SUPPORTING REPORT [D]

SOCIAL FORESTRY

ANNEX D: SOCIAL FORESTRY
CONTENTS

Table D-1 Principal Indigenous Tree Species
in El Salvador

COMMON NAME	SCIENTIFIC NAME	FAMILY
Aceituno	Simarouba glauca	Simaroubaceae
Almendro macho	Adira inermis	Papilionaceae
Balsa	Ochroma lagopus	Bombacaceae
Bálsamo	Myroxylon balsamum	Papilionaceae
Brasil	Sickingia salvadorensis	Rubiaceae
Caoba	Swietenia humilis	Meliaceae
Cedro	Cedrela odrata	Meliaceae
Cedro real	Cedrela fissilis	Meliaceae
Cenícero	Albizzia guachapele	Mimosaceae
Ciprés	Cupressus lusitanica	Cupresaceae
Conascate blanco	Albizzia caribaea	Mimosaceae
Conacaste negro	Enterolobium cyclocarpum	Mimosaceae
Cortez blanco	Cybistax donell-smithii	Bignoniaceae
Cortez negro	Tabebuia guayacan	Bignoniaceae
Flor de Fuego	Delonix regia	Caesalpinaceae
Granadillo	Platymiscium dimorphandrum	Papilionaceae
Guachipilin	Diphysa robinoides	Papilionaceae
Ishtaten	Aicennia nitida	Verbenaceae
Laurel	Cordia alliodora	Borraginaceae
Leucaena	Leucaena leucocephala	Leguminosae
Liquidambar	Liquidambar styraciflua	Hamameliaceae
Madrecacao	Gliricidia sepium	Papolionaceae
Madresal o mangle negro	Avisennia bicolor	Verbenaceae
Mangle colorado	Rhizophora mangle	Verbenaceae
Maquilishuat	Tabebuia rosea	Bignoniaceae
Mora	Chlorophora tintoria	Moraceae
Nogal	Juglans nigra	Juglandaceae
Pino	Pinus tenuifolia	Pinaceae
Pino ocote	Pinus oocarpa	Pinaceae
Pino blanco	Pinus pseudostrobus	Pinaceae
Pino resinoso	Pinus ayacahuite	Pinaceae
Pito	Eritrina berteroana	Papilionaceae
Roble negro	Quercus hondurensis	Fagaceae
Roble blanco	Quercus skinneri	Fagaceae
Varillo	Calophyllum brasiliense	Gutifferae
Volador	Terminalia obovata	Combretaceae

Table D-2 Principal Tree Species for Reforestation
in El Salvador

COMMON NAME	SCIENTIFIC NAME	FAMILY
Acacia mangium*	Accacia mangium	Leguminosae
Bálsamo	Myroxylon balsamum	Papilionaceae
Caoba	Swietenia humilis	Meliaceae
Casuarina*	Casuarina equisetifolia	Casuarinaceae
Cedro	Cedrela mexicana	Meliaceae
Cedro real	Cedrela fissilis	Meliaceae
Ciprés	Cupressus lucitanica	Cupressaceae
Conacaste	Enterolobium cyclocarpum	Mimosaceae
Cortez blanco	Cybistax donell -smithii	Bignoniaceae
Eucalipto alba*	Eucalyptus alba	Myrtaceae
Eucalipto camaldulensis*	Eucalyptus camaldulensis	Myrtaceae
Eucalipto citriodora*	Eucalyptus citriodora	Myrtaceae
Eucalipto deglupta*	Eucalyptus deglupta	Myrtaceae
Eucalipto saligma*	Eucalyptus saligma	Myrtaceae
Flor amarilla	Cassia siamea	Leguminosae
Laurel	Cordia alliodora	Borraginaceae
Leucaena	Leucaena leucocephala	Leguminosae
Madrecacao	Gliricidia sepium	Papolionaceae
Melina*	Gmelina arborea	Verennaceae
Nim*	Azadirachta indica	Meliaceae
Pino caribe*	Pinus caribaea	Pinaceae
Pino hondureño*	Pinus caribaea	Pinaceae
Pino ocote	Pinus oocarpa	Pinaceae
Teca*	Tectona grandis	Verbenaceae
Volador	Terminalia obovata	Combretaceae

(Notes) Mark of * indicates exotic species.

Table D-3 Principal Tree Species for Special Forest Products
in El Salvador

COMMON NAME	SCIENTIFIC NAME	FAMILY
Aguacate	Persea americana	Lauraceae
Anona	Annona reticulata	Annonaceae
Caimito	Chrysophyllum cainito	Sapotaceae
Caulote	Guazuma ulmifolia	Sterculiaceae
Caña fistola	Cassia fistula	Leguminosae
Ceiba	Ceiba pentandra	Bombacaceae
Chaperno	Lonchocarpus caulatus	Leguminosae
Chaquiro	Colubrina ferruginosa	Rhamnaceae
Copalch	Croton reflexifolius	Euphorbiaceae
Copinol	Hymenea courbaril	Leguminosae
Funera	Dalbergia funera	Leguminosae
Jiote	Bursera simaruba	Burseraceae
Jocote	Spondias mombim	Anacardiaceae
Jupiter de Java	Lagerstroemia speciosa	Lythraceae
Lluvia rosada	Cassia javanica	Leguminosae
Mango	Mangifera indica	Anacardiaceae
Mano de León	Dendropanax arboreum	Araliaceae
Marañón	Anacardium occidentale	Anacardiaceae
Memble	Poeppigia procera	Leguminosae
Níspero	Acharas zapota	Sapotaceae
Paraiso o Volador	Melia azedarach	Meliaceae
Pepeto	Inga edulis	Leguminosae
Pinabete	Abies guatemalensis	Pinaceae
Quebracho	Piptadenia constricta	Leguminosae
Ron-Ron	Astronium graveolens	Anacardiaceae
Sauce	Salix chilensis	Salicaceae
Tamarindo	Tamarindus indica	Leguminosae
Tihuilote	Cordia dentata	Boraginaceae
Zapote	Pouteria mamosum	Sapotaceae
Zorra	Phitecolobium saman	Leguminosae

Table D-4 Main Plantations in and around the Project Area

No.	OWNER	NAME OF THE PROPERTY	DPTO/ MUNICIPIO/ CANTON	SPECIES	AREA (Mz)	PLAN-TING YEAR
1	Cooperativa de la Reforma Agraria Santa Lucia Ercoyo	Cooperativa Santa Lucia Ercoyo	La Paz, San Luis Talpa, Cantón Ercoyo.	Teca	30	1984
				Eucalipto deglupta	30	1984
				Laurel	30	1984
2	Asociación Cooperativa Santo Tomás de R.L.	Cooperativa Santo Tomás	La Paz, San Luis Talpa, Cantón Tecualuya	Eucalipto camaldulensis	12	1993
				Teca	12	1993
				Leucaena	12	1993
				Madrecacao	1	1993
3	Asociación Cooperativa San José de Luna	Cooperativa San José de Luna	La Paz, San Pedro Masahuat, Cantón Astoria	Eucalipto camaldulensis	15	1987
				Teca	40	1987
				Leucaena	25	1987
				Madrecacao	2	1995
4	Asociación Cooperativa de R.L. Nahualapa	Cooperativa Nahualapa	La Paz, Rosario la Paz, Cantón El Pedregal	Madrecacao	10	1993
				Leucaena	10	1993
				Flor amarilla	10	1993
				Teca	80	1995
5	Asociación Cooperativa de R.L. Astoria	Hacienda Hastoria	La Paz, San Luis Talpa, Cantón Astoria	Eucalipto camaldulensis	20	1993
				Teca	10	1993
				Leucaena	20	1993
6	INCOCA	EL INCOCA	La Paz, Rosario La Paz, Cantón Tilapa	Eucalipto alba	7	1989
				Eucalipto citriodora	7	1989
7	LA CAPO	GRANJA CAPO	La Paz, Desvio San Pedro Masahuat	Eucalipto alba	20	1989
				Eucalipto citriodora		
				Teca	10	1989
				Leucaena	10	1989
8	Cooperativa Los Novillos	Los Novillos	La Paz, San Pedro Masahuat Cantón Los Novillos	Teca	20	1980
9	Cooperativa El Guaje	El Guaje	San Salvador, Soyapango, Cantón El Guaje	Teca	10	1984
10	Sherwin Williams	Sherwin Williams	San Salvador, Ilopango, Amatitlán	Pino caribe	25	1980
				Eucalipto deglupta		
11	ANDA	Guluchapa	San Salvador, Ilopango, Cantón Guluchapa	Eucalipto deglupta	10	1980
12	Jaime Cuéllar	Jaime Cuéllar	Cuscatlán, Santa Cruz Michapa Cantón El Carmen	Pino caribe	5	1980
13	Carlos Mejía	Without Name	Cuscatlán, Candelaria, Cantón Candelaria	Teca	10	1982
				Eucalipto deglupta		
14	Without Registration	Without Registration	Cuscatlán, San Agustin	Eucalipto deglupta	10	1980

(Notes) See Fig. D-1 Location Map.

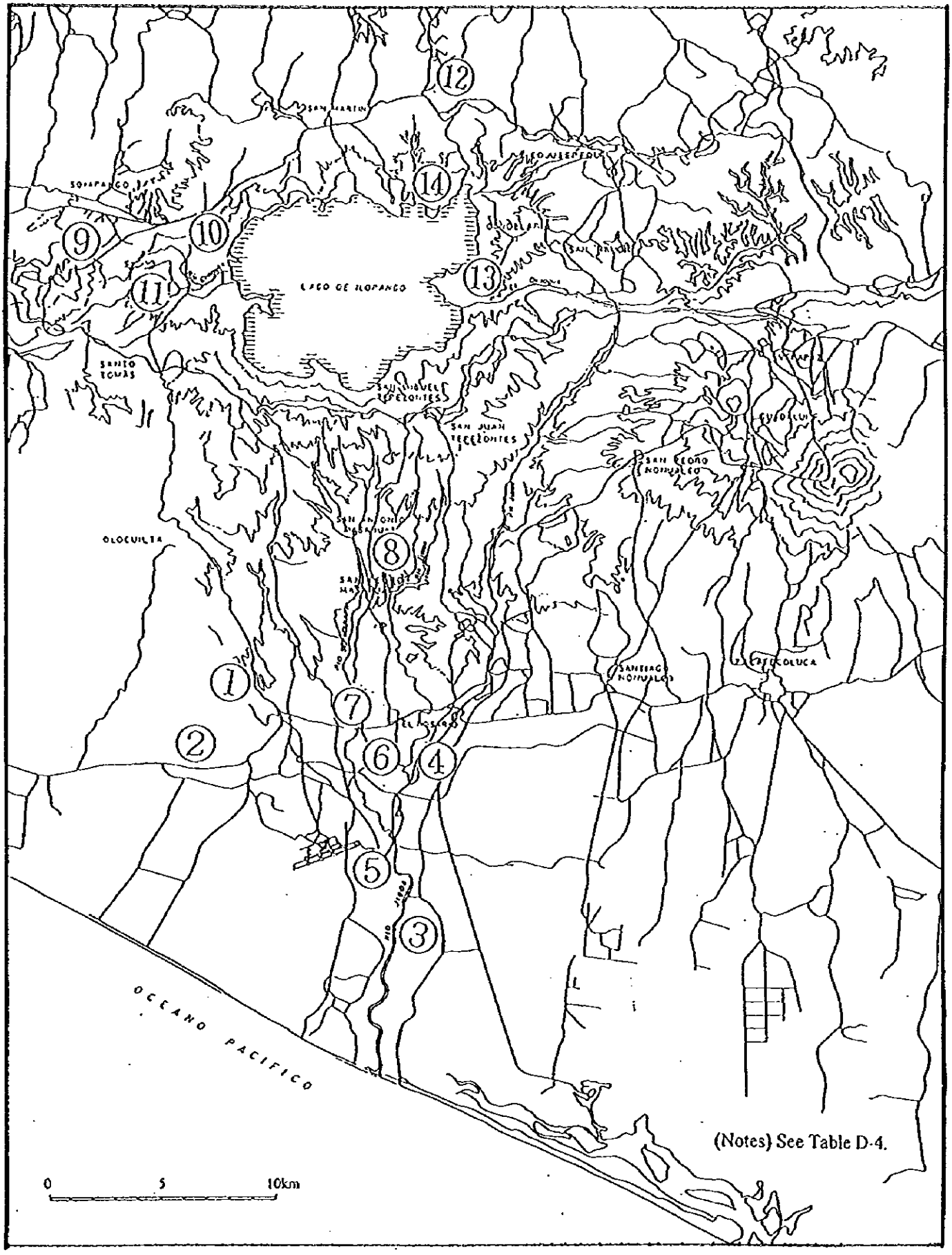


Fig. D-1 Location Map of Main Plantations in and around the Project Area

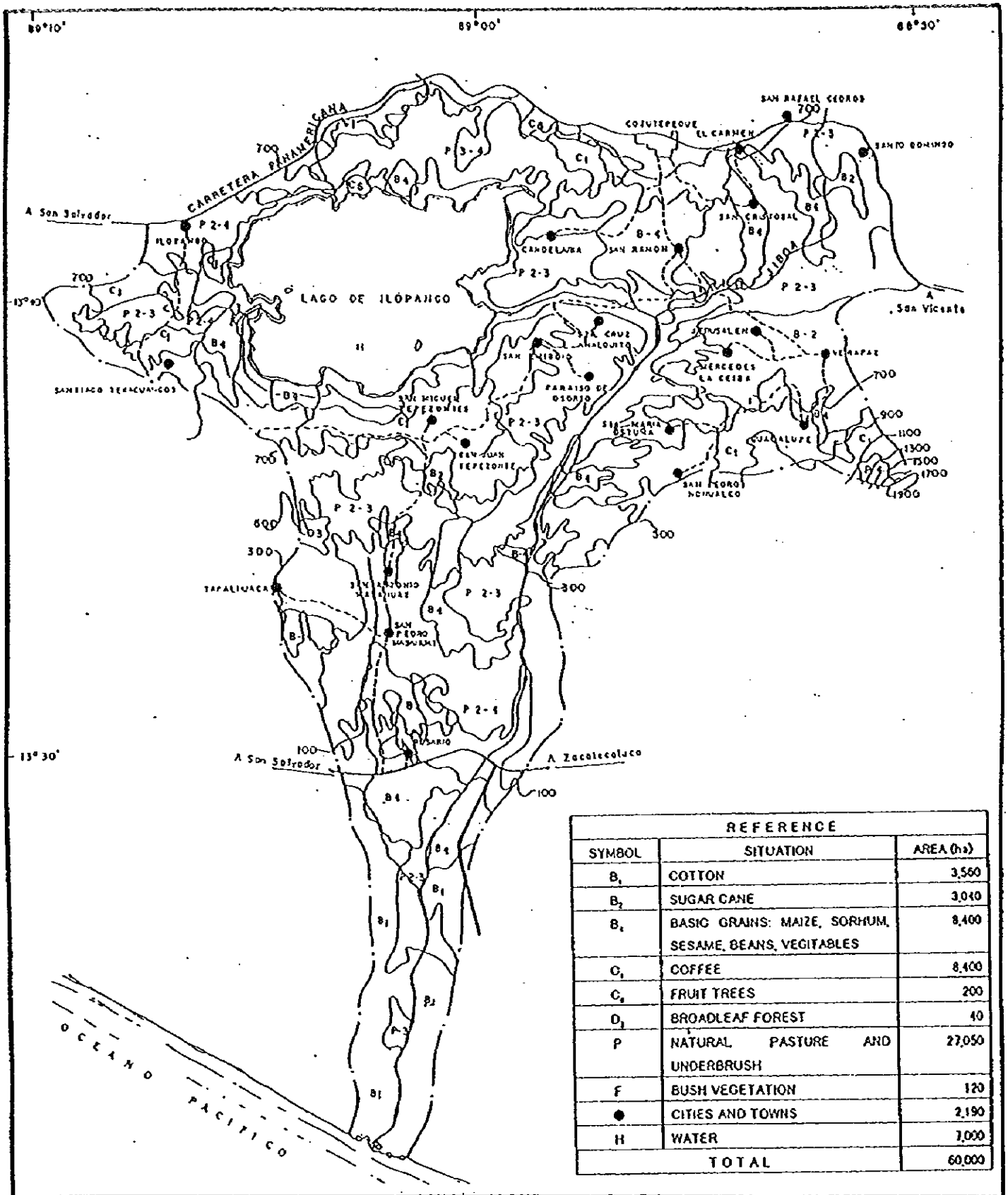
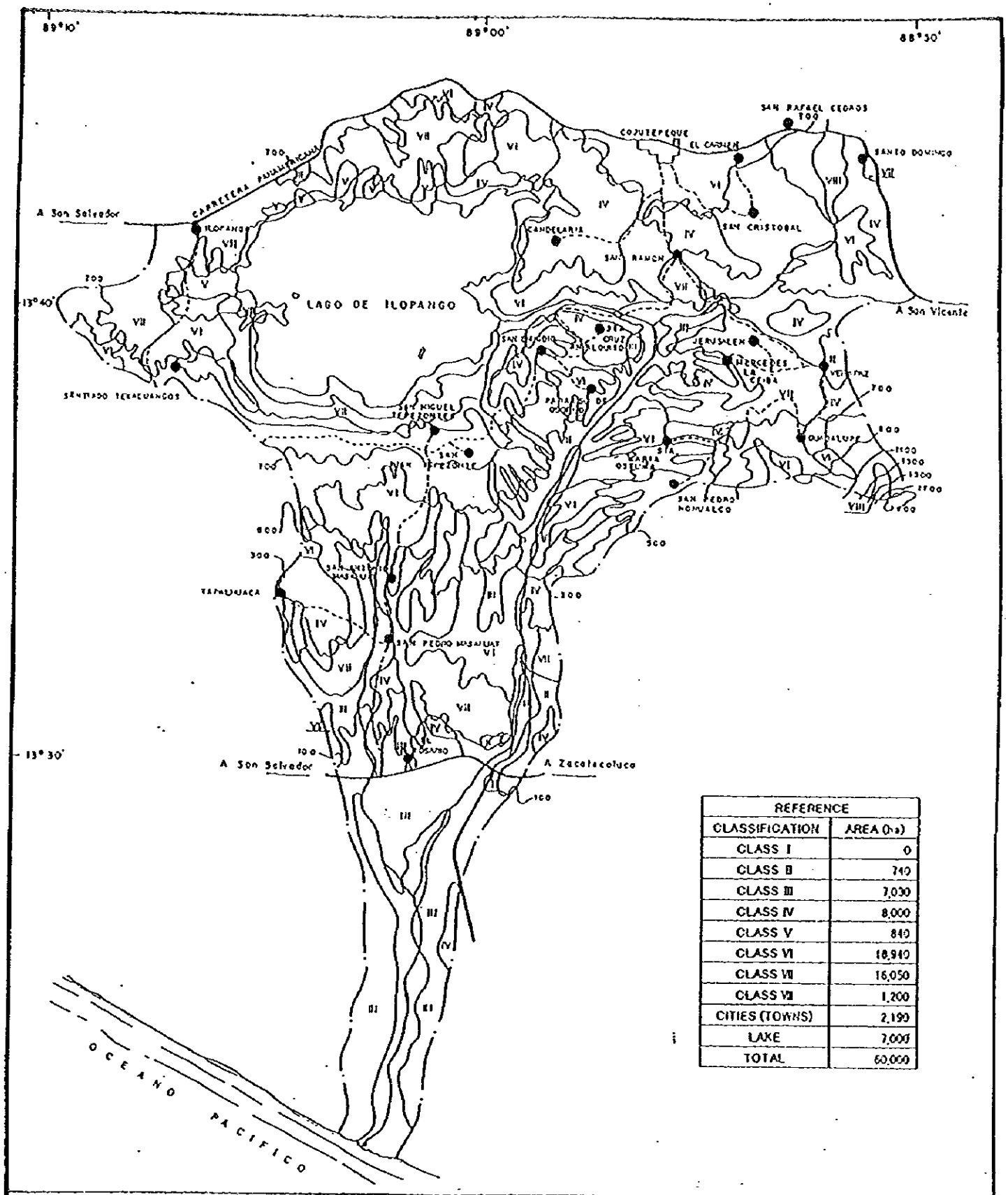


Fig. D-2 Actual Land Use of the Project Area (1986)



REFERENCE	
CLASSIFICATION	AREA (ha)
CLASS I	0
CLASS II	740
CLASS III	7,030
CLASS IV	8,000
CLASS V	840
CLASS VI	18,940
CLASS VII	16,050
CLASS VIII	1,200
CITIES (TOWNS)	2,199
LAKE	7,000
TOTAL	60,000

REPUBLIC OF EL SALVADOR MINISTRY OF AGRICULTURE AND LIVESTOK	POTENTIAL USE	PREPARED BY: CHICAS A	SCALE :
GENERAL DIRECTORATE OF RENEWABLE NATURAL RESOURCES		DATE : OCTOBER - 1986	1:200,000

Fig. D-3 Potential Land Use of the Project Area (1986)

Table D-5 LAND CAPABILITY CLASSIFICATION

(THE USDA STANDARD)

Land Suited to Cultivation and Other Uses	
Class I	Soils have few limitations that restrict their uses.
Class II	Soils have some limitations that reduce the choice of plants or require moderate conservation practices.
Class III	Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV	Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.
Land Limited in Use - Generally Not Suited for Cultivation	
Class V	Soils have little or no erosion hazard, but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.
Class VI	Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.
Class VII	Soils have very severe limitations that make them generally unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
Class VIII	Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Table D-6 Coffee Plantations in the Departments and Municipalities related to the Project

	Number of Farms	Area (Mz)	Area (ha)	Area per Farm (ha)
1.Ilopango	4	299.50	209.65	52.41
2.San Marcos	46	800.39	560.27	12.18
3.San Martin	56	243.75	170.63	3.05
4.Santiago Texacuangos	183	316.45	221.52	1.21
5.Santo Tomas	37	592.37	414.66	11.21
6.Soyapango	12	554.50	388.15	32.35
Sub-Total	338	2,806.96	1,964.87	5.81
SAN SALVADOR Total	885	9,638.60	6,747.02	7.62
1.Cojutepeque	107	941.02	658.71	6.16
2.Candelaria	83	186.23	130.36	1.57
3.El Carmen	14	102.25	71.58	5.11
4.San Cristobal	16	55.50	38.85	2.43
5.San Pedro Perulapan	54	242.83	169.98	3.15
6.San Rafael Cedros	3	13.00	9.10	3.03
7.San Ramon	13	23.83	16.68	1.28
8.Santa Cruz Analquito	19	56.50	39.55	2.08
9.Santa Cruz Michapa	11	101.00	70.70	6.43
Sub-Total	320	1,722.16	1,205.51	3.77
CUSCATLAN Total	356	2,054.31	1,438.02	4.04
1.El Rosario				
2.Jerusalen	3	5.75	4.03	1.34
3.Mercedes La Ceiba				
4.Paraiso de Osorio	8	58.00	40.60	5.08
5.San Antonio Masahuat				
6.San Emigdio	47	127.64	89.35	1.90
7.San Francisco Chinameca	124	687.30	481.11	3.88
8.San Juan Nonualco	46	805.83	564.08	12.26
9.San Juan Tepezontes	20	74.50	52.15	2.61
10.San Luis				
11.San Miguel Tepezontes	109	446.39	312.47	2.87
12.San Pedro Masahuat				
13.San Pedro Nonualco	62	591.75	414.23	6.68
14.Santa Maria Ostuma	31	175.25	122.68	3.96
15.Santiago Nonualco	3	70.00	49.00	16.33
16.Tapalhuaca				
Sub-Total	453	3,042.41	2,129.69	4.70
LA PAZ Total	525	3,689.88	2,582.92	4.92
1.Guadalupe	378	728.77	510.14	1.35
2.Santo Domingo	1	1.00	0.70	0.70
3.Tepetitan	5	76.25	53.38	10.68
4.Verapaz	22	92.75	64.93	2.95
Sub-Total	406	898.77	629.14	1.55
SAN VICENTE Total	413	1,021.27	714.89	1.73
Total in the Municipalities related	1,517	8,470.30	5,929.21	3.91
Total in the Departments related	2,179	16,404.06	11,482.85	5.27
EL SALVADOR	114,696	188,118.14	131,682.70	1.15

Source: Salvadorean Counsil of Coffee (CSC) Oct.1996

(Notes) Area of the estimated 17,500 ha is not recorded in this table.

Table D-7 Afforestation Plan for 15 years (1/3)
(for the Establishment of Plantation)

(Unit: ha)

Municipality\Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	258					258
2.San Marcos	50					50
3.San Martin	248					248
4.Santiago Texacuangos	277					277
5.Santo Tomas	173					173
6.Soyapango	71					71
Sub-total	1,077					1,077
CUSCATLAN						
1.Cojutepeque	201	92				294
2.Candelaria	319	56				376
3.El Carmen		85				85
4.San Cristobal		219				219
5.San Pedro Perulapan	362					362
6.San Rafael Cedros		157				157
7.San Ramon	8	168				176
8.Santa Cruz Analquito	100		73			172
9.Santa Cruz Michapa	113					113
Sub-total	1,103	777	73			1,954
LA PAZ						
1.El Rosario				64	170	234
2.Jerusalen		24	113			137
3.Mercedes La Ceiba			43			43
4.Paraiso de Osorio			116			116
5.San Antonio Masahuat			120		283	403
6.San Emigdio	93		72			166
7.San Francisco Chinameca	123				187	310
8.San Juan Nonualco			9			9
9.San Juan Tepezontes	2		269		48	318
10.San Luis				6	3	8
11.San Miguel Tepezontes	174		39		74	288
12.San Pedro Masahuat			31	210	488	729
13.San Pedro Nonualco			263			263
14.Santa Maria Ostuma			347			347
15.Santiago Nonualco			76	19		96
16.Tapalhuaca					254	254
Sub-total	392	24	1,498	299	1,508	3,722
SAN VICENTE						
1.Guadalupe			312			312
2.Santo Domingo		131				131
3.Tepetitan		7				7
4.Verapaz		145	153			298
Sub-total		283	465			748
Total	2,572	1,085	2,036	299	1,508	7,500

(Notes) The target of the plan for the establishment of plantation 7,500 ha was allotted to each block and municipality based on the present land use according to the following weight distribution.

Total Land-use Area	Slope Class I Area	Slope Class II Area	Slope Class III -VI Area	Slop Class III -VI Woodland Area	Total Woodland Area	Weight Total
10	5	10	30	30	15	100

Table D-7 Afforestation Plan for 15 years (2/3)
(for the Introduction of Agroforestry System)

(Unit: ha)

Municipality \ Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	263					263
2.San Marcos	73					73
3.San Martin	204					204
4.Santiago Texacuangos	209					209
5.Santo Tomas	145					145
6.Soyapango	156					156
Sub-total	1,051					1,051
CUSCATLAN						
1.Cojutepeque	198	120				318
2.Candelaria	260	62				321
3.El Carmen		259				259
4.San Cristobal		274				274
5.San Pedro Perulapan	266					266
6.San Rafael Cedros		164				164
7.San Ramon	7	190				197
8.Santa Cruz Analquito	61		59			120
9.Santa Cruz Michapa	76					76
Sub-total	867	1,069	59			1,995
LA PAZ						
1.El Rosario				122	165	287
2.Jerusalen		24	102			125
3.Mercedes La Ceiba			38			38
4.Paraiso de Osorio			126			126
5.San Antonio Masahuat			90		266	356
6.San Emigdio	68		67			135
7.San Francisco Chinameca	74				187	261
8.San Juan Nonualco			7			7
9.San Juan Tepezontes	1		212		47	260
10.San Luis				12	3	14
11.San Miguel Tepezontes	124		36		84	244
12.San Pedro Masahuat			25	409	481	915
13.San Pedro Nonualco			253			253
14.Santa Maria Ostuma			329			329
15.Santiago Nonualco			68	43		111
16.Tapalhuaca					282	282
Sub-total	267	24	1,352	585	1515	3,743
SAN VICENTE						
1.Guadalupe			284			284
2.Santo Domingo		134				134
3.Tepetitan		8				8
4.Verapaz		144	141			286
Sub-total		286	426			711
Total	2,185	1,378	1,837	585	1,515	7,500

(Notes) The target of the plan for the introduction of Agroforestry System 7,500 ha was allotted to each block and municipality based on the population and present land use according to the following weight distribution.

Total Population	Agriculture Population	Total Land-use Area	Total Arable Area	Slop Class I Arable Area	Slop Class II Arable Area	Slop Class III -VI Arable Area	Weight Total
10	30	10	5	5	10	30	100

Table D-7 Afforestation Plan for 15 years (3/3)
(Total)

(Unit: ha)

Municipality\Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	521					521
2.San Marcos	123					123
3.San Martin	451					451
4.Santiago Texacuangos	486					486
5.Santo Tomas	318					318
6.Soyapango	227					227
Sub-total	2,127					2,127
CUSCATLAN						
1.Cojutepeque	399	212				611
2.Candelaria	579	118				697
3.El Carmen		345				345
4.San Cristobal		493				493
5.San Pedro Perulapan	629					629
6.San Rafael Cedros		320				320
7.San Ramon	15	358				372
8.Santa Cruz Analquito	161		132			292
9.Santa Cruz Michapa	189					189
Sub-total	1,971	1,846	132			3,948
LA PAZ						
1.El Rosario				185	336	521
2.Jerusalen		48	215			263
3.Mercedes La Ceiba			81			81
4.Paraiso de Osorio			243			243
5.San Antonio Masahuat			210		549	759
6.San Emigdio	161		140			300
7.San Francisco Chinameca	197				374	571
8.San Juan Nonualco			16			16
9.San Juan Tepezontes	3		480		95	578
10.San Luis				17	5	22
11.San Miguel Tepezontes	298		75		159	531
12.San Pedro Masahuat			56	619	969	1,644
13.San Pedro Nonualco			516			516
14.Santa Maria Ostuma			676			676
15.Santiago Nonualco			144	62		206
16.Tapalhuaca					537	537
Sub-total	659	48	2,851	884	3,024	7,465
SAN VICENTE						
1.Guadalupe			596			596
2.Santo Domingo		264				264
3.Tepetitan		15				15
4.Verapaz		289	294			584
Sub-total		569	891			1460
Total	4,757	2,462	3,873	884	3,024	15,000

(Notes) This table shows total of 1/3 and 2/3.

Table D-8 Annual Afforestation Plan (1/3)
(for the Establishment of Plantation)

(Unit: ha)

Municipality \ Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	17					17
2.San Marcos	3					3
3.San Martin	17					17
4.Santiago Texacuangos	18					18
5.Santo Tomas	12					12
6.Soyapango	5					5
Sub-total	72					72
CUSCATLAN						
1.Cojutepeque	13	6				20
2.Candelaria	21	4				25
3.El Carmen		6				6
4.San Cristobal		15				15
5.San Pedro Perulapan	24					24
6.San Rafael Cedros	0	10				10
7.San Ramon	1	11				12
8.Santa Cruz Analquito	7		5			11
9.Santa Cruz Michapa	8					8
Sub-total	74	52	5			130
LA PAZ						
1.El Rosario				4	11	16
2.Jerusalen		2	8			9
3.Mercedes La Ceiba			3			3
4.Paraiso de Osorio			8			8
5.San Antonio Masahuat			8		19	27
6.San Emigdio	6		5			11
7.San Francisco Chinameca	8				12	21
8.San Juan Nonualco			1			1
9.San Juan Tepezontes	1		18		3	21
10.San Luis				1	1	1
11.San Miguel Tepezontes	12		3		5	19
12.San Pedro Masahuat			2	14	33	49
13.San Pedro Nonualco			18			18
14.Santa Maria Ostuma			23			23
15.Santiago Nonualco			5	1		6
16.Tapalhuaca					17	17
Sub-total	26	2	100	20	101	248
SAN VICENTE						
1.Guadalupe			21			21
2.Santo Domingo		9				9
3.Tepetitan		1				1
4.Verapaz		10	10			20
Sub-total		19	31			50
Total	172	72	136	20	101	500

(Notes) Figures are 1/15 of Afforestation Plan for 15 years.

Table D-8 Annual Afforestation Plan (2/3)
(for the Introduction of Agroforestry System)

(Unit: ha)

Municipality\Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	18					18
2.San Marcos	5					5
3.San Martin	14					14
4.Santiago Texacuangos	14					14
5.Santo Tomas	10					10
6.Soyapango	10					10
Sub-total	70					70
CUSCATLAN						
1.Cojutepeque	13	8				21
2.Candelaria	17	4				21
3.El Carmen		17				17
4.San Cristobal		18				18
5.San Pedro Perulapan	18					18
6.San Rafael Cedros		11				11
7.San Ramon	1	13				13
8.Santa Cruz Analquito	4		4			8
9.Santa Cruz Michapa	5					5
Sub-total	58	71	4			133
LA PAZ						
1.El Rosario				8	11	19
2.Jerusalen		2	7			8
3.Mercedes La Ceiba			3			3
4.Paraiso de Osorio			8			8
5.San Antonio Masahuat			6		18	24
6.San Emigdio	5		4			9
7.San Francisco Chinameca	5		0		12	17
8.San Juan Nonualco			1			1
9.San Juan Tepezontes	1		14		3	17
10.San Luis			0	1	1	1
11.San Miguel Tepezontes	8		2		6	16
12.San Pedro Masahuat			2	27	32	61
13.San Pedro Nonualco			17			17
14.Santa Maria Ostuma			22			22
15.Santiago Nonualco			5	3		7
16.Tapalhuaca					19	19
Sub-total	18	2	90	39	101	250
SAN VICENTE						
1.Guadalupe			19			19
2.Santo Domingo		9				9
3.Tepetitan		1				1
4.Verapaz		10	9			19
Sub-total		19	28			47
Total	146	92	122	39	101	500

(Notes) Figures are 1/15 of Afforestation Plan for 15 years.

Table D-8 Annual Afforestation Plan (3/3)
(Total)

(Unit: ha)

Municipality \ Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	35					35
2.San Marcos	8					8
3.San Martin	30					30
4.Santiago Texacuangos	32					32
5.Santo Tomas	21					21
6.Soyapango	15					15
Sub-total	142					142
CUSCATLAN						
1.Cojutepeque	27	14				41
2.Candelaria	39	8				46
3.El Carmen		23				23
4.San Cristobal		33				33
5.San Pedro Perulapan	42					42
6.San Rafael Cedros		21				21
7.San Ramon	1	24				25
8.Santa Cruz Analquito	11		9			19
9.Santa Cruz Michapa	13					13
Sub-total	131	123	9			263
LA PAZ						
1.El Rosario				12	22	35
2.Jerusalen		3	14			18
3.Mercedes La Ceiba			5			5
4.Paraiso de Osorio			16			16
5.San Antonio Masahuat			14		37	51
6.San Emigdio	11		9			20
7.San Francisco Chinameca	13				25	38
8.San Juan Nonualco			1			1
9.San Juan Tepezontes	1		32		6	39
10.San Luis				1	1	1
11.San Miguel Tepezontes	20		5		11	35
12.San Pedro Masahuat			4	41	65	110
13.San Pedro Nonualco			34			34
14.Santa Maria Ostuma			45			45
15.Santiago Nonualco			10	4		14
16.Tapalhuaca					36	36
Sub-total	44	3	190	59	202	498
SAN VICENTE						
1.Guadalupe			40			40
2.Santo Domingo		18				18
3.Tepetitan		1				1
4.Verapaz		19	20			39
Sub-total		38	59			97
Total	317	164	258	59	202	1,000

(Notes) Figures are 1/15 of Afforestation Plan for 15 years.

Table D-9 Number of Seedling required for Annual Afforestation Plan (1/3)
(for the Establishment of Plantation)

(Unit: seedling)

Municipality\Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	27,200					27,200
2.San Marcos	4,800					4,800
3.San Martin	27200					27,200
4.Santiago Texacuangos	28,800					28,800
5.Santo Tomas	19,200					19,200
6.Soyapango	8,000					8,000
Sub-total	115,200					115,200
CUSCATLAN						
1.Cojutepeque	20,800	9,600				32,000
2.Candelaria	33,600	6,400				40,000
3.El Carmen		9,600				9,600
4.San Cristobal		24,000				24,000
5.San Pedro Perulapan	38,400					38,400
6.San Rafael Cedros		16,000				16,000
7.San Ramon	1,600	17,600				19,200
8.Santa Cruz Analquito	11,200		8,000			17,600
9.Santa Cruz Michapa	12,800					12,800
Sub-total	118,400	83,200	8,000			208,000
LA PAZ						
1.El Rosario				6,400	17,600	25,600
2.Jerusalen		3,200	12,800			14,400
3.Mercedes La Ceiba			4,800			4,800
4.Paraiso de Osorio			12,800			12,800
5.San Antonio Masahuat			12,800		30,400	43,200
6.San Emigdio	9,600		8,000			17,600
7.San Francisco Chinameca	12,800				19,200	33,600
8.San Juan Nonualco			1,600			1,600
9.San Juan Tepezontes	1,600		28,800		4,800	33,600
10.San Luis				1,600	1,600	1,600
11.San Miguel Tepezontes	19,200		4,800		8,000	30,400
12.San Pedro Masahuat			3,200	22,400	52,800	78,400
13.San Pedro Nonualco			28,800			28,800
14.Santa Maria Ostuma			36,800			36,800
15.Santiago Nonualco			8,000	1,600		9,600
16.Tapalhuaca					27,200	27,200
Sub-total	41,600	3,200	160,000	32,000	161,600	396,800
SAN VICENTE						
1.Guadalupe			33,600			33,600
2.Santo Domingo		14,400				14,400
3.Tepetitan		1,600				1,600
4.Verapaz		16,000	16,000			32,000
Sub-total		30,400	49,600			80,000
Total	275,200	115,200	217,600	32,000	161,600	800,000

(Notes) Planting density is based on 1,600 seedlings per ha.

Table D-9 Number of Seedling required for Annual Afforestation Plan (2/3)
(for the Introduction of Agroforestry System)

(Unit: seedling)

Municipality\Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	14,400					14,400
2.San Marcos	4,000					4,000
3.San Martin	11,200					11,200
4.Santiago Texacuangos	11,200					11,200
5.Santo Tomas	8,000					8,000
6.Soyapango	8,000					8,000
Sub-total	56,000					56,000
CUSCATLAN						
1.Cojutepeque	10,400	6,400				16,800
2.Candelaria	13,600	3,200				16,800
3.El Carmen		13,600				13,600
4.San Cristobal		14,400				14,400
5.San Pedro Perulapan	14,400					14,400
6.San Rafael Cedros		8,800				8,800
7.San Ramon	800	10,400				10,400
8.Santa Cruz Analquito	3,200		3,200			6,400
9.Santa Cruz Michapa	4,000					4,000
Sub-total	46,400	56,800	3,200			106,400
LA PAZ						
1.El Rosario				6,400	8,800	15,200
2 Jerusalen		1,600	5,600			6,400
3.Mercedes La Ceiba			2,400			2,400
4.Paraiso de Osorio			6,400			6,400
5.San Antonio Masahuat			4,800		14,400	19,200
6.San Emigdio	4,000		3,200			7,200
7.San Francisco Chinameca	4,000				9,600	13,600
8.San Juan Nonualco			800			800
9.San Juan Tepezontes	800		11,200		2,400	13,600
10.San Luis				800	800	800
11.San Miguel Tepezontes	6,400		1,600		4,800	12,800
12.San Pedro Masahuat			1,600	21,600	25,600	48,800
13.San Pedro Nonualco			13,600			13,600
14.Santa Maria Ostuma			17,600			17,600
15.Santiago Nonualco			4,000	2,400		5,600
16.Tapalhuaca					15,200	15,200
Sub-total	14,400	1,600	72,000	31,200	80,800	200,000
SAN VICENTE						
1.Guadalupe			15,200			15,200
2.Santo Domingo		7,200				7,200
3.Tepetitan		800				800
4.Verapaz		8,000	7,200			15,200
Sub-total		15,200	22,400			37,600
Total	116,800	73,600	97,600	31,200	80,800	400,000

(Notes) Planting density is based on 800 seedlings per ha.

Table D-9 Number of Seedling required for Annual Afforestation Plan (3/3)
(Total)

(Unit: seedling)

Municipality\Block	A	B	C	D	E	Total
SAN SALVADOR						
1.Ilopango	41,600					41,600
2.San Marcos	8,800					8,800
3.San Martin	38,400					38,400
4.Santiago Texacuangos	40,000					40,000
5.Santo Tomas	27,200					27,200
6.Soyapango	16,000					16,000
Sub-total	171,200					171,200
CUSCATLAN						
1.Cojutepeque	31,200	16,000				48,800
2.Candelaria	47,200	9,600				56,800
3.El Carmen		23,200				23,200
4.San Cristobal		38,400				38,400
5.San Pedro Perulapan	52,800					52,800
6.San Rafael Cedros		24,800				24,800
7.San Ramon	2,400	28,000				29,600
8.Santa Cruz Analquito	14,400		11,200			24,000
9.Santa Cruz Michapa	16,800					16,800
Sub-total	164,800	140,000	11,200			314,400
LA PAZ						
1.El Rosario				12,800	26,400	40,800
2 Jerusalen		4,800	18,400			20,800
3.Mercedes La Ceiba			7,200			7,200
4.Paraiso de Osorio			19,200			19,200
5.San Antonio Masahuat			17,600		44,800	62,400
6.San Emigdio	13,600		11,200			24,800
7.San Francisco Chinamoca	16,800				28,800	47,200
8.San Juan Nonualco			2,400			2,400
9.San Juan Tepezontes	2,400		40,000		7,200	47,200
10.San Luis				2,400	2,400	2,400
11.San Miguel Tepezontes	25,600		6,400		12,800	43,200
12.San Pedro Masahuat			4,800	44,000	78,400	127,200
13.San Pedro Nonualco			42,400			42,400
14 Santa Maria Ostuma			54,400			54,400
15.Santiago Nonualco			12,000	4,000		15,200
16.Tapalhuaca					42,400	42,400
Sub-total	56,000	4,800	232,000	63,200	242,400	596,800
SAN VICENTE						
1.Guadalupe			48,800			48,800
2.Santo Domingo		21,600				21,600
3.Tepetitan		2,400				2,400
4.Verapaz		24,000	23,200			47,200
Sub-total		45,600	72,000			117,600
Total	392,000	188,800	315,200	63,200	242,400	1,200,000

(Notes) This table shows total of 1/3 and 2/3.

SUPPORTING REPORT [E]

BASIN MANAGEMENT

ANNEX E: BASIN MANAGEMENT

CONTENTS

E. Basin Management (Basin management situation)

E.1 Water use

E.1.1 Present situation

Groundwater is the main source of the drinking and irrigation (small-scale) water supply in the study area. The surface water of the Jiboa River is used by the residents along the river for laundry and bathing, and by the animals for drinking. Studies were not carried out on the middle and downstream basin areas where sand extraction is widely carried out. On the 30th of September 1996, this excessive extraction of sand was observed to have caused the El Rosario bridge to tilt, thereby destabilizing the main river course which resulted in the erosion of the river banks.(see Figure E.1.1.1)

E.1.2 Review of the plan for using the water of Ilopango lake

ANDA has a plan for using the water of the Ilopango lake. The plan is to take 1.0m3/s of water from Ilopango lake and to use it as drinking water in eastern San Salvador city. Punta Shuguayo on the west side is being considered as intake point. ANDA has reported by succeeded in the experimental removal of Arsenic(As), and is at present conducting experiments to remove Boron(B), as shown in the attached table.

The development potential of the Ilopango lake is examined. The water amount that can be developed of the lake is presumed to be 1.5m3/s according to the investigation report of ANDA.
Therefore, the available amount of water becomes 0.5m3/s when the intake plan for water supply from this lake is put into practice by ANDA.In the water resource development plan of the Jiboa river basin, it is difficult to include Ilopango lake, even if the water quality problem is removed.

There are two reports which examine the water balance of the Ilopango lake, One is Datos Preliminares del Lago de Ilopango para el Proyecto Regional de Eutroficacion Lagos Calidos, which Ing.Jose Mario Sorto(MPCDES) did in 1985, and the other is Balance Hidrologico del Area de la Subcuenca del Lago de Ilopango, which Departmento de Hidrogeologia of ANDA did in 1995.

The content of the report of ANDA is introduced because there is no big difference in the contents of the two reports.
The water balance of the Ilopango lake is shown by the undermentioned expression.

$P = El + Etl + Qd + Ql + \Delta S \pm \Delta B$

P: Amount of precipitation during year:1770mm/year=354X106m3/year

El: Amount of evaporation from water surface of the lake :2000mm/year=140x106m3/year

ETl: Amount of evapo-transpiration from sub-basins other than water surface of the lake :1100mm/year=143x106m3/year

Qd: Amount of discharge from the lake to the Desague river:1.5m3/sec=47.3x106m3/year

Ql: Amount of discharge from the lake to the sub-basin area:0.4m3/sec=12.6x10m3/year

ΔS: Water level rise during a year:2cm/year=1.4x106m3/year

ΔB: Difference of adjustment of balance

354=140+143+47.3+47.3+12.6+1.4±ΔB

ΔB Amount of adjustment:9.7x106m3/year

The amount of the outflow to the Desague river is estimated at 1.5m3/s.

Therefore, if intake amount of 1.0m3/sec is done by ANDA for drinking water, the possible development will be the remainder of 0.5m3/sec.

The small water amount which can be developed originates in the fact that the basin area, which includes 70km2 of the Ilopango lake, is only 137.9km2. The amount of the evaporation of the lake water surface and a sub-basins accounts for 83% of the whole.

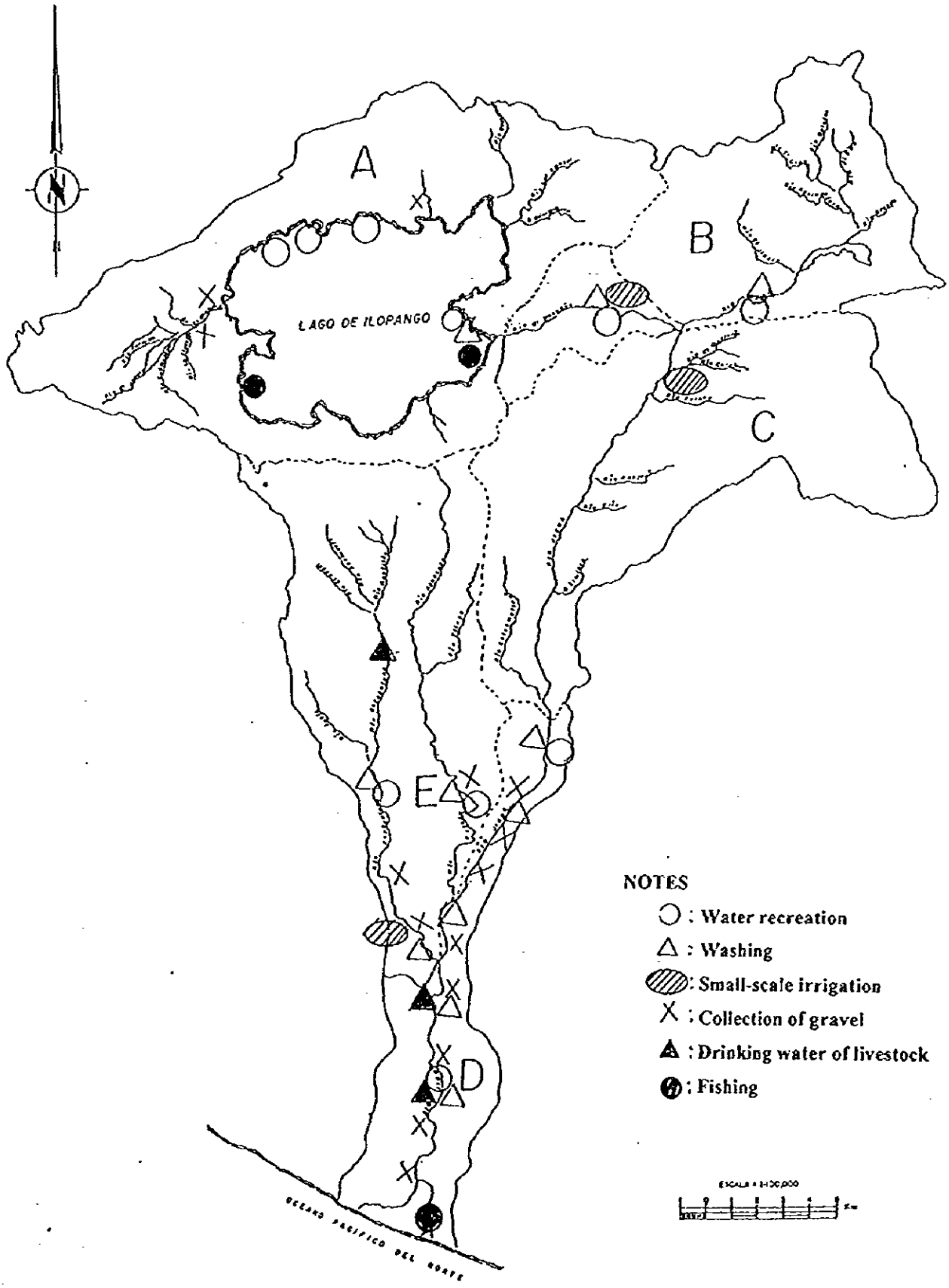


Figure E.1.1.1 Present Condition of Water-Use in the Basin

E.2 Water Quality

E.2.1 Water quality investigation result

Water quality surveys were carried out from February to October of 1996 -- twice in February, the dry season, and twice in September and October, the rainy season -- to determine whether the water quality of the Jiboa River, Ilopango Lake and the wells in the basin are suitable for agricultural use and as drinking water for the residents and animals. Sampling was conducted at a total of 27 points: 10 from the river, 6 from the lake, and 11 from wells (see Figure E.2.1.1). However, the wells were only surveyed twice: once each the rainy and dry seasons.

The following 35 parameters were used to survey the water quality of the river, lake and wells, and the results are shown in Table E.2.1.1.

Temperature (FAO)	SO_4 (FAO)	NH_3 (FAO)	SS (FAO)
Turbidity (FAO)	RAS	As (FAO, WHO)	TN
Color (FAO)	Ca (FAO)	Cr (WHO)	TP (FAO)
pH (FAO)	Mg (FAO)	Hg (WHO)	PO_4-P (FAO)
E.C (FAO)	Mn (FAO)	Pb (WHO)	CO_3 (FAO)
DO (FAO)	Na (FAO)	Cd (WHO)	HCO_3 (FAO)
Total Coliform (WHO)	K (FAO)	B (FAO, WHO)	Dissolved Solids (FAO)
Cl (FAO)	NO_3 (FAO, WHO)	COD	Total Solids (FAO)
Hardness (FAO)	NO_2 (FAO, WHO)	BOD	

* The items underlined were analyzed by the MAG, and the rest by FUSADES.

Because no water quality guidelines have been established in El Salvador at present, the drinking water guidelines of WHO and the agricultural water guidelines of FAO were used. The drinking water guidelines of WHO specifies 0.30 mg/l as the permissible limit for boron and 0.01 mg/l as the permissible limit for arsenic. Likewise, the agricultural water guidelines of FAO specifies 0.70 mg/l as the permissible limit for boron and 0.10 mg/l as the permissible limit for arsenic.

E.2.1.1 Water Quality of the Jiboa River

Figure E.2.1.2 shows the changes in the water quality of the Jiboa River in terms of boron and arsenic concentrations. The boron and arsenic concentrations in the Jiboa River widely exceeds the permissible limits established by FAO for agricultural water. Only heavy metals such as chrome, mercury and cadmium were detected from the samples taken from the river.

E.2.1.2 Water Quality of Ilopango Lake

Figure E.2.1.3 shows the boron and arsenic concentrations in the lake analyzed during the survey. The concentrations of both properties exceed the permissible limit set by FAO for agricultural water. This phenomena is attributed to the fact that the lake is in a caldera. The Chaguite River, which flows into the lake, is not considered a contaminant source in terms of boron and arsenic properties, as concentrations of both are extremely low.

On the other hand, because of the urbanization of the Chaguite River basin, the water of the lake becomes significantly turbid, particularly after it has rained. Soil conservation measures must be adopted in this basin.

The changes in the water quality of Ilopango Lake were studied based on the surveys of ANDA and Fundacion Amigos del Lago de Ilopango. In 1994, ANDA conducted surveys from March to July in Rincon Shuguallo, one of the planned intake points for drinking water. The results indicate that the water in this point contains 0.6 to 0.8 mg/l of arsenic, values exceeding the permissible limits set for drinking and agricultural water. In 1995, the two surveys conducted by Fundacion Amigos del Lago de Ilopango from October to December did not detect any arsenic in the water. However, the water was found to contain 7 to 10 mg/l of boron. Conclusively, even past water quality data of the lake corroborates its unsuitability for agricultural use.

E.2.1.3 Well Water Quality

The water quality surveys conducted on existing wells in the study area from February to October of 1996 indicate that 9 of the 13 wells produce water not suitable for drinking. (see Figure E.2.1.4)

Items 1, 2 and 3 above emphatically point out the unsuitability of water of the Jiboa River and Ilopango Lake for drinking and agricultural use, and the limited number of wells producing drinkable water.

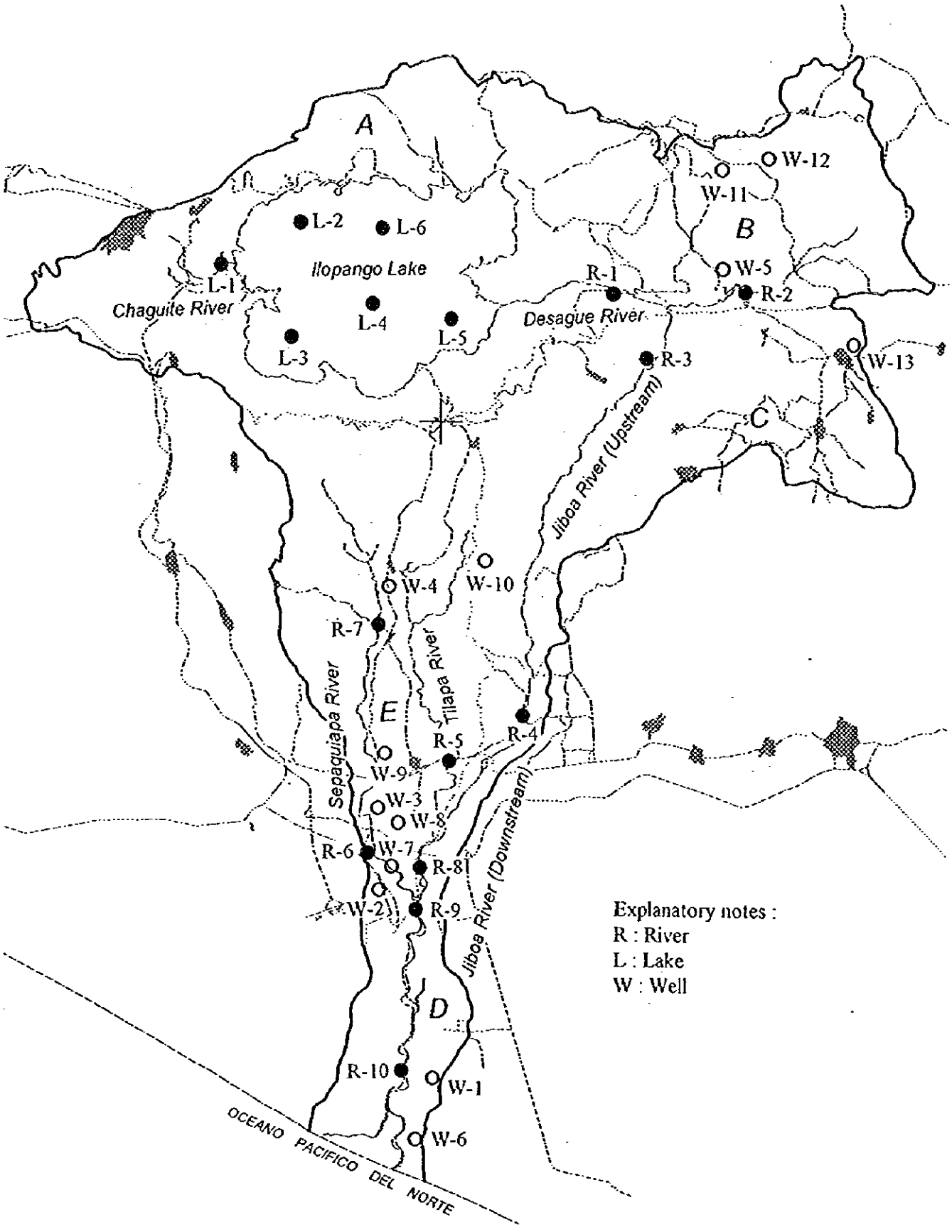
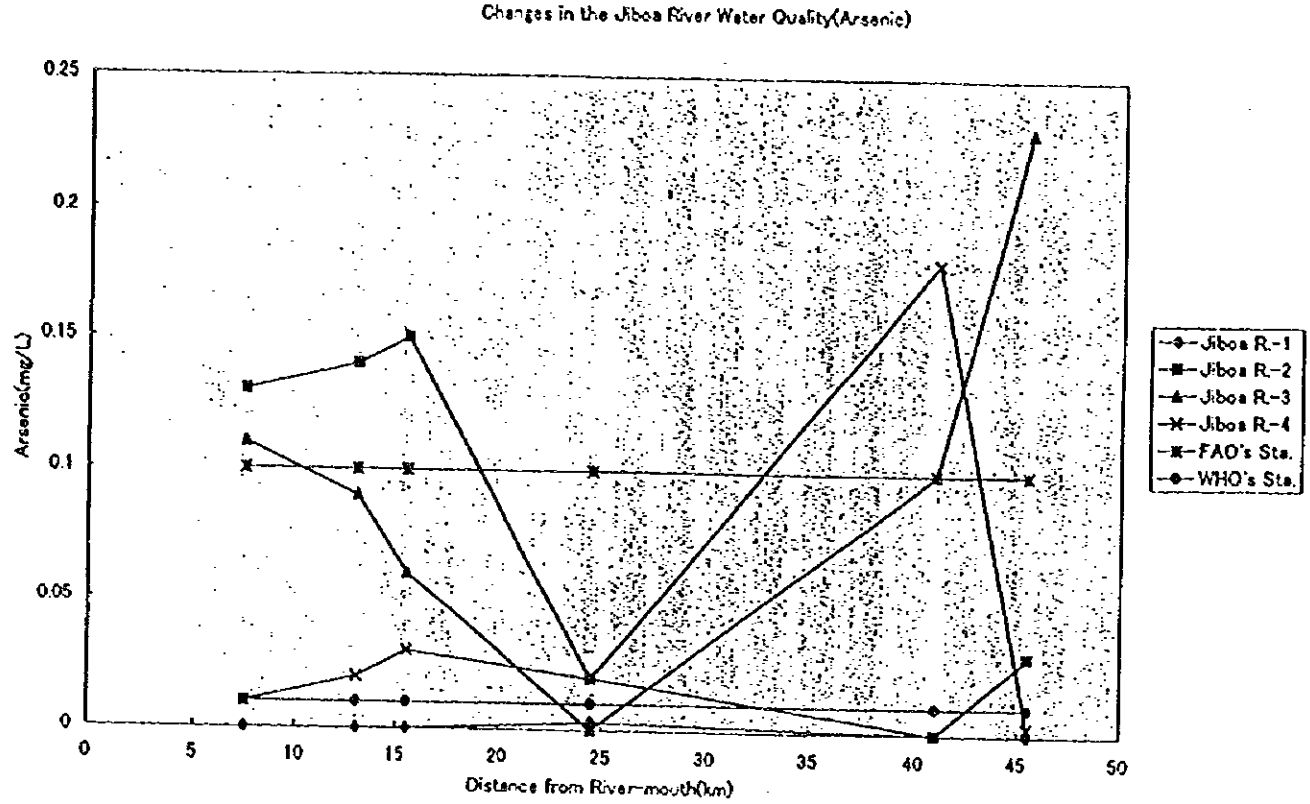


Figure E.2.1.1 Location of Water Quality Sampling Station



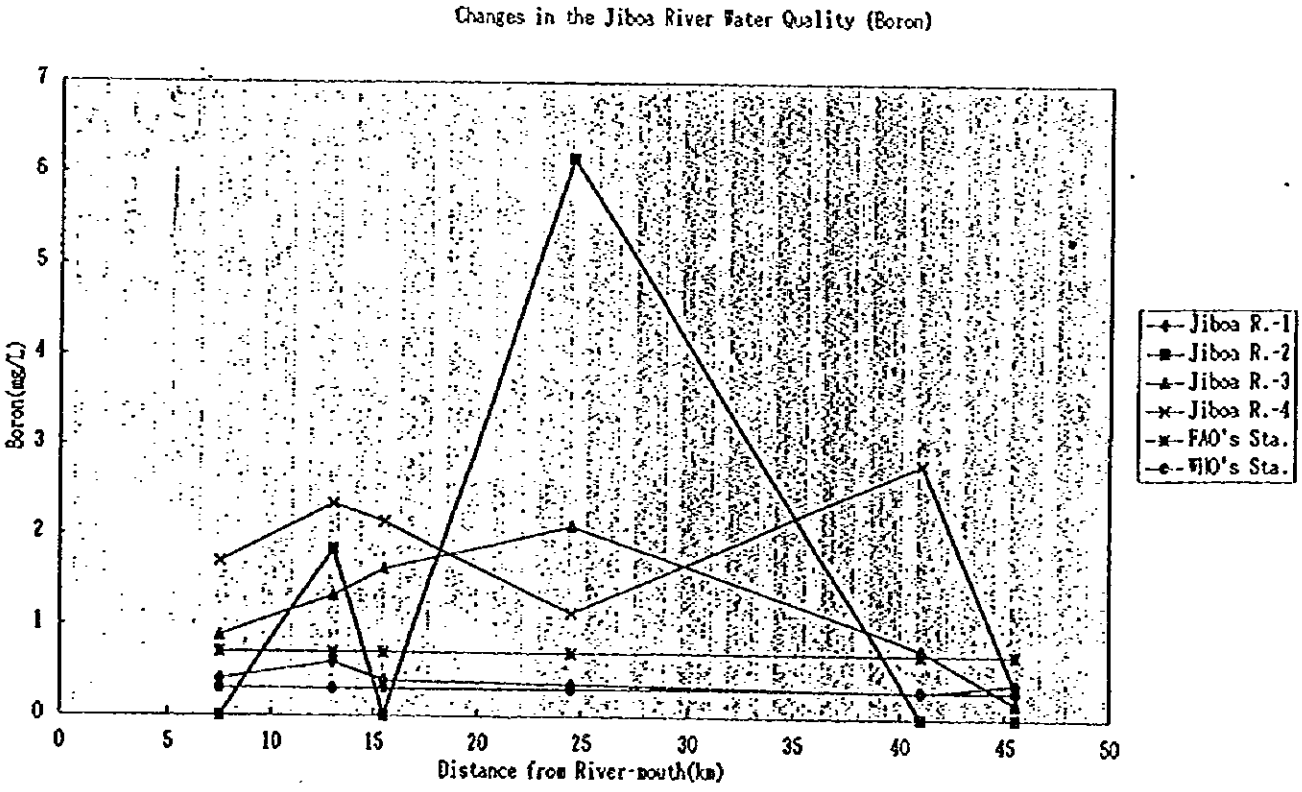
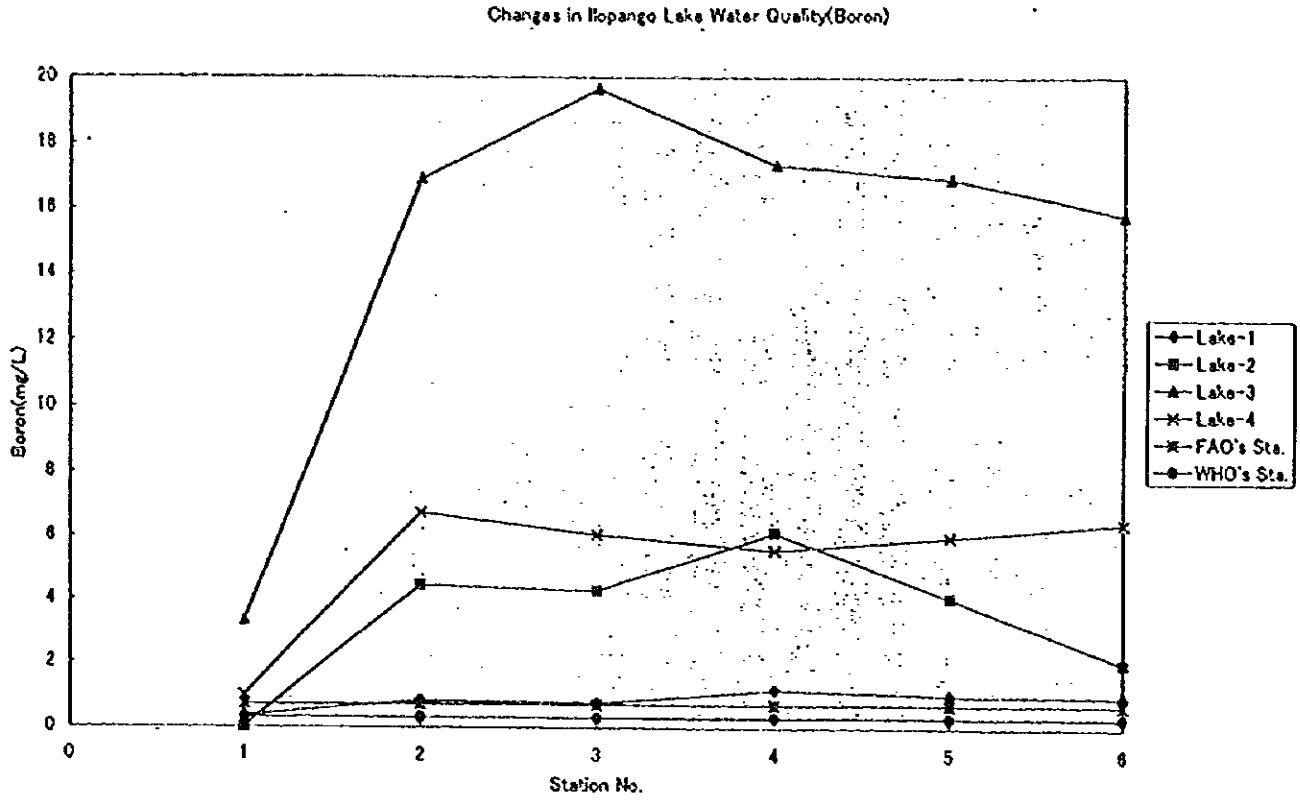


Fig.E.2.1.2 Changes in Jiboa River Water Quality'



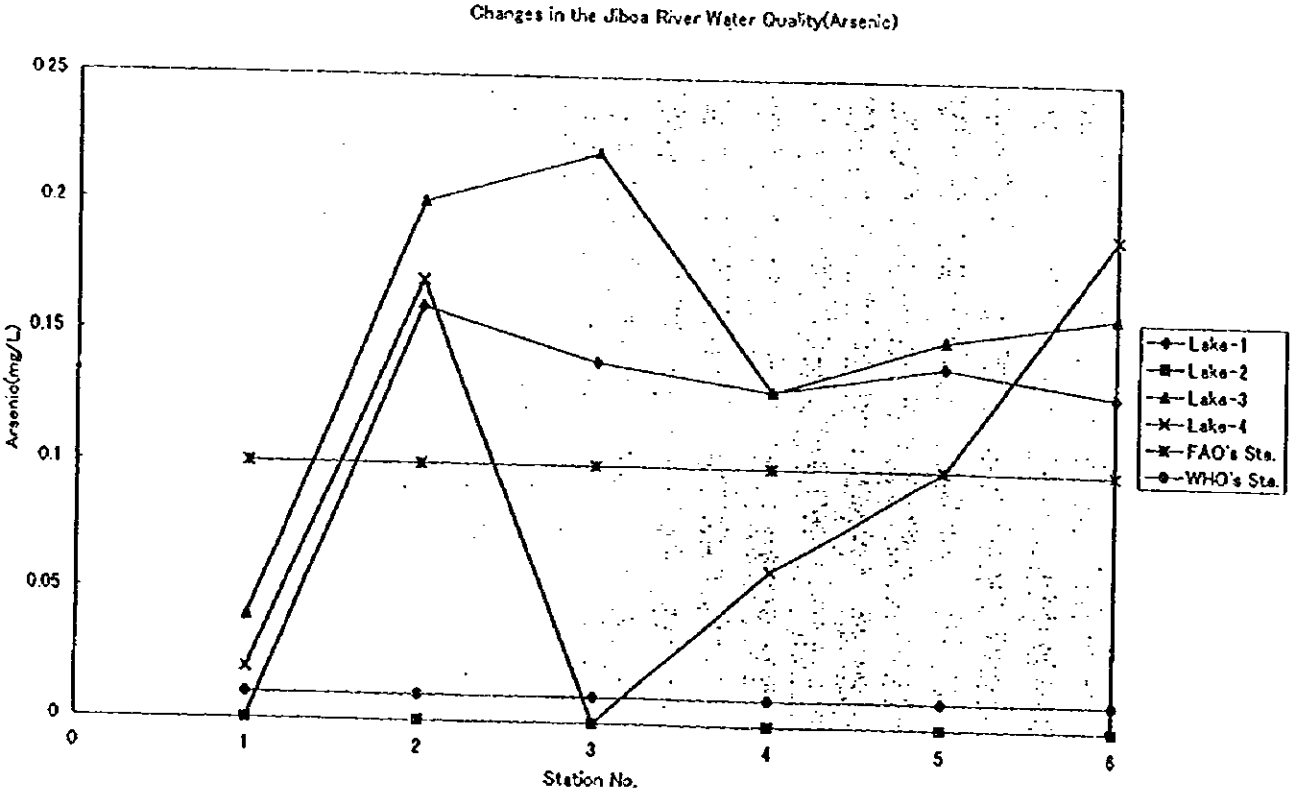
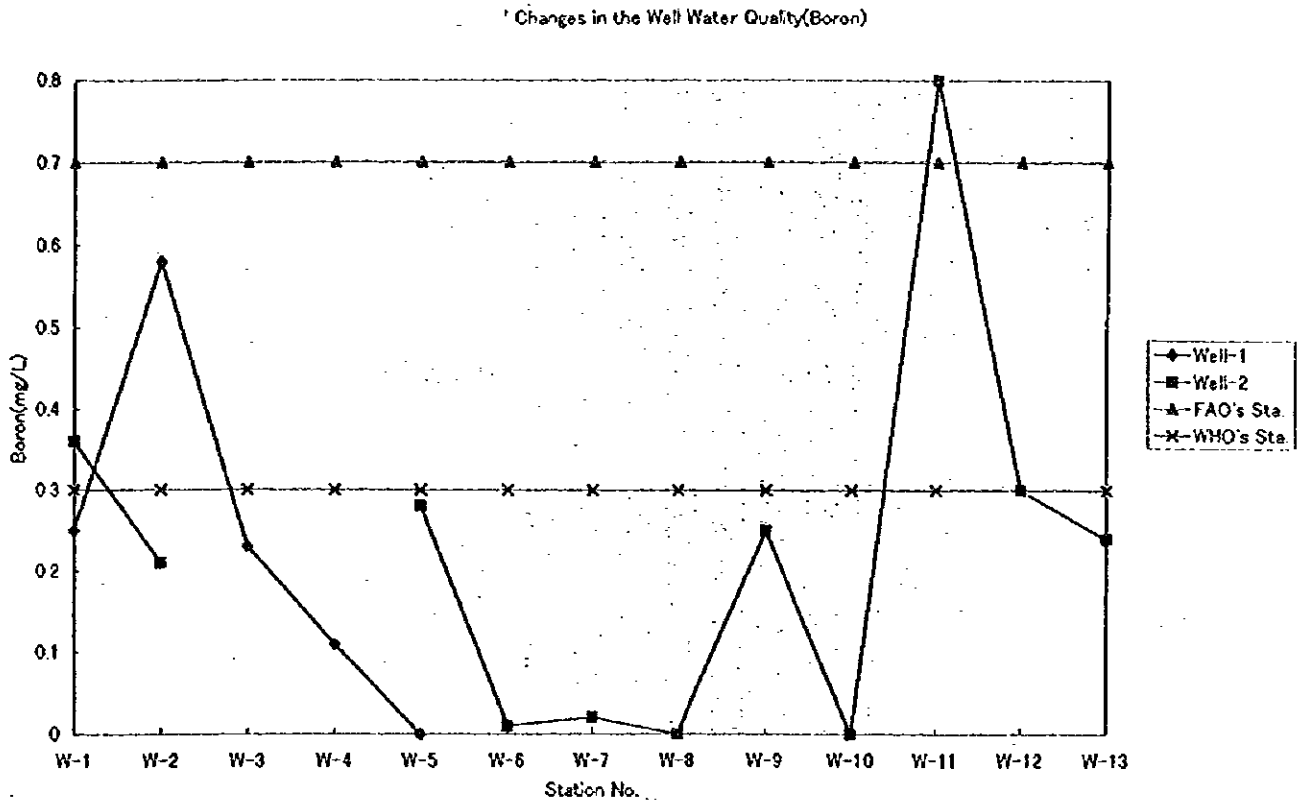


Fig. E.2.1.3 Changes in Ilopango Lake Water Quality



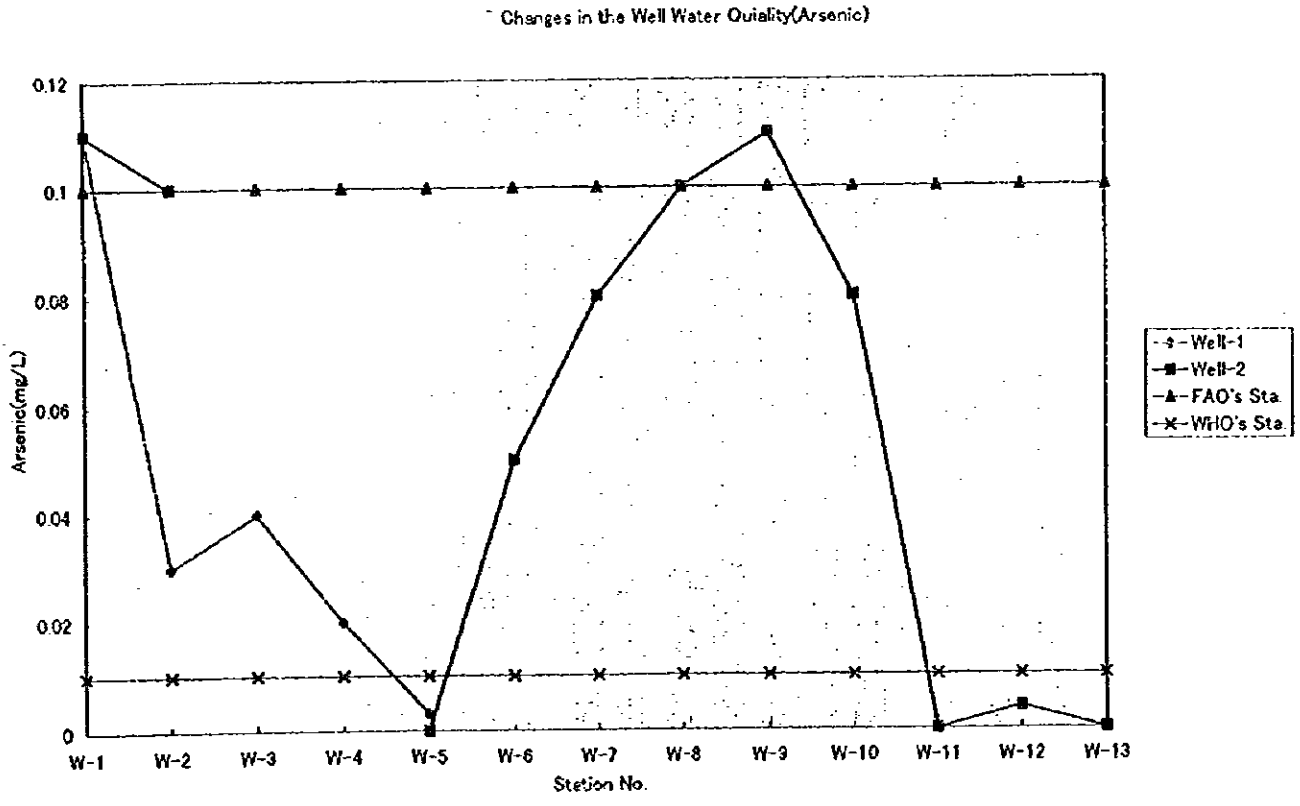


Fig.E.2.1.4 Changes in the Well Water Quality

Table E.2.1.1 Evaluation in Water Quality Survey Results

	1st (12-14 Feb. 1996)				2nd (26-28 Feb. 1996)				3rd (24-25 Sep. 1996)				4th (15-17 Oct. 1996)				Evaluation
	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	(for Irrigation Water)
	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	
Ilopango Lake	×	×	×	×	×	○	×	○	×	×	×	×	×	×	×	×	×
Desague River	×	×	○	○	○	×	○	×	×	×	×	×	×	×	×	○	×
Jiboa River (Upstream from Montecristo St)	×	○	○	○	×	×	×	○	×	×	×	×	×	×	×	×	×
Jiboa River (Downstream from Montecristo St)	×	○	○	○	×	×	×	×	×	×	×	×	×	×	×	○	×
Tilapa River	×	○	○	○	○	×	○	○	○	×	○	○	○	×	○	○	○
Sepaquiapa River	×	○	○	○	○	○	○	○	○	×	○	○	○	×	○	○	○

Well Water

	1st (12-13 Feb 1996)		2nd (3~4 Oct 1996)	
	Who's Standard for Drinking Water		Who's Standard for Drinking Water	
	Boron <0.3mg/L	Arsenic <0.01mg/L	Boron <0.3mg/L	Arsenic <0.01mg/L
W-1	○	×	×	×
W-2	×	×	○	×
W-3	○	×		
W-4	○	×		
W-5	○	○	○	○
W-6			○	○
W-7			○	○
W-8			○	○
W-9			○	×
W-10			○	○
W-11			×	○
W-12			○	○
W-13			○	○

Table E.2.1.1(1) Results of Water Quality Analysis(1st of Survey of the Jiboa River)

Station No.		R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10
Site		Rio Desac	Rio Jibo	Rio Jibc	Rio Jibc	Rio Tila	Rio Sep	Rio Sep	Rio Jibc	Rio Jibc	Rio Jibo
Date		13/2/96	13/2/96	13/2/96	12/2/96	12/2/96	12/2/96	12/2/96	12/2/96	12/2/96	12/2/96
TDS	mg/l										
ECw	ds/ml	717	168	248	260	308	250	213	272	356	265
T	C	26.3	21.5	26.9	28.3	33.4	27.5	29.9	27.7	29.8	32
Turbidity	NTU										
Hardness	mg equiv.	176.72	53.79	90.28	88.36	80.68	79.72	65.31	96.05	92.2	91.24
Sediments	g/l										
pH		7.45	7.6	7.95	8	8	7.7	7.7	7.85	7.7	7.8
Ca	mg/l	37.47	11.22	17.23	20.24	21.64	20.24	18.84	14.43	21.64	13.03
Mg	mg/l	3.89	10.46	8.76	11.19	6.08	9.61	7.9	5.23	8.76	7.05
Na	mg/l	121.21	24	48.8	47	42 5	26.9	25.6	69.4	58.8	68.5
CO3--	mg/l	18	9	18	18	18	18	18	18	18	18
HCO3	mg/l	146.42	112.87	106.16	122.02	85.41	85.41	85.41	150.08	122.02	143.98
Cl-	mg/l	93.37	6.75	19.88	33.37	26.63	19.88	13.49	33.37	53.25	33.37
SO4	mg/l	100.44	N.D	21.78	18.9	32.94	32.76	11.16	18.72	33.12	38.7
SAR											
B	mg/l	0.52	0.39	0.29	0.35	0.39	0.42	0.33	0.39	0.59	0.4
As	mg/l	0.03	N.D	N.D	0.003	N.D	N.D	N.D	N.D	N.D	N.D
NO3-N	mg/l	0.63	0.93	1	0.5	1.38	0.45	0.65	0.65	0.63	0.93
PO4-P	mg/l	1.33	1.15	0.86	0.94	0.98	1.02	0.76	0.91	1.15	1.11
K	mg/l	12.4	5.9	7	6.8	7.8	6.7	6.5	9.9	8.6	10.9
DO	mg/l	8.54	9.36	8.37	9.01	8.23	8.33	7.81	9.58	8.54	7.72
Mn	mg/l										
NO2-N	mg/l	N.D	N.D	N.D	0.07	N.D	N.D	N.D	N.D	N.D	0.08
COD	mg/l										
BOD	mg/l	3.53	2.46	1.06	2.58	3.18	3.68	1.54	2.79	1.44	5.58
SS	mg/l	42	52	36	68	98	62	92	40	136	10
TN	mg/l	2.14	0.71	3.57	7.14	7.14	4.71	8.71	11.72	6.43	2.14
TP	mg/l										
Total Coliform	mg/l	>1100	1100	1100	1100	>1100	>1100	>1100	>1100	>1100	>1100
Cr	mg/l	N.D	N.D	N.D	0.2	N.D	N.D	0.22	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Cd	mg/l	0.22	0.03	0.05	0.79	0.22	0.14	0.31	0.31	0.09	N.D
Total Solids	mg/l	680	266	354	376	386	340	316	400	500	428
Dissolved Solid	mg/l	638	214	318	308	288	278	224	360	364	418

Table E.2.1.1(2) Results of Water Quality Analysis(2nd of Survey of the Jiboa River)

Station No.		R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10
Site		Rio Desa	Rio Jibo	Rio Jibo	Rio Jibo	Rio Tila	Rio Sep	Rio Sep	Rio Jibo	Rio Jibo	Rio Jibo
Date		27/2/96	27/2/96	27/2/96	26/2/96	26/2/96	26/2/96	26/2/96	26/2/96	26/2/96	26/2/96
TDS	mg/l										
ECw	ds/ml	740	198	323	306	325	274	254	368	406	414
T	C	32	26.8	24.8	28.2	34	27	32	27.8	33.2	33.2
Turbidity	NTU										
Hardness	mg equiv.	177.68	55.71	101.81	86.44	78.76	80.68	67.23	92.2	88.36	90.28
Sediments	g/l										
pH		7.95	7.85	8	8.1	7.9	7.5	7.4	8	7.4	7.9
Ca	mg/l	43.29	12.02	21.64	22.44	24.05	24.05	19.24	24.05	22.44	24.05
Mg	mg/l	19.97	6.81	12.65	8.76	5.84	5.84	4.86	8.76	7.78	7.3
Na	mg/l	94.3	22.1	35.42	34.8	38.4	28.2	22.8	49	51.4	52.3
CO3--	mg/l	0	0	6.3	6.3	6.3	0	0	6.3	0	0
HCO3	mg/l	200.11	118.97	147.62	125.07	112.87	118.97	106.16	150.08	144	156.8
Cl-	mg/l	65.68	6.04	15.98	17.75	29.82	17.75	16	43.67	47.6	43.67
SO4	mg/l	169.2	3.06	23.58	19.62	32.22	29.16	21.06	34.2	25.92	28.62
SAR											
B	mg/l	N.D	N.D	N.D	6.16	N.D	N.D	N.D	N.D	1.85	N.D
As	mg/l	0.34	0.03	N.D	0.02	0.02	0.01	0.003	0.15	0.14	0.13
NO3-N	mg/l	0.38	N.D	0.1	0.4	0.4	N.D	0.58	1.48	0.63	0.05
PO4-P	mg/l	1.75	1.59	0.96	1.03	1.2	1.18	1.05	1	1.08	1.14
K	mg/l	10.2	5.9	5.9	5.9	7.2	6.4	6.6	7	7.6	8.3
DO	mg/l										
Mn	mg/l										
NO2-N	mg/l	0.02	0.02	0.01	0.07	0.03	0.13	0.09	0.04	0.05	0.02
COD	mg/l										
BOD	mg/l	2.15	3.93	0.58	1.86	4.86	7.86	1.43	2.15	2.15	3.15
SS	mg/l	16	16	16	96	76	52	28	58	194	248
TN	mg/l	N.D	N.D	N.D	2.14	2.71	2.29	3.14	4.14	2.86	N.D
TP	mg/l										
Total Coliform	mg/l	>1100	1100	210	4600	2400	>11000	4600	11000	430	750
Cr	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Cd	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	582	252	322	410	390	344	304	422	492	434
Dissolved Solid	mg/l	566	236	306	314	314	292	276	364	298	186

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Table E.2.1.1(3) Results of Water Quality Analysis(3 rd of Survey of the Jiboa River)

Station No.		R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10
Site		Rio Desagüe	Rio Jiboa	Rio Jiboa	Rio Jiboa	Rio Tilapa	Rio Sepaquiapa	Rio Sepaquiapa	Rio Jiboa	Rio Jiboa	Rio Jiboa
Date		25/9/96	25/9/96	25/9/96	24/9/96	24/9/96	24/9/96	24/9/96	24/9/96	24/9/96	24/9/96
TDS	mg/l										
ECw	ds/ml	1550	163	345	509	144	108	95	360	350	264
T	C	29.8	24.4	29.2	28.9	30.7	26.8	27.6	27	28.1	31.1
Turbidity	NTU										
Hardness	mg equiv.	157.14	29.1	64.02	71.78	38.8	29.1	34.92	58.2	60.14	56.26
Sediments	g/l										
pH		8.2	7.25	7.4	7.65	7	6.95	7.05	7.3	7.1	7.05
Ca	mg/l	44.09	10.42	16.83	20.04	9.62	16.03	6.41	16.83	16.83	12.82
Mg	mg/l	14.11	2.43	6.32	5.84	3.4	3.89	4.38	5.35	4.86	5.84
Na	mg/l	294	12.9	48	78.3	12.4	10.4	9.6	55.6	50	41
CO3--	mg/l	36.9	0	0	0	0	0	0	0	0	0
HCO3	mg/l	194.01	50.03	112.87	118.97	62.84	50.03	56.13	106.16	106.16	100.06
Cl-	mg/l	377.72	3.91	51.83	93.36	6.06	3.91	7.8	65.67	55.74	39.76
SO4	mg/l	63.36	42.66	37.8	40.5	47.7	49.77	25.02	48.6	58.5	72
SAR											
B	mg/l	4.48	0.17	0.76	2.11	0.13	0.22	N.D	1.63	1.32	0.88
As	mg/l	0.101	0.226	0.099	N.D	0.068	0.086	0.082	0.06	0.089	0.11
NO3-N	mg/l	N.D	2.4	1.1	0.83	1.33	1.68	1.73	0.7	0.95	0.58
PO4-P	mg/l	1.95	0.95	1.43	1.24	1.08	0.94	0.73	1.86	1.83	1.91
K	mg/l	32	7.5	11	13.2	6.7	6.4	5.9	9.8	10	8.7
DO	mg/l	6.51	7.67	6.66	6.83	6.37	7.12	7.02	7.34	6.85	6.45
Mn	mg/l										
NO2-N	mg/l	0.16	0.74	0.82	N.D	N.D	N.D	N.D	N.D	N.D	N.D
COD	mg/l	3.73	3.73	7.46	37.31	22.39	67.16	52.24	37.31	74.63	74.63
BOD	mg/l	2.88	3.15	2.88	4.5	5	5	7.25	3.25	6.5	11.25
SS	mg/l	158	170	298	247	259	748	206	1253	1532	1285
TN	mg/l	5.71	6	6.57	8.57	6	5.71	6.57	4.29	7.14	8.57
TP	mg/l										
Total Coliform	MPN/100L	2300	110000	46000	110000	15000	24000	24000	>110000	110000	110000
Cr	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Cd	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	1128	423	653	664	477	972	395	1615	1877	1604
Dissolved Solid	mg/l	970	253	355	417	218	224	189	362	345	319

Table E.2.1.1(4) Results of Water Quality Analysis(4th of Survey of the Jiboa River)

Station No.		R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10
Site		Rio Desaque	Rio Jiboa	Rio Jiboa	Rio Jiboa	Rio Tilapa	Rio Sepaquiapa	Rio Sepaquiapa	Rio Jiboa	Rio Jiboa	Rio Jiboa
Date		17/10/96	17/10/96	17/10/96	15/10/96	15/10/96	15/10/96	15/10/96	15/10/96	15/10/96	15/10/96
TDS	mg/l										
ECw	ds/m1	1468	228	769	256	173	162	135	614	651	533
T	C	27.5	27.6	26.4	26.6	28	27.2	27.4	31.2	27.8	30.1
Turbidity	NTU										
Hardness	mg equiv.	156.13	39.98	99.96	47.6	43.79	49.5	38.08	85.68	89.49	85.68
Sediments	g/l										
pH		8.15	7.4	7.9	7.3	7.1	7.25	7.7	7.6	7.5	7.5
Ca	mg/l	38.48	11.22	27.25	12.02	9.62	13.63	8.82	23.25	23.25	22.44
Mg	mg/l	19.46	5.84	14.59	4.38	5.84	5.35	6.32	8.27	10.21	8.76
Na	mg/l	304	15.2	123.6	49.6	16.2	18.3	15.2	98.4	101.7	79.8
CO3–	mg/l	42.9	0	0	0	0	0	0	0	0	0
HCO3	mg/l	200.1	81.14	200.11	87.85	62.84	93.96	69.94	156.8	162.9	142.76
Cl-	mg/l	380.56	9.58	162.96	55.74	12.07	7.81	7.81	119.28	123.19	95 5
SO4	mg/l	19.89	24.3	40.68	41.67	21.06	15.93	116.28	33.12	32.94	30.6
SAR											
B	mg/l	5.4	0.33	2.82	1.14	0.21	0.15	0.11	2.15	2.35	1.71
As	mg/l	0.0934	0.0031	0.178	0.0202	0.017	0.064	0.0264	0.027	0.0218	0.1028
NO3-N	mg/l	N.D	0.65	0.15	N.D	N.D	N.D	N.D	N.D	N.D	N.D
PO4-P	mg/l	2.15	0.84	1.62	1.17	1.22	1.09	0.63	1.54	1.76	1.49
K	mg/l	33	6 2	16.2	7.6	4.1	6.4	4.6	12.8	13.3	11.6
DO	mg/l	7.52	8.54	8.37	26.6	28	27.2	27.4	31.2	27.8	30.1
Mn	mg/l										
NO2-N	mg/l	N.D	0.22	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
COD	mg/l	16	8	8	217.39	94.2	181.16	79.71	94.2	79.7	79.7
BOD	mg/l	5.18	3.43	3.86	96.56	3	3	1.5	4.5	6.25	7.5
SS	mg/l	273	9	226	1016	163	98	53	262	139	199
TN	mg/l	2.86	3.57	1.43	11.43	5.71	5.71	2.86	5	4.29	6.43
TP	mg/l										
Total Coliform	MPN/100L	23	1160	210	11000	7500	4600	430	43000	93000	43000
Cr	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	36.81	N.D	15.36	3.57	N.D	N.D	N.D	10.14	10.72	8.21
Cd	mg/l	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	1199	201	766	1248	322	270	224	695	606	525
Dissolved Solid	mg/l	926	192	540	232	159	172	171	433	467	326

Table E.2.1.1(5) Results of Water Quality Analysis(1st of Survey of the Ilopango Lake)

Station No.		L-1	L-2	L-3	L-4	L-5	L-6
Site		Rio Chag	Ilopango	Ilopango	Ilopango	Ilopango	Ilopango Lake
Date		14/2/96	14/2/96	14/2/96	14/2/96	14/2/96	14/2/96
TDS	mg/l						
ECw	ds/ml	444	1621	1646	1653	1651	1663
T	C	25.1	26.3	26.5	26.7	26.7	26.3
Turbidity	NTU						
Hardness	mg equiv.	147.91	167.12	166.16	165.2	165.2	165.2
Sediments	g/l						
pH		7.6	7.6	7.7	7.7	7.7	7.65
Ca	mg/l	37.47	44.69	41.68	41.68	43.29	43.29
Mg	mg/l	17.51	17.51	18.36	18.36	16.66	13.13
Na	mg/l	49.9	316.94	317.4	312.11	213.57	318.09
CO3--	mg/l	18	36	36	54	54	36
HCO3	mg/l	195.23	268.44	256.24	219.64	219.64	231.83
Cl-	mg/l	19.88	430.26	420.36	420.32	400.44	420.32
SO4	mg/l	75.78	52.38	55.62	52.92	51.66	52.92
SAR							
B	mg/l	0.34	0.81	0.75	1.17	1	0.97
As	mg/l	N.D	0.16	0.14	0.13	0.14	0.13
NO3-N	mg/l	0.73	0.98	0.65	0.75	0.6	0.73
PO4-P	mg/l	1.67	2.63	2.62	2.67	2.65	2.65
K	mg/l	6.3	32.76	33.54	31.3	32.5	31.8
DO	mg/l	7.76	3.94	4.39	4	4.18	3.63
Mn	mg/l						
NO2-N	mg/l	1.04	N.D	N.D	N.D	N.D	N.D
COD	mg/l						
BOD	mg/l	5.05	0.5	1.66	1.28	4.55	3.05
SS	mg/l	48	16	28	6	38	30
TN	mg/l	1.29	3	3.43	2.14	3.57	2.86
TP	mg/l						
Total Coliform	mg/l	>1100	4	4	<3	11	20
Cr	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	0.03	0.02	0.03	0.03	0.03
Cd	mg/l	0.19	0.14	0.09	0.19	0.16	0.02
Total Solids	mg/l	492	1046	1056	1046	1092	1060
Dissolved Solid	mg/l	444	1030	1028	1040	1052	1030
Transparency	meter						

Table E.2.1.1(6) Results of Water Quality Analysis(2nd of Survey of the Ilopango Lake)

Station No.		L-1	L-2	L-3	L-4	L-5	L-6
Site		Rio Chag	Ilopango	Ilopango	Ilopango	Ilopango	Ilopango Lake
Date		28/2/96	28/2/96	28/2/96	28/2/96	28/2/96	28/2/96
TDS	mg/l						
ECw	ds/ml	460	1756	1795	1806	1756	1754
T	C	26.5	28	27.5	28.8	27.8	28
Turbidity	NTU						
Hardness	mg equiv.	139.5	159.96	161.82	163.68	161.82	161.82
Sediments	g/l						
pH		7.45	7.8	7.8	7.8	7.75	7.8
Ca	mg/l	39.28	44.89	44.89	45.69	44.89	46.49
Mg	mg/l	23.35	14.59	15.56	14.06	14.59	44.59
Na	mg/l	51.06	304.06	336.95	336.95	336.95	319.93
CO3--	mg/l	0	6.3	0	0	0	0
HCO3	mg/l	212.92	287.97	287.97	294.07	294.07	287.97
Cl-	mg/l	15.98	393.7	410.74	410.74	410.74	410.74
SO4	mg/l	32.76	40.68	41.31	29.52	25.2	38.34
SAR							
B	mg/l	N.D	4.42	4.27	6.12	4.05	2
As	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
NO3-N	mg/l	0.88	0.08	0.1	0.13	N.D	0.1
PO4-P	mg/l	1.51	2.21	2.19	2.2	2.24	2.18
K	mg/l	6.2	28.9	35.1	35.1	37.05	33.93
DO	mg/l						
Mn	mg/l						
NO2-N	mg/l	1.5	N.D	N.D	N.D	N.D	N.D
COD	mg/l						
BOD	mg/l	2.65	3.5	1.83	3.65	3.15	2.15
SS	mg/l	56	28	60	48	48	62
TN	mg/l						
TP	mg/l						
Total Coliform	mg/l	4300	<3	<3	<3	<3	<3
Cr	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Cd	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	382	1016	1014	1042	1042	1042
Dissolved Solid	mg/l	326	988	954	994	994	980
Transparency	meter	-	9.5	9.6	10.4	7.3	10.15

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Table E.2.1.1(7) Results of Water Quality Analysis(3 rd of Survey of the Ilopango Lake)

Station No.		L-1	L-2	L-3	L-4	L-5	L-6
Site		Rio Chagute	Ilopango Lake	Ilopango Lake	Ilopango Lake	Ilopango Lake	Ilopango Lake
Date		18/9/96	18/9/96	18/9/96	18/9/96	18/9/96	18/9/96
TDS	mg/l						
ECw	ds/ml	366	1612	1526	1656	1700	1656
T	C	31.8	31.4	30.4	30.4	29.6	30.5
Turbidity	NTU						
Hardness	mg equiv.	119.04	158.36	155.52	163.2	157.44	159.36
Sediments	g/l						
pH		7.2	8.5	8.45	8.45	8.4	8.45
Ca	mg/l	31.26	42.49	46.49	46.49	45.69	44.89
Mg	mg/l	12.65	15.56	13.13	13.13	13.13	14.59
Na	mg/l	33.9	278	296	287	290	300
CO3--	mg/l	0	73.8	49.2	61.5	49.2	61.5
HCO3	mg/l	162.9	150.68	175.09	161.06	200.11	162.28
Cl-	mg/l	13.85	390.5	390.5	390.5	400.44	400.44
SO4	mg/l	117.72	67.32	38.88	62.46	53.64	54.54
SAR							
B	mg/l	3.3	16.91	19.66	17.33	16.91	15.81
As	mg/l	0.042	0.2	0.22	0.134	0.149	0.161
NO3-N	mg/l	4.75	N.D	N.D	N.D	N.D	N.D
PO4-P	mg/l	1.71	1.83	1.86	1.85	1.87	1.89
K	mg/l	9.4	26	27	27	29	29
DO	mg/l	8.4	8.15	8.21	8.13	7.91	7.87
Mn	mg/l						
NO2-N	mg/l	0.57	N.D	N.D	N.D	N.D	N.D
COD	mg/l	7.46	14.93	14.93	18.66	7.46	7.46
BOD	mg/l	2.76	4.98	2.26	3.76	1.26	4.26
SS	mg/l	1256	77	14	22	50	44
TN	mg/l	14.18	14.18	0	14.18	6.57	12.57
TP	mg/l						
Total Coliform	MPN/100c	11x105	<300	<300	<300	<300	<300
Cr	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	0.042	0.042	0.042	0.034	0.039
Cd	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	1607	1044	1043	1060	1034	1047
Dissolved Solid	mg/l	351	967	1029	1038	984	1003

Table E.2.1.1(8) Results of Water Quality Analysis(4th of Survey of the Ilopango Lake)

Station No.		L-1	L-2	L-3	L-4	L-5	L-6
Site		Rio Chagüite	Ilopango Lake	Ilopango Lake	Ilopango Lake	Ilopango Lake	Ilopango Lake
Date		8/10/96	8/10/96	8/10/96	8/10/96	8/10/96	8/10/96
TDS	mg/l						
ECw	ds/ml	322	1,573	1,562	1,553	1,568	1611
T	C	31.2	29.4	29.3	29.4	28.7	26.2
Turbidity	NTU						
Hardness	mg equiv.	95.4	147.6	151.2	147.6	144	147.6
Sediments	g/l						
pH		7.2	8.4	8.35	8.35	8.35	8.35
Ca	mg/l	28.86	41.68	41.68	42.48	43.28	43.28
Mg	mg/l	8.76	14.59	15.56	14.59	14.11	14.59
Na	mg/l	28.5	295	307	308	307	308
CO3--	mg/l	0	49.9	49.2	55.5	55.5	61.5
HCO3	mg/l	162.9	150.08	142.76	131.17	131.17	143.98
Cl-	mg/l	12.07	400.44	426	400.44	390.5	390.5
SO4	mg/l	47.7	34.92	57.6	25.38	49.86	35.82
SAR							
B	mg/l	0.96	6.73	6.07	5.57	6	6.43
As	mg/l	0.015	0.171	N.D	0.056	0.101	0.192
NO3-N	mg/l	1.05	N.D	N.D	N.D	N.D	N.D
PO4-P	mg/l	0.17	0.19	0.19	0.19	0.19	0.19
K	mg/l	6.5	31.98	32	33	32	33
DO	mg/l	4.83	7.73	7.62	7.95	7.62	7.93
Mn	mg/l						
NO2-N	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
COD	mg/l	28.98	23.81	15.87	31.71	15.87	31.74
BOD	mg/l	5.5	4.1	4.1	9.1	2.3	9.6
SS	mg/l	722	3	10	4	0	0
TN	mg/l	8.57	5.71	2.86	7.14	5.71	3.57
TP	mg/l						
Total Coliform	MPN/100L	11000	230	<30	<30	<30	<30
Cr	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	N.D	0.043	0.049	0.05	0.048
Cd	mg/l	N.D	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	1034	989	994	1009	973	994
Dissolved Solid	mg/l	312	986	984	1005	973	994

Table E.2.1.1(9) Results of Water Quality Analysis(1st of Survey of the Wells)

Station No.		W-1	W-2	W-3	W-4	W-5
Site		Las Islet	Astoria	Dulce N	San Ant	San Ramon
Date		23/2/96	23/2/96	23/2/96	23/2/96	27/2/96
TDS	mg/l					
ECw	ds/ml	911	525	563	7.58	305
T	C	29.5	29	29.8	26.5	26.8
Turbidity	NTU					
Hardness	mg equiv.	286.21	179.6	209.38	242.03	97.97
Sediments	g/l					
pH		6.5	6.7	6.65	6.3	6.5
Ca	mg/l	48.1	59.32	74.55	60.12	20.04
Mg	mg/l	47.18	8.76	21.16	16.54	11.19
Na	mg/l	74.8	36.8	42.3	60.5	28.5
CO3--	mg/l	0	0	0	0	0
HCO3	mg/l	200.11	137.88	281.84	225.13	143.98
Cl-	mg/l	103.3	49.7	19.88	79.52	9.94
SO4	mg/l	91.8	75.6	18	79.92	13.5
SAR						
B	mg/l	0.25	0.58	0.23	0.11	N.D
As	mg/l	0.11	0.03	0.04	0.02	0.003
NO3-N	mg/l	18.88	0.1	0.4	15.45	1.15
PO4-P	mg/l	0.9	2.21	4.23	0.76	1.12
K	mg/l	9.4	6.3	2.1	9.4	5.9
DO	mg/l					
Mn	mg/l					
NO2-N	mg/l	0.05	0.39	0.54	0.14	0.02
COD	mg/l					
BOD	mg/l	2.67	4.34	4.17	4.34	1.08
SS	mg/l	60	86	72	42	6
TN	mg/l	11.29	16.43	2.86	5.43	N.D
TP	mg/l					
Total Coliform	mg/l	930	4600	430	2400	<3
Cr	mg/l	N.D	0.05	N.D	N.D	N.D
Hg	mg/l	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	N.D	N.D	N.D	N.D
Cd	mg/l	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	778	484	534	620	314
Dissolved Solid	mg/l	718	398	462	578	308

Table E.2.1.1(10) Results of Water Quality Analysis(2nd 1st of Survey of the Wells)

Station No.		W-1	W-2	w-3	w-4	W-5	w-6	w-7	w-8	w-9	w-10	w-11	w-12	W-13
Site		Snta Emilid	Astoria	Dulce Nombre	San Antonio Masahuat	San Ramon	H.Lazorra	Sepaquicapa	El Carmen	C.El Carmen	Belen	El Carmen	San Juan	Verapaz
Date		3/10/96	3/10/96			4/10/96	3/10/96	3/10/96	3/10/96	3/10/96	3/10/96	4/10/96	4/10/96	4/10/96
TDS	mg/l													
ECw	ds/m1	465	643			254	209	272	268	378	471	169	253	303
T	C													
Turbidity	NTU													
Hardness	mg equiv.	114.46	215.34			89.24	62.08	97	0	110.58	0	42.68	69.84	27.16
Sediments	g/l													
pH		6.3	6.4			6.55	6.7	6.6	6.7	6.3	6.4	6.2	6.4	6.4
Ca	mg/l	20.84	49.7			16.83	19.24	27.25	19.24	28.06	43.29	9.62	21.64	26.45
Mg	mg/l	16.54	23.35			12.65	6.32	7.78	9.73	11.19	13.62	5.84	6.32	13.13
Na	mg/l	52.9	51.6			25.7	13	21.2	30.6	34.5	41.8	14.1	28.6	21
CO3--	mg/l	0	0			0	0	0	0	0	0	0	0	0
HCO3	mg/l	162.9	137.88			137.88	112.87	112.87	137.88	137.88	125.07	75.04	112.26	125.07
Cl-	mg/l	37.63	75.62			13.85	7.81	6.04	6.04	23.78	6.04	12.07	7.81	7.81
SO4	mg/l	30.78	68.58			1.8	N.D	7.92	N.D	N.D	157.5	1.26	9.72	29.88
SAR														
B	mg/l	0.36	0.21			0.28	0.01	0.02	N.D	0.25	N.D	0.8	0.3	0.24
As	mg/l	110.11	101.74			N.D	47.91	78.24	95.16	106.81	82.42	N.D	4.18	N.D
NO3-N	mg/l	2	1.7			1.1	1.38	1.28	0.63	4.25	0.6	2.5	1.08	7.98
PO4-P	mg/l	13.95	25.69			0.55	13.8	13.24	8.89	36.9	14.180	0.46	0.69	0.74
K	mg/l	26.5	7.4			4.7	6.8	4.7	5.9	11.5	1.9	5.2	3.6	4.7
DO	mg/l													
Mn	mg/l													
NO2-N	mg/l	0.19	N.D			N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
COD	mg/l													
BOD	mg/l													
SS	mg/l	8	37			3	33	27	8	39	4	24	23	26
TN	mg/l	2.86	7.14			3.14	3.14	4.29	2	6.29	4.29	7.43	8	11.43
TP	mg/l													
Total Coliform	MPN/100L	1100	1100			<3	>1100	>1100	<3	1100	1100	43	>1100	>1100
Cr	mg/l	N.D	N.D			N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Hg	mg/l	N.D	N.D			N.D	N.D	N.D	N.d	N.D	N.D	N.D	N.D	N.D
Pb	mg/l	N.D	0.99			N.D	N.D	N.D	2.96	N.D	N.D	N.D	N.D	N.D
Cd	mg/l	N.D	N.D			N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
Total Solids	mg/l	453	555			262	221	304	292	364	454	215	279	313
Dissolved Solid	mg/l	445	518			259	188	277	284	325	450	191	256	287

E.2.2 Review of the existing water quality data

E.2.2.1 Data of MAG

Water quality is evaluated based on the WHO's water quality standard for drinking water (Table-E.2.2.1) and the FAO's water quality standard for the irrigation water (Table-E.2.2.2-4). MAG regularly conducts water quality investigation in the Jiboa river (Monte Cristo station) and the Ilopango lake (Apulo and Desague station)(Table-2.2.5-6).

Boron in the Jiboa river water sometimes reaches 0.7mg/l or more, and exceeds the limit for irrigation water as long as this investigation result is taken as true.

The boron density of the Ilopango lake water exceeds the irrigation water quality standard and is not suitable for irrigation.

E2.2.2 Data of ANDA

It is reported that arsenic, boron, and chlorine in the water of the Ilopango lake are very high according to the water quality investigation reports of the Ilopango lake "Investigacion para Potabilizar las Aguas del Lago de Ilopango, ANDA/OPS/OMS,1994,and Datos Preliminares del Lago de Ilopango para el Proyecto Regional de Eutroficacion de Lagos Calidos,MPCDES,1985"(Table-E.2.2.7-8 Figure E2.2.1)

.The water of the Ilopango lake has a range of arsenic density of 0.575-0.807mg/l and boron density of 0.42 mg/l ,as far as this investigation result is concerned. These values largely exceed the WHO's water quality standard for drinking water, and the FAO's water quality standard for irrigation.

E.2.2.3 Data of Fundacion Amigos del Lago de Ilopango.

Fundacion Amigos del Lago de Ilopango is a NGO which acts to maintain the environment of the Ilopango lake. The water quality of the lake has been investigated every three weeks from September of 1995,but mysteriously despite 6 samplings(4 stations in the lake) arsenic has notbeen found(see Table.E.2.2.9 and Investigation Results of Aquatic organism).

Table E.2.2.1 WHO's Water Quality Standard Items for Drinking Water

Element	WHO Acceptable Level in mg/L
Al	0.2
Sb	0.005
As	0.010
Ba	0.70
B	0.30
Cd	0.003
Cr	0.050
Cu	1.0
Fe	0.30
Pb	0.010
Mn	0.10
Hg	0.001
Mo	0.070
Ni	0.020
Sc	0.010
Na	200.0
Zn	3.0
NH3	1.5
Cl-	250.0
CN-	0.070
F	1.5
H2S	0.050
NO3	50.0
NO2	3.0
SO4-2	250.0
Total Dissolved Solidos	1,000.0
Total Coliform	N.D/100ml

Table E.2.2.2 Guidelines for Interpretation of Water Quality for Irrigation

Potential irrigation problem	Units	Degree of restriction on use		
		None	Slight to moderate	Severe
Salinity				
EC_w[1]	dS/m	< 0.7	0.7 - 3.0	> 3.0
or				
TDS	mg/l	< 450	450 - 2000	> 2000
Infiltration				
SAR[2] = 0 - 3 and EC_w		> 0.7	0.7 - 0.2	< 0.2
3 - 6		> 1.2	1.2 - 0.3	< 0.3
6 - 12		> 1.9	1.9 - 0.5	< 0.5
12 - 20		> 2.9	2.9 - 1.3	< 1.3
20 - 40		> 5.0	5.0 - 2.9	< 2.9
Specific ion toxicity				
Sodium (Na)				
Surface irrigation	SAR	< 3	3 - 9	> 9
Sprinkler irrigation	me/l	< 3	> 3	
Chloride (Cl)				
Surface irrigation	me/l	< 4	4 - 10	> 10
Sprinkler irrigation	m^3/l	< 3	> 3	
Boron (B)	mg/l	< 0.7	0.7 - 3.0	> 3.0
Trace Elements (see Table 10)				
Miscellaneous effects				
Nitrogen (NO_3-N)[3]	mg/l	< 5	5 - 30	> 30
Bicarbonate (HCO_3)	me/l	< 1.5	1.5 - 8.5	> 8.5
pH			Normal range 6.5 - 8.4	

1 EC_w means electrical conductivity in deciSiemens per metre at 25°C
2 SAR means sodium adsorption ratio
3 NO_3-N means nitrate nitrogen reported in terms of elemental nitrogen

Source: FAO (1985)

Table E.2.2.3 Threshold Levels of Trace Elements for Crop Production

Element		Recommended maximum concentration (mg/l)	Remarks
Al	(aluminium)	5.0	Can cause non-productivity in acid soils (pH < 5.5), but more alkaline soils at pH > 7.0 will precipitate the ion and eliminate any toxicity.
As	(arsenic)	0.10	Toxicity to plants varies widely, ranging from 12 mg/l for Sudan grass to less than 0.05 mg/l for rice.
Be	(beryllium)	0.10	Toxicity to plants varies widely, ranging from 5 mg/l for kale to 0.5 mg/l for bush beans.
Cd	(cadmium)	0.01	Toxic to beans, beets and turnips at concentrations as low as 0.1 mg/l in nutrient solutions. Conservative limits recommended due to its potential for accumulation in plants and soils to concentrations that may be harmful to humans.
Co	(cobalt)	0.05	Toxic to tomato plants at 0.1 mg/l in nutrient solution. Tends to be inactivated by neutral and alkaline soils.
Cr	(chromium)	0.10	Not generally recognized as an essential growth element. Conservative limits recommended due to lack of knowledge on its toxicity to plants.
Cu	(copper)	0.20	Toxic to a number of plants at 0.1 to 1.0 mg/l in nutrient solutions.
F	(fluoride)	1.0	Inactivated by neutral and alkaline soils.
Fe	(iron)	5.0	Not toxic to plants in aerated soils, but can contribute to soil acidification and loss of availability of essential phosphorus and molybdenum. Overhead sprinkling may result in unsightly deposits on plants, equipment and buildings.
Li	(lithium)	2.5	Tolerated by most crops up to 5 mg/l; mobile in soil. Toxic to citrus at low concentrations (<0.075 mg/l). Acts similarly to boron.
Mn	(manganese)	0.20	Toxic to a number of crops at a few-tenths to a few mg/l, but usually only in acid soils.
Mo	(molybdenum)	0.01	Not toxic to plants at normal concentrations in soil and water. Can be toxic to livestock if forage is grown in soils with high concentrations of available molybdenum.
Ni	(nickel)	0.20	Toxic to a number of plants at 0.5 mg/l to 1.0 mg/l; reduced toxicity at neutral or alkaline pH.
Pd	(lead)	5.0	Can inhibit plant cell growth at very high concentrations.
Se	(selenium)	0.02	Toxic to plants at concentrations as low as 0.025 mg/l and toxic to livestock if forage is grown in soils with relatively high levels of added selenium. As essential element to animals but in very low concentrations.
Sn Ti W	(tin) (titanium) (tungsten)	-	Effectively excluded by plants; specific tolerance unknown.
C	(vanadium)	0.10	Toxic to many plants at relatively low concentrations.
Zn	(zinc)	2.0	Toxic to many plants at widely varying concentrations; reduced toxicity at pH > 6.0 and in fine textured or organic soils.

1 The maximum concentration is based on a water application rate which is consistent with good irrigation practices (10 000 m^3 per hectare per year). If the water application rate greatly exceeds this, the maximum concentrations should be adjusted downward accordingly. No adjustment should be made for application rates less than 10 000 m^3 per hectare per year. The values given are for water used on a continuous basis at one site.

Source: Adapted from National Academy of Sciences (1972) and Pratt (1972).

Table E.2.2.4 . Parameters used in The Evaluation of Agricultural Water Quality

PARAMETERS USED IN THE EVALUATION OF AGRICULTURAL WATER QUALITY

Parameters	Symbol	Unit
Physical		
Total dissolved solids	TDS	mg/l
Electrical conductivity	EC_w	dS/m[1]
Temperature	T	°C
Colour/Turbidity		NTU/JTU[2]
Hardness		mg equiv. $CaCO_3$/l
Sediments		g/l
Chemical		
Acidity/Basicity	pH	
Type and concentration of anions and cations:		
Calcium	Ca^{++}	me/l[3]
Magnesium	Mg^{++}	me/l
Sodium	Na^{+}	me/l
Carbonate	CO_3^{--}	me/l
Bicarbonate	HCO_3^{-}	me/l
Chloride	Cl^{-}	me/l
Sulphate	SO_4^{--}	me/l
Sodium adsorption ratio	SAR	
Boron	B	mg/l[4]
Trace metals		mg/l
Heavy metals		mg/l
Nitrate-Nitrogen	NO_3-N	mg/l
Phosphate Phosphorus	PO_4-P	mg/l
Potassium	K	mg/l

[1] dS/m = deciSiemen/metre in SI Units (equivalent to 1 mmho/cm)
[2] NTU/JTU = Nephelometric Turbidity Units/Jackson Turbidity Units
[3] me/l = milliequivalent per litre
[4] mg/l = milligrams per litre = parts per million (ppm); also,
mg/l ~ 640 x EC in dS/m

Source: Kandiah (1990a)

Table E.2.2.5 Results of Jiboa River Water Quality Analysis(Analyzed by MAG)

Site		Rio Jiboa							
Station No.		Montecristo							
Date		1/95	2/95	3/95	5/95	6/95	8/95	9/95	11/95
TDS	mg/l								
ECw	ds/ml	260	425	326	302	251	186	415	916
T	C								
Turbidity	NTU								
Hardness	mg equiv.								
Sediments	g/l								
pH		8.4	8.5	8.1	8.05	8	7.35	7.4	8.1
Ca	mg/l	22.4	20.8	37.7	17.6	17.6	14.4	12.8	28.8
Mg	mg/l	10.7	10.7	1.46	14.6	11.2	5.83	5.84	14.1
Na	mg/l	47	37.7	37.3	33.4	31.5	19.1	45.3	12.8
CO3--	mg/l	7.5	36.9	12.3	0	24.6	0	0	30.9
HCO3	mg/l	118	100	125	162	100	112	100	331
Cl-	mg/l	39.8	19.9	16	13.9	13.8	9.9	55.8	172
SO4	mg/l	22	22	24	17	17	10	15	40
SAR									
B	mg/l	1.14	0.32	0.23	0.12	0	0.02	1.18	3.67
As	mg/l								
NO3-N	mg/l								
PO4-P	mg/l								
K	mg/l	6.6	5.8	5.9	7.1	10.7	7.8	10.2	15.7
DO	mg/l								
Mn	mg/l								
NO2-N	mg/l								
COD	mg/l								
BOD	mg/l								
SS	mg/l								
TN	mg/l								
TP	mg/l								
Total Coliform	mg/l								
Cr	mg/l								
Hg	mg/l								
Pb	mg/l								
Cd	mg/l								
Class		C2S1	C2S1	C2S1	C2S1	C2S1	C1S1	C2S1	C2S1

Table E.2.2.6 Results of Ilopango Lake Water Quality Analysis(Analyzed by MAG)

Site		Lago de Ilopango									
Station No.		Desague									
Date		6/6/83	17/7/8	21/4/8	16/8/8	29/8/8	19/10/	12/1/90	7/5/94	23/3/9	23/8/9	2/10/95
TDS	mg/l											
ECw	ds/m1	2.1	2.2	1.79	1.04	1.7		1.82	1.84	1.87	1.61	1.62
T	C								28			
Turbidity	NTU								2			
Hardness	mg equiv.											
Sediments	g/l											
pH		8.3	8.2	8.1	8.4	8.4	8.5	7.9		8.45	8.3	8.7
Ca	mg/l	2.12	2.88	2.32	2.23	2.27	2.34	2.27		42.5	48.1	44.9
Mg	mg/l	1.26	0.43	1.21	1.11	1.38	1.05	1.36		17	13.1	11.7
Na	mg/l	14.78	11.9		2.87			14.17		325	309	280
CO3--	mg/l	2.48	0.8	0	0	0	0	0		61.5	36.9	43.2
HCO3	mg/l	2.92	4.4	6.41	6.14	6.14	5.57	4.8		162	237.9	162
Cl-	mg/l	9.76	10.26	10	10.34	10.56	10.12	13.01		430	343	365
SO4	mg/l	1.93	1.01		0.13			1.14		60	58	54
SAR												
B	mg/l	6.05	6.22							6.6	6.56	6.75
As	mg/l											
NO3-N	mg/l				0.08	0.44	0.21	0.72				
PO4-P	mg/l											
K	mg/l									34	32	34
DO	mg/l											
Mn	mg/l											
NO2-N	mg/l											
COD	mg/l											
BOD	mg/l						0.7					
SS	mg/l								34			
TN	mg/l											
TP	mg/l											
Total Colifor	mg/l											
Cr	mg/l											
Hg	mg/l											
Pb	mg/l											
Cd	mg/l											

Table E.2.2.7 Results of Ilopango Lake Water Quality Analysis(Analyzed by ANDA)

Site		Lago de Ilopango								
Station No.		Rincon Shuguallo								
Date		12/3/94	15/4/94	23/4/94	21/5/94	28/5/94	4/6/94	18/6/94	25/6/94	
TDS	mg/l									
ECw	ds/ml	1.92	1.95	1.94	2.04	2	2.03	2.02	2.04	
T	C		29.6	28.3	31	30	29	29	30	
Turbidity	NTU	2	2	2	3	1	1	3	3	
Hardness	mg equiv.	170	162	168	162	172	164	172	168	
Sediments	g/l									
pH		8.06	8.1	8.06	8.07	8.02	7.94	8.67	8.9	
Ca	mg/l	44.8	47.2	52		48	45.6	44.8	45.6	
Mg	mg/l	14	10.7	9.23	10.7	13.1	14.1	14.6	13.1	
Na	mg/l									
CO3--	mg/l									
HCO3	mg/l									
Cl-	mg/l	391	377	392	396	330	386	389	389	
SO4	mg/l	46								
SAR										
B	mg/l	0.42								
As	mg/l	0.662	0.745	0.807	0.575	-	0.575	0.575	0.592	0.647286
NO3-N	mg/l									
PO4-P	mg/l									
K	mg/l									
DO	mg/l				4.15	3.16	-	8.65	8.79	
Mn	mg/l									
NO2-N	mg/l									
COD	mg/l									
BOD	mg/l				0.55	0.76	-	1.76	2.38	
SS	mg/l									
TN	mg/l									
TP	mg/l									
Total Coliform	mg/l	50	2	2	-	0	22	2	0	
Cr	mg/l									
Hg	mg/l									
Pb	mg/l									
Cd	mg/l									

Table E.2.2.8 Results of Ilopango Lake Water Quality(As) Analysis(1980)

unit:mg/l

Fecha de Muestreo		17 Abril/80		27 Junio/80		18 Sept./80
No. de estacion	Profundidad mts	Lab. CEL	Lab. ANDA	Lab. CENTA	Lab. ANDA	Lab. CENTA
11	0	0.51	0.8	1.09	0.57	0.47
	2	–	0.6	0.90	0.65	0.40
12	0	0.60	1.0	1.24	0.66	0.39
	2	0.49	1.0	1.35*	0.59	0.53
	20	0.60	1.2	1.29	0.44	0.39
13	0	0.63	1.0	1.23	0.58	0.61
	2	0.51	1.0	0.98	0.63	0.55
	20	0.59	1.0	0.97	0.48	0.61
14	0	0.54	0.6	1.14	0.55	0.53
	2	0.55	1.0	0.76	0.62	0.53
21	0	0.51	0.3	1.19	0.58	0.41
	2	0.62	1.0	1.16	0.60	0.65
22	0	0.55	0.4	1.04	0.63	0.65
	2	0.58	0.3	0.97	0.29	0.59
	20	0.54	0.5	0.83	0.55	0.61
23	0	0.55	1.1	1.05	0.68	0.55
	2	0.55	1.2	1.18	0.57	0.63
	20	0.47	1.1	1.24	0.62	0.57
24	0	0.51	0.9	1.23	0.54	0.41
	2	0.64*	0.9	1.26	0.60	0.57
31	0	0.54	1.6	1.21	0.69*	0.65
	2	0.52	1.0	1.12	0.62	0.47
32	0	0.51	0.6	1.06	0.58	0.64
	2	0.45	0.4	1.23	0.55	0.59
	20	0.52	0.2	0.97	0.63	0.75*
33	0	0.56	1.4	1.33	0.52	0.69
	2	0.48	1.9*	0.92	0.45	0.63
	20	0.55	0.8	1.32	0.44	0.61
34	0	0.51	1.1	1.17	0.56	0.69
	2	0.53	0.8	1.07	0.56	0.59
	Máximo	0.64	1.9	1.35	0.69	0.75
	Mínimo	0.45	0.2	0.76	0.29	0.39

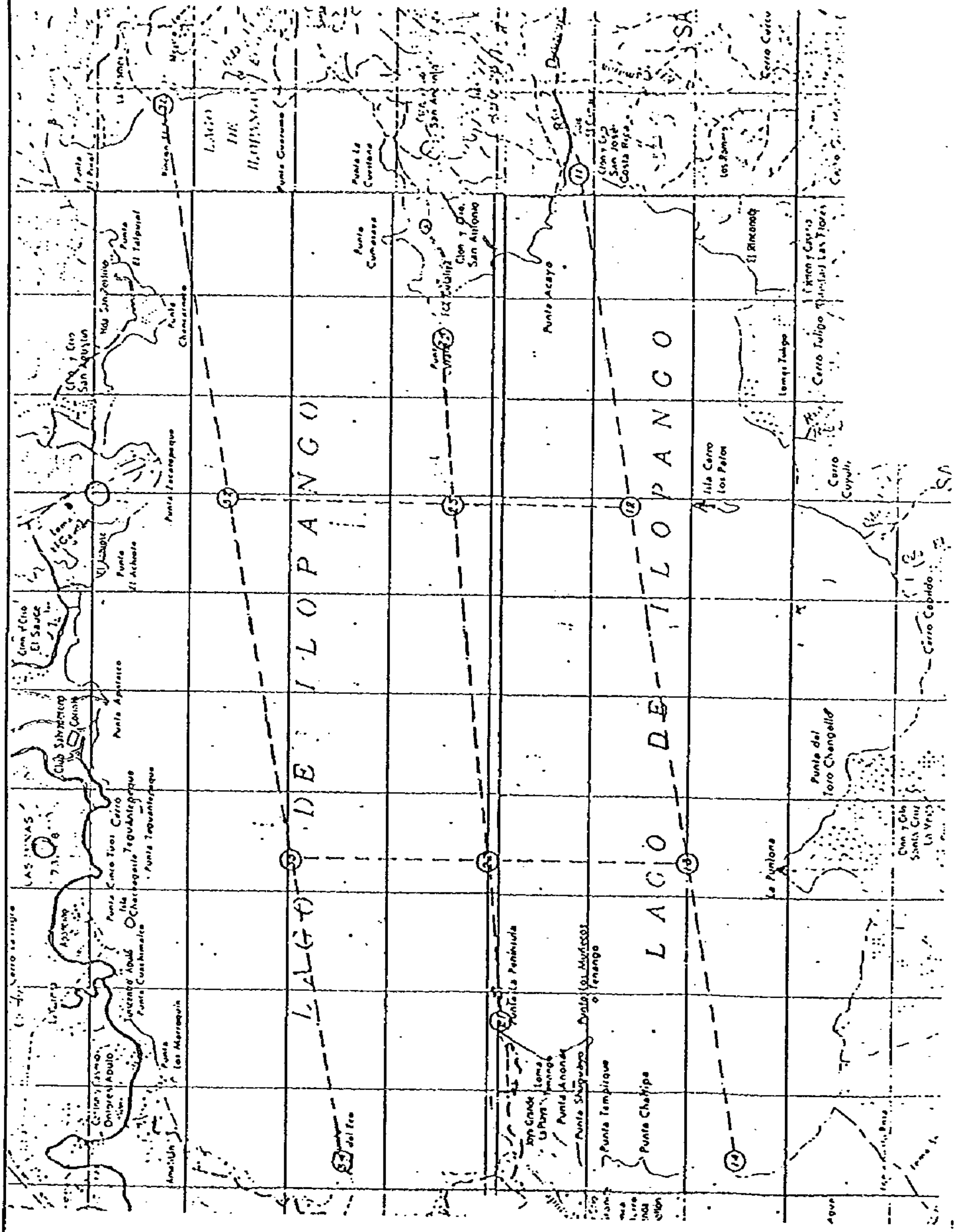

Figure E.2.2.1 Location of Water Quality(As) Sampling Station(ANDA,1980)

Table E.2.2.9 Results of Ilopango Lake Water Quality Analysis(1995)
(surveyed by Fundacion Amigos del Lago de Ilopango)

Station No.		L-1	L-5	L-7
Site		Chaguite	Desague	Corinto
Date		10/2/95	10/3/95	10/3/95
TDS	mg/l			
ECw	ds/ml	1650	1700	1800
T	C	29	28	28
Turbidity	NTU			
Hardness	mg equiv.			
Sediments	g/l			
pH		8.1	7.9	8.9
Ca	mg/l			
Mg	mg/l			
Na	mg/l			
CO3--	mg/l			
HCO3	mg/l			
Cl-	mg/l			
SO4	mg/l	68.4	67.5	67.5
SAR				
B	mg/l	9.13	8.25	8.8
As	mg/l	N.D	N.D	N.D
NO3-N	mg/l	N.D	N.D	N.D
PO4-P	mg/l	1.92	1.88	1.88
K	mg/l			
DO	mg/l	7.93	6.6	8.6
Mn	mg/l			
NO2-N	mg/l	N.D	N.D	0.06
COD	mg/l			
BOD	mg/l			
SS	mg/l			
TN	mg/l			
TP	mg/l			
Total Coliform	mg/l			
Cr	mg/l			
Hg	mg/l			
Pb	mg/l			
Cd	mg/l			
Total Solids	mg/l	987	1036	1008
Dissolved Solid	mg/l	968	1028	1000
Transparency	meter	1.8	4.2	6.2

Station No.		L-1	L-5	L-7
Site		Chaguite	Desague	Corinto
Date		12/11/95	12/11/95	12/11/95
TDS	mg/l			
ECw	ds/ml			
T	C	28	28	28
Turbidity	NTU			
Hardness	mg equiv.			
Sediments	g/l			
pH		7.7	8.3	7.7
Ca	mg/l			
Mg	mg/l			
Na	mg/l			
CO3--	mg/l			
HCO3	mg/l			
Cl-	mg/l			
SO4	mg/l	43.2	6.12	6.03
SAR				
B	mg/l	8.03	8.87	8.36
As	mg/l	N.D	N.D	N.D
NO3-N	mg/l			
PO4-P	mg/l	1.93	1.91	1.93
K	mg/l			
DO	mg/l	8.25	8.9	7.5
Mn	mg/l			
NO2-N	mg/l			
COD	mg/l			
BOD	mg/l			
SS	mg/l			
TN	mg/l			
TP	mg/l			
Total Coliform	mg/l			
Cr	mg/l			
Hg	mg/l			
Pb	mg/l			
Cd	mg/l			
Total Solids	mg/l	N.A	N.A	N.A
Dissolved Solid	mg/l	N.A	N.A	N.A
Transparency	meter			

(3) Investigation Results of Aquatic organism

Investigation of Aquatic organism in the Jiboa River was carried out by Fundacion Amigos del Lago de Ilopango at the same time as river water quality investigation. The investigation results were as follows.

FUNDACION AMIGOS DEL LAGO DE ILOPANGO

INFORME DE RESULTADOS FISICO-QUIMICOS Y BIOLOGICOS OBTENIDOS EN LA CUENCA DEL RIO JIBOA , SUS RIOS TRIBUTARIOS SEPAQUIAPA,TILAPA Y DESAGUE DEL LAGO DE ILOPANGO Y CINCO ESTACIONES DE MUESTREO EN EL LAGO DE ILOPANGO . EL SALVADOR. FEBRERO DE 1996.

RESPONSABLES: *Lic. Mario Sagastizado y Lic. Jeannette de Hernández*
(Biologos de Fundación Amigos del Lago de Ilopango.).

COOPERACION CON EL PLAN MAESTRO :
"DESARROLLO AGRICOLA INTEGRADO DE LA CUENCA DEL RIO JIBOA EN LA REPUBLICA DEL SALVADOR".
AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON (JICA),
MINISTERIO DE AGRICULTURA Y GANADERIA (MAG),
REPUBLICA DE EL SALVADOR.

San Salvador, 8 de Marzo de 1996.

ANTECEDENTES

A solicitud de los especialistas en hidrología de la Misión Japonesa (JICA), los biólogos salvadoreños : Lic. Jeannette de Hernández y Lic. Mario Sagastizado, acompañaron, a la Misión en los monitoreos y registro de parámetros Físico-Químicos y Biológicos.

OBJETIVOS

-Reconocer las características ambientales de los sitios de muestreo selecionados por el JICA.
-Colectar muestras para análisis microbiologicos , biológicos y Físico-Químicos.
-Medir los volúmenes del caudal de los puntos selecionados

ACTIVIDADES

En cada sitio selecionado , se describieron las características ecológicas : como tipo de sustrato , vegetación , uso del suelo y del agua, presencia de asentamientos humanos, industrias , etc.Además, se registraron los parámetros fisicos-químicos : temperatura del ambiente y del agua, aspecto y olor del agua, turbidez, pH, Oxígeno Disuelto, Potencial Redox, Porcentaje de Saturación de Oxígeno, Salinidad (Parámetro tomados con el Multipruebas Hidrolab, financiado con fondos del FIAES).

Los miembros de la Misión colectaron muestras para análisis químicos siguientes : Boro, Arsénico, Sólidos Totales, Disueltos, y Suspendidos, Cloro, Sodio, Calcio, Magnesio, Sulfatos, Cromo, Mercurio, Plomo, Cadmio, Nitrógeno total, Fosfato Total, Fosfatos, Carbonatos, y también, muestras para determinación de Coliformes Totales.
Además registraron los volumenes de caudales en cada lugar..

Los sitios considerados fueron los siguientes:
E1 : ESTACION RIO DESAGUE DEL LAGO DE ILOPANGO.
E2: ESTACION RIO JIBOA (Ctn. Santa Anita y Sn Juan Buena Vista, Cuscatlan).
E3 : ESTACION RIO JIBOA (Ctn. y Crio. Miraflores, Paraiso de Osorio, La Paz).
E4: ESTACION JIBOA (Montecristo).
E5: ESTACION RIO TILAPA (Cerca de Santa Cruz el Tunal).
E6: ESTACION RIO SEPAQUIAPA (Hda. San Mauricio, El Rosario).
E7: ESTACION RIO JIBOA (Hda. Monteverde).
E8 : ESTACION RIO JIBOA (Puente Carretera a la Herradura)
E9 : ESTACION UNION RIOS SEPAQUIAPAY JIBOA
E10 : ESTACION RIO JIBOA (Hda. San Jose La Luna).

CARACTERISTICAS AMBIENTALES

ESTACION RIO DESAGUE .LAGO DE ILOPANGO (E1)

Este rio es el efluente del lago de Ilopango(ubicado aproximadamente a 5 km. abajo del desague).Se encuentra en una cuenca bastante forestada, posee piedras de tamaño mediano, con restos vegetales suspendidos.

El caudal del rio es moderado, de movimiento lento y con una delgada lámina de agua.

ESTACION RIO JIBOA (Ctn. Santa Anita y San Juan buenavista). (E2).

El Rio Jiboa presenta en este sitio un abundante caudal , con corrientes fuertes.El lecho del rio está constituido por rocas de gran tamaño y con abundantes vegetación arbórea cubriendo las márgenes.

Algunos agricultores poseen regadíos para el cultivo de hortalizas(guisquileras, loroco, tomate,etc).Existen actividades domésticas de lavado de ropa, limpieza y extracción de agua para consumo humano .

Se visitó el caserio Cacahuatales del Municipio de San Ramón, en el lugar ANDA desarrolla un proyecto de extracción y tratamiento de agua de pozos, para ser enviada a los municipios de Cojutepeque, Candelaria, y El Carmen, para consumo humano.

El sitio del Caserío Cacahuatales, está rodeado de cultivos de guisquiles, y arboles maderables abundantes.

ESTACION RIO JIBOA (E3)

Dicho sitio se encuentra entre los municipios de Paraíso de Osorio y Santa María Ostuma, Cantón y Caserío Zacatales ,La Paz.

La cuenca del rio Jiboa ,en este punto , es sumamente accidentado, bastante cubierta de árboles, no existen caseríos cercanos , pero si campos de cultivo de sorgo , piña y frijolares en las areas cercanas al río.

El lecho del caudal esta compuesto por arena y piedras de diferente tamaño y existen pequeñas caidas de agua que causan turbulencias en el caudal.

El sitio descrito presenta poco impacto antropogénico.

Durante las fechas 17 Y 18 de febrero, se incluyo el sitio : Rio Jiboa, Cantón y Caserío Concepción, municipio de Mercedes La Ceiba (acá se encuentra una antigua represa y planta generadora de electricidad, actualmente en desuso), en estas fechas no se realizó el muestreo en el sitio de Paraíso de Osorio por la dificultad del acceso.

Las características medioambientales del nuevo punto de muestreo son:

El rio Jiboa a la altura del municipio de Mercedes la Ceiba está rodeado por una cuenca muy accidentada (aprox. a 600 msnm), existen actualmente actividades agricolas de recolección de caña de azucar, se observan numeroso campos de cultivo en fase de preparación para la proxima temporada de siembra , los alrededores son áreas muy forestadas con especies arbustivas propias de la zona y de gran valor para la población , como también cultivo frutales permanentes(cítricos).

En las zonas de poca pendiente y aledañas al rio se desarrolla cultivos anuales de frijol y guisquiles, utilizando agua proveniente del reservorio señalado anteriormente (agua de origen

subterraneo) , los cultivadores entrevistados prefieren usar dicha agua en lugar de la proveniente del río, pues afirmaron que esta última es muy " salina " para sus cultivos.
Es de señalar que el acceso es bastante accidentado, aunque existe una adecuada red de caminos vecinales recien construida que comunica a los diferentes caserios de la zona.
Algunas de las especies vegetales identificadas en la zona fueron :
Cítricos "Volador", "capulín macho","laurel maderable", "caulote", "ficus", "Conacaste", "zapote","carreto", "chilamate","ceiba", "aceituno", "irayol", existen otro número de especies forestales no identificadas.

ESTACION RIO JIBOA (Montecristo). (E4).

Esta área es bastante forestada , con vegetación de Selva Baja Caducifolia (árboles sin hojas), el sustrato está constituido por afloramientos rocosos(roca fundida), el rio posee abundantes rocas de gran tamaño en su cauce, tiene un caudal fuerte y con áreas de golpeteo, las actividades domésticas de lavado de ropa y baño son considerable , y se encontraron desperdicios téxtiles en las orillas del río.

ESTACION RIO TILAPA (E5) (cerca de Santa Cruz el Tunal, La Paz).

Este río es otro tributario del Jiboa, en sus alrededores se encuentran poblaciones rurales que hacen uso del agua para actividades domésticas y abrevadero de ganado.

El sustrato del rio es arenoso , su corriente es lenta.

ESTACION RIO SEPAQUIAPA (E6)

Esta área está rodeada de poblaciones rurales, Fábricas de Maquilas, actividades de extracción y procesamiento de arena y piedras; así como actividades agrícolas, pastoreo y abrevadero de ganado , siembra de cultivos anuales como sorgo, y ajonjolí, el agua se utiliza para actividades domesticas (lavado de ropa ,baño), y pesca.

Con respecto a la vegetación sólo se observa crecimiento de gramíneas en los bordes arenosos de la cuenca , es escasa la vegetación arbórea , también se observan plantas acuáticas como *Lemna* sp. *Hidrilla verticillata* .

El lecho de rio está constituido principalmente por piedras de menor tamaño , arena y piedra pómez ;con relación a la biota , se observaron peces de la familia Poecili dae .

ESTACION RIO JIBOA (Hda. Monteverde) (E7).

Ubicada en el área de San Pedro Masahuat, cuenca rodeada de paredones y con sustrato arenosos, rocas de diferentes tamaños y con un caudal moderado.Existe crianza de ganado en los alrededores.

RIO JIBOA (E8).

Este sitio se caracteriza por ser una cuenca arenosa y deforestada , esta ubicada en la zona costera del departamento de la Paz, con industrias de extracción de arena y piedra , el agua es utilizada en actividades domésticas de lavado de ropa, baño, recreación,etc.

En los alrededores existen campos de cultivo que en estos momentos se hallan abandonados.Igualmente el sustrato está constituido por piedras de gran tamaño y arena.

ESTACION UNION DE LOS RIOS SEPAQUIAPA Y JIBOA.(E9).

Este sitio es arenoso , con una mayor corriente, escaso de piedras, y notable arrastre de arena, igualmente despoblada de estrato arbóreo.En este sitio se realiza la pesca de camarón de río.*(Macrobrachium sp.)*.

. ESTACION RIO JIBOA (Hda San Jose La Luna). (E10).

En esta área , la Cuenca del rio Jiboa se extiende considerablemente, no existe un caudal principal , el sustrato es arenoso y la lámina de agua es delgada, se presenta bordes deforestados, con áreas de cultivos como sorgo, maíz, arroz, etc. y pastoreo de ganado.

El agua se utiliza para actividades domésticas,y la extracción de arena alta.Tambien se realiza la captura de camaron de río.

RESULTADOS PRELIMINARES

Los resultados que se han obtenido en cada una de las estaciones se presentan agrupados en los cuadros del 1 al 10.

CUADRO Nº 1 . DATOS FISICO QUIMICOS DE 10 SITIOS DE MUESTREO DE LA CUENCA DEL RIO JIBOA Y SUS RIOS TRIBUTARIOS. 12-13 DE FEBRERO/96 (JICA-FUNDACION ILOPANGO).

SITIO	T AMB.	T AGUA	pH	OD	COND.	REDOX	% SAT.	TURB.	S o/oo
E1	29	26.34	8.42	8.54	1.11	341	1055	0	0.5
E2	28.5	21.54	8.57	9.36	0.233	332	104.3	0	0.1
E3	32	26.89	8.77	8.37	0.452	319	102.5	0	0.2
E4	33	28.27	8.8	9.01	0.436	282	114.1	0	0.2
E5	36	33.41	8.53	8.23	0.396	288	114.6	0	0.1
E6	32	27.54	8.12	8.33	0.324	320	102.9	0	0.1
E7	33	29.9	8.28	7.81	0.9	315	100.9	0	0.1
E8	33	27.7	8.6	9.58	0.519	315	120	0	0.2
E9	33.5	29.83	8.23	8.54	0.514	338	111.3	0	0.2
E10	34	32.04	8.58	7.72	0.524	305	104.7	0	0.2

SIMBOLOGIA :
E1 : ESTACION DESAGUE (Lago de Ilopango)
E2 : ESTACION RIO JIBOA (Ctn. Santa Anita y Sn . Juan buenavista, Cuscatlán).
E3 : ESTACION JIBOA (Ctn. y Crio. Miraflores, Paraiso de Osorio, La Paz).
E4 . ESTACION RIO JIBOA (Montecristo).
E5 : ESTACION RIO TILAPA.
E6: ESTACION RIO SEPAQUIAPA (Hda. San Mauricio, El Rosario).
E7 : ESTACION RIO JIBOA (Hda. Monteverde).
E8 : ESTACION RIO JIBOA (El Rosario, Hda. San Mauricio).
E9: ESTACION UNION DE LOS RIOS SEPAQUIAPA Y JIBOA (Ctn. El Pedregal, EL Rosario).
E10 : ESTACION RIO JIBOA (Hda. San José La Luna).

CUADRO Nº2. DATOS FISICO QUIMICOS DE 10 SITIOS DE MUESTREO DE LA CUENCA DEL RIO JIBOA Y SUS RIOS TRIBUTARIOS. 26-27 DE FEBRERO/96 (JICA-FUNDACION ILOPANGO).

SITIO	T AMB.	T AGUA	pH	OD
E1	32.2	32	7.7	
E2	32	26.8	7.1	
E3	30.8	24.8	7.1	
E4	33.5	28.2	7.1	
E5	37	34	6.8	
E6	32	27	6.8	
E7	31.8	32	7.1	
E8	33	27.8	6.8	
E9	33	33.2	7.4	
E10	33	33.2	7.4	

SIMBOLOGIA :
E1 : ESTACION DESAGUE (Lago de Ilopango)
E2 : ESTACION RIO JIBOA (Ctn. Santa Anita y Sn . Juan buenavista, Cuscatlán).
E3 : ESTACION JIBOA (Ctn. y Crio. Miraflores, Paraiso de Osorio, La Paz).
E4 . ESTACION RIO JIBOA (Montecristo).
E5 : ESTACION RIO TILAPA.
E6: ESTACION RIO SEPAQUIAPA (Hda. San Mauricio, El Rosario).
E7 : ESTACION RIO JIBOA (Hda. Monteverde).
E8 : ESTACION RIO JIBOA (El Rosario, Hda. San Mauricio).
E9: ESTACION UNION DE LOS RIOS SEPAQUIAPA Y JIBOA (Ctn. El Pedregal, El. Rosario).
E10 : ESTACION RIO JIBOA (Ctn. Crio. Concepción, Mercedes La Ceiba, cerca de Presa Hidroeléctrica).

CUADRO N°3. DATOS FISICO QUIMICOS DE 5 POZOS MUESTREADOS EN LA CUENCA DEL RIO JIBOA.. 23 Y27 DE FEBRERO/96 . (JICA-FUNDACION ILOPANGO).

POZOS	T AMB.	T AGUA	pH	PROF.
P1	36	29.5	7.1	4.4
P2	36	29	7.4	5.95
P3	29	29.8	7.7	6.31
P4	31.5	26.5	7.4	*
P5	31	28.5	7.4	*

SIMBOLOGIA :
P1 : POZO DEL CANTON Y CASERIO LAS ISLETAS (San José La Luma).
P2 : POZO DE LA HACIENDA ASTORIA
P3 : POZO CON BOMBA MANUAL DEL CANTON Y CASERIO EL CARMEN
P4 : POZA O NACIMIENTO DE CHANCUSME,SAN ANTONIO MASAHUAT.
P5: POZO DE ANDA EN EL CANTON CACAHUATAL.

CUADRO N°3. DATOS FISICO QUIMICOS DE 5 POZOS MUESTREADOS EN LA CUENCA DEL RIO JIBOA.. 23 Y27 DE FEBRERO/96 . (JICA-FUNDACION ILOPANGO).

POZOS	T AMB.	T AGUA	pH	PROF.
P1	36	29.5	7.1	4.4
P2	36	29	7.4	5.95
P3	29	29.8	7.7	6.31
P4	31.5	26.5	7.4	*
P5	31	28.5	7.4	*

SIMBOLOGIA :
P1 : POZO DEL CANTON Y CASERIO LAS ISLETAS (San José La Luma).
P2 : POZO DE LA HACIENDA ASTORIA
P3 : POZO CON BOMBA MANUAL DEL CANTON Y CASERIO EL CARMEN
P4 : POZA O NACIMIENTO DE CHANCUSME,SAN ANTONIO MASAHUAT.
P5: POZO DE ANDA EN EL CANTON CACAHUATAL.

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CUADRO No 4. DATOS FISICO QUIMICOS DE 6 ESTACIONES DE MUESTREOS EN EL LAGO DE ILOPANGO. 14 DE FEBRERO/96.

ESTACION	T AMB	T AGUA	PH	OD	TURB	REDOX	CONDC	%SAT	So/oo
E1	30	26.34	8.15	4.43	0	364	2.08	.51.4	1.1
E2	25	26.26	8.11	3.94	0.2	363	2.08	43.8	1.1
E3	30	26.51	8.17	4.39	0.2	364	2.08	53.2	1.1
E4	30	26.71	8.15	4	0	364	2.08	49.5	1.1
E5	29	26.67	8.16	4.18	0	364	2.08	53.4	1.1
E7	24	26.25	8.09	3.63	0	351	2.08	43.2	1.1

SIMBOLOGIA:
E1 :ESTACION CHAGUITE
E2:ESTACION APULO
E3: ESTACION CUTENAMA
E4: ESTACION CERROS QUEMADOS
E5: ESTACION DESAGUE
E7: ESTACION CORINTO

CUADRO No 5. DATOS FISICO QUIMICOS DE 5 ESTACIONES DE MUESTREOS EN EL LAGO DE ILOPANGO. 28 DE FEBRERO/96.

ESTACION	T AMB	T AGUA	PH	OD
E1	27.5	26.5	7.1	
E2	28	28	7.4	
E3	27.5	27.5	7.4	
E4	30	28.8	7.7	
E5	28.2	27.8	7.7	
E7	27	28	7.4	

SIMBOLOGIA:
E1 :ESTACION CHAGUITE (R%O CHAGUITE).
E2:ESTACION APULO
E3: ESTACION CUTENAMA
E4: ESTACION CERROS QUEMADOS
E5: ESTACION DESAGUE
E7: ESTACION CORINTO

Cuadro No.6 **Lista de especies y frecuencia de aparicion de las algas microscopicas en diferente puntos del Rio Jiboa y los rios Tributarios : Sepaquilapa, Tilapa y Desague (Ilopango) 12-27/Febrero/1996.**

DIVISION TAXONOMICA	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
CYANOPHYTA										
Anabaena constricta		E			E	A				E
Calothrix sp.								E		
Chroococcus limneticus		M	E		P.P	M				
Coelosphaerium sp.						A				
Lyngbya sp.					P.P			E		
Merismopedia glauca		E	E			P.P				E
Nostochopsis sp.		A								
Oscillatoria sp.		E	E	E	E	E		E	E	
CHRYSOPHYTA										
Achnantes heterovalvata	E	E	E	E	E	E				
Amphipleura pellucida		E	P.P	E						
Amphiprora alata	P.P									
Amphora clevell	M	E				E				
A. ovalis	E	P.P	M	E	P.P	E		E		
Anomoeoneis sp.		E								
Caloneis sp				E		E		E	E	
Cocconeis placentula		P.P		P.P						
Cyclotella			P.P					E		
Cymatopleura solea			P.P	P.P						
Cymbella sp.			P.P	M	P.P					
Denticula elegans		P.P	E		E					
Eucocconeis flexella		P.P	E							
Fragilaria alpestris	D			M						
F. brevistriata	E	M	P.P							
F. capucina	P.P	D	P.P	M	M			E	P.P	
F. rupestris	E									
Gomphonema olivaceum	E	P.P	M	E						
G. parvulum	E	M	P.P		P.P		E	E	P.P	
Gomphoneis herculeanum	M	P	M			E	E			
Gyrosigma sp.			E	M	P.P	E	E	M		E
Hantzschia amphioxys			E	E		E				
Nav%cula gracilis	E									
Navicula sp.	P.P	E	M			M		E	P.P	
Nitzschia closterium	M		P.P	E						
N. ignorata	D		M	P.P				P		E
N. vexillifera										
Mastoglia sp.	P				E					
Pinnularia borealis			E							
Pinnularia sp.		P		E	E	E				
Stephanodiscus sp.	E									

Continua . . .

Cuadro No. 7. Lista de Microfauna reportados para las aguas del RIO JIBOA y sus Rios Tributarios.

GRUPO TAXONOMICO
PHYLUM CILIOPHORA
Colpidium colpoda
Onychodromus grandis
Spirostomus sp.
Stylonichia sp.
Urosoma sp.
Urocentrum turbo
Vorticella sp.
PHYLUM SARCODINA
Acanthocystis sp.
Arcella vulgaris
Hyalosphaenia papilio
Difflugia corona
PHYLUM ROTATORIA
Lecane sp.
Lepadella sp.
PHYLUM OSTRACODA
PHYLUM GASTROTRICHA
PHYLUM NEMATODA
PHYLUM PLATELMINTOS

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CUADRO No 8. PRESENCIA DE LA COMUNIDAD DE INSECTOS ACUATICOS REGISTRADOS EN LA CUENCA DEL RIO JIBOA Y SUS RIOS TRIBUTARIOS. 12 AL 27 DE FEBRERO/1996.

TAXA	E1	E2	E3	E5	E6	E8
ORDEN DIPTERA						
Fam.Ceratopogonidae		MODERADA	ESPORADICA			
Fam. Culicidae		MODERADA				
Fam.Chironomidae	ESPORADICA	DOMINANTE	ESPORADICA	ESPORADICA	DOMINANTE	ESPORADICA
Fam. Tabanidae			ESPORADICA			
O. EPHEMEROPTERA	DOMINANTE	ESPORADICA	DOMINANTE	DOMINANTE	POCA PRESC.	DOMINANTE
O. TRICHOPTERA	DOMINANTE		MODERADA	MODERADA	ESPORADICA	
O. MEGALOPTERA			ESPORADICA			
Fam. Corydalidae	MODERADA	ESPORADICA	MODERADA			
O. HEMIPTERA						
Fam. Naucoridae			MODERADA			
O. Coleoptera		ESPORADICA			ESPORADICA	
O. Odonata	MODERADA	MODERADA		MODERADA		

SIMBOLOGIA

E1 = RIO DESAGUE
E2 = RIO JIBOA (Ctn. Santa Anita y San Juan Buenavista)
E3 = RIO JIBOA (Paraiso de Osorio)
E5 = RIO TILAPA
E6 = RIO SEPAQUIAPA
E8 = RIO JIBOA (El Rosario, Hda. San Mauricio).

CUADRO N0 9. ORGANISMOS PLANCTONICOS REPORTADOS EN EL LAGO DE ILOPANGO. 14 Y 28 DE FEBRERO /1996.

PLANCTON	TAXA	ESPECIES	PRESENCIA
FITOPLANCTON	DIVISION CYANOPHYTA	Oscillatoria limosa	esporadica
	DIVISION CHRYSOPHYTA	Melosira granulata	abundante
		Melosira sp.	dominante
		Tercipnoe sp.	esporadica
	DIVISION CHLOROPHYTA	Staurastrum gracili	esporadica
		Staurastrum aff.	esporadica
ZOOPLANCTON	PHYLUM ROTATORIA	Ephifanes sp.	esporadicos
		Filinia pejleri	esporadico
	PHYLUM COPEPODA	Prionodiaptomus sp.	moderada
	PHYLUM CLADOCERA	Ceriodaphnia affinis	moderada
	PHYLUM CILIOPHORA	Familia Tintinnidae	esporadica

CUADRO No 10 ALGAS UTILIZADAS COMO CARACTERIZADORES ECOLOGICOS

DIVISION	ESPECIES	TIPO DE INDICADOR	AUTOR
CYANOPHYTA	*Anabaena constricta*	Contaminacion organica	Palmer (1962)
	Calothrix sp.	Sapidez y olor	Aguillon (1995)
	Chroococcus sp.	Aguas ricas en nutientes	Palmer (1962)
	Lyngbya sp.	Contaminacion organica	Palmer (1962) y
		y con aguas alcalinas	Aguillon (1995)
	Oscillatoria sp.	Contaminacion organica	Palmer (1962).
	Merismopedia sp.	Aguas poco contaminadas	Monterrosa (1991)
CHRYSOPHYTA	*Amphipleura pellucida*	Aguas ricas en fosfatos	Aguillon (1995)
	Amphora ovalis	Aguas limpias o en	Palmer (1962) y
		proceso de recuperacion	Aguillon et al.(1990)
	Anomoeonels sp.	presencia de hierro	Palmer (1962)
	Cocconels placentula	Aguas limpias	Palmer (1962)
	Cymatopleura solea	Lugares cenagosos	Palmer (1962)
	Fragilaria alpestris	Presencia de Calcio	Aguillon (1995)
	Fragilaria brevistriata	Contaminacion organica	Monterrosa (1993)
	Fragilaria capucina	Contaminacion organica	Aguillon (1995)
		Dureza,presencia de	
		Fosfatos	
	Gomphonema olivaceum	Presencia de cloruros	Aguillon (1995)
	Gomphonema parvulum	Contaminacion organica	Palmer (1962)
	Navicula gracilis	Aguas limpias	Palmer (1962)
	Tercipnoe musica	Aguas limpias	Prescott (1972).
CHLOROPHYTA	*Ankistrodesmus sp.*	Aguas limpias	Prescott (1972).
	Closterium lunula	Aguas alcalinas ,aguas	Aguillon (1995)
		limpias	
	Cosmarium spp.	Alta alcalinidad y	Aguillon (1995)
		muchos nutrientes	
	Cladophora glomerata	Aguas limpias y mineraliza	Palmer (1962)
		das	Margalef,(1983)
	Scenedesmus quadricauda	Contaminacion organica	Palmer (1962)
	Spirogyra spp.	Contaminacion organica y	Palmer (1962)
		presentes en aguas	
		alcalinas y cenagosas	
	Rhizoclonium sp.	Aguas limpias (1962)	Palmer(1962)

E.3 Soil Conservation

E.3.1 Review of the existing installations of erosion control

E.3.1.1 RESEARCH CENTER OF SOIL EROSION AT THE DISTRICT OF METAPAN

At the district of Metapan on the North-East region of El Salvador, some experimental models for the measurement of soil loss were settled during the period of 1974 through 1981 by a technical cooperation of UNDP (United Nations Development Program). At present this models are not operating due to lack of maintenance.

The main purposes of these installations were:

a) Determination of the erosivity of rainfall
b) Measurement of soil erodibility,
c) Measurement of soil loss under different conditions of crops and soil conservation practices,
d) Evaluation of the protection of several types of vegetation coverage.

The blocks had dimensions of 20 m in length and 5 m in width.

Gradients of the different blocks:

Block	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Gradient %	30	29	31	31	33	34	35	34	33	31	25	24	30.8

The summary of Results during the period 1975 through 1980 is as follows:

AMOUNT OF SOIL LOSS IN METAPAN AREA (TON/HA)

YEAR	CONTROL TEST 1/	BASIC CROPS 2/	LIVING BARRIERS	HILLSIDE DITCHES
Gradient(%):	30, 33	31, 34	29, 35	31, 34
1975	420.68	137.01	129.04	58.11
1976	362.45	72.17	5.10	5.95
1977	408.47	12.68	------	--- 3/
1978	794.67	4.50	6.89	3.25
1979	489.45	18.51	19.95	6.89
1980	351.81	------	------	--- 3/

1/ The control tests remain without any vegetation. Raking is made in the direction of the slope
2/ The basic crops are settled without any soil conservation practice
3/ The measuring could not be executed due to be too small amount.

Limitations of this work:

- The soil of this area is clayish type which do not allow to use the results for the sandy soils predominant in the Jiboa River Basin

- The successful results of models are limited to a narrow range of gradients between 29 to 35%. Results of block models 9,10,11,12 of gradients between 24-25% and 31-33% were not successful.

- Considering the control test was limited to two different gradients their comparativeness is also limited

It is to be considered the continuation of the experiments initiated in Metapan area for the region of Jiboa River with other geological and topographical conditions.
A wider range of models should be settled in order to have more representative results of the natural conditions of the basin.

E.3.1.2 EXPERIMENTAL STATION OF SOIL CONSERVATION OF ANALQUITO AND SAN MARTIN (1975-1980)

These are two demonstration projects as a result of the FIRST GENERAL FRAME FOR THE PROMOTION OF THE NATIONAL PROGRAM OF SOIL CONSERVATION AT INCLINED LANDS (1975). The activities proposed in such project have been executed in the areas of Santa Cruz Analquito and San Martin, both in the Department of Cuscatlan.

The main features of the project are:

Project area: 13.4 Ha Santa Cruz Analquito, 1.7 Ha San Martin

Main soil conservation works executed:

- Bank terraces
- Individual terraces
- Garden terraces
- Channeling works
- Afforestation with pine and fruits
- Vetiver grass cultivation at contour lines

Main crops:

- Permanent fruits: mango, orange, persian lemon, avocado, bamboo
- Pineapple

At present the project is lacking of maintenance and do not comply with the initial objectives of investigation and training on the erosion control techniques with the different soil conservation treatments.