	0	37	0	0	37
2	0.25-0.5	263	612	278	1,152	23	1,175	37	0	0	37
3	0.5-1.0	410	955	435	1,803	36	1,839	338	418	1,766	2,522
4	1.0-1.5	190	442	201	833	17	850	183	241	1,026	1,450
5	1.5-2.0	162	377	171	709	14	723	75	196	803	1,074
	Total	1,024	2,388	1,084	4,497	90	4,587	670	855	3,595	5,120

Table 6.10 (1/2) ESTIMATE OF ECONOMIC COST

II. Priority Project-Alt. 1 (O+J+U)-2-year Flood Control Plan

(1) Financial Cost

1999 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	0.00	0.00	0.00	
4	Engineering Fee	7.53	12.84	20.37	
5	Physical Contingency	0.75	1.28	2.04	
	Sub-total	8.28	14.12	22.41	
6	Price Contingency	1.02	0.86	1.88	
	Total	9.30	14.98	24.29	OM Cost 0.00

2000 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	0.24	0.00	0.24	
4	Engineering Fee	2.01	3.42	5.43	
5	Physical Contingency	0.71	0.34	1.05	
	Sub-total	7.76	3.76	11.52	
6	Price Contingency	1.48	0.35	1.83	
	Total	9.24	4.11	13.35	OM Cost 0.00

2001 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	4.58	0.00	4.58	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	5.46	5.00	10.45	
	Sub-total	60.01	54.99	114.99	
6	Price Contingency	15.75	6.90	22.65	
	Total	75.76	61.89	137.64	OM Cost 0.00

2002 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	4.58	0.00	4.58	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	5.46	5.00	10.45	
	Sub-total	60.01	54.99	114.99	
6	Price Contingency	20.30	8.76	29.06	
	Total	80.31	63.75	144.05	OM Cost 0.64

2003 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	4.80	0.00	4.80	
3	Administration Cost	4.58	0.00	4.58	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	5.46	5.00	10.45	
	Sub-total	60.01	54.99	114.99	
6	Price Contingency	25.11	10.67	35.78	
	Total	85.12	65.65	150.77	OM Cost 1.35

2004 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	4.34	0.00	4.34	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	4.95	5.00	9.95	
	Sub-total	54.46	54.99	109.45	
6	Price Contingency	27.43	12.64	40.07	
	Total	81.89	67.63	149.52	OM Cost 2.15

2005 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	42.06	44.68	86.74	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	4.29	0.00	4.29	
4	Engineering Fee	3.11	5.31	8.42	
5	Physical Contingency	4.95	5.00	9.95	
	Sub-total	54.41	54.99	109.40	
6	Price Contingency	32.30	14.66	45.96	
	Total	86.71	69.65	156.36	OM Cost 3.04

(2) Economic Cost

1999 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	0.00	0.00	0.00	
4	Engineering Fee	6.66	12.84	19.50	
5	Physical Contingency	0.67	1.28	1.95	
	Sub-total	7.33	14.12	21.45	
6	Price Contingency	0.00	0.00	0.00	
	Total	7.33	14.12	21.45	OM Cost 0.00

2000 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	0.00	0.00	0.00	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	0.21	0.00	0.21	
4	Engineering Fee	1.78	3.42	5.20	
5	Physical Contingency	0.57	0.34	0.91	
	Sub-total	6.23	3.76	9.99	
6	Price Contingency	0.00	0.00	0.00	
	Total	6.23	3.76	9.99	OM Cost 0.00

2001 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	4.05	0.00	4.05	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.41	5.00	9.41	
	Sub-total	48.47	54.99	103.46	
6	Price Contingency	0.00	0.00	0.00	
	Total	48.47	54.99	103.46	OM Cost 0.00

2002 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	4.05	0.00	4.05	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.41	5.00	9.41	
	Sub-total	48.47	54.99	103.46	
6	Price Contingency	0.00	0.00	0.00	
	Total	48.47	54.99	103.46	OM Cost 0.43

2003 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	3.67	0.00	3.67	
3	Administration Cost	4.05	0.00	4.05	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.41	5.00	9.41	
	Sub-total	48.47	54.99	103.46	
6	Price Contingency	0.00	0.00	0.00	
	Total	48.47	54.99	103.46	OM Cost 0.86

2004 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.84	0.00	3.84	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.02	5.00	9.02	
	Sub-total	44.20	54.99	99.19	
6	Price Contingency	0.00	0.00	0.00	
	Total	44.20	54.99	99.19	OM Cost 1.29

2005 — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	33.59	44.68	78.27	
2	Land Acquisition	0.00	0.00	0.00	
3	Administration Cost	3.80	0.00	3.80	
4	Engineering Fee	2.75	5.31	8.06	
5	Physical Contingency	4.01	5.00	9.01	
	Sub-total	44.15	54.99	99.14	
6	Price Contingency	0.00	0.00	0.00	
	Total	44.15	54.99	99.14	OM Cost 1.72

Table 6.10 (2/2) ESTIMATE OF ECONOMIC COST

II. Priority Project-Alt. I (O+J+H)-2-year Flood Control Plan

(1) Financial Cost

Total — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	210.30	223.40	433.70	
2	Land Acquisition	19.20	0.00	19.20	
3	Administration Cost	22.61	0.00	22.61	
4	Engineering Fee	25.09	42.81	67.90	
5	Physical Contingency	27.72	26.62	54.34	
	Sub-total	304.92	292.83	597.75	
6	Price Contingency	123.39	54.84	178.23	
	Total	428.31	347.67	775.98	OM Cost 4.03

(2) Economic Cost

Total — Unit : Cols. Million

No.	Specification	L.C.	F.C.	Total	
1	Construction Cost	167.94	223.40	391.34	
2	Land Acquisition	14.68	0.00	14.68	
3	Administration Cost	20.01	0.00	20.01	
4	Engineering Fee	22.20	42.81	65.01	
5	Physical Contingency	22.48	26.62	49.10	
	Sub-total	247.32	292.83	540.15	
6	Price Contingency	0.00	0.00	0.00	
	Total	247.32	292.83	540.15	OM Cost 2.15

Table 6.11 ECONOMIC ANALYSIS

II. Priority Project-Alt.1(O+J+U)-2-Year P Unit : Cols. Million

	Year	Economic Cost			Economic	Net Benefit
		Construction	OM	Total (C)	Benefit (B)	(B)-(C)
1	1999	21.45	0.00	21.45	0.00	-21.45
2	2000	9.99	0.00	9.99	0.00	-9.99
3	2001	103.46	0.00	103.46	0.00	-103.46
4	2002	103.46	0.43	103.89	21.08	-82.81
5	2003	103.46	0.86	104.32	42.17	-62.15
6	2004	99.19	1.29	100.48	63.25	-37.23
7	2005	99.14	1.72	100.86	84.34	-16.52
8	2006	0.00	2.15	2.15	105.42	103.27
9	2007	0.00	2.15	2.15	105.42	103.27
10	2008	0.00	2.15	2.15	105.42	103.27
11	2009	0.00	2.15	2.15	105.42	103.27
12	2010	0.00	2.15	2.15	105.42	103.27
13	2011	0.00	2.15	2.15	105.42	103.27
14	2012	0.00	2.15	2.15	105.42	103.27
15	2013	0.00	2.15	2.15	105.42	103.27
16	2014	0.00	2.15	2.15	105.42	103.27
17	2015	0.00	2.15	2.15	105.42	103.27
18	2016	0.00	2.15	2.15	105.42	103.27
19	2017	0.00	2.15	2.15	105.42	103.27
20	2018	0.00	2.15	2.15	105.42	103.27
21	2019	0.00	2.15	2.15	105.42	103.27
22	2020	0.00	2.15	2.15	105.42	103.27
23	2021	0.00	2.15	2.15	105.42	103.27
24	2022	0.00	2.15	2.15	105.42	103.27
25	2023	0.00	2.15	2.15	105.42	103.27
26	2024	0.00	2.15	2.15	105.42	103.27
27	2025	0.00	2.15	2.15	105.42	103.27
28	2026	0.00	2.15	2.15	105.42	103.27
29	2027	0.00	2.15	2.15	105.42	103.27
30	2028	0.00	2.15	2.15	105.42	103.27
31	2029	0.00	2.15	2.15	105.42	103.27
32	2030	0.00	2.15	2.15	105.42	103.27
33	2031	0.00	2.15	2.15	105.42	103.27
34	2032	0.00	2.15	2.15	105.42	103.27
35	2033	0.00	2.15	2.15	105.42	103.27
36	2034	0.00	2.15	2.15	105.42	103.27
37	2035	0.00	2.15	2.15	105.42	103.27
38	2036	0.00	0.00	0.00	0.00	0.00
39	2037	0.00	0.00	0.00	0.00	0.00
40	2038	0.00	0.00	0.00	0.00	0.00
41	2039	0.00	0.00	0.00	0.00	0.00
42	2040	0.00	0.00	0.00	0.00	0.00
	Total	540.15	68.80	608.95	3,373.44	2,764.49

EIRR (%) 18.11

Discount Rate (%)	B/C	PV(Cols. Million) Cost	Benefit	NPV (Cols.Million)
20	0.90	241.50	218.32	-23.18
15	1.21	292.16	352.29	60.13
12	1.49	330.34	491.65	161.31
10	1.75	360.10	629.53	269.44
5	2.87	456.22	1,309.23	853.01