As indirect effect due to enhanced land use potential, increased pollution load discharge by progressing urban, industrial and agricultural development to the surrounding water bodies is anticipated.

The baseline environmental condition of the Study Area, including the relevant environmental issues, and the insignificance of environmental impacts by the project are described in the "Preliminary Environmental Assessment Report".

11.6.7 Project Evaluation

The project evaluation is based on effectiveness in economic, social and environmental terms. However ,the social and environmental adverse impacts may not be significant.

The results of evaluation are as follows:

(1) According to the economic evaluation, the proposed facility plans for the Rio Choloma and the Rio El Sauce will be feasible from sediment control and flood mitigation related benefits. The EIRR values for the Rio Choloma and the Rio El Sauce are 15.3 % and 14.5 % respectively, for the 50 year return period.

(2) In case of the Rio Blanco the proposed facility plan has only low economic efficiency, according to the EIRR value of 4.3 % for the 50-year return period, due to a low potential of assets inundated in the lower river basin. However, the alternative plan that diverts the lower reach of the Rio Blanco to the El Sauce, has a higher economic efficiency, according to the EIRR of 13.0 % for the 50-year return period.

(3) By modification of the tentative implementation program, the project will be more effective in social and economic terms. It will be better to select only urgent measures for an early implementation and the others for a long period of time.

TABLES

TABLE 11.1 PROPOSED FACILITY OF MASTER PLAN

Area/River	Flood Control Facilities/Works	Main Feature	Area/River	Sediment Control Facilities/Works	Main Feature	Remarks
1.Rio Choloma	1).Embankment	15.6 km	1.Rio Choloma	1) Sabo (Check) Dam	10 pls	
			*Rio Majine &			
	2).Revetment	4.8 km	Rio La Jutosa	2) Consolidation Dam	17 pls	
	3). Channel Improvement	7.8 km		3) Training Levee	1,325 m	
	4).Bridge Improvement	2pls				
	5).Land Acquision	91.0 ha				
2.Rio.Blanco-Canal San Roqe						
With Rio El Sauce						
2.1. Rio Blanco	1).Embankment	1.5 km	2.1 Rio Blanco	1) Sabo (Check) Dam	9 pls	
	*Left Bank Only		*Rio Chiquito			
	2).Land Acquision	4.2 ha	Rio Del Zapotal &	2) Consolidation Dam	7 pls	
			Rio De Armenta			
				3) Channel Works	1pls	
				4) Training Levee	4,060 m (8pls)	
2.2 Diversion Canal (2.6 km)	1).Embankment	5.2 km				
*Rio Blanco-El.Sauce						
	2). Channel Improvement	2.6km				
	3).Diversion Weir	1 Pls				
	4).Land Acquision	56.7 ha				
2.3 El.Sauce			2.3 El Sauce	1) Sabo (Check) Dam	14 pls	
1).Left Bank	1).Embankment	5.5 km	* Rio Santa Ana &			
			Rio Piedras	2) Consolidation Dam	0	
2).Right Bank	1).Embankment	7.5 km				
	*Heightning			3) Channel Works	2 pls	
	2). Channel Improvement	7.5km		Ground Sill	(12 pls)	
				Riverbed Gindle	(4pls)	
	3).Revetment	2.0 km				
	4).Bridge	1				
	5).Land Acquision	117.8 ha				

TABLE 11.2 UNIT PRICE OF TYPICAL MATERIAL

Unit:Lp (1993,June Price)

Item	Description	Unit	Price (Lp)	Foreign Portion (%)	Local Portion (%)
Binding Wire		kg	7	100	0
Plain Steel Bar		kg	3	50	50
Deformed Bar		kg	3	50	50
River Sand	for Concrete	m3	65	0	100
Pit Sand		m3	35	0	100
Artificial Gravel		m3	70	0	100
Cobble Stone		m3	40	0	100
Cement		ton	345	25	75
Ready mixed Concrete	170 kg/m3	m3	320	15	85
Ready mixed Concrete	220 kg/m3	m3	330	15	85
Ready mixed Concrete	240 kg/m3	m3	340	15	85
Pine Plywood		m3	3,400	10	90
Timber (Low Class)	High Class	m3	1,568	0	100
Timber (Higr Class)	Low Class	m3	1,334	0	100
Iron Plate		kg	4	50	50
Gasoline		Ltr	2	100	0
Diesel Oil		Ltr	2	100	0

TABLE 11.3 LABOR WAGES

Unit:Lp (1993,June Price)

Type of Labour	Labour Wages	Remarks
1 Foreman	75.00	Per 8 hrs
2 Skilled Labor	25.00	" "
3 Common Labour	20.00	" "
4 Operator(Machine)	50.00	" "
5 Assistant Operator	25.00	" "
6 Electrician	35.00	" "
7 Mechanic	35.00	" "
8 Driver	25.00	" "
9 Steel Worker	35.00	" "
10 Concrete Worker	25.00	" "
11 Carpenter	30.00	" "
12 Mason	30.00	" "
13 Welder	30.00	" "
14 Scaffolder	30.00	" "

TABLE 11.4 LAND COST

Unit:Lp/m2 (1993,June Price)

Area		Official Price		Market Price		Remarks
		Urban Area	Rural Area	Urban Area	Rural Area	
Choloma	Max	50	1	*75	**1.0	
	Common	18	0	*27	**0.5	
	Min	10	0	*15	**0.4	
San Pedro Sula	Max	850	1	1500	1.2	
	Common	100	1	150	0.7	
	Min	5	0	8	0.01	
La Lima	Max	110	1	*165	**0.7	
	Common	37	1	*56	**0.7	
	Min	5	0	*8	**0.1	

Note:
1)*: Assumed Price :Official Pricex1.5
2)**: Assumed Price :Official Pricex1.2
3) Common Price in Market Price is to be used for Cost Estimate

TABLE 11.5 SUMMARY OF UNIT CONSTRUCTION COST

Unit:Lp (1993,June Price)

	Work Items	Description	Unit	Price	Foreign Portion (%)	Local Portion (%)	Remarks	
1	Excavation Work	Sandy Soil	m3	11	92	8	For River Works	Ref,Table11.5(1),Code38
2	Banking Work (L=200m)	" "	m3	25	92	8	" "	Ref,Table11.5(1),Code38-1
3	Spoiling Work (L=1000m)	" "	m3	28	92	8	" "	Ref,Table11.5(1),Code42
4	Filling Work	" "	m3	24	92	8	" "	Ref,Table11.5(1),Code39
5	Excavation for Foundation	Sand/Gravel	m3	39	94	6	For Debris Levee	Ref,Table11.5(1),Code40
6	" "	Rock/Coble	m3	244	96	4	For Sabo Dam	Ref,Table11.5(1),Code7
7	Sodding Work		m2	8	0	100		Ref,Table11.5(1),Code16
8	Gabion Work	Cobble Stone	m3	156	54	46		Ref,Table11.5(2),Cuc10
9	Wet Maisonry (Revetment)	Cobble With Conc.	10 m2	1,700	13	87		Ref,Table11.5(2),Code37
10	Flood Control Strctures							
	1) Box Culvert	Concrete	m3	2,722	44	56	Incld.form work,et	Ref,Table11.6(1),Cuc15
	2) Gate A	Steel	m2	15,000	95	5		Ref,Table11.6(2)
	3) Gate B	Steel	m2	13,000	95	5		Ref,Table11.6(2)
	4) Bridges (Concrete Type	Slab,Etc	m2	6,937	37	63	Incld. pier ,etc	Ref,Table11.6(1),Cuc16
	5) Weir Type Structure	Concrete	m3	1,035	77	23	Incld.form work,et	Ref,Table11.6(1),Cuc19
	6) Consolidation Dam	Boulder Concrete	m3	752	79	21	" "	Ref,Table11.6(1),Cuc20
11	Debris Control Structure							
	1) Check Dam (Sabo Dam)	Boulder Concrete	m3	1,100	62	38	Incld.form work,et	Ref,Table11.7(1)
12	Steel Sheet Pile	Type II	m2	1,150	99	1		Ref,Table11.5(2),Code32-1
		Type III	m2	1,450	99	1		Ref,Table11.5(2),Code32-2

Note:
1.Conc.:Concrete
2.Exca. :Excavation

TABLE 11.6 CONSTRUCTION COST OF THE RIO CHOLOMA (M/P)

Unit :Lp

Work Items	Description	Unit	Price	Foreign Portion (%)	Local Portion (%)	Quantity	Cost	Foreign Portion (%)	Local Portion (%)	Remarks
A.RIVER WORKS										
1.PREPARATORY WORK						1	7,686,872	6,007,610	1,679,262	
2.EMBANKMENT WORK										
Excavation	Sandy Soil	m3	11	94	6	1,102,000	12,122,000	11,394,680	727,320	
Spoiling		m3	28	94	6	621,300	17,396,400	16,352,616	1,043,784	
Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	3,600	561,600	303,264	258,336	
Wet Maisonry	For Revetment	m2	170	13	87	42,576	7,237,920	940,930	6,296,990	
Concrete Structure	Box Culvert	m3	2,722	44	56	0	0	0	0	Incld.form work
(for River Strcture)	Gate A (Steel)	m2	15,000	95	5	0	0	0	0	,excavation,etc
	Gate B (Steel)	m2	13,000	95	5	0	0	0	0	
	Bridge(Slab,Etc)	m2	6,937	37	63	1	8,500	3,145	5,355	Incld. pier ,etc
	Weir	m3	1,035	77	23	0	0	0	0	
	Consolid.Dam	m3	1,100	62	38	0	0	0	0	
Banking	By Machine	m3	25	92	8	480,700	12,017,500	11,056,100	961,400	
Sodding		m2	8	0	100	237,737	1,901,896	0	1,901,896	
						Sub-Total (LP):	58,932,682	46,058,345	12,874,344	
						%:	100	78	22	
B. SABO WORKS										
1.PREPARATORY WORKS						1	38,222,673	23,689,448	14,533,225	
2.SABO DAM WORKS										
Debris Control Structure	Concrete Work	m3	1,100	62	38	102,890	113,179,000	70,170,980	43,008,020	Incld.form work
Gabion (Mat Type)	D=0.45m	m3	156	54	46	3,630	566,280	305,791	260,489	
3.CONSOLIDATION WORKS										,excavation,etc
Excavation	Sand/Gravel	m3	39	94	6	33,360	1,301,040	1,222,978	78,062	
Debris Control Structure	Concrete Works	m3	1,100	62	38	116,880	128,568,000	79,712,160	48,855,840	Incld.form work
Gabion (Mat Type)	40*120*400	m3	156	54	46	33,360	5,204,160	2,810,246	2,393,914	
Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	21,350	3,330,600	1,798,524	1,532,076	
4.LEVEE										
Excavation	Sand/Gravel	m3	39	94	6	0	0	0	0	
Banking	By Machine	m3	36	92	8	34,200	1,231,200	1,132,704	98,496	
Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	9,215	1,437,540	776,272	661,268	
						Sub-Total (LP):	293,040,493	181,619,103	111,421,390	
						%:	100	62	38	
						Total(A+B):	351,973,181	227,677,448	124,295,734	
						%:	100	65	35	
5.LAND ACQUISITION			0.50	0	100	2,138,568	1,069,284		1,069,284	

Unit: Lp(x1000)

Item	Total	F/C	L/C	Remarks
A Direct Cost				
1)Flood Control Facilities	58,933	46,058	12,874	
2)Sediment Control Facilities	293,040	181,619	111,421	
Sub-Total	351,973	227,677	124,296	
B Indirect Cost				
1)Land Acquisition	1,069	0	1,069	
2)Administration Cost	17,599	0	17,599	A X5.0 %
3)Engineering Service Cost	42,237	27,321	14,915	(A+C) X10%
Sub-Total	60,905	27,321	33,583	
C Physical Contingency	70,395	45,535	24,859	A X20 %
Total	483,273	300,534	182,738	
	%	62	38	

TABLE 11.7 CONSTRUCTION COST OF THE RIO BLANCO AND THE RIO EL SAUCE (M/P)

Unit :Lp

Work Items		Description	Unit	Price	Foreign Portion (%)	Local Portion (%)	Quantity	Cost	Foreign Portion (%)	Local Portion (%)	Remarks
A.RIVER WORKS											
1.PREPARATORY WORK							1	12,407,716	8,426,982	3,980,734	
2.EMBANKMENT WORK											
	Excavation	Sandy Soil	m3	11	94	6	1,327,100	14,598,100	13,722,214	875,886	
	Spoiling		m3	28	94	6	348,860	9,768,080	9,181,995	586,085	
	Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	7,000	1,092,000	589,680	502,320	
	Wet Masonry	For Revetment	m2	170	13	87	43,324	7,365,080	957,460	6,407,620	
	Concrete Structure	Box Culvert	m3	2,722	44	56	0	0	0	0	Incld.form work
	(for River Strcture)	Gate A (Steel)	m2	15,000	95	5	0	0	0	0	,excavation,etc
		Gate B (Steel)	m2	13,000	95	5	0	0	0	0	
		Bridge(Slab,Etc)	m2	6,937	37	63	2,200	15,261,400	5,646,718	9,614,682	Incld. pier ,etc
		Weir	m3	1,035	77	23	4,495	4,652,325	3,582,290	1,070,035	
		Consolid.Dam	m3	1,100	62	38	0	0	0	0	
	Banking	By Machine	m3	25	92	8	978,240	24,456,000	22,499,520	1,956,480	
	Sodding		m2	8	0	100	690,640	5,525,120	0	5,525,120	
							Sub-Total (LP):	95,125,821	64,606,860	30,518,961	
							%:	100	68	32	
B. SABO WORKS											
1.PREPARATORY WORKS							1	42,189,771	26,330,889	15,858,883	
2.SABO DAM WORKS											
	Debris Control Structere	Concrete Work	m3	1,100	62	38	208,840	229,724,000	142,428,880	87,295,120	Incld.form work
	Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	10,395	1,621,620	875,675	745,945	
3.CONSOLIDATION WORKS											,excavation,etc
	Excavation	Sand/Gravel	m3	39	94	6	48,670	1,898,130	1,784,242	113,888	
	Debris Control Structere	Concrete Works	m3	1,100	62	38	28,630	31,493,000	19,525,660	11,967,340	Incld.form work
	Gabion (Mat Type)	40*120*400	m3	156	54	46	20,040	3,126,240	1,688,170	1,438,070	
	Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	12,800	1,996,800	1,078,272	918,528	
4.LEVEE											
	Excavation	Sand/Gravel	m3	39	94	6	0	0	0	0	
	Banking	By Machine	m3	36	92	8	146,160	5,261,760	4,840,819	420,941	
	Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	39,382	6,143,592	3,317,540	2,826,052	
							Sub-Total (LP):	323,454,913	201,870,146	121,584,767	
							%:	100	62	38	
							Total(A+B):	418,580,734	266,477,006	152,103,728	
							%:	100	64	36	
5.LAND ACQUISITION				0.50	0	100	2,143,560	1,071,780		1,071,780	

Unit: Lp(x1000)

Item	Total	F/C	L/C	Remarks
A Direct Cost				
1)Flood Control Facilities	95,126	64,607	30,519	
2)Sediment Control Facilities	323,455	201,870	121,585	
Sub-Total	418,581	266,477	152,104	
B Indirect Cost				
1)Land Acquisition	1,072	0	1,072	
2)Administration Cost	20,929	0	20,929	A X5.0 %
3)Engineering Service Cost	50,230	31,977	18,252	(A+C) X10%
Sub-Total	72,231	31,977	40,253	
C Physical Contingency	83,716	53,295	30,421	A X20 %
Total	574,527	351,750	222,778	
%		61	39	

TABLE 11.8 CONSTRUCTION COST OF THE RIO BLANCO (M/P)

Unit :Lp

Work Items	Description	Unit	Price	Foreign Portion (%)	Local Portion (%)	Quantity	Cost	Foreign Portion (%)	Local Portion (%)	Remarks
A.RIVER WORKS										
1.PREPARATORY WORK						1	25,643,189	20,275,864	5,367,325	
2.EMBANKMENT WORK										
Excavation & Spoiling	Sandy Soil	m3	39	94	6	1,022,856	39,891,384	37,497,901	2,393,483	
Gabion (Clynder Type)	D=0.45m	m3	156	54	46	92,920	14,495,520	7,827,581	6,667,939	
Wet Malsonry	For Revetment	m2	170	13	87	5,692	967,640	125,793	841,847	
Concrete Structure	Box Culvert	m3	2,722	44	56	2,220	6,042,840	2,658,850	3,383,990	Incld.form work
(for River Sircture)	Gate A (Steel)	m2	15,000	95	5	64	960,000	912,000	48,000	,excavation,etc
	Gate B (Steel)	m2	13,000	95	5	288	3,744,000	3,556,800	187,200	
	Bridge(Slab,Etc)	m2	6,937	37	63	2,250	15,608,250	5,775,053	9,833,198	Incld. pier ,etc
	Weir	m3	1,035	77	23	0	0	0	0	
	Consolid.Dam	m3	1,100	62	38	3,024	3,326,400	2,062,368	1,264,032	
Exca.& Banking	By Machine	m3	36	92	8	2,257,128	81,256,608	74,756,079	6,500,529	
Sodding		m2	8	0	100	582,744	4,661,952	0	4,661,952	
						Sub-Total (LP):	196,597,783	155,448,288	41,149,495	
						%:	100	79	21	
B. SABO WORKS										
1.PREPARATORY WORKS						1	21,539,805	13,556,439	7,983,366	
2.SABO DAM WORKS										
Debris Control Structure	Concrete Work	m3	1,100	62	38	88,190	97,009,000	60,145,580	36,863,420	Incld.form work
Gabion (Mat Type)	D=0.45m	m3	156	54	46	4,155	648,180	350,017	298,163	
3.CONSOLIDATION WORKS										,excavation,etc
Excavation	Sand/Gravel	m3	39	94	6	35,470	1,383,330	1,300,330	83,000	
Debris Control Structure	Concrete Works	m3	1,100	62	38	28,630	31,493,000	19,525,660	11,967,340	Incld.form work
Gabion (Mat Type)	40*120*400	m3	156	54	46	6,840	1,067,040	576,202	490,838	
Gabion (Clynder Type)	D=0.45m	m3	156	54	46	3,800	592,800	320,112	272,688	
4.LEVEE										
Excavation	Sand/Gravel	m3	39	94	6	0	0	0	0	
Banking	By Machine	m3	36	92	8	146,160	5,261,760	4,840,819	420,941	
Gabion (Clynder Type)	D=0.45m	m3	156	54	46	39,382	6,143,592	3,317,540	2,826,052	
						Sub-Total (LP):	165,138,507	103,932,699	61,205,808	
						%:	100	63	37	
						Total(A+B):	361,736,290	259,380,987	102,355,303	
						%:	100	72	28	
5.LAND ACQUISITION			0.50	0	100	2,138,568	1,069,284		1,069,284	

Unit: Lp(x1000)

Item	Total	F/C	L/C	Remarks
A Direct Cost				
1)Flood Control Facilities	196,598	155,448	41,150	
2)Sediment Control Facilities	165,139	103,933	61,206	
Sub-Total	361,737	259,381	102,356	
B Indirect Cost				
1)Land Acquisition	1,069	0	1,069	
2)Administration Cost	18,087	0	18,087	A X5.0 %
3)Engineering Service Cost	43,408	31,126	12,283	(A+C) X10%
Sub-Total	62,564	31,126	31,439	
C Physical Contingency	72,347	51,876	20,471	A X20 %
Total	496,649	342,383	154,266	
%		69	31	

TABLE 11.9 CONSTRUCTION COST OF THE RIO EL SAUCE (M/P)

Unit :Lp

Work Items	Description	Unit	Price	Foreign Portion (%)	Local Portion (%)	Quantity	Cost	Foreign Portion (%)	Local Portion (%)	Remarks
A.RIVER WORKS										
1.PREPARATORY WORK						1	7,149,032	4,202,751	2,946,281	
2.EMBANKMENT WORK										
Excavation & Spoiling	Sandy Soil	m3	39	94	6	86,340	3,367,260	3,165,224	202,036	
Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	3,500	546,000	294,840	251,160	
Wet Maisonry	For Revetment	m2	170	13	87	43,324	7,365,080	957,460	6,407,620	
Concrete Structure	Box Culvert	m3	2,722	44	56	0	0	0	0	Incld.form work
(for River Structure)	Gate A (Steel)	m2	15,000	95	5	0	0	0	0	,excavation,etc
	Gate B (Steel)	m2	13,000	95	5	0	0	0	0	
	Bridge(Slab,Etc)	m2	6,937	37	63	1,500	10,405,500	3,850,035	6,555,455	Incld. pier ,etc
	Weir	m3	1,035	77	23	0	0	0	0	
	Consolid Dam	m3	1,100	62	38	0	0	0	0	
Exca.& Banking	By Machine	m3	36	92	8	596,340	21,468,240	19,750,781	1,717,459	
Sodding		m2	8	0	100	563,517	4,508,136	0	4,508,136	
						Sub-Total (LP):	54,809,243	32,221,092	22,388,157	
						%:	100	59	41	
B. SABO WORKS										
1.PREPARATORY WORKS						1	20,650,902	12,774,955	7,875,947	
2.SABO DAM WORKS										
Debris Control Structure	Concrete Work	m3	1,100	62	38	120,650	132,715,000	82,283,300	50,431,700	Incld.form work
Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	6,280	979,680	529,027	450,653	
3.CONSOLIDATION WORKS										,excavation,etc
Excavation	Sand/Gravel	m3	39	94	6	13,200	514,800	483,912	30,888	
Debris Control Structure	Concrete Works	m3	1,100	62	38	0	0	0	0	Incld.form work
Gabion (Mat Type)	40*120*400	m3	156	54	46	13,200	2,059,200	1,111,968	947,232	
Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	9,000	1,404,000	758,160	645,840	
4.LEVEE										
Excavation	Sand/Gravel	m3	39	94	6	0	0	0	0	
Banking	By Machine	m3	36	92	8	0	0	0	0	
Gabion (Cilynder Type)	D=0.45m	m3	156	54	46	0	0	0	0	
						Sub-Total (LP):	158,323,382	97,941,322	60,382,250	
						%:	100	62	38	
						Total(A+B):	213,132,830	130,162,414	82,970,416	
						%:	100	61	39	
5.LAND ACQUISITION			0.50	0	100	1,143,000	572		572	

Unit: Lp(x1000)

Item	Total	F/C	L/C	Remarks
A Direct Cost				
1)Flood Control Facilities	54,809	32,221	22,588	
2)Sediment Control Facilities	158,324	97,941	60,382	
Sub-Total	213,133	130,162	82,970	
B Indirect Cost				
1)Land Acquisition	572	0	572	
2)Administration Cost	10,657	0	10,657	A X5.0 %
3)Engineering Service Cost	25,576	15,619	9,956	(A+C) X10%
Sub-Total	36,805	15,619	21,185	
C Physical Contingency	42,627	26,032	16,594	A X20 %
Total	292,564	171,814	120,749	
%		59	41	

TABLE 11.10 SUMMARY OF ECONOMIC CONSTRUCTION COST FOR CHOLOMA, BLANCO AND EL SAUCE PROJECTS - RETURN PERIOD : 50-YEAR

Unit: Lps. 1,000

Costs	Choloma	Blanco	El Sauce	Blanco & El Sauce
Financial				
F.C.	219,101	282,839	123,881	251,925
L.C.	148,944	134,640	94,363	170,864
Total	368,045	417,479	218,244	422,789
Economic				
F.C.	219,101	282,839	123,881	251,925
L.C.	125,113	113,098	79,265	143,526
Total	344.214	395,937	203,146	395,451

TABLE 11.11 SUMMARY OF ECONOMIC CONSTRUCTION COST FOR CHOLOMA PROJECT - RETURN PERIOD : 2, 5, 30, 50 AND 100 YEARS

Unit: Lps. 1,000

Costs	Return Period (year)				
	2	5	30	50	100
Financial					
F.C.	47,638	80,509	192,240	219,101	248,361
L.C.	40,854	58,782	134,398	148,944	165,323
Total	88,492	139,291	326,638	368,045	413,684
Economic					
F.C.	47,638	80,509	192,240	219,101	248,361
L.C.	34,317	49,377	112,894	125,113	138,871
Total	81,955	129,886	305,134	344,214	387,232

FIGURES

Area/River	Flood Control Facilities/Works	Main Feature	Area/River	Sediment Control Facilities/Works	Main Feature	Remarks
1. Río Choloma	1) Embankment	16.9 km	1. Río Choloma *Río Highe & Río La Jutosa	1) Sabo (Check) Dam	10 pls	
	2) Revetment	4.8 km		2) Consolidation Dam	17 pls	
	3) Channel Improvement	7.3 km		3) Training Levee	1,325 m	
	4) Bridge Improvement	2pls				
	5) Land Acquisition	81.9 ha				
2. Río Blanco-Canal San Roque With Río El Sauce 2.1. Río Blanco	1) Embankment *Left Bank Only	1.5 km	2.1 Río Blanco *Río Chiquito Río Del Zapotal & Río De Armenta	1) Sabo (Check) Dam	9 pls	
	2) Land Acquisition	4.2 ha		2) Consolidation Dam	7 pls	
				3) Channel Works	1pls	
				4) Training Levee	4,050 m (5pls)	
2.2 Diversion Canal (2.6 km) *Río Blanco-El Sauce	1) Embankment	5.2 km				
	2) Channel Improvement	2.6km				
	3) Diversion Weir	1 Pls.				
	4) Land Acquisition	56.7 ha				
2.3 El Sauce 1) Left Bank	1) Embankment	5.9 km	2.3 El Sauce * Río Santa Ana & Río Piedras	1) Sabo (Check) Dam	14 pls	
2) Right Bank	1) Embankment *Heightening	7.5 km		2) Consolidation Dam	0	
	2) Channel Improvement	7.5km		3) Channel Works Ground Sill Revetted Girdle	2 pls (12 pls) (4pls)	
	3) Revetment	2.8 km				
	4) Bridge	1				
	5) Land Acquisition	117.8 ha				

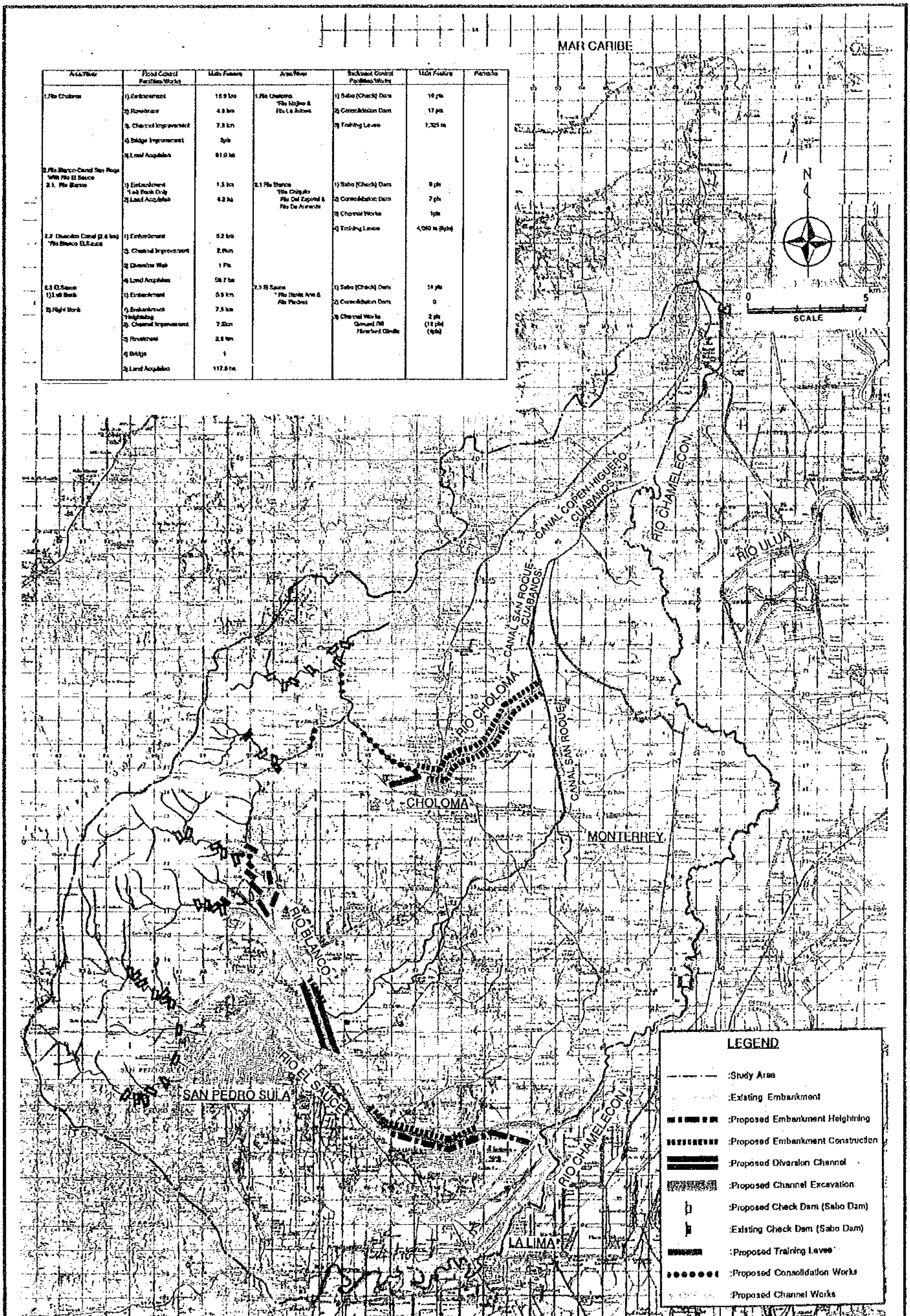
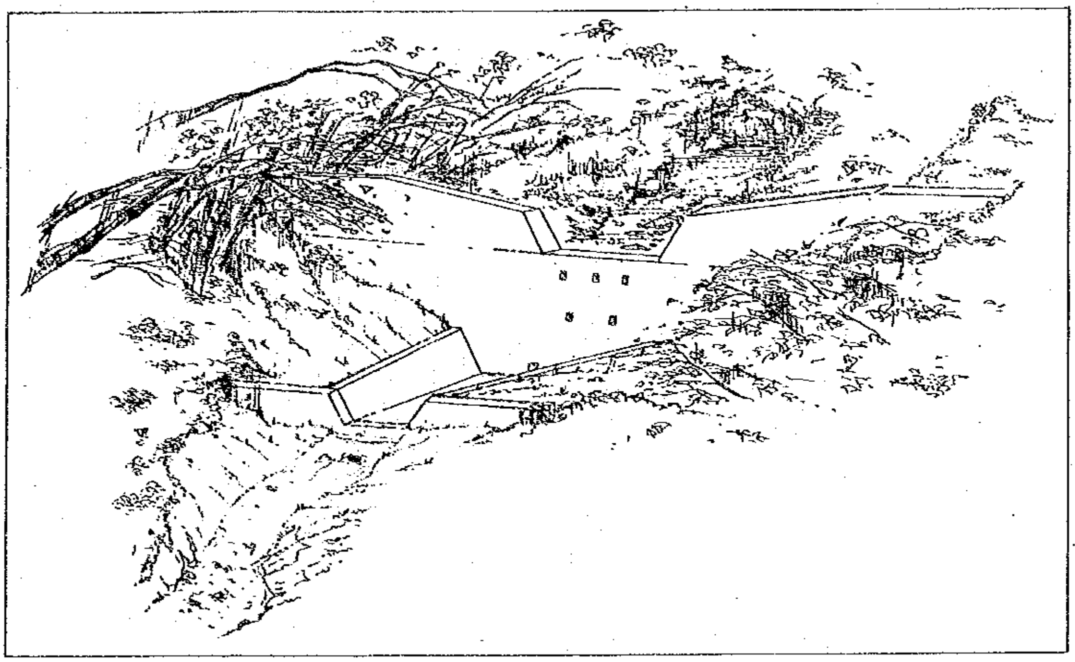


FIG.11.1 PROPOSED MASTER PLAN



TYPICAL IMAGE OF A CHECK DAM (SABO DAM)

CHAPTER 12
FEASIBILITY STUDY ON THE RIO CHOLOMA

CHAPTER 12 FEASIBILITY STUDY ON THE RIO CHOLOMA

12.1 General

In the Master Plan (March 1993), the Rio Choloma basin was identified as the priority basin for a Feasibility Study. During the field study from May to August 1993, a priority order of the proposed facilities have been studied from technical aspects and the urgent facilities which would require an early implementation, have been decided and studied based on the supplementary field surveys. The Feasibility Study on the Rio Choloma has been carried out.

12.2 Erosion and Sediment Control Measures

12.2.1 Basic Concept

The basic concepts for planning of erosion and sediment control measures are summarized as follows:

(1) Design Scale

The erosion and sediment control measures are decided to have a scale to cope with the sediment yield and discharge of a scale caused by the hurricane Fifi.

(2) Facility Plan

The erosion and sediment control facilities are planned to control the sediment yield and discharge from the basin by using sand retarding areas, constructing check dams and consolidation dams.

The check dams are planned at the reach of stream gradient less than 1/6, where debris flows begin to deposit, in order to check and control debris flows from the upper reach.

The consolidation works are planned at the reach of stream gradient (1/30~1/100), where erosion and sediment deposits are remarkable, in order to stabilize unstable deposits.

In the Master Plan, 10 check dams, 3 consolidation works and 1 training levee are planned based on the design sediment balance (*Table* 12.1). The locations of the proposed facilities are shown in *Table* 12.2 and *Figs.* 12.1~12.2 (3). The sediment balances with and without project are prepared and shown in *Fig.* 12.3.

In the Feasibility Study stage the locations of major facilities have been surveyed and the preliminary designs of the urgent facilities drawings are prepared. The project is evaluated based on the preliminary drawings.

12.2.2 Facility Plan

The facility plan of the master plan is studied and the urgent facilities are selected as follows:

1) Rio Choloma (from the design control point to the confluence with the Rio La Jutosa)

Before the Hurricane Fifi, the river course of the Rio Choloma was bending largely toward the right bank according to the aerial photographs of 1954, however, during the hurricane Fifi the river course was covered flat by sedimentation. Since then the river course has been almost same as now. The historical river courses identified through the aerial photographs taken in 1954, 1974, 1977, 1989 and 1992, are shown in *Fig.* 12.4 and the range of their meandering is shown in *Fig.* 12.5.

The flood caused by the hurricane Fifi covered a wide flood plain in the reach between the design control point and the confluence with the Rio La Jutosa, and flowed through Choloma urban area, causing severe flood damage to the area. From the sediment deposits of fine materials (silt and fine sand), which are identified at the flood plain located near the bridge, it is assumed that the flood formed a pond due to the backwater effect by the national road bridge which was clogged and demolished by the flood.

In order to stabilize the existing unstable deposits in the reach, one (1) series of consolidation works composed of seven (7) consolidation dams, are planned. The distance between 2 consolidation dams is planned to be about 350 meters, considering the distances of the meandering wave-lengths that are from 350 to 700 meters.

The design gradients of the riverbed are planned to be 1/240~1/180 for obtaining stabilization, because the existing riverbed gradient is 1/120 in average. The design gradient of the riverbed is planned to be 1/180, that is estimated to be a static stable bed gradient, in order to avoid sediment yield during mid scale floods.

In order to protect the urban area of Choloma from sediment flows or flood flows, a training levee is planned. The training levee is to connect the consolidation dam (No. 1) and the local road (from Choloma to La Neuter Jutosa) where the stream (No. 3-12) is crossing.

The crest height of the levee is planned to be higher than the flood stage of clogging at the national road bridge and the longitudinal slope of the levee crest is planned according to the surface slope of the flood water nearby.

2) Rio Majaine basin

a) From the confluence to the Rio La Jutosa to the confluence with the Rio del Ocotillo

The reach has no proper site for construction of any optimum check dam and one large check dam would cause adverse effects by backwater and sedimentation to the village of Ocotillo during floods. The channel is assumed to be a major sediment yielding area, of which the riverbed materials consist of comparatively fine materials. In order to stabilize the area, two (2) consolidation dams are planned.

b) Rio Ocotillo and Rio Majaine (the reach upstream of the confluence with the Rio Ocotillo)

The mountain streams of the Rio Ocotillo have comparatively gentle slopes except near the confluence to the Rio Majaine. The debris flow marks identified along the mountain streams are only old ones. In order to control anticipated debris flows from the basin, three (3) check dams are planned near the confluence with the Rio Majaine, where the stream bed slope is as steep as 1/27~1/14.

The upper basin of the Rio Majaine has a high potential of debris flows from technical aspects based on the topographic and geological conditions. A lot of debris flow marks, currently occurred, are identified in the mountain streams. It is considered that the river basin is to be a major sediment yield area in the Rio Choloma basin. In order to control sediment yield and discharge, four (4) check dams are planned.

c) Rio La Jutosa

The hurricane Fifi caused numerous hill slope collapses and debris flows in this river basin. The lower reach is identified as the debris flow deposit area by the hurricane Fifi and still has plenty of unstable deposits. The upper reach has a high potential for sediment yield and discharge from topographic and geologic conditions.

The proposed facilities are composed of a series of consolidation dams and check dams. Although Takemoto dam is considered to be very effective against debris flows from the upper basin, more facilities are required in order to control the sediment discharge from the basin. The proposed facilities are summarized as follows:

At the downstream reach, eight (8) consolidation dams are planned to stabilize the sediment deposits at the lower reach (23.835 km 24.800 km) by the debris flows of the hurricane Fifi.

Three (3) check dams are planned in the basin. Two (2) of them are planned in the upper reach between the consolidation works and Takemoto dam and the other is planned at the Qda. La Danta that is a large scale branch of the Rio La Jutosa.

The location and longitudinal profile of the consolidation works are shown in *Figs.* 12.6 and 12.7.

12.2.3 Urgent Facilities

1) Facility and Location

Among these facilities, an early implementation is recommended for the followings:

- Consolidation dam (No. 1) at 18.885 km of the Rio Choloma.
- Consolidation dam (No. 7) at 21.235 km of the Rio Choloma.
- Training levee at the consolidation dam (No. 1).
- Check dam (No. 1) at 25.72 km of the Rio Majaine.
- Check dam (No. 9) at 26.535 km of the Rio La Jutosa.

The location and the longitudinal profile of the consolidation works for the Rio Choloma are planned and shown in *Figs.* 12.8 (1)~(3) and 12.9. Those four (4) dams are shown in *Figs.* 12.1, 12.2 (2) and (3).

2) Sediment Balance

The effect of the urgent facilities is assessed on the sediment balance. The urgent facilities would control 34 percent of the design sediment discharge. The sediment balance after implementation of the urgent facilities is shown in *Table* 12.3.

3) Peak Discharge

The design peak discharges of the facilities are estimated based on the scale of a daily rainfall once in 100-year frequency and the sediment concentration of 20 percent. The design peak discharges are estimated by the Rational Formula.

The design discharges for the urgent facilities are estimated based on the peak discharges and 20 percent of sediment concentration. They are estimated for each urgent facility and shown in the following table:

Facility	Catchment area (km^2)	Peak Discharge (m^3/s)	Design Flood Discharge (m^3/s)
Check dam (No. 1)	12.04	216	260
Check dam (No. 8)	9.02	173	208
Consolidation dams	------	680	830

4) Hydraulic Analysis

The hydraulic effects by the urgent consolidation dams, were assessed by the water levels that were estimated at by non-uniform flow calculations. The hydraulic assessments were conducted on the following cases:

- Design flood discharge (830 m^3/s) with and without facilities,
- Design discharge (680 m^3/s) with and without facilities,
- Design low water discharge (5-year flood discharge: 300 m^3/s) without facilities,
- Flood water level of EL. 38 meters at the national road bridge with and without facilities.

The results of the assessment are summarized as follows:

- The existing river channel is able to convey the design low waters discharge normally, but unable to convey the design food discharge normally. The water surface slope of the design flood discharge shows a steep slope near the national road bridge and suggests the necessity of optimum river improvement works. The result of the non uniform calculation without the river improvement is shown in *Fig.* 12.10 (1).
- With the river improvement, the water surface slope of the design flood discharge becomes normal. With the consolidation dam (No. 1), the water level of the design flood discharge shows no increase from the existing conditions

and the upper stream flow regime of the consolidation dam, becomes better (*Fig.* 12.10 (2)).

- The two upper stream figures show that the ponding area by clogging at the national road bridge, could expand about 300 meters upward from the consolidation dam (No. 1).

5) Preliminary Design

Preliminary designs of the proposed urgent facilities are prepared as follows:

a) Consolidation Dam (No. 1) of the Rio Choloma

The preliminary design drawing of the consolidation dam (No. 1) is shown in *Fig.* 12.11. The facility is designed as follows:

- Height : 3.4 m (effective height: 2.0 m)
- Length : 395.0 m
- Crest level : EL. 34.80 m

b) Training Levee

The preliminary design drawing of the training levee is shown in *Fig.* 12.12. The facility is designed as follows:

- Length : 1,325.0 m
- Crest level : EL. 39.1~ EL. 47.90 m
- Crest slope : 1/150

c) Consolidation dam (No. 7)

The preliminary design drawing of the consolidation dam is shown in *Fig.* 12.13. The facility is designed as follows:

- Height : 3.0 m (effective height: 1.5 m)
- Length : 528.0 m
- Crest level : EL. 54.74 m

d) Check dam (No. 1)

The preliminary design drawing of the check dam is shown in *Fig.* 12.14. The facility is designed as follows:

- Height : 14.0 m (effective height: 11.5 m)
- Length : 197.0 m
- Crest level : EL. 139.60 m

e) Check dam (No. 9) of the Rio Jutosa

The preliminary design drawing of the check dam is shown in *Fig.* 12.15. The facility is designed is as follows:

- Height : 14.0 m (effective height: 11.2 m)
- Length : 209.0 m
- Crest level : EL. 220.90 m

12.3 Flood Mitigation Measures

12.3.1 Basic Concept

The basic concept for planning of flood mitigation measures is summarize as follows:

(1) Design Scale

The design discharge and the design high water levels are planned to protect the flood hazard area from the flood of a scale of the hurricane Fifi, of which the peak flood discharge is assessed as a flood of approximately 50-year return period.

(2) Design Discharge

The Rio Choloma basin is divided into eight (8) watersheds and the design discharges are estimated by the unit hydrograph method based on the design rainfall of 50-year return period as shown in *Figs.* 12.16~19.

The design discharges and high water levels of the design reach are estimated as follows:

Design Discharge and High Water Level

Location	Design Discharge	Design High Water(EL)
- Junction with Canal San Roque (CH-001)	790 (m^3/s)	11.00 (m)
- CH-012	720 (m^3/s)	16.50 (m)
- CH-032	680 (m^3/s)	29.60 (m)
- Road bridge, CH-040	680 (m^3/s)	33.70 (m)
- CH-043	680 (m^3/s)	36.22 (m)

(3) Design Longitudinal Profile

The existing river bed slope between CH-001 and CH-043 is about 1/312. The longitudinal profile of the existing river bed and the water level of a flood of 50-year return period are prepared and shown in *Figs.* 12.20 (1) and (2).

The design slopes of the river channel are planned to be 1/378~1/247 referring to the existing topographic conditions

(4) Design Cross Section

A compound cross section is applied with due consideration to a large fluctuation in the run-offs between the rainy season and the dry season. The design cross section of the low water channel is planned to have a flow capacity against the flood of a 3~5-year return period and to be 40~50 m width with 2~2.5 m depth. The design section of the compound channel is planned to be 150~170 m width.

(5) Standard Profile of Embankment

The standard profile of embankment is designed as follows:

- Crest width (B) : 4.0 m in principal
- Side slope : 1V : 3H
- Berm width : 3.0 m at every 4.0 m for river side and every 3.0 m for land side

12.3.2 Facility Plan

The flood mitigation measures are planned for the reach from the junction of the Canal San Roque to the consolidation dam (No. 1) for the erosion and sediment control works. In order to protect the study area from the flood water of the Rio Choloma, the embankments along the river course and channel excavation are planned. Also some protection works such as revetment and ground sills are planned to cope with local scouring along the river channels.

However the area along the reach needs also countermeasures for the flood waters from the Rio Chamelecon. Because a part of the area is rather low lying and affected by the flood waters not only from the Rio Choloma, but also from the Rio Chamelecon. The flood waters from the Rio Choloma flow to the Rio Chamelecon through those canals downstream such as the Canal San Roque-Cuabanos and the Canal Copen-Higuero-Cuabanos. These canals are under improvement by the Sula Valley Committee and the flow capacities of these canals are still extremely small compared to the flood peak discharges from the Rio Choloma basin. In order to avoid any adverse effects by the implementation of flood mitigation works, A part of the proposed channel excavation and embankment construction, say from CH-001 to CH-023, should be executed after the completion of the canal improvement works downstream.

The railway bridge is assessed to become a bottle neck during floods, because the maximum flow capacity under the bridge is approximately 170 m^3/s. The railway bridge requires to be raised at least 2.0 meters higher than the existing level.

The existing river channel between the national road bridge and the railway bridge require channel improvement works, although the existing embankments are high enough against the design high water level.

The national road bridge has an enough clearance for the design high water, but it is necessary to be provided with optimum protection works for the river bed and its foundation against local scouring. It would need widening in future according to the river improvement plan.

The river channel from the national road bridge to the consolidation dam, requires channel improvement works, embankments, protection works and transition works.

The flood mitigation facilities planned for the reach, are summarized as follows:

- Channel improvement	7.57 km (988,400 m^3)
- Embankment :	15.13 km (476,800 m^3)

-	Revetment (wet masonry)	4 place, 4.8 km (44,130 m^2)
-	Sodding	15.13 km (139,000 m^2)
-	Reconstruction of the railway bridge: and approaches,	1 (L: 160 m x 5.0 m)
-	Extension of the national road bridge	1 (L: 90 m x 26.5 m x 1 no)
-	Foot protection of the national road bridge	16,800 m^2

The locations of the planned facilities and the design slopes are shown in ***Figs.*** 12.21 (1)~(4), *Figs.* 12.22 (1)and (2). The standard cross sections are shown in *Fig.* 12.23.

12.3.3 Urgent Facilities

1) Facility and Location

Among the proposed facilities, the facilities that require an early implementation are as follows:

-	Channel improvement:	3.43 km (536,500 m^3)
-	Embankment:	6.86 km (134,400 m^3)
-	Revetment (wet masonry):	3.43 km (30,420 m^2)
-	Reconstruction of the railway bridge:	160 m x 5.0 m
-	Protection works for the road bridge	Foot protection (11,400 m^2)
-	Land acquisition:	42.1 ha

The locations of the urgent facilities are shown in *Fig.* 12.24.

2) Preliminary Design of Urgent Facilities

Preliminary designs of the following facilities are shown in *Figs.* 12.25~12.28:

- Channel work and Embankment (*Figs.* 12.25 (1)~(3))
- Revetment (*Fig.* 12.26)
- Rehabilitation of the national road bridge (*Fig.* 12.27)
- Rehabilitation of the railway bridge (*Fig.* 12.28)

12.4 Cost Estimation

12.4.1 Basic Conditions

The base construction cost is estimated based on the preliminary design drawings, and the other conditions are the same as those in the Master Plan.

12.4.2 Project Cost

1) Long Term Facility Plan

The total project cost is estimated at Lps. 501.87 million (F/C: Lps. 300.72 million, L/C: 201.15 million).

PROJECT COST FOR THE LONG TERM PLAN

(unit: million Lps.)

	Item	F/C	L/C	Total
A	Direct Cost			
	1)River Improvement	48.65	29.31	77.96
	2)Sediment Control Facilities	179.17	108.79	287.96
	3)Sub-total	227.82	138.10	365.92
B	Indirect Cost			
	1)Land Acquisition Cost	0.00	0.54	0.54
	2)Administration Cost	0.00	18.32	18.32
	3)Engineering Service Cost	27.34	16.57	43.91
	4)Sub-total	27.34	35.43	62.77
C	Physical Contingency A x 20 %	45.56	27.62	73.18
D	Total	300.72	201.15	501.87

The details of the project cost are shown in *Table* 12.4. The construction cost for a scale of 50 year flood frequency and its disbursement schedule are shown in *Tables* 12.5 and 12.6 respectively.

2) Urgent Facility Plan

The project cost for the urgent facilities is tentatively estimated at Lps.141.92 million (F/C: 88.02 million, L/C: 53.90 million) and summarized as follows:

PROJECT COST FOR THE URGENT PLAN

(unit: million Lps.)

	Item	F/C	L/C	Total
A	Construction Cost			
	1) River Improvement	24.82	13.24	38.06
	2) Sediment Control Facilities	41.86	23.41	65.27
	3) Sub Total	66.68	36.65	103.33
B	Indirect Cost			
	1) Land Acquisition	0.00	0.33	0.33
	2) Administration Cost	0.00	5.19	5.19
	3) Engineering service	8.00	4.40	12.40
	4) Sub Total	8.00	9.92	17.92
C	Physical Contingency A x 20 %	13.34	7.33	20.67
D	Total	88.02	53.90	141.92

The details of the urgent project cost are shown in *Table* 12.7.

12.5 Implementation Program

12.5.1 General

The overall coordination for the project will be provided by SECOPT and the execution of the project will be responsibility of DGOP of SECOPT. The other implementing agencies will be the Municipality of Choloma.

The project consists of the two parts, i. e. long term and urgent plans. The urgent plan is composed of two check dams, two consolidation dams, training levee and river improvement works. The river improvement works include embanked channel, revetment, protection works for the national road bridge and reconstruction of the railway bridge, that was considered as a bottle neck of the flood flows, and has been washed away by the flood "GERT" in September 1993.

The implementation program for the project is proposed as follows:

- The engineering services for implementation of the urgent plan shall commence in the year of 1995.

- The construction works of the urgent facilities shall be commenced in the year of 1996 and completed within two years.

- The urgent facilities shall be executed in the following order:

  (1) Check dam No. 1

  (2) Consolidation dam No. 1 and training levee

  (3) River improvement works

  (4) Check dam No. 8

  (5) Consolidation dam No. 7

- preparation and execution of the long term plan shall be commenced in the year of 1998.

12.5.2 Basic Conditions

1) Preparation of Detail Design

The detail design for the urgent facilities shall be carried out under the management of international consultants according to the design concept. During the preparation of the detailed designs, DGOP should assign counterparts to the project for on the job training. The detail designs of the remaining works should be done by DGOP.

2) Construction and Supervision

The construction of the urgent facilities shall be constructed by international contractors under the supervision of international consultants and DGOP. The remaining long term plan shall be done by local contractors under the supervision of DGOP.

3) Workable Days and Working Hours

Standard workable days for respective works will be estimated on daily rainfall records, Sunday, national holidays and experience of similar works in and around the area. The annual workable days for earthwork and concrete work are assumed to be approximately 220 days. Daily working hours is set at 8 hours.

4) Construction Material

Local material shall be used as much as possible.

12.5.3 Implementation Schedule

The proposed implementation schedule is based on the following assumption:

- Financial and required arrangements shall be complete in 1994,
- Engineering services for the urgent project shall be commenced in 1995,
- The construction works shall be started in 1996 and complete within two years,
- The remaining works shall be commenced in 1998 and complete by the year of 2005.

12.6 Project Evaluation

12.6.1 Economic Evaluation.

1) Economic Cost

An economic feasibility study is carried out about the Rio Choloma project with return period of 50-year in accordance with a conclusion of the Master Plan study. The economic cost of the project is estimated from the project cost shown in Section 12.3, taking into account the conditions and assumptions mentioned in Chapter 1 of the Supporting Report J.

The total economic construction cost is estimated at Lps. 344,152 thousand, and the economic OM cost is appropriated Lps. 3,016 thousand per annum during the period of project life after completion of the construction works. The annual disbursements of these costs are provided in *Table* 12.8.

2) Economic Benefit

The economic benefit of the project with return period of 50-year is the same value as estimated in the Master Plan study, i.e., the estimated annual economic benefit is Lps. 55,855 thousand during the period of project life after completion of the construction works.

3) Economic Evaluation of the Rio Choloma Project

a) Estimate of EIRR

The EIRR of the Rio Choloma project with return period of 50-year is estimated at 15.33 %, using the annual flows of economic cost and benefit shown in Table 12.8.

This EIRR is nearly equal to the percentage estimated in the Master Plan study, i.e., it indicates that the project is economically feasible.

b) Sensitivity Test of EIRR

In the process of estimating the project cost and benefit, various conditions and assumptions have been set in careful consideration based on professional experiences and appropriate judgment of experts. However, there always remains a problem on the reliability of inputs, which have a direct influence on the project cost and benefit. Therefore, a test is carried out about sensitivity of the EIRR to variations in the economic cost and benefit estimated.

The sensitivity test of EIRR is made with respect to a 5 % and 10 % increases in the economic cost and 5 % and 10 % decreases in economic benefit. The results are summarized as follows:

Sensitivity Test of EIRR (%)

		Increase in Cost		
		0 %	5 %	10 %
Decrease in Benefit	0 %	15.33	14.55	13.84
	5 %	14.51	13.77	12.99
	10 %	13.69	13.09	12.34

The results of sensitivity test show that the EIRR still remains more than 12 %, which exceeds the opportunity cost of capital in Honduras, even in a pessimistic condition combined the 10 % increase in cost and the 10 % decrease in benefit. Accordingly, it is concluded that the flood protection project with return period of 50-year for the Rio Choloma is viable economically.

In addition to the above-mentioned tangible effects, the intangible impacts described in Paragraph 11.6.5 of foregone Chapter 11 would be applied also to this project.

12.6.2 Environmental Impacts by the Project

1) General

The anticipated environmental impacts by the project are both direct and indirect. However, the adverse effects directly by the project is anticipated to be insignificant in comparison to the beneficial effects. The proposed plan in itself is an environmental improvement plan.

The anticipated beneficial and adverse effects, both directly and indirectly by the project, are delineated below.

2) Beneficial Effects

The effects by the project will be mostly beneficial. No adverse effects by the project on the Merendon mountain range is anticipated. However, in order to enhance the beneficial effects of erosion control, slope stabilization and erosion control measures like reforestation, agroforestation and soil conservation agricultural practice with terracing are necessary.

The major beneficial effects by the project due to erosion and sediment control will be to the valley floor of the Sula Valley. The mitigation of flooding will enhance the land use potential of this fertile terrain to a variety of economically beneficial uses like urban, industrial and agricultural development. Moreover, enhanced protection to such existing land utilization will be obtained. It is noted that under existing conditions, about 90% land use of the valley floor of the Sula Valley occupies potential economic beneficial use.

3) Adverse Effects

No significant adverse effects by the project to the Merendon mountain range is anticipated. The facilities proposed in the mountain range are confined to check dams to control debris flows and consolidation works to stabilize river beds. Other than these, no other river works are involved.

In the valley floor, the lagoons and the associated wetlands of Jucutuma, Ticamaya, El Carmen, Lama and others are a delicate ecosystem. Most of them are formed due to their distinct topography of a low land area surrounded with a relatively high land or hilly area as its catchment area.

However the proposed river improvement works along Rio Choloma are not expected to interfere with any of these lagoon and wetlands. The erosion and sediment control