Description	Percentage	
	F/C	L/C
Cement	80	20
Reinforcement	70	30
Steel material	70	30
Fuel	80	20
Timber	20	80
Explosive	80	20
Depreciation for equipment	100	-
Repair for equipment	80	20
Maintenance for equipment	-	100
Labor	-	100

3-2 Unit Rate

The unit rate for the civil works is estimated, based on the output of construction equipment, the basic rate for labor, the material and equipment, and the construction plan.

The estimated unit rate for the civil works is presented in Table I-3-1.

3-3 Project Cost

The project cost consists of the construction cost of the civil works and other costs for survey & investigation works, land acquisition ,consulting services and administration.

(1) Construction cost

The construction cost of the civil works is estimated, based on the quantities calculated by preliminary design and the unit rate as described in Table I-3-1.

An overhead of 25 percent for the unit rate has been considered for the works to be carried out on a Contract Basis, administration of 15 percent and profits of 10 percent.

The detailed construction cost estimation is shown in Tables I-3-5 to I-3-10 and summarized in Table I-3-2.

(2) Other cost

(a) Survey and investigation works

The survey and investigation works consist of the preparation of map, geological investigation and construction material survey for the detailed design of the civil works.

The cost is estimated at 408,000 $ as shown in Table I-3-11.

(b) Land acquisition

The land acquisition will be required for cultivated area along the canal and road alignment of the service area. The cost is estimated with a unit of 1,000,000 S/. per ha, and 10,000 $ in total.

(c) Consulting services

The cost of consulting services for the detailed design and construction supervision of the civil works is estimated at 2,540,000 $ as shown in Table I-3-12.

(d) Administration cost

The administration cost is estimated at about 1,657,000 $ corresponding to about 6 percent of the total construction cost. The cost consists of salary, transportation means and miscellaneous costs, except the cost of building facilities and the maintenance of the project office, which is estimated in the construction cost of the preparatory works of the civil works.

(e) Project cost

The project cost based on the above estimation is summarized in Table I-3-3. Assumed that the construction period including detailed design would be four years as alternative (II), the project cost would be increased as shown in Table I-3-4.

Table I-3-1 Unit Rate

Description	Unit	Unit Rate (S/.)		
		F/C	L/C	Total
A. Diversion Weir & Protection Work				
- Common Excavation	cu.m	2,102	1,078	3,180
- Trench Excavation	cu.m	6,938	3,961	10,899
- Fill & Backfill	cu.m	2,976	1,646	4,622
- Reinforced Concrete	cu.m	215,507	174,001	389,508
- Plain Concrete	cu.m	106,277	86,801	193,078
- Stone Pitching	cu.m	24,112	31,046	55,158
- Protection Levee, Type I	m	184,064	257,562	441,626
- - do - , Type II	m	118,453	152,306	270,759
- - do - , Type III	m	16,852	30,307	47,159
B. Irrigation System				
- CommonExcavation	cu.m	1,331	671	2,002
- Fill & Backfill	cu.m	161	3,476	3,637
- Dredging	cu.m	3,682	1,854	5,536
- Reinforced Concrete	cu.m	199,900	167,247	367,147
- Plain Concrete	cu.m	95,813	90,225	186,038
- Lining Concrete	cu.m	123,061	91,202	214,263
- Dry Masonry	cu.m	7,979	14,034	22,013
- Wet Masonry	cu.m	34,098	31,604	65,702
C. Drainage System				
- Common Excavation	cu.m	763	3,433	4,196
- Pipe Drain	m	10,431	6,091	16,522
D. Road Network				
- Grading & Compaction	cu.m	1,081	569	1,650
- Rock Excavation	cu.m	7,802	15,739	23,541
- Rock Embank	cu.m	5,329	2,950	8,279
- Metalling	cu.m	17,026	11,618	28,644

Table I-3-2 Construction Cost

(unit; $)

Description	F/C	L/C	Total
1. Preparatory Work	411,000	373,000	784,000
2. Diversion Weir	3,602,000	1,919,000	5,521,000
3. Irrigation System			
- Irrigation Canal	5,141,000	4,267,000	9,408,000
- Regulated Reservoir	776,000	405,000	1,181,000
sub - total	5,917,000	4,672,000	10,589,000
4. Drainage System			
- Open Drain	406,000	912,000	1,318,000
- Pipe Drain	1,909,000	1,114,000	3,023,000
sub - total	2,315,000	2,026,000	4,341,000
5. Road Network	1,385,000	1,191,000	2,576,000
6. Flood Protection Work	352,000	501,000	853,000
Total	13,982,000	10,682,000	24,664,000

(US$1 is equivalent to S/. 3,340)

Table I-3-3 Project Cost (Original)

(unit; $)

Description	F/C	L/C	Total
A. Civil Work			
1. Preparatory Work	411,000	373,000	784,000
2. Diversion Weir	3,602,000	1,919,000	5,521,000
3. Irrigation System	5,917,000	4,672,000	10,589,000
4. Drainage System	2,315,000	2,026,000	4,341,000
5. Road Network	1,385,000	1,191,000	2,576,000
6. Flood Protection Work	352,000	501,000	853,000
Total	13,982,000	10,682,000	24,664,000
B. Survey & Investigation	82,000	326,000	408,000
C. Land Acquisition	-	10,000	10,000
D. Consulting Services	1,843,000	697,000	2,540,000
E. Administration	-	1,657,000	1,657,000
Base Cost	15,907,000	13,372,000	29,279,000
F. Physical Contingencies	1,591,000	1,337,000	2,928,000
G. Price Contingencies	5,086,000	4,181,000	9,267,000
Grand - Total	22,584,000	18,890,000	41,474,000

Table I-3-4 Project Cost (Alternative)

(unit; $)

Description	F/C	L/C	Total
A. Civil Work			
1. Preparatory Work	411,000	373,000	784,000
2. Diversion Weir	3,602,000	1,919,000	5,521,000
3. Irrigation System	8,706,000	5,977,000	14,683,000
4. Drainage System	2,315,000	2,026,000	4,341,000
5. Road Network	1,385,000	1,191,000	2,576,000
6. Flood Protection Work	352,000	501,000	853,000
Total	16,771,000	11,987,000	28,758,000
B. Survey & Investigation	82,000	326,000	408,000
C. Land Acquisition	-	10,000	10,000
D. Consulting Services	1,843,000	697,000	2,540,000
E. Administration	-	1,903,000	1,903,000
Base Cost	18,696,000	14,923,000	33,619,000
F. Physical Contingencies	1,870,000	1,492,000	3,362,000
G. Price Contingencies	4,395,000	3,426,000	7,821,000
Grand - Total	24,961,000	19,841,000	44,802,000

Table I-3-5 Cost of Preparatory Work

Description	Unit	Quantity	Unit Rate (x 10^3 S/.)	Amount (x 10^3 S/.) Total	F/C	L/C
1. Office & Equipment						
- Office	sq.m	400	8,410	200,400	-	-
- Equipment	L.S.	-	-	100,500	-	-
sub - total				300,600	-	-
2. Residence						
- Grade I (100 sq.m)	unit	2	97,528	195,056	-	-
- Grade II (80 sq.m)	unit	4	40,080	160,320	-	-
- Grade III (70 sq.m)	unit	2	26,186	52,372	-	-
sub - total				407,748	-	-
3. Demetory	sq.m	200	167	33,400	-	-
4. Garage & Warehouse	sq.m	200	434	86,840	-	-
5. Site Laboratory	sq.m	50	985	49,250	-	-
6. O/M Cost	L.S.	-	-	438,919	-	-
Total(1)				1,316,757	395,027	921,730
7. Transportation Means						
- Capital Cost	L.S.	-	-	525,000	525,000	-
- O/M Cost	L.S.	-	-	254,000	177,800	76,200
sub - total				779,000	702,800	76,200
Total				2,095,757	1,097,827	997,930
8. Contractor's Overhead	L.S.	-	-	523,939	274,457	249,482
Grand - Total				2,619,696	1,372,284	1,247,412
				US$ (784,000)	(411,000)	(373,000)

Table I-3-6 Construction Cost of Diversion Weir

Description	Unit	Quantity	Unit Rate (S/.)			Amount (x 10^3 S/.)		
			F/C	L/C	Total	F/C	L/C	Total
1. Diversion Weir								
- Common Excavation	cu.m	33,600	2,102	1,078	3,180	70,627	36,221	106,848
- Trench Excavation	cu.m	8,300	6,938	3,961	10,899	57,585	32,877	90,462
- Fill & Backfill	cu.m	12,500	2,976	1,646	4,622	37,200	20,575	57,775
- Reinforced Concrete	cu.m	8,310	215,507	174,001	389,508	1,790,863	1,445,948	3,236,811
- Plain Concrete	cu.m	17,650	106,277	86,801	193,078	1,875,789	1,532,038	3,407,827
- Wet Masonry	cu.m	1,510	34,098	31,604	65,702	51,488	47,722	99,210
- Stone Pitching	cu.m	2,280	24,112	31,046	55,158	54,975	70,786	125,761
- Protection Levee, Type I	m	515	184,064	257,562	441,626	94,793	132,644	227,437
- do - , Type II	m	1,000	118,453	152,306	270,759	118,453	152,306	270,759
- Gabion	stick	170	49,743	62,997	112,740	8,456	10,709	19,165
- Tunnel	m	50	1,800,000	450,000	2,250,000	90,000	22,500	112,500
- Sluice Gate	sq.m	186	20,250,000	2,250,000	22,500,000	3,766,500	418,500	4,185,000
sub - total						8,016,729	3,922,826	11,939,555
- Temporary Work	L.S.	-	-	-	-	850,046	700,865	1,550,911
- Miscellaneous	L.S.	-	-	-	-	443,339	231,184	674,523
sub - total						1,293,385	932,049	2,225,434
Total(1)						9,310,114	4,854,875	14,164,989
2. Collecting Conduit								
- Common Excavation	cu.m	52,000	1,331	671	2,002	69,212	34,892	104,104
- Plain Concrete	cu.m	10	95,813	90,225	186,038	958	902	1,860
- Fill	cu.m	4,800	7,979	14,034	22,013	38,299	67,363	105,662
- Sand	cu.m	380	3,000	12,000	15,000	1,140	4,560	5,700
- Timber	cu.m	31	157,200	628,800	786,000	4,873	19,493	24,366
- R.C. Pipe, 1,000 mm	m	800	195,933	135,079	334,012	156,746	110,463	267,209
sub - total						271,228	237,673	508,901
- Temporary Work	L.S.	-	-	-	-	27,123	23,767	50,890
- Miscellaneous	L.S.	-	-	-	-	14,918	13,072	27,990
sub - total						42,041	36,839	78,880
Total(2)						313,269	274,512	587,781
Total						9,623,383	5,129,387	14,752,770
3. Contractor's Overhead	L.S.	-	-	-	-	2,405,846	1,282,347	3,688,193
Grand - Total						12,029,229	6,411,734	18,440,963
						US$ (3,602,000)	(1,919,000)	(5,521,000)

Table I-3-7 Construction Cost of Irrigation System

Description	Unit	Quantity	Unit Rate (S/.)			Amount (x 10^3 S/.)		
			F/C	L/C	Total	F/C	L/C	Total
1. Irrigation Canal								
- Common Excavation	cu.m	189,000	1,331	671	2,002	251,559	126,819	378,378
- Fill & Backfill	cu.m	389,000	161	3,476	3,637	62,629	1,352,164	1,414,793
- LiningConcrete	cu.m	27,500	123,061	91,202	214,263	3,384,178	2,508,055	5,892.233
- Dry Masonry	cu.m	23,600	7,979	14,034	22,013	188,304	331,202	519,506
- Wet Masonry	cu.m	75,300	34,098	31,604	65,702	2,567,579	2,379,781	4,947,360
- Related Structure	L.S.	-	-	-	-	5,133,458	2,405,743	7,539,201
sub - total						11,587,707	9,103,764	20,691,471
- Temporary Work	L.S.	-	-	-	-	1,158,771	910,376	2,069,147
- Miscellaneous	L.S.	-	-	-	-	596,535	468,662	1,065,197
sub - total						1,755,306	1,379,038	3,134,344
- Contractor's Camp	L.S.	-	-	-	-	393,800	918,800	1,312,600
Total(1)						13,736,813	11,401,602	25,138,415
2. Regulated Reservoir								
- Dredging	cu.m	71,000	3,682	1,854	5,536	261,422	131,634	393,056
- Common Excavation	cu.m	82,800	1,331	671	2,002	110,207	55,559	165,766
- Earth Embank	cu.m	64,600	6,204	3,463	9,667	400,778	223,710	624,488
- Reinforced Concrete	cu.m	630	199,900	167,247	367,147	125,937	105,366	231,303
- Plain Concrete	cu.m	3,180	95,813	90,225	186,038	304,685	286,916	591,601
- Fill	cu.m	500	7,979	14,034	22,013	3,990	7,017	11,007
- Sluice Gate	sq.m	39	13,500,000	1,500,000	15,000,000	526,500	58,500	585,000
sub - total						1,733,519	868,702	2,602,221
- Temporary Work	L.S.	-	-	-	-	241,404	162,040	403,444
- Miscellaneous	L.S.	-	-	-	-	98,746	51,537	150,283
sub - total						340,150	213,577	553,727
Total(2)						2,073,669	1,082,279	3,155,948
Total						15,810,482	12,483,881	28,294,363
3. Contractor's Overhead	L.S.	-	-	-	-	3,952,621	3,120,970	7,073,591
Grand - Total						19,763,103	15,604,851	35,367,954
						US$ (5,917,000)	(467,200)	(10,589,000)

Table I-3-8 Construction Cost of Drainage System

Description	Unit	Quantity	Unit Rate (S/.)			Amount (x 10^3 S/.)		
			F/C	L/C	Total	F/C	L/C	Total
1. Open Canal								
- Common Excavation	cu.m	589,800	763	3,433	4,196	450,017	2,024,783	2,474,800
- Grading & Compaction	cu.m	81,200	1,081	569	1,650	87,777	46,203	133,980
sub - total						537,794	2,070,986	2,608,780
- Related Structure	L.S.	-	-	-	-	547,844	365,229	913,073
Total(1)						1,085,638	2,436,215	3,521,853
2. Pipe Drain								
- Pipe Drain	m	407,400	10,431	6,091	16,521	4,249,589	2,481,473	6,731,062
- Miscellaneous	L.S.	-	-	-	-	849,918	496,295	1,346,213
Total(2)						5,099,507	2,977,768	8,077,275
Total						6,185,145	5,413,983	11,599,128
3. Contractor's Overhead	L.S.	-	-	-	-	1,546,286	1,353,496	2,899,782
Grand - Total						7,731,431	6,767,479	14,498,910
						US$ (2,315,000)	(2,026,000)	(4,341,000)

Table I-3-9 Construction Cost of Road Network

Description	Unit	Quantity	Unit Rate (S/.)			Amount (x 10^3 S/.)		
			F/C	L/C	Total	F/C	L/C	Total
1. Road								
- Grading & Compaction	cu.m	356,500	1,081	569	1,650	385,377	202,848	588,225
- Rock Excavation	cu.m	73,800	7,802	15,739	23,541	575,788	1,161,538	1,737,326
- Rock Embank	cu.m	40,000	5,329	2,950	8,279	213,160	118,000	331,160
- Metalling	cu.m	81,330	17,026	11,618	28,644	1,384,725	944,892	2,329,617
- Floorboard for Bridge	L.S.	-	-	-	-	525,000	225,000	750,000
sub - total						3,084,050	2,652,278	5,736,328
- Related Structure	L.S.	-	-	-	-	616,810	530,456	1,147,266
Total						3,700,860	3,182,734	6,883,594
2. Contractor's Overhead	L.S.	-	-	-	-	925,215	795,684	1,720,899
Grand - Total						4,626,075	3,978,418	8,604,493
						(1,385,000)	(1,191,000)	(2,576,000)

Table I-3-10 Construction Cost of Flood Protection Work

Description	Unit	Quantity	Unit Rate (S/.)			Amount ($\times 10^3$ S/.)		
			F/C	L/C	Total	F/C	L/C	Total
1. Protection Levee								
- Type I	m	1,500	184,064	257,562	441,626	276,096	386,344	662,440
- Type II	m	3,000	118,453	152,306	270,759	355,359	456,918	812,277
- Type III	m	9,000	16,852	30,307	47,159	151,668	272,763	424,431
sub - total						783,123	1,116,025	1,899,148
- Temporary Work	L.S.	-	-	-	-	156,625	223,205	379,830
Total						939,748	1,339,230	2,278,978
2. Contractor's Overhead	L.S.	-	-	-		234,937	334,808	569,745
Grand - Total						1,174,685	1,674,038	2,848,723
						US$ (352,008)	(501,000)	(853,000)

Table I-3-11 Cost of Survey, Investigation & Test

Description	Unit	Q'ty	Unit Rate (x 10^3 S/.)	Amount (x 10^3 S/.) Total	F/C	L/C
- Plane Map, S=1:1,000	sq.km	29.4	38,410	1,129,254	225,851	903,403
- Profile Survey, SV=1:100, SH=1:2,500	km	509.0	434	220,906	44,181	176,725
- Test Pit	nos.	9	750	6,750	-	6,750
- Laboratory Test	L.S.	-	-	6,815	4,771	2,044
sub - total				1,363,725	274,803	1,088,922
- Miscellaneous	L.S.	-	-	275	55	220
Total				1,364,000	274,858	1,089,142
				US$ (408,000)	(82,000)	(3,260,000)

Table I-3-12 Cost of Consulting Services

Description	Unit	Q'ty	Rate ($\times 10^3$ S/.)	Amount ($\times 10^3$ S/.)
A. Detailed Design				
1. Foreign Currency				
- Remuneration of Foreign Experts	month	79	30,000	2,370,000
- Remuneration of Local Experts	month	69	3,000	207,000
- International Travel Expenses	trip	13	10,500	136,500
- Reimbursable Cost	L.S.	-	-	271,500
sub - total				2,985,000
2. Local Currency				
- Consultants per Diem	month	144	3,750	540,000
- Living Allowance	month	144	3,000	432,000
- Local Transportation	unit-month	56	4,600	257,600
- Printing of Reports	L.S.	-	-	225,000
- Miscellaneous	L.S.	-	-	400
sub -total				1,455,000
Total				4,440,000
B. Construction Supervision				
1. Foreign Currency				
- Remuneration of Foreign Experts	month	80	30,000	2,400,000
- Remuneration of Local Experts	month	133	3,000	399,000
- International Travel Expenses	trip	8	10,500	84,000
- Reimbursable Cost	L.S.	-	-	289,000
sub - total				3,172,000
2. Local Currency				
- Consultants per Diem	month	213	3,750	798,750
- Printing of Reports	L.S.	-	-	75,000
- Miscellaneous	L.S.	-	-	250
sub - total				874,000
Total				4,046,000
Grand - Total				8,486,000
				($ 2,540,000)

Table I-3-13 (1) Disbursement Schedule (1 of 2)

(unit : x 10^3 $)

Description	1986			1987			1988			1989		
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
A. Civil Work												
1. Preparatory Work	-	-	-	306	283	589	21	18	39	21	18	39
2. Diversion Weir	-	-	-	-	-	-	1,081	576	1,657	1,081	575	1,656
3. Irrigation System	-	-	-	872	684	1,566	1,162	912	2,074	1,268	1,024	3,099
4. Open Drain	-	-	-	52	163	215	78	244	322	224	342	566
5. Pipe Drain	-	-	-	-	-	-	-	-	-	157	79	236
6. Road Network	-	-	-	277	238	515	485	417	902	485	416	901
7. Protection Work	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	1,507	1,368	2,875	2,827	2,167	4,994	3,236	2,454	5,690
B. Survey & Investigation	82	326	408	-	-	-	-	-	-	-	-	-
C. Land Acquisition	-	-	-	-	10	10	-	-	-	-	-	-
D. Consulting Services	829	314	1,143	184	70	254	184	70	254	185	69	254
E. Administration	-	332	332	-	166	166	-	248	248	-	249	249
Base Cost	911	972	1,883	1,691	1,614	3,305	3,011	2,485	5,496	3,421	2,772	6,193
G. Physical Contingencies	91	97	188	169	162	331	301	249	550	342	277	619
F. Price Contingencies	103	110	213	294	280	574	715	591	1,306	1,039	841	1,880
Grand - Total	1,105	1,179	2,284	2,154	2,056	4,210	4,027	3,325	7,352	4,802	3,890	8,692

Note : Price escalation rate of 5 % for F/C and L/C is applied for estimating Price Contingencies.

Table I-3-13 (2) Disbursement Schedule (2 of 2)

(unit : x 10^3 $)

Description	1990			1991			1992			Total		
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
A. Civil Work												
1. Preparatory Work	21	18	39	21	18	39	21	18	39	411	373	784
2. Diversion Weir	720	384	1,104	720	384	1,104	-	-	-	3,602	1,919	5,521
3. Irrigation System	1,162	912	2,074	872	684	1,556	581	456	1,037	5,917	4,672	10,589
4. Open Drain	52	163	215	-	-	-	-	-	-	406	912	1,318
5. Pipe Drain	657	388	1,045	657	388	1,045	438	259	697	1,909	1,114	3,023
6. Road Network	138	120	258	-	-	-	-	-	-	1,385	1,191	2,576
7. Protection Work	176	251	427	176	250	426	-	-	-	352	501	853
Total	2,926	2,236	5,162	2,446	1,724	4,170	1,040	733	1,773	14,011	10,653	24,664
B. Survey & Investigation	-	-	-	-	-	-	-	-	-	82	236	408
C. Land Acquisition	-	-	-	-	-	-	-	-	-	-	10	10
D. Consulting Services	185	69	254	184	70	254	92	35	127	1,842	697	2,540
E. Administration	-	248	248	-	248	248	-	166	166	-	1,657	1,657
Base Cost	3,111	2,553	5,664	2,630	2,042	4,672	1,132	934	2,066	15,907	13,372	29,279
G. Physical Contingencies	311	255	566	263	204	467	114	93	207	1,591	1,337	2,928
F. Price Contingencies	1,164	954	2,118	1,177	915	2,092	594	490	1,084	5,086	4,181	9,267
Grand - Total	4,586	3,762	8,348	4,070	3,161	7,231	1,840	1,517	3,357	22,584	18,890	41,474

Note : Price escalation rate of 5 % for F/C and L/C is applied for estimating Price Contingencies.

Table I-3-14 Depreciation Cost of Construction Equipment

Description	Purchase Price	Life Time	Depreci-ation	Repair Cost			Administration		Total	
				Rate	F/C	L/C	Rate	L/C	F/C	L/C
	(x 10^3 S/.)		(S/.)	(%)	(S/.)	(S/.)	(%)	(S/.)	(S/.)	(S/.)
Bulldozer, 8 ton, 86 HP	144,200	9,600 hr.	13,519	150	18,025	4,506	56	8,412	31,544	12,918
- do - , 11 ton, 108 HP	186,100	11,600 hr.	14,439	150	19,252	4,813	56	8,984	33,691	13,797
Swamp Bulldozer, 9 ton , 89 HP	154,000	11,600 hr.	11,948	190	20,179	5,045	56	7,434	32,127	12,479
Back-hoe Shovel, 0.4 m3, 86 HP	184,500	10,800 hr.	15,375	110	15,033	3,758	42	7,175	30,408	10,933
- do - , 0,6 m3, 108 HP	234,400	10,800 hr.	19,533	110	19,099	4,775	42	9,116	38,632	13,891
Tractor Shovel , 0.4 m3, 38 HP	69,600	8,800 hr.	7,118	125	7,909	1,977	56	4,429	15,027	6,406
- do - , 0.8 m3, 67 HP	103,900	8,800 hr.	10,626	130	12,279	3,070	56	6,612	22,905	9,682
Dump Truck, 6 ton, 170 HP	58,400	9,500 hr.	5,533	130	6,393	1,598	50	3,074	11,926	4,672
- do - , 8 ton, 242 HP	81,000	9,500 hr.	7,674	115	7,844	1,961	50	4,263	15,518	6,224
- do - , 10 ton, 314 HP	119,300	9,500 hr.	11,302	105	10,549	2,637	50	6,279	21,851	8,916
Truck Crane, 10 ton, 230 HP	196,000	8,400 hr.	21,000	55	10,267	2,567	49	11,433	31,267	14,000
Trencher, D= 250 cm, 200 HP	580,000	5,600 hr.	93,214	225	186,429	46,607	56	58,000	279,643	104,607
Concrete Mixer, 0.2 m3	9,000	900 day	9,000	105	8,400	2,100	25	2,500	17,400	4,600
- do - , 1.0 m3	94,400	900 day	94,400	105	88,107	22,027	25	26,222	182,507	48,249
Vibro Roller, 6 ton, 56 HP	119,700	5,700 hr.	18,900	85	14,280	3,570	42	8,820	33,180	12,390
Vibro Compactor, 100 kg, 4 HP	4,300	900 day	4,300	120	4,587	1,147	25	1,194	8,887	2,341

Fig. I-1-1 (1) Project Orgnization Chart for Implementation

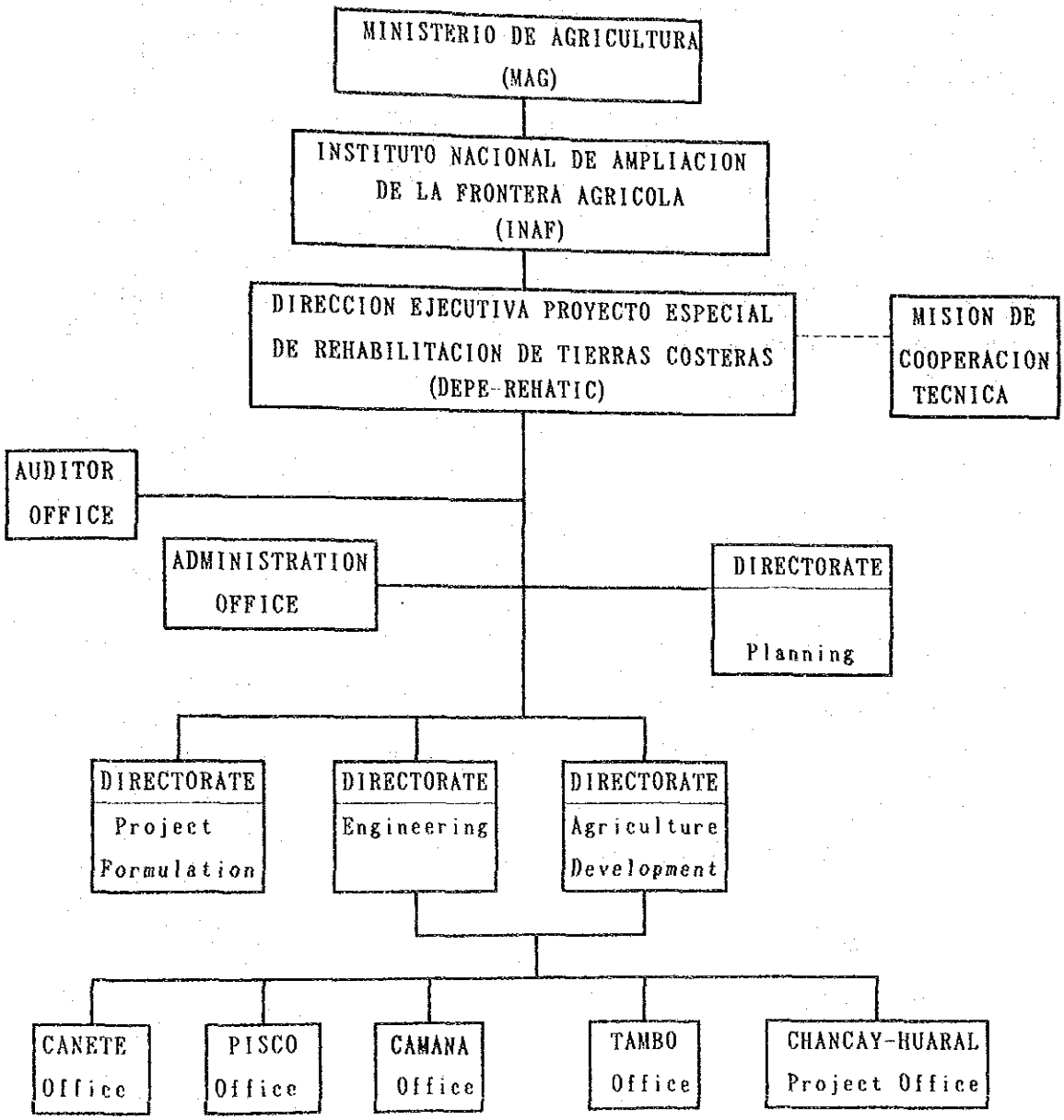
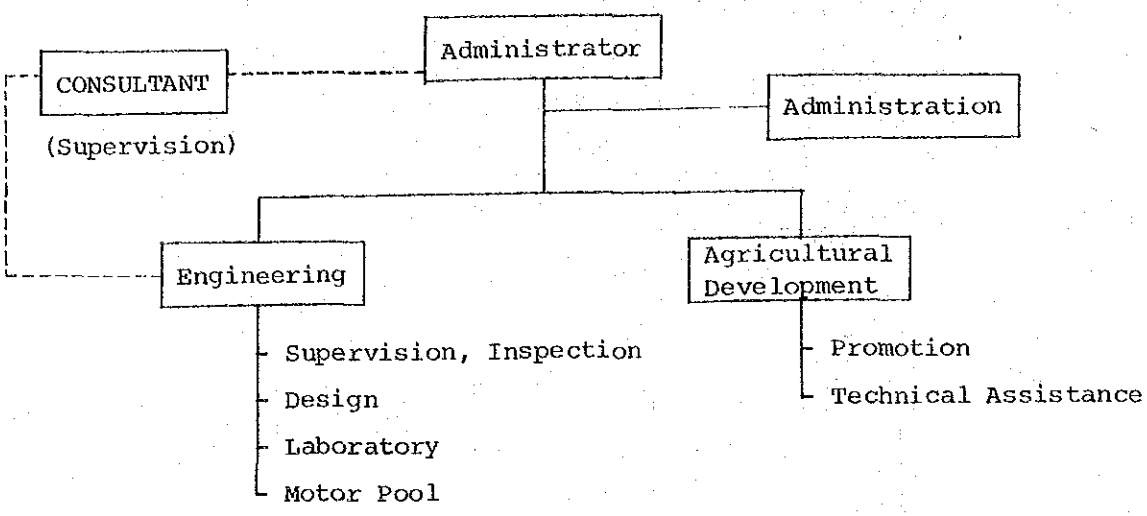


Fig. I-1-1(2) Proposed Project Office Chart



Proposed number of personnel (Project Office)

Administrator	1
Engineer	10
Technician	10
Office clerk	5
Driver/Mechanic	10
Watch man	2

Proposed number of transportation facility

Station Wagon	1
4 WD Jeep	5
Pick up	5
Motor cycle	10

FIG. I-1-2 Work Schedule for Detailed Design

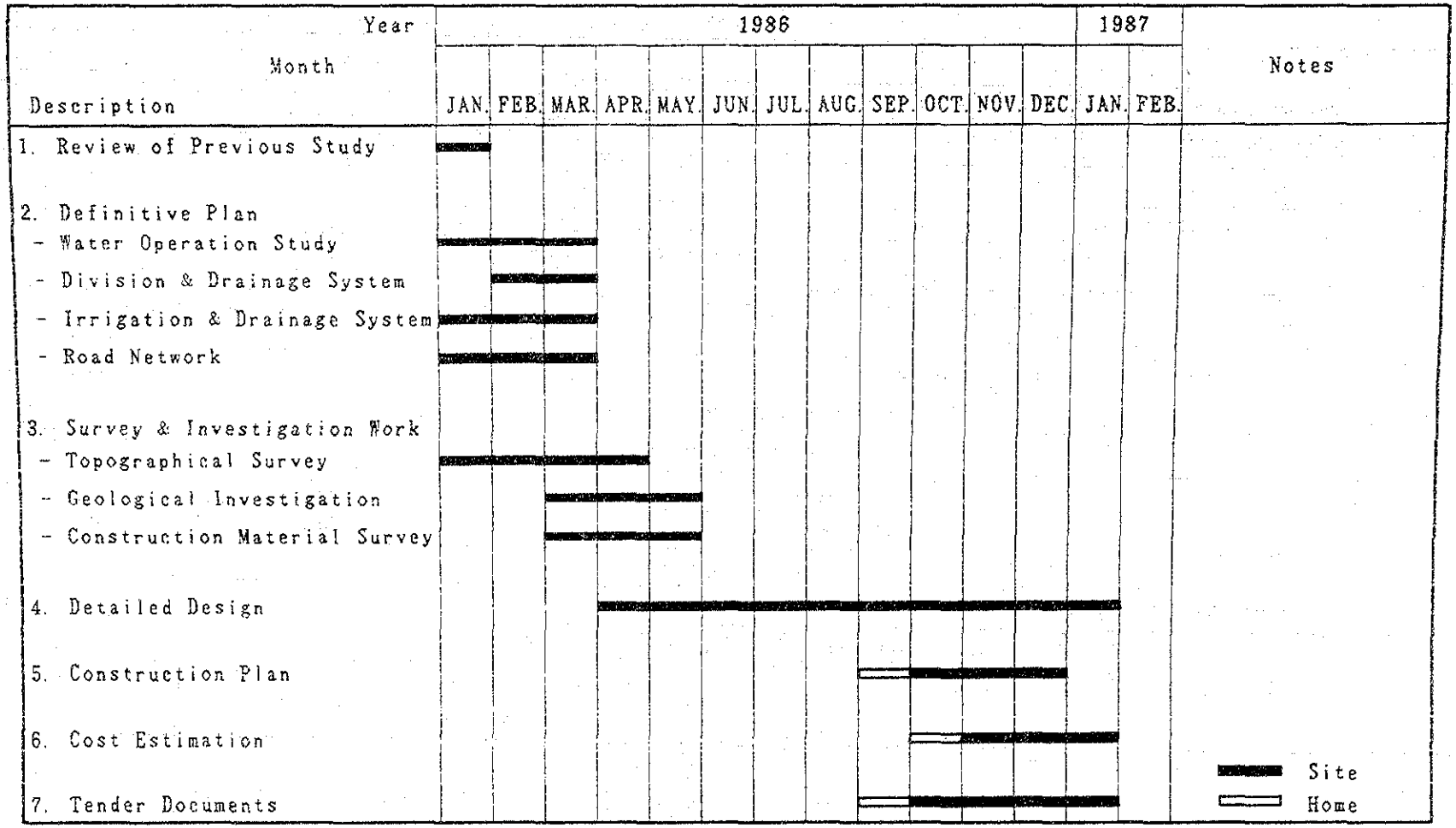


FIG. I-1-3 Manning Schedule for Detailed Design

Engineering Staff	Man-Month				1986												1987			No. of Trips
	Foreign		Local	Total	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC	JAN.	FEB.	MAR.	
	Local	Home																		
Team Leader (F)	12	1	-	13																2
Hydrogist (F)	3	-	-	3																1
Soil Mechanist (F)	3	-	-	3																1
Geologist (F)	3	-	-	3																1
Irrigation Engineer (F)	5	-	-	5																1
-do- (L)	-	-	5	5																-
Design Engineer. Diversion (F)	12	-	-	12																1
-do- (F)	-	-	12	12																-
Design Eng. Canal. 2 Persons (F)	23	-	-	23																2
-do- 4 Persons (L)	-	-	52	52																-
Construction Planner (F)	3	1	-	4																1
Cost Estimater (F)	3	1	-	4																1
Civil Eng. for Specification (F)	4	1	-	5																1
Civil Eng. for Tender Documents (F)	4	-	-	4																1
TOTAL	75	4	69	148																13

* F : Foreign
* L : Local

Site
Home

FIG. 1-1-4 Manning Schedule for Construction Supervision

Engineering Staff	Man-Month			1987			1988			1989			1990			1991			1992			No. of
	Foreign	Local	Total	APR.	AUG.	DEC.	APR.	AUG.	DEC.	APR.	AUG.	DEC.	APR.	AUG.	DEC.	APR.	AUG.	DEC.	APR.	AUG.	DEC.	Trips
Civil Eng. for Tendering (F)	6	-	6																			1
Resident Eng. for Supervision (F)	36	-	36																			3
Supervisor for Diversion (F)	14	-	14																			2
-do- (L)	-	43	43																			-
Supervisor foe Canal (F)	24	-	24																			2
-do- (L)	-	60	60																			-
Laboratory Eng. (L)	-	30	30																			-
TOTAL	80	133	213																			8

F : Foreign

L : Local

FIG. I-1-5 Implementation Schedule for the Project (Original)

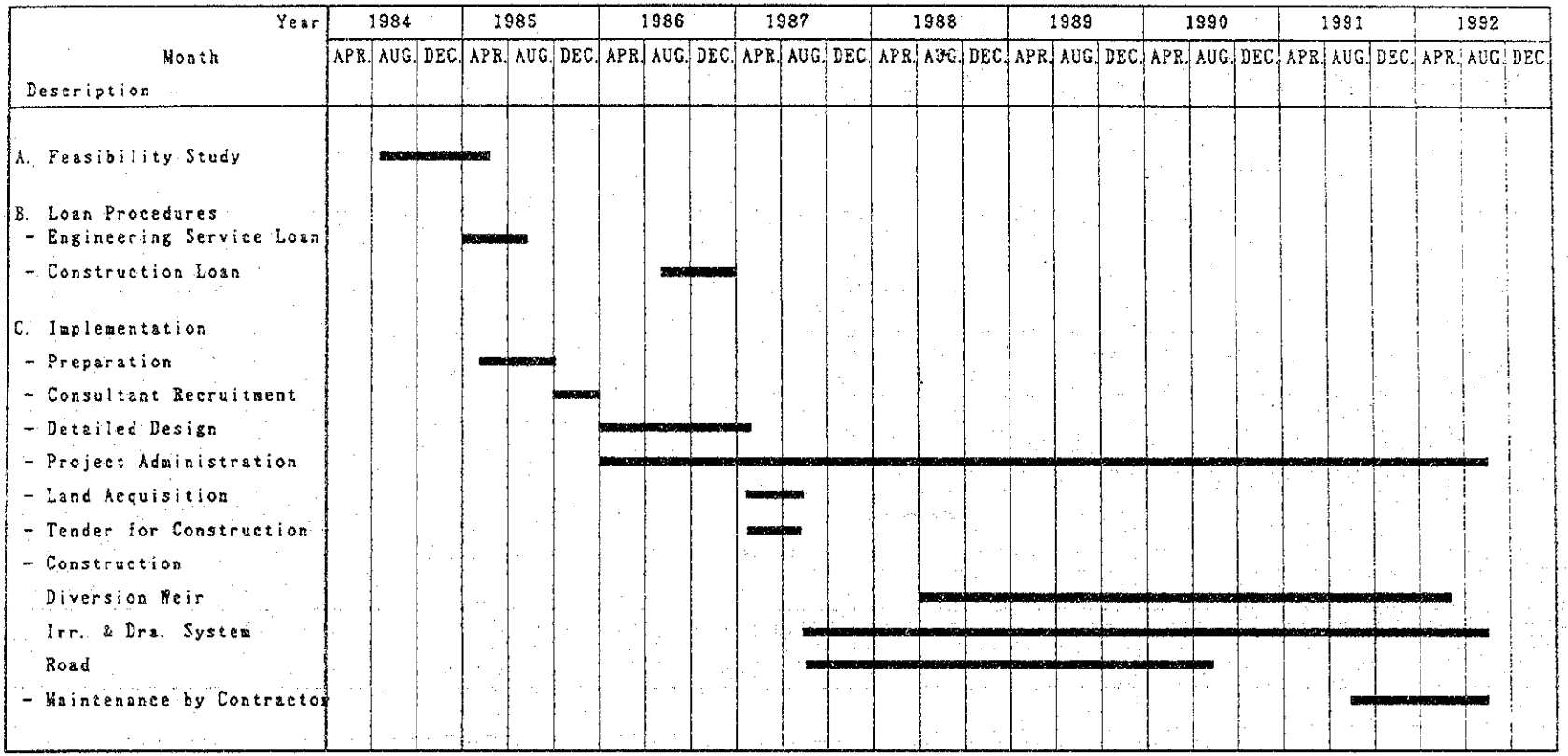


Table I-1-6 Implementation Schedule for the Project (Alternative 1)

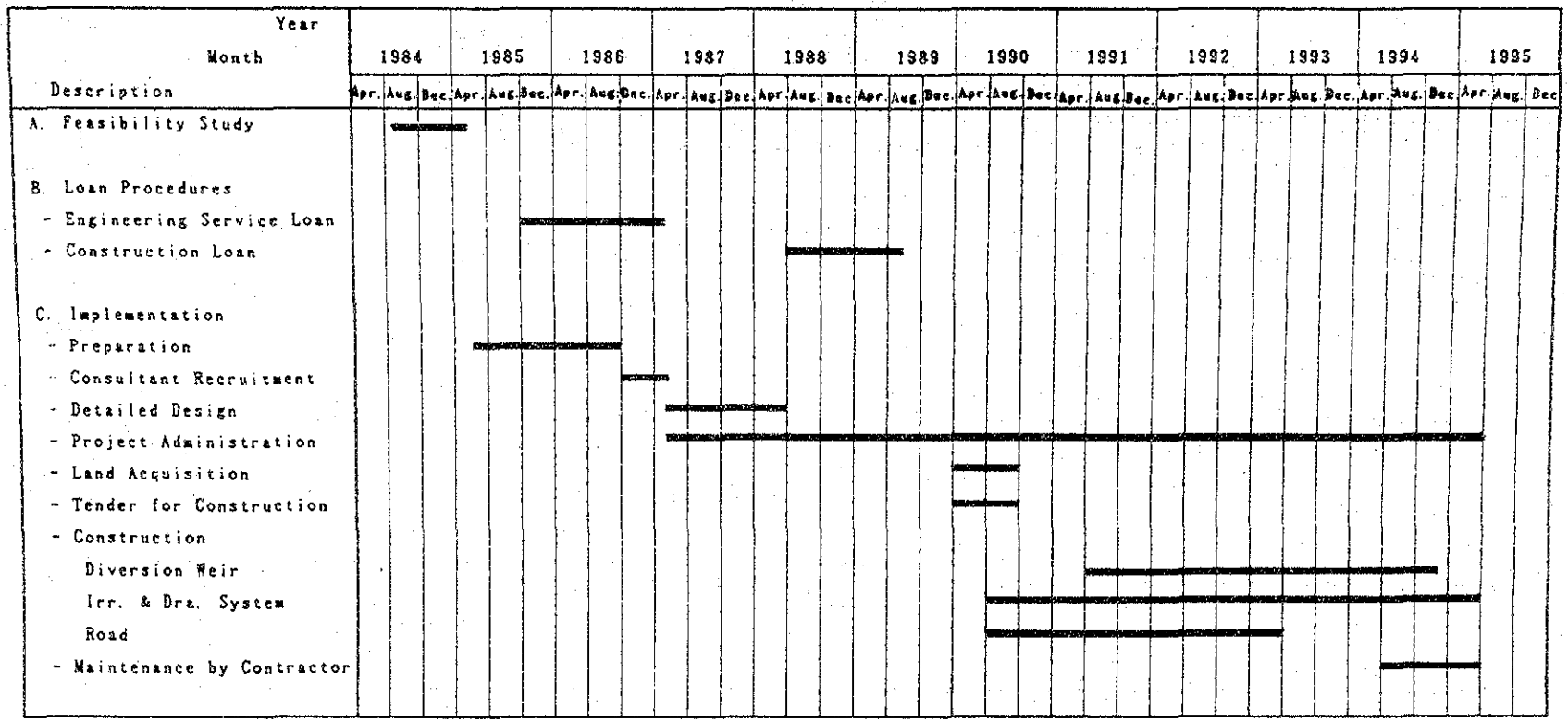


FIG. I-2-1 Construction Schedule

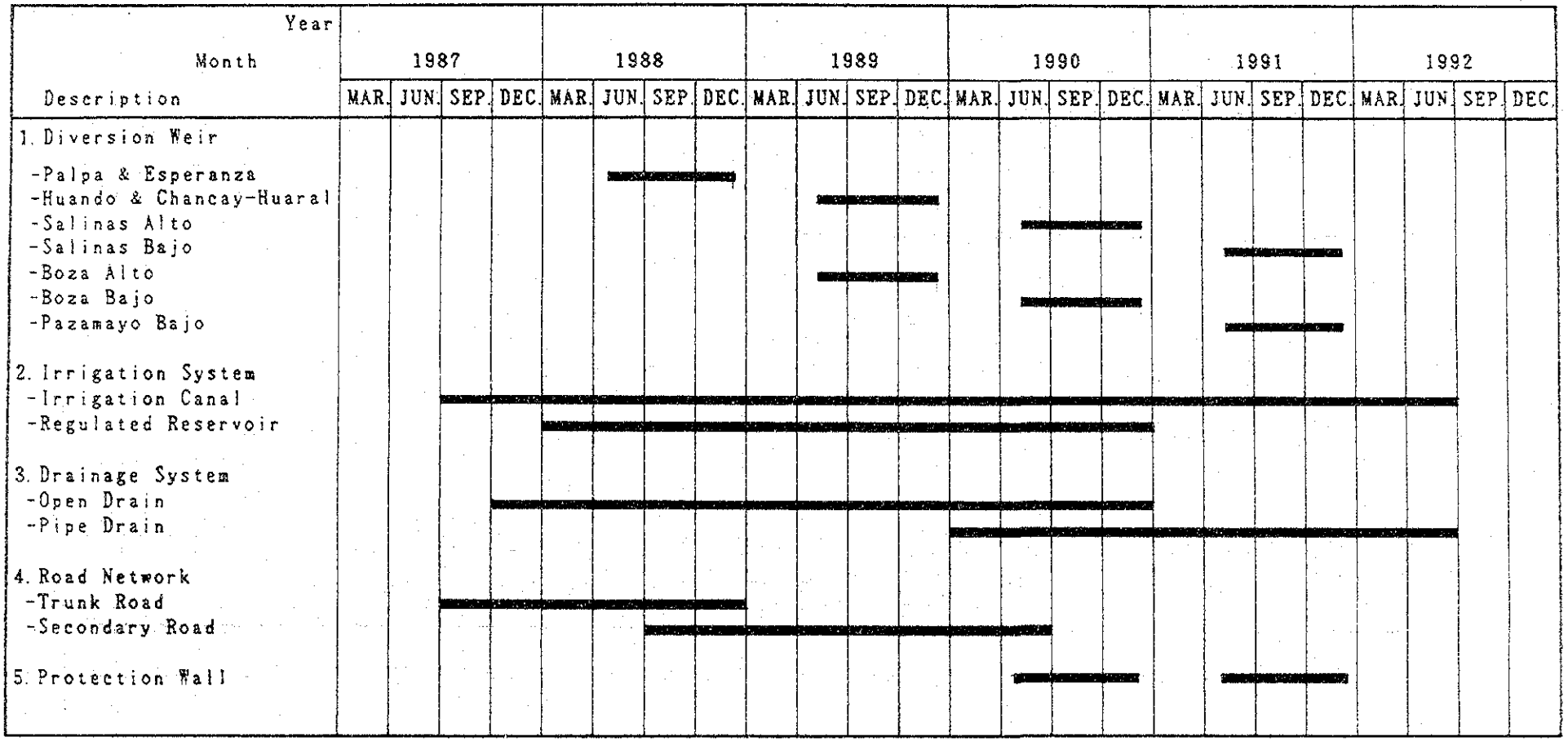


Table I-3-15(1) BREAKDOWN OF UNIT PRICE

ITEM NO.: E-1a WORK: Common Excavation by Bulldozer (Gravel) ... for Weir

PRICE: 3,180 S/./m^3 NOTE: 20.7 m^3/hr. Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d	0.13	-	34,380	-	4,469	4,469	
Assistant Operator	"	0.06	-	26,750	-	1,605	1,605	
Sub-total					-	6,074	6,074	
2. Material								
Light Oil	lit.	14.00	584	146	8,176	2,044	10,220	
Miscellaneous	%	20	-	-	1,635	409	2,044	
Sub-total					9,811	2,453	12,264	
3. Depreciation								
Bulldozer, 11 ton	hr.	1.00	33,691	13,797	33,691	13,797	47,488	E=0.5, ℓ=50m
Sub-total					33,691	13,797	47,488	
Total					43,502	22,324	65,826	
per m^3					2,102	1,078	3,180	

Table I-3-15(2) BREAKDOWN OF UNIT PRICE

ITEM NO.: E-1b WORK: Common Excavation by Back-hoe Shovel (Sandy)

PRICE: 2,002 S/./m^3 NOTE: 27.8 m^3/hr. Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d	0.13	-	34,380	-	4,469	4,469	
Assistant Operator	"	0.06	-	26,750	-	1,605	1,605	
Sub-total					-	6,074	6,074	
2. Material								
Light Oil	lit.	9.40	584	146	5,490	1,372	6,862	
Miscellaneous	%	0.20	-	-	1,098	275	1,373	
Sub-total					6,588	1,647	8,235	
3. Depreciation								
Back-hoe Shovel,0.4m^3	hr.	1.00	30,408	10,933	30,408	10,933	41,341	E=0.6, ϕ=90°
Sub-total					30,408	10,933	41,341	
Total					36,996	18,654	55,650	
per m^3					1,331	671	2,002	

Table I-3-15(3) BREAKDOWN OF UNIT PRICE

ITEM NO.: E-1c WORK: Common Excavation (Sandy) ... for Open Drain

PRICE: 4,196 S/./ m^3 NOTE: 60 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.60	-	39,760	-	23,856	23,856	
Common Labor	"	6.00	-	26,750	-	160,500	160,500	
Operator	"	0.13	-	34,380	-	4,469	4,469	
Assistant Operator	"	0.06	-	26,750	-	1,605	1,605	
Sub-total					-	190,430	190,430	
2. Material								
Light Oil	lit.	10.20	584	146	5,957	1,489	7,446	
Miscellaneous	%	20	-	-	1,191	298	1,489	
Sub-total					7,148	1,787	8,935	
3. Depreciation								
Back-hoe Shovel, 0.6m^3	hr.	1.00	38,632	13,891	38,632	13,891	52,523	E=0.7, ∅=90°
Sub-total					38,632	13,891	52,523	
Total					45,780	206,108	251,888	
per m^3					763	3,433	4,196	

Table I-3-15(4) BREAKDOWN OF UNIT PRICE

ITEM NO.: E-2 WORK: Trench Excavation (Gravel) ... for Weir (H ≥ 2.0m)

PRICE: 10,899 S/./ m^3 NOTE: 29.5 m^3/hr. Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d	0.82	-	34,380	-	28,192	28,192	
Assistant Operator	"	0.41	-	26,750	-	10,967	10,967	
Sub-total					-	39,159	39,159	
2. Material								B.S T.S B.D
Light Oil	lit.	51.00	584	146	29,784	7,446	37,230	11.0 +36.0 +4.0
Miscellaneous	%	20	-	-	5,957	1,489	7,446	
Sub-total					35,741	8,935	44,676	
3. Depreciation								
Back-hoe Shovel, 0.6m^3	hr.	1.00	38,632	13,891	38,632	13,891	52,523	E=0.5, ϕ=180°
Tractor Shovel, 0.8m^3	"	5.00	22,905	9,682	114,525	48,410	162,935	E=0.6, ℓ=50m
Bulldozer, 8 ton	"	0.50	31,544	12,918	15,772	6,459	22,231	E=0.6
Sub-total					168,929	68,760	237,689	
Total					204,670	116,854	321,524	
per m^3					6,938	3,961	10,899	

Table I-3-15(5) BREAKDOWN OF UNIT PRICE

ITEM NO.: E-3a WORK: Fill & Backfill ... for Weir

PRICE: 4,622 S/./m^3 NOTE: 40.0 m^3/hr. Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d	0.43	-	34,380	-	14,783	14,783	
Assistant Operator	"	0.25	-	26,750	-	6,688	6,688	
Sub-total					-	21,471	21,471	
2. Material								B.D V.R W.I
Light Oil	lit.	23.66	584	146	13,817	3,455	17,272	16.0 +5.34 +2.32
Miscellaneous	%	20	-	-	2,763	691	3,454	
Sub-total					16,580	4,146	20,726	
3. Depreciation								
Bulldozer, 8 ton	hr.	2.00	31,544	12,918	63,088	25,836	88,924	E=0.6, ℓ=30m
Vibro Roller, 6 ton	"	1.00	33,180	12,390	33,180	12,390	45,570	E=0.4, D=30cm,N=
Water Tanker, 6 kℓ	"	0.40	15,451	5,055	6,180	2,022	8,202	
Sub-total					102,448	40,248	142,696	
Total					119,028	65,863	184,893	
per m^3					2,976	1,646	4,622	

Table I-3-15(6) BREAKDOWN OF UNIT PRICE

ITEM NO.: E-3b WORK: Fill & Backfill

PRICE: 3,637 S/./m^3 NOTE: 10 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.11	-	39,760	-	4,374	4,374	
Skilled Labor	"	0.21	-	34,380	-	7,220	7,220	
Common Labor	"	0.85	-	26,750	-	22,737	22,737	
Sub-total					-	34,331	34,331	
2. Material								
Gasoline	lit.	0.12	744	186	89	23	112	
Miscellaneous	%	15	-	-	13	4	17	
Sub-total					102	27	129	
3. Depreciation								
Vibro Compactor,100kg	day	0.17	8,887	2,341	1,511	398	1,909	
Sub-total					1,511	398	1,909	
Total					1,613	34,756	36,369	
per m^3					161	3,476	3,637	

Table I-3-15(7) BREAKDOWN OF UNIT PRICE

ITEM NO.: F-4 WORK: Dredging

PRICE: 5,536 S/./ m^3 NOTE: 16.6 m^3/hr. Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d	0.19	-	34,380	-	6,532	6,532	
Assistant Operator	"	0.09	-	26,750	-	2,408	2,408	
Sub-total					-	8,940	8,940	
2. Material								
Light Oil	lit.	13.80	584	146	8,059	2,015	10,074	$8.3^{B.D}+5.5^{B.S.}$
Miscellaneous	%	20	-	-	1,612	402	2,014	
Sub-total					9,671	2,417	12,088	
3. Depreciation								
Swamp Bulldozer 9 ton	hr.	1.00	32,127	12,479	32,127	12,479	44,606	E=0.5, ℓ=50
Back-hoe Shovel 0.6m^3	"	0.50	38,632	13,891	19,316	6,946	26,262	E=0.6, ∅=180°
Sub-total					51,443	19,425	70,868	
Total					61,114	30,782	91,896	
per m^3					3,682	1,854	5,536	

Table I-3-15(8) BREAKDOWN OF UNIT PRICE

ITEM NO.: C-1a WORK: Reinforced Concrete, 6c=210 kg/cm^2... for Weir

PRICE: 389,508 S/./ m^3 NOTE: 1 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Concrete								
Material	m^3	1.00	97,410	36,041	97,410	36,031	133,441	
Mixing	"	"	2,892	9,730	2,892	9,730	12,622	
Placing	"	"	5,576	11,518	5,576	11,518	17,094	
Sub-total					105,878	57,279	163,157	
2. Others								
Reinforcement	Kg	40.00	1,728	947	69,120	37,880	107,000	
Form	m^2	3.50	11,264	22,196	39,424	77,686	117,110	
Curing	L.S.	1	-	-	1,085	1,156	2,241	
Sub-total					109,629	116,722	226,351	
Total					215,507	174,001	389,508	

Table I-3-15(9) BREAKDOWN OF UNIT PRICE

ITEM NO.: C-1b WORK: Reinforced Concrete, 6c=210 kg/cm^2

PRICE: 367,147 S/./ m^3 NOTE: 1 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Concrete								
Material	m^3	1.00	97,410	36,031	97,410	36,031	133,441	
Mixing	"	1.00	1,366	13,795	1,366	13,795	15,161	
Placing	"	1.00	495	18,511	495	18,511	19,006	
Sub-total					99,271	68,337	167,608	
2. Others								
Reinforcement	Kg	40.00	1,728	947	69,210	37,880	107,000	
Form	m^2	3.50	8,718	17,157	30,513	60,050	90,563	
Curing	L.S.	1	-	-	996	980	1,976	
Sub-total					100,629	98,910	199,539	
Total					199,900	167,247	367,147	

Table I-3-15(10) BREAKDOWN OF UNIT PRICE

ITEM NO.: C-2a WORK: Plain Concrete, 6c=175 kg/cm^2 ... for Weir

PRICE: 193,078 S/./m^3 NOTE: 1 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Concrete								
Material	m^3	1.00	80,744	31,926	80,744	31,926	112,670	
Mixing	"	1.00	2,892	9,730	2,892	9,730	12,622	
Placing	"	1.00	5,576	11,518	5,576	11,518	17,094	
Sub-total					89,212	53,174	142,386	
2. Others								
Form	m^2	1.50	11,264	22,196	16,896	33,294	50,190	
Curing	L.S.	1	-	-	169	333	502	
Sub-total					17,065	33,627	50,692	
Total					106,277	86,801	193,078	

Table I-3-15(11) BREAKDOWN OF UNIT PRICE

ITEM NO.: C-2b WORK: Plain Concrete, 6c=175 kg/cm^2

PRICE: 186,038 S/./ m^3 NOTE: 1 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Concrete								
Material	m^3	1.00	80,744	31,926	80,744	31,926	112,760	
Mixing	"	1.00	1,366	13,795	1,366	13,795	15,161	
Placing	"	1.00	495	18,511	495	18,511	19,006	
Sub-total					82,605	64,232	146,837	
2. Others								
Form	m^2	1.50	8,718	17,157	13,077	25,736	38,813	
Curing	L.S.	1	-	-	131	257	388	
Sub-total					13,208	25,993	39,201	
Total					95,813	90,225	186,038	

Table I-3-15(12) BREAKDOWN OF UNIT PRICE

ITEM NO.: C-3 WORK: Lining Concrete, 6c=175 kg/cm^2

PRICE: 214,263 S/./ m^3 NOTE: 1 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Concrete								
Material	m^3	1.00	80,744	31,926	80,744	31,926	112,760	
Mixing	"	1.00	1,366	13,795	1,366	13,795	15,161	
Placing	"	1.00	495	18,511	495	18,511	19,006	
Sub-total					82,605	64,232	146,837	
2. Others								
Form	m^2	2.58	15,525	10,350	40,055	26,703	66,758	
Curing	L.S.	1	-	-	401	267	668	
Sub-total					40,456	26,970	67,426	
Total					123,061	91,202	214,263	

Table I-3-15(13) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-1 WORK: Pipe Drain

PRICE: 16,522 S/./ m NOTE: 500 m/hr. Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.25	-	39,760	-	9,940	9,940	
Skilled Labor	"	0.25	-	34,380	-	8,595	8,595	
Common Labor	"	25.00	-	26,750	-	668,750	668,750	
Operator	"	0.50	-	34,380	-	17,190	17,190	
Assistant Operator	"	0.06	-	26,750	-	1,605	1,605	
Driver	"	0.63	-	29,620	-	18,661	18,661	
Sub-total					-	724,741	724,741	
2. Material								
Drain Pipe ø100mm	m	500.00	8,400	3,600	4,200,000	1,800,000	6,000,000	
Filter	m^3	45.00	12,950	8,036	582,750	361,620	944,370	$27.6^{T.R}+28.0^{D.T}+13.2^{T.}$
Light Oil	lit	68.80	584	146	40,179	10,045	50,224	
Miscellaneous	%	20	-	-	8,036	2,009	10,045	
Sub-total					4,830,965	2,173,674	7,004,639	
3. Depreciation								
Trencher 200 HP	hr.	1.00	279,643	104,607	279,643	104,607	384,250	
Dump Truck 6 ton	"	5.00	11,926	4,672	59,630	23,360	82,990	E=0.8 ℓ=1 km
Tractor Shovel, 0.4m^3	"	3.00	15,027	6,406	45,081	19,218	64,299	E=0.7
Sub-total					384,354	147,185	531,539	
Total					5,215,319	3,045,600	8,260,919	
per m					10,431	6,091	16,522	

Table I-3-15(14) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-2 WORK: Stone Pitching

PRICE: 55,158 S/./ m^3 NOTE: 16 m^3/day Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.80	-	39,760	-	31,808	31,808	
Skilled Labor	"	2.00	-	34,380	-	68,760	68,760	
Common Labor	"	6.00	-	26,750	-	160,500	160,500	
Operator	"	1.00	-	34,380	-	34,380	34,380	
Assistant Operator	"	0.50	-	26,750	-	13,375	13,375	
Driver	"	1.00	-	29,620	-	29,620	29,620	
Sub-total					-	338,443	338,443	
2. Material								
Light Oil	lit.	89.80	584	146	52,443	13,111	65,554	$47.0^{T}+42.8^{C}$
Miscellaneous	%	20	-	-	10,489	2,622	13,111	
Sub-total					62,932	15,733	78,665	
3. Depreciation								
Truck w/crane 4 ton	hr.	8.00	12,998	5,570	103,984	44,560	148,544	$\ell=500^{m}$
Truck Crane 10 ton	"	7.00	31,267	14,000	218,869	98,000	316,869	
Sub-total					322,853	142,560	465,413	
Total					385,785	496,736	882,521	
per m^3					24,112	31,046	55,158	

Table I-3-15(15) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-3 WORK: Dry Masonry

PRICE: 22,013 S/./ m^3 NOTE: 15 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.47	-	39,760	-	18,687	18,687	
Common Labor	"	4.70	-	26,750	-	125,725	125,725	
Driver	"	0.38	-	29,620	-	11,256	11,256	
Operator	"	0.25	-	34,380	-	8,595	8,595	
Assistant Operator	"	0.06	-	26,750	-	1,605	1,605	
Sub-total					-	165,868	165,868	
2. Material								
Light Oil	lit.	37.90	584	146	22,134	5,533	27,667	$8.0^{B.P}+4.4^{T.S}+25.5^{D.}$
Miscellaneous	%	20	-	-	4,427	1,106	5,533	
Sub-total					26,561	6,639	33,200	
3. Depreciation								
Bulldozer 8 ton	hr.	1.00	31,544	12,918	31,544	12,918	44,462	E=0.5 ℓ=30 m
Tractor Shovel 0.4m^3	"	1.00	15,027	6,406	15,027	6,406	21,433	E=0.6
Dump Truck 8 ton	"	3.00	15,518	6,224	46,554	18,672	65,226	E=0.8, ℓ=5 km
Sub-total					93,125	37,996	131,121	
Total					119,686	210,503	330,189	
per m^3					7,979	14,034	22,013	

Table I-3-15(16) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-4 WORK: Wet Masonry

PRICE: 65,702 S/./ m^3 NOTE: 1 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Plain Concrete								
Material	m^3	0.35	80,744	31,926	28,261	11,174	39,435	
Mixing	"	0.35	1,366	13,795	478	4,828	5,306	
Placing	"	0.35	495	18,511	173	6,479	6,652	
Sub-total					28,912	22,481	51,393	
2. Dry Masonry	m^3	0.65	7,979	14,034	5,186	9,123	14,309	M-3
Total					34,098	31,604	65,702	

Table I-3-15(17) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-5a WORK: Protection Levee, Type-I

PRICE: 441,626 S/./ m NOTE: 1 m Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Plain Concrete								
Material	m^3	1.00	80,744	31,926	80,744	31,926	112,760	
Mixing	"	1.00	1,366	13,795	1,366	13,795	15,161	
Placing	"	1.00	495	18,511	495	18,511	19,006	
Sub-total					82,605	64,232	146,837	
2. Others								
Form	m^2	8.16	8,718	17,157	71,139	140,001	211,140	
Filling	m^3	3.80	7,979	14,034	30,320	53,329	83,649	M-3
Sub-total					101,459	193,330	294,789	
Total					184,064	257,562	441,626	

Table I-3-15(18) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-5b WORK: Protection Levee, Type-II

PRICE: 270,759 S/./ m NOTE: 10 m Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Huge Stone	m^3	45.00	24,112	31,046	1,085,040	1,397,070	2,482,110	M-2
2. Gabion 0.6 x 0.6 x 5.0m	Stick	2.00	49,743	62,997	99,486	125,994	225,480	M-6
Total					1,184,526	1,523,064	2,707,590	
per m					118,453	152,306	270,759	

Table I-3-15(19) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-5c WORK: Protection Levee, Type-III

PRICE: 47,159 S/./ m NOTE: 10 m Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.76	-	39,760	-	30,218	30,218	
Common Labor	"	7.50	-	26,750	-	200,625	200,625	
Sub-total					-	230,843	230,843	
2. Material								
Wire, #8	kg	65.42	2,576	1,104	168,522	72,224	240,746	
Sub-total					168,522	72,224	240,746	
Total					168,522	303,067	471,589	
per m					16,852	30,307	47,159	

Table I-3-15(20) BREAKDOWN OF UNIT PRICE

ITEM NO.: M-6 WORK: Gabion 0.6 x 0.6 x 5.0 m

PRICE: 112,740 S/./ Stick NOTE: 1 stick Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.14	-	39,760	-	5,566	5,566	
Common Labor	"	1.35	-	26,750	-	36,113	36,113	
Sub-total					-	41,679	41,679	
2. Material								
Wire, #8	Kg	19.31	2,576	1,104	49,743	21,318	71,061	
Sub-total					49,743	21,318	71,061	
Total					49,743	62,997	112,740	

Table I-3-15(21) BREAKDOWN OF UNIT PRICE

ITEM NO.: R-1 WORK: Grading & Compaction

PRICE: 1,650 S/./ m^3 NOTE: 38.3 m^3/hr. Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d	0.13	-	34,380	-	4,469	4,469	
Assistant Operator	"	0.06	-	26,750	-	1,605	1,605	
Sub-total					-	6,074	6,074	
2. Material								
Light Oil	lit.	11.00	584	146	6,424	1,606	8,030	
Miscellaneous	%	20	-	-	1,285	321	1,606	
Sub-total					7,709	1,927	9,636	
3. Depreciation								
Bulldozer, 11 ton	hr.	1.00	33,691	13,797	33,691	13,797	47,488	E=0.6,D=30cm,N=5
Sub-total					33,691	13,797	47,488	
Total					41,400	21,798	63,198	
per m^3					1,081	569	1,650	

Table I-3-15(22) BREAKDOWN OF UNIT PRICE

ITEM NO.: R-2 WORK: Rock Excavation by Blasting

PRICE: 23,541 S/./m^3 NOTE: 10 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Foreman	m.d	0.38	-	39,760	-	15,109	15,109	
Skilled Labor	"	2.45	-	34,380	-	84,231	84,231	
Common Labor	"	1.36	-	26,750	-	36,380	36,380	
Sub-total					-	135,720	135,720	
2. Material								
Dynamite	Kg	0.99	10,400	2,600	10,296	2,574	12,870	
Detonator	pc.	9.90	1,120	280	11,088	2,772	13,860	
Others	%	35	-	-	7,484	1,871	9,355	
Light Oil	lit.	20.00	584	146	11,680	2,920	14,600	
Miscellaneous	%	20	-	-	2,336	584	2,920	
Sub-total					42,884	10,721	53,605	
3. Depreciation								
Compresser 10.5m^3/min	day	0.26	86,864	35,136	22,585	9,135	31,720	
Leg Hammer, 40 kg	"	0.78	16,091	2,319	12,511	1,809	14,360	
Sub-total					35,136	10,944	46,080	
Total					78,020	157,385	235,405	
per m^3					7,802	15,739	23,541	

Table I-3-15(23) BREAKDOWN OF UNIT PRICE

ITEM NO.: R-3 WORK: Rock Embank (Excavated Material)

PRICE: 8,279 S/./m^3 NOTE: 28.0 m^3/hr Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d	0.38	-	34,380	-	13,064	13,064	
Assistant Operator	"	0.25	-	26,750	-	6,688	6,688	
Driver	"	0.25	-	29,620	-	7,405	7,405	
Sub-total					-	27,157	27,157	
2. Material								T.S D.T B.D
Light Oil	lit.	40.54	584	146	23,675	5,919	29,594	7.2 +17.0 +11.0 V.R
Miscellaneous	%	20	-	-	4,735	1,184	5,919	+5.34
Sub-total					28,410	7,103	35,513	
3. Depreciation								
Tractor Shovel 0.8m^3	hr.	1.00	22,905	9,682	22,905	9,682	32,587	E=0.6
Dump Truck 8 ton	"	2.00	15,518	6,224	31,036	12,448	43,484	E=0.8, ℓ=700m
Bulldozer 11 ton	"	1.00	33,691	13,797	33,691	13,797	47,488	E=0.5, ℓ=30m
Vibro Roller 6 ton	"	1.00	33,180	12,390	33,180	12,390	45,570	E=0.4, D=30cm,N=
Sub-total					120,812	48,317	169,129	
Total					149,222	82,577	231,799	
per m^3					5,329	2,950	8,279	

Table I-3-15(24) BREAKDOWN OF UNIT PRICE

ITEM NO.: R-4 WORK: Metalling

PRICE: 28,644 S/./ m^3 NOTE: 10 m^3 Base

DESCRIPTION	UNIT	QUANTITY	UNIT PRICE		AMOUNT			NOTE
			F/C	L/C	F/C	L/C	TOTAL	
1. Labor								
Operator	m.d.	0.05	-	34,380	-	1,719	1,719	
Assistant Operator	"	0.03	-	26,750	-	803	803	
Common Labor	"	0.43	-	26,750	-	11,503	11,503	
Sub-total					-	14,025	14,025	
2. Material								
Gravel	m^3	12.00	12,950	8,036	155,400	96,432	251,832	
Light Oil	lit.	3.20	584	146	1,869	467	2,336	
Miscellaneous	%	20	-	-	374	93	467	
Sub-total					157,643	96,992	254,635	
3. Depreciation								
Bulldozer, 8 ton	hr.	0.40	31,544	12,918	12,618	5,167	17,785	
Sub-total					12,618	5,167	17,785	
Total					170,261	116,184	286,445	
per m^3					17,026	11,618	28,644	

ANNEX J

OPERATION AND MAINTENANCE

C O N T E N T S

ANNEX J Operation and Maintenance

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ANNEX J

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J. Operation and Maintenance

1 Present Condition

Administracion Tecnica de Distrito de Riego (ATDR) Chancay-Huaral, which is supervised by Oficina Agraria Huacho of Regional Agraria VI, Ministerio de Agricultura, is in charge of operation and maintenance (called "O/M" hereinafter) for agricultural infrastructure and has a responsibility for O/M of them. Junta de Usuarios (water users' organization), supervised by ATDR, consists of water users representative organization and is actually in charge of O/M of irrigation facilities in his district.

(1) Administracion Tecnica de Distrito de Riego (ATDR)

ATDR is managing all of water including the upstream lagoons and its roles are:

- supervising the water resources and evaluating the soil conservation,
- to authorize the distribution of irrigation water,
- formulating the program for maintenance and conservation of the infrastructures,
- to authorize the realization of works for maintenance, rehabilitation of the infrastructures,
- to audit and inspect the account of water charge collected by the Junta de Usuarios, and to
- participate in the formulation of budget of Junta de Usuarios and Comisiones de Regantes.

Discharge of Chancay river has been daily observed at Santo Domingo, and diverged capacity from intakes and principal canals is

checked in regular day.

The intake structures have been suffered damages from annual floodings, also canals and reservoirs are filled up with sediments, since Chancay river has a steep slope.

(2) Junta de Usuarios (Water users' organization)

At the present time, O/M services of irrigation facilities and levy of water charge, etc. are performed by Junta de Usuarios, which is beneficiary legal organization in the project area. Junta de Usuarios has 15 Comisiones de Regantes (irrigation district commision) and each Comision de Regantes is formed of the representatives of Comite de Regantes that is a farmers' organization by each canal.

2 Proposed Practice

After completion of construction works by DEPE-REHATIC, O/M would be transferred to ATDR, which will be in charge of O/M for not only the major infrastructures but on-farm facilities in cooperation with Junta de Usuarios.

These organizations would control and manage the functional operation in the diversion weir and canal system with the following particular attentions to water management.

- Adjustment between discharge at Palpa and operation of upstream lagoons in dry year and/or season.

- O/M of the settling basin in flood season.

- Accurate water control at diversion and turnout of canal system to the service area.

Consequently, O/M services in this project would be mainly carried out by Junta de Usuarios under the control of ATDR. The basic roles,

viz, of ATDR and Junta de Usuarios would not be changed, since it is considered to get a satisfactory target assumed that the roles of these organizations would be the same as present as mentioned in paragragh J-1 herein. For this purpose, it is desired to newly establish the section for O/M in the Junta de Usuarios, irrigation and drainage section in ATDR only for the project, due to smooth water management.

The proposed organization for O/M is shown in Figure J-1-1.

(1) Water management system

Water Management System in the Project Area would be proposed as follows:

Organization	Description
ATDR Chancay-Huaral	General water management authority and supervise Junta de Usuarios
Junta de Usarios	Organized by 15 representatives of Valle Chancay-Huaral Comision de Regantes. Determination of water distribution and water charge, levying of water charge, operation and maintenance for lagoons and main irrigation and drainage facilities as intakes, diversions, etc. and main roads.
Administration Motor Pool (Machinery Center)	Management and maintenance of machinery for operation and maintenance.
Comision de Regantes	Organized by representatives of Comite de Regantes. Operation and maintenance for principal canal, main drainage canal, reservoir levee and secondary road.

Comite de Regantes	Organized by beneficiary farmers in field canal and lateral canal. Operation and maintenance for lateral canal, drainage facility, pumping station, and farm road.

The water management system is in operation by General Water Law (Derecto Ley No. 17752 Ley General de Aguas, de fecha 24 de Julio de 1969, sus modificatorias y ampliatorias.) and the relation between ATDR and Junta de Usuarios abide by the above mentioned law.

(2) Major infrastructure

Sand deposition, weed infestation and malfunction of the structure make practically impossible to rational control. It is, particulary, need to take into consideration for design of the settling basin and intake facility so as to make O/M easy and accurate, and to keep O/M cost cheap.

On the other hand, as for O/M, it would be uneconomical for the government to supply a full-time operator to regulate water use and carry out proper maintenance of the facilities, but it will require considerable effort to organize and train personnel among the Junta de Usuarios. The government, therefore, should set up training programs by utilizing the existing institutions such as university and technical school, etc. With emphasis on training in the field, the existing projects and demonstration farms should be used for the on-the-job training purpose in accordance with acquisition of sound engineering practices.

It is expected that ATDR would be required to continue technical assistance for O/M in the field and then responsibility of ATDR will be shifted to only nomitoring of all the activities to be made by the Junta de Usuarios.

(3) On-farm facility

O/M of on-farm facility would ultimately be the responsibility of the farmers. ATDR and CIPA will provide the technical assistance to them for proper development of effective and self-sustaining activities including rotational water schedule, etc. for at least two or three years, after that, with frequent advice on the problems encountered. (Refer to K-1-2-4)

3 Cost for Operation and Maintenance

Annual O/M cost of the proposed organization would be estimated at 48 $/ha. The detail estimation is presented below, and is summarized in Table J-2-1.

O/M office will be placed at Huaral, and office and motor pool, etc. provided during the construction period will be utilized. O/M equipments will be newly purchased, because the construction work will be done on a Contract Basis. The recommended equipments are presented in Table J-2-3.

(1) Administration cost

Administration cost for O/M with project are summed up to $255,000 based on Table J-2-2. Total amount of $163,000, expenditure for Junta de Usuarios as of 1982 to 1983, corresponds to administration cost for present conditions.

(2) Running cost for pumping station

- With project

Required operation hour for drought year with a 10-year return period.

Site	Nos. of Pumping Station	Pump Capacity (in total)	Operation Hour			
		l/s		hr/day		days
Palpa, Caqui	4	185	Oct.	12	x	31
			Nov.	18	x	30
			Dec.	18	x	31
			Jan.	15	x	31
						1,935 hr
Boza Alto	1	199	Nov.	18	x	30
			Dec.	18	x	31
						1,098 hr
Huando	5	260	Oct.	12	x	31
			Nov.	18	x	30
			Dec.	18	x	31
			Jan.	15	x	31
						1,935 hr
Central Parts of Project Area	12	613	Oct.	12	x	31
			Nov.	18	x	30
			Dec.	18	x	31
			Jan.	15	x	31
						1,935 hr

Pump capacity

hr	1/sec	sec	l	m3
1,935	x 185	x 3,600/1,000	=	1,288,710
1,098	x 199	x 3,600/1,000	=	786,607
1,935	x 260	x 3,600/1,000	=	1,811,160
1,935	x 613	x 3,600/1,000	=	4,270,158
6,903			Total	8,156,635

Return Period	Pump Capacity	Operation Hour	Hourly Cost	Total Cost
year	m3	hr	$	
5	0	-	-	-
6	1,631,327	1,381	0.4 1/	552
7	3,262,654	2,761	0.4	1,104
8	4,893,981	4,141	0.4	1,656
9	6,525,308	5,522	0.4	2,209
10	8,156,635	6,903	0.4	2,761
				$/year
			10 year average	828

Note: 1/ Hourly cost estimated based on the actual results of existing pumping stations in Esquivel and Palpa.

- Without project

Year	Pump Capacity	Operation Hour	Hourly Cost	Cost
	m3	hr	$	
1977	8,523,000	52,611	0.4	21,044
1978	12,735,000	78,611	0.4	31,444
1979	20,510,000	126,604	0.4	50,642
1980	7,220,000	44,568	0.4	17,827
1981	5,618,000	34,679	0.4	13,871
1982	0	-	0.4	-
1983	301,000	1,858	0.4	743
				$/year
			Average	19,367

Pump capacity 45 l/sec = 162 m3/hr
Hourly cost 0.4 $

(3) Repair cost

(a) Diversion weir

Annual repair cost for structures cost with project condition is estimated as below.

- Construction cost : $5,521 \times 10^3$ $

$5,521 \times 10^3 \times 0.02 = 110,411$ $/year

Disaster rehabilitation cost in a year of 1984 is counted as the repair cost of without project.

- Esperanza :	138,700
- Pasamayo Bajo:	1,900
- Pasamayo Alto:	31,400
- San Jose :	17,800
Total	$ 189,800

(b) Irrigation system

Annual repair cost for irrigation system is estimated as follows. Cost for dredging work is also counted in repairs cost.

- With project,

Improvement section	Dredging	175.0 km x 50 M/D x 2 times x 1.8 $	= 31,500
	Repair	9,408 x 10^3 $ x 0.02	= 188,160
Sub-total			219,660
Existing canal section	Dredging	174.0 km x 100 M/D x 2 times x 1.8 $	= 62,640
	Repair	3 m3 x 174 x 10^3 x 4.6 $ x 0.04	= 96,048
Sub-total			158,688
			$/year
Total			378,348

- Without project

Dredging	344 km x 125 M/D x 2 times x 1.8 $	= 154,800
Repair	3 m3 x 344 km x 10^3 x 4.6 $ x 0.04	= 189,888
		344,688 $/year

(c) Drainage canal

Annual repair cost for drainage canals is estimated as the same method of irrigation canals.

- With project

2.0 % of construction cost

$4,341,000 \times 10^3 \times 0.02 = \$86,820$

- Without project

Existing $(12\text{m3} \times 51.7\ \text{km} \times 10^3 \times \$4.6 = \$2,853,840) = \$114,154$

(d) Pump equipments

Number of pumping station : 33 places

900 $/place x 33 = $29,700*

* Equivalent to 3% of construction cost estimated

(e) Road

- With project

$173.7\ \text{km} \times 10^3 \times 0.4\ \text{m3/m} \times 0.49\ \$/\text{m3} \times 3$ times

= 102,136 $/year*

* Cost of leveling and graveling.

- Without project

$173.7\ \text{km} \times 10^3 \times 0.4\ \text{m3/m} \times 0.49\ \$/\text{m3} \times 6$ times

= 204,271 $/year

4 Required machinery and equipment for on-farm and O/M

4-1 Machinery and equipment for O/M

Required machinery and equipment for operation and maintenance is as shown Table J-2-3, and the sum US$1,190,000 will be estimated.

4-2 Tractor for on-farm

As the required number of tractor for on-farm is described in E-2-5(7), necessary cost in case of newly purchase of shortage (20 tractors) will be estimatged at the sum US$700,000.
(Tractor: 86 HP, 20, US$35,000/tractor)

Table J-2-1 Operation and Maintenance Cost

Description	without Project	with Project
	x 10^3 $	x 10^3 $
(1) Administration cost	163	255
(2) Running Cost for Pumping Station	19	1
(3) Repair Cost		
(a) Diversion Weir (newly)	-	110
Diversion Weir (existing)	190	-
(b) Irrigation System (improve)	-	220
Irrigation System (existing)	345	159
(c) Drainage Canal	114	103
(d) Pump Equipments	30	30
(e) Road	204	102
Total	1,065	964
Per Ha	52.7	47.7

Table J-2-2 Administration Cost
(Junta de Usuarios)

Description	Without Project	With project
Administ cost for lagoons	$ 20,000	$ 20,000
" for Office	$ 20,000	$ 20,000
" for water management (incl. levying water charge)	$ 123,000	$ 184,000 **
Depreciation and Repair cost (building and facilities)		$ 26,000 *
Total	$ 163,000	$ 255,000

* Office and equipment	$ 45,000
Garage and Warehouse	$ 85,000
Total	$130,000
Repair cost 5%) Depression Cost 15%)	$ 26,000

Proposed staff members and their wages

Administration			
Manager	1	14,400	14,400
Zone man	3	10,200	30,600
Accountant	1	10,800	10,800
Clerk	1	8,400	8,400
Typist	2	7,800	15,600
Janitor	2	5,400	10,800
Gate Tender	45	4,200	189,000
Driver	2	7,200	14,400
Sub-total			294,000

Operation and maintenance (Machinery Center)			
Administ. Officer	1	11,700	11,700
Mechanic	1	9,600	9,600
Electrician	1	9,600	9,600
Operator	5	9,000	45,000
Store Reeper	2	8,400	16,800
Driver/worker	8	7,200	57,600
Watchman	2	4,200	8,400
			158,700

Total S/452,700,000 ÷ $ 135,500

Note: US$ 1.00 = S/3,340

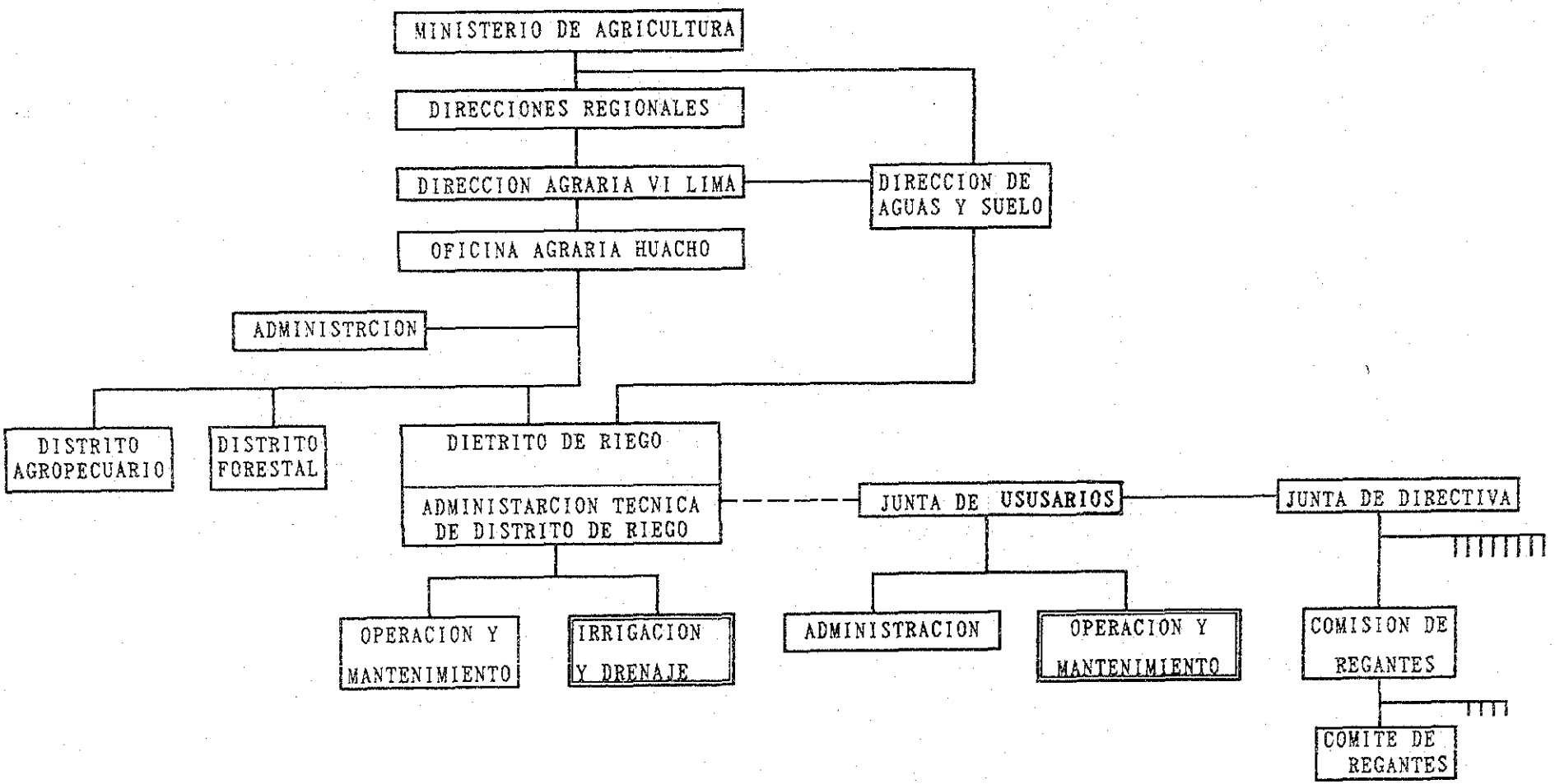
** The wages amount of $ 135,500 is included in the administration cost of $ 184,000 for water management with project.

Table J-2-3 O/M Equipments (Recommended)

Description	Q'ty	Unit Cost	Purchaing Cost ($\times 10^3$ S/.)
Bulldozer, 11 ton	4	186,100	744,400
Swamp Bulldozer, 9 ton	2	154,000	308,000
Back-hoe Shovel, 0,4 m^3	3	184,500	553,500
Tractor Shovel , 0.4 m^3	3	69,600	208,800
Dump Truck, 6 ton	6	58,400	350,400
- do - , 10 ton	4	119,300	477,200
Flat Bed Truck, 4 ton	5	40,000	200,000
Station Wagon, 4 x 4	2	60,000	120,000
Pick-up Wagon	5	30,000	150,000
Motor Cycle, 125 cc	20	4,500	90,000
Motor Grader, 2,5 m	3	129,600	388,800
Concrete Mixer, 0.2 m^3	5	9,000	45,000
Vibrator, 38 mm	10	2,100	21,000
Tamper, 100 kg	10	4,300	43,000
Air Compressor,10.5 m^3	2	73,200	146,400
Generator, 15 KVA	2	21,800	43,600
Submerged Pump, 50 mm	4	900	3,600
- do - , 100 mm	4	2,600	10,400
Gas Welding & Cutting	2	2,500	5,000
Chain Hoist, 10 ton	2	2,500	5,000
Electric Grinder	2	13,800	27,600
Electric Hand Drill	2	10,700	21,400
Total			3,963,000
			($ 1,190,000)

Note : 1 $ = S/. 3,340

Fig. J-1-1 Proposed Organization Chart for Operaton and Maintenance (Junta de Usarios)



ANNEX K

ECONOMIC EVALUATION AND FINANCIAL ANALYSIS

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ANNEX K Economic Evaluation and Financial Analysis

1. Economic evaluation

1-1 Annual Benefit

The expected benefit by the project consist of increased production of crops, saving cost for operation and maintenace (O&M) and reduced transportation cost. while the benefit on munincipal water service is assumed to be insignificant (Refer to Table K-1-6).

1-1-1 Annual benefit by agricultural production

Increased agricultural production is estimated as below;

Without project	:	US$48,405 x 10^3
With project	:	US$72,571 X 10^3
Increased production	:	US$24,166 x 10^3

Details are shown in Table K-1-3.

The increased production has been calculated assuming the following conditions.

- Five years will be required to spread farming technicques in order to achieve the target income.

- Open price is prevailing in the market of agricultural products in Peru. However, international market price of agricultural production should be considered for the economical evaluation of project. Therefore, free farm gate price is applied for this purpose which is directly reflected with the international market price.

In order to decide price of agricultural products for the project, the following items are taken into consideration.

(1) Principally, price of agricultural products for the economic evaluation is decided in basis of the prices in early part of 1984 which were provided by the Ministry of Agriculture, Peru. Futhermore, these prices are modified after having been incorporated with trend of prices in the period from 1979 to 1983 to make the proposed prices more reasonable for the economic evaluation. The modified prices are shown in Fig. F-2-5 and Table F-2-7.

(2) Whole crops will be sold out at farm yard.

(3) As for unit price of cotton fiber, the farm gate price, (US$1,700 per metric ton) is assumed from FOB Callao price.

(4) The ratio of raw cotton (Fiber) and seed is 0.4 to 0.6 in weight after process by cotton gin, accordingly, the profit of US$38 per one metric ton in the yield including fiber and seed is estimated as follows;

Price of cotton seed	US$130/metric ton
Expense on burling	US$ 40/metric ton
Farmer's earnings by seed	US$130 x 0.6 - US$40 = US$38

(5) Applied unit price of maize is assumed to be import for domestic use.

(6) High quality mandarin orange is considered to make possible to be exported for abroad in future. The production of 20% is considered to be exported. Unit price of US$470 per ton is presumed for the price on farm from FOB Lima airport.

(7) The value of fruits, except citrus, apple, passion fruit and grape, is applied the average value of palto and peach.

(8) The yield of perenial crops is considered to be average of production period and life span, also supposing to carry out succesively transplantation.

	Life span	Production period
Oranges (Mandarin, Washington)	40 years	35 years
Apple	25	20
Maracuya	5	5
Grape	15	12
Peach	12	9

(9) The value of minor crops is assumed to be equal to that of choclo (maize).

- The cropping ratio of vegitables is assumed considering market price.

- Interest for farming credit and water charge are not included in the production costs for calculation of the internal rate of return.

- Water charge is included in O/M cost.

- Annual production cost after completion of the project seems to be equal to the cost corresponding to the yield in target year.

- The production cost is paid in advance six months of income.

1-1-2 Saving cost on O & M

Without project: US$1,065 x 10^3 per annum
With project : US$ 964 x 10^3 "
Saving : US$ 101 x 10^3 "

O&M costs in case of without and with project are as below and described in Annex J.

1-1-3 Reduced transportation cost

Reduced transportation cost is calculated at US$ 284,000 per annum as shown in table K-1-4.

1-2 Costs

1-2-1 Project Cost

Project cost, amount of US$ 41,477,000 will be paid corresponding to the process of the works as described in Annex G.

Annual outlay are estimated as follow;

1986	us$	2,284,000
1987		4,210,000
1988		7,352,000
1989		8,692,000
1990		8,348,000
1991		7,231,000
1992		3,357,000
Total		41,474,000

Annual outlay for alternative plan (construction period of 4 years);

1986	us$	2,613,000
1987		11,829,000
1988		19,632,000
1989		14,728,000
Total		44,802,000

1-2-2 Replacement Cost

Replacement cost for newly installed gate and dren pipe will be required after 25 years. Required cost is estimated as follows ;

Construction cost for gate	US$2,157,185
Price contingencies (40%)	862,874
Physical contingencies (10%)	302,064
Total	US$3,322,064

Constructioncost for drain pipe	US$2,157,185	(Year: 2,0150)
Price contingency (40%)	967,200	
Physical contingencies (10%)	344,520	
	US$3,729,720	(Year: 2,016)

1-2-3 Production Cost

Without project	:	US$21,012.9 x 10^3 per annum
With project	:	US$26,579.2 X 10^3 "
Increased production cost	:	US$ 5,566.3 X 10^3 "

Detail is shown in table K-1-5.

1-2-4 Other Cost

(1) Cost for Chemical Amendment

About 1,900 ton of gypsum are required to improve sodicity of surface layer (0 -- 15 cm) of saline-alkali soil as describe in D-5(4).

The works will be made after completion of the drainage facilities and the cost for them is estimated as below ;

Item	Q'ty	Unit Price	Cost
Gypsum	1,900 ton	s/. 18,050	US$10,300
tractor	3,375 hr (675 hr x 5 hr)	us$ 7.5	US$25,313
Miscellaneous			US$3,387
Total			US$39,000

(US$1 = s/.3,340)

(2) Cost for Promotion

The cost estimated below are required to accelerate the promotion of agriculture in the Project area.

Investiment

Item	Q'ty	Unit Price	Cost
			us$
Housing			
Office	200 m^2	225 us$	45,000
Ware House	100 m^2	130	13,000
Others			2,000
Sub Total			60,000
Equipment			
Wagon	1	s/.30,000 x 10^3	9,000
Truck	1	40,000 x 10^3	12,000
Motor Cycle (125 cc)	8	4,500 x 10^3	10,800
Others			13,200
Sub Total			45,000
Total			US$105,000

Running expenses

Item	Q'ty	Unit Price	Cost
			us$
Wages			
Engineer	2	s/.18,000 x 10^3	10,800
Asistant engineer	8	14,400 x 10^3	34,490
Others	8	10,000 x 10^3	24,070
Sub Total			69,360
Repair Cost			5,000
O & M Cost			8,000
Other Cost			6,640
Total			US$89,000

(3) Cost of demonstration Farm

Area : 50 ha (10 ha x 5)
Remuneration : 300 us$/ha/year
Annual Cost : 15,000 us$

The extension services (Promotion & demonstratin) are taken to be continued for seven years as shown in Table K-1-7.

(4) Cost for leaching

If there is seepage water at irrigation water, it should be introduced the water into farm yard for the purpose of desalinization. The leaching would be carried out for three years on the planning, and had better to continue after completion of the project.

Leaching cost on and after fouth year is appropriated to be continued yearly as on 1/3 scale of the proposed.

The leaching cost would be estimated as below:

El Hatillo area 10 times/year 1st year 2nd year 3rd year after 4th year

Item	Area	Times	Total number of times			
	ha		1st year	2nd year	3rd year	after 4th year
S_2	536	3 times/year	1,608	1,608	1,608	536
S_3	736	6 times/year	4,416	4,416	4,416	1,472
El Hatillo	160	10 times/year	1,600	-	-	178
Total			7,624	6,024	6,024	2,186

Note: Leaching cost 1st year 2nd year 3rd year after 4th year
(Unit price: US$4.5/time)

$34,308 $27,108 $27,108 $9,837

One time per ha. 10 hours

8 hr/day :	$1.9
Over time 2 hr. :	$0.95
Sub-total	$2.85
Social insurance	$1.65
Total	$4.48 = $4.50/time

1-3 Economic Internal Rate of Return

Economic internal rate of return is calculated to be 17.8% based on the benefit and cost as mentioned above.

1-4 Sensitivity Analysis

Sensitivity analysis have been made considering the parameters employed such as increase in project cost, reduction in benefits, delay in benefits, and combinations of these parameters.

Case (1)	Original	17.8 %
Case (2)	A four-year impremementation period	20.5 %
Case (3)	A 10% increase in construction cost	16.9 %
Case (4)	A 5% reduction in production	15.6 %
Case (5)	A combination of (3) and (4) (10% increase in construction cost and 5% reduction in production)	14.8 %
Case (6)	A two-year delay in benefits	14.1 %
Case (7)	A combination of (3) and (6) (10% increase in construction cost and two years delay in benefit)	13.5 %
Case (8)	A combination of (4) and (6) (5% reduction in production and two years delay in benefit)	12.4 %
Case (9)	A combination of (5) and (6) (10% increase in construction cost, 5% reduction in production and two years delay in benefit)	11.8 %
Case (10)	A two-year delay in the commencement of construction work	16.7 %

Detailed analysis is shown in Table K-1-7.

2. Financial Analysis

The project cost estimated at US$ 41,474,000 and its disbursment schedule is shown in Table I-3-13.

An alternative plan with construction period of three years and the amount of US$ 44,802,000 in project cost would be proposed.

Assuming that a considerable sum of the project cost will be financed from an international financial agency and the remain is assumed to take charge of national treasury (a part of this cost will be withdrawed as water charge from farmers in future).

Repayment schedules have been proposed as shown in Table K-2-1.

Assumptions for financial analysis are as follow ;

(1) Financing

(Unit: US$ dollar)

Year	Amount	Case A		Case B	
		F/C	L/C	F/C	L/C
1986	2,284,000	1,105,000	1,179,000	1,599,000	685,000
1987	4,210,000	2,154,000	2,056,000	2,947,000	1,263,000
1988	7,352,000	4,027,000	3,325,000	5,146,000	2,206,000
1989	8,692,000	4,802,000	3,890,000	6,084,000	2,608,000
1990	8,348,000	4,586,000	3,762,000	5,844,000	2,504,000
1991	7,231,000	4,070,000	3,161,000	5,062,000	2,169,000
1992	3,357,000	1,840,000	1,517,000	2,350,000	1,007,000
Total	41,477,000	22,584,000	18,890,000	29,032,000	12,442,000
		(54.4%)	(45.6%)	(70%)	(30%)

Year	Amount	Case C		Case D	
		F/C	L/C	F/C	L/C
1986	2,613,000	1,216,000	1,397,000	1,829,000	784,000
1987	11,829,000	6,491,000	5,338,000	8,280,000	3,549,000
1988	15,632,000	8,711,000	6,921,000	10,942,000	4,690,000
1989	14,728,000	8,543,000	6,185,000	10,310,000	4,418,000
Total	44,802,000	24,961,000	19,841,000	31,361,000	13,441,000
		(55.7%)	(44.3%)	(70%)	(30%)

(2) Interest rates and the terms of repayment

Case	Interest rate	Grace period	Amortization
- I	7% per annum	5 years	20 years Uniform annual repayment of principal & interest.
- II	15% per annum	3.5 years	15 years

Seeing that in Table k-2-1, repayment and state contribution for the project implementation by each case will be tabulated as follows;

Unit: US$ 1,000

Case	Repayment			National Treasury Disbursement (2)	State Contribution (1) + (2)
	During Construction	Other Period	Sub-Total (1)		
A - I	77.4 - 1,660.4	174.0 - 2,131.5	71,736.6	18,890.0	90,626.6
A - II	165.8 - 3,591.3	157.6 - 3,862.1	69,688.5	18,890.0	88,578.5
B - I	111.9 - 2,142.7	221.6 - 2,737.7	92,292.0	12,442.0	104,734.0
B - II	239.9 - 4,622.2	200.9 - 4,964.5	89,709.7	12,442.0	102,151.7
C - I	85.1 - 1,747.3	801.8 - 2,948.8	81,586.5	19,841.0	101,427.5
C - II	182.4 - 3,757.1	730.4 - 4,268.8	77,137.1	19,841.0	96,978.1
D - I	128.0 - 2,195.2	973.3 - 3,682.2	102,751.5	13,441.0	116,192.5
D - II	274.4 - 4,723.4	881.5 - 5,362.5	96,906.7	13,441.0	110,347.7

Table K-1-1 Agricultural Production and Farm Input Without Project

CROP	AREA (ha)	PRODUCTION (t/ha)	PRODUCTION (t)	FARMING INPUT (t/ha)	FARMING INPUT (t)	TOTAL WEIGHT (t)
Naranja	1,550	18	27,900	6.80	10,540	38,440
Mandarina	570	20	11,400	6.68	3,807	15,207
Manzana	1,680	10.5	17,640	6.93	11,642	29,282
Maracuya	550	10	5,500	2.10	1,155	6,655
Vid	350	6	2,100	6.16	2,156	4,256
Other Fruits	1,830	8.5	15,555	5.26	9,625	25,180
Algodon	5,300	2.7	14,310	6.81	36,093	50,403
Maiz Amarillo	3,850	4.5	17,325	0.47	1,809	19,134
Frijol seco	900	1	900	0.16	144	1,044
Frijol verde	700	4	2,800	0.16	122	2,912
Papa	900	15	13,500	7.74	6,966	20,466
Camute	300	16	4,800	0.62	186	4,986
Tomate	500	17	8,500	6.36	3,180	11,680
Col	600	17	10,200	0.35	210	10,410
Maiz Choclo	500	9	4,500	0.42	210	4,710
Coliflor	400	17	6,800	0.35	140	6,940
Aji	300	10	3,000	0.37	111	3,111
Caigua	300	7	2,100	0.34	102	2,202
Maiz Chala	1,200	35	42,000	0.50	600	42,600
Alfalfa	150	18	2,700	0.46	69	2,769
Others	1,050	9	9,450	0.46	483	9,933
Sub-total	23,480		222,980		89,340	312,320
Out of Project area	3,500	10	35,000	0.90	3,150	38,150
TOTAL	26,980		257,980		92,490	350,470

(Note) Volume of crop yield and farming input for other fruits are applied the average volume of palto and melocoton.

	Crop Yield		Farming Input
Palto	10	t/ha	4.04 t/ha
Melocoton	7		6.48
AVERAGE	8.5		5.26

Crop yield and farming input for others are applied the average of choclo.

Table K-1-2 Agricultural Production and Farm Input With Project

CROP	AREA (ha)	PRODUCTION (t/ha)	PRODUCTION (t)	FARMING INPUT (t/ha)	FARMING INPUT (t)	TOTAL WEIGHT (t)
Naranja	1,550	23	35,650	9.72	15,066	50,716
Mandarina	570	26	14,820	9.54	5,437	20,257
Manzana	1,680	14	23,520	9.90	16,632	40,152
Maracuya	550	15	8,250	3.00	1,650	9,900
Vid	350	9	3,150	8.80	3,080	6,230
Other Fruits	1,830	11.75	21,502	7.51	13,743	35,245
Algodon	5,660	4	22,640	9.73	55,071	77,711
Maiz Amarillo	5,660	7	39,620	0.67	3,792	43,412
Frijol sero	2,830	1.3	3,679	0.23	650	4,329
Frijol verde	700	6	4,200	0.23	161	4,361
Abono verde	2,830	-	0	0.23	651	651
Papa	450	22	9,900	11.05	4,972	14,872
Camote	200	24	4,800	0.88	176	4,976
Tomate	625	25	15,625	9.09	5,681	21,306
Col	500	25	12,500	0.50	250	12,750
Maiz Choclo	900	13	11,700	0.60	540	12,240
Coliflor	300	25	7,500	0.50	150	7,650
Caigua	300	10	3,000	0.49	147	3,147
Zanahoria	200	22	4,400	0.65	130	4,530
Alfalfa	150	25	3,750	0.65	97	3,847
Others	1,100	13	14,300	0.65	715	15,015
Sub-total	28,935		264,506		128,791	393,297
Out of Project area	3,500	10	35,000	0.90	3,150	38,150
TOTAL	32,435		299,506		131,941	431,447

(Note) Volume of crop yield and farming input for other fruits are applied the average volume of palto and melocoton.

	Crop Yield	Farming Input
Palto	13 t/ha	5.77 t/ha
Melocoton	10.5	9.25
AVERAGE	11.75	7.51

Crop yield and farming input for others are applied the average of choclo.

Table K-1-3 Agricultural Production and Income

CROP	UNIT PRICE (US$)	WITHOUT PROJECT		WITH PROJECT	
		YIELD (ton)	AMOUNT (10^3 US$)	YIELD (ton)	AMOUNT (10^3 US$)
Naranja	360	27,900	10,044	35,650	12,834
Mandarina	(470) 300	11,400	3,420	14,820	1,393.1 3,556.8
Manzana	240	17,640	4,233.6	23,520	5,644.8
Maracuya	140	5,500	770	8,250	1,155
Vid	240	2,100	504	3,150	756
Other Fruits	305	15,555	4,744.3	21,502	6,558.1
Algodon	0.4 X 1,700 38	14,310 14,310	9,730.8 543.8	22,640 22,640	15,395.2 860.3
Maiz Amarillo	230	17,325	3,984.8	39,620	9,112.6
Frijol seco	1,100	900	990	3,679	4,046.9
Frijol verde	180	2,800	504	4,200	756
Abono verde	-	-	-	-	-
Papa	240	13,500	3,240	9,900	2,376
Camute	55	4,800	264	4,800	264
Tomate	120	8,500	1,020	15,625	1,875
Col	80	10,200	816	12,500	1,000
Maiz Choclo	125	4,500	562.5	11,700	1,462.5
Califlor	80	6,800	544	7,500	600
Aji	160	3,000	480	-	-
Caigua	170	2,100	357	3,000	510
Zanahoria	100	-	-	4,400	440
Maiz Chala	8	42,000	336	-	-
Alfalfa	50	2,700	135	3,750	187.5
Others	125	9,450	1,181.3	14,300	1,787.5
TOTAL			48,405.1	287,146	72,571.3

(Note) Unit prices of other fruits are applied the average value of palto and melocoton.

	Unit Price
Palto	130 US$
Melocoton	480
AVERAGE	305

Unit price of others is applied the average value of Chocho.

Table K-1-4 REDUCED TRANSPORTATION COST

(1) Condition

	Capacity	Velocity
Without project	4 t truck	15 km/hr
With project	8 truck	30 km/hr

Transported distance: 10 km

(2) Cost

Description	Without project	With project
Capacity (90%)	3.6 t	7.2 t
Travelling hour	0.67 hr	0.33 hr
Travelling hour per 1 ton	0.19 hr/t	0.046 hr/t
Depreciation	US$3.55	US$7.72
Fuel	1.49	2.43
Operator	1.15	1.15
Operating cost per hour	6.19	11.30
Transportation cost per ton	1.18	0.52

(3) Annual benefit

1.18 - 0.52 = 0.66 US$/ton

Year	Production	Farm input	Total	Annual benefit
0	257,980 ton	92,490 ton	350,470 ton	(US$221,310)
1	266,285	131,941	398,226	262,829
2	274,590	131,941	406,531	268,310
3	282,895	131,941	414,836	273,791
4	291,200	131,941	423,141	279,273
5	299,506	131,941	431,449	284,755

(Refer to Table K-1-1 K-1-2)

Table K-1-5 Production Cost

CROP	WITHOUT PROJECT			WITH PROJECT		
	AREA (ha)	UNIT PRICE (US$/ha)	AMOUNT (10^3 US$)	AREA (ha)	UNIT PRICE (US$/ha)	AMOUNT (10^3 US$)
Naranja	1,550	2,793.5	4,329.9	1,550	3,147.8	4,879
Mandarina	570	2,793.5	1,592.3	570	3,147.8	1,794.2
Manzana	1,680	849	1,426.3	1,680	1,035.2	1,739.1
Maracuya	550	802.1	441.2	550	959.4	527.7
Vid	350	554.8	194.2	350	646.1	226.1
Other Fruits	1,830	990	1,811.7	1,830	1,146.4	2,097.9
Algodon	5,300	902.1	4,781.1	5,660	1,025.7	5,805.5
Maiz Amarillo	3,850	513.9	1,978.5	5,660	594.2	3,363.2
Frijol seco	900	499.9	449.9	2,830	551.9	1,561.9
Frijol verde	700	326.4	228.5	700	356.8	249.8
Papa	900	1,282.6	1,154.3	450	1,508.7	678.9
Camote	300	386.1	115.8	200	446.2	89.2
Abono Verde	-	-	-	2,830	356.8	1,009.7
Tomate	500	824	412	625	964.5	602.8
Col	600	527.6	316.6	500	595.9	297.9
Maiz Choclo	500	486.3	243.2	900	555.8	500.2
Coliflor	400	501.2	200.5	300	579.8	173.9
Aji	300	742.1	222.6	-	-	-
Caigua	300	500	150	300	575	172.5
Zanahoria	-	634.9	-	200	719.9	143.9
Maiz Chala	1,200	338.4	406.1	-	-	-
Alfalfa	150	605.7 X (1/6) 259.8 X (5/6)	15.1 32.5	150	699.8 X (1.6) 295 X (5/6)	17.5 36.9
Others	1,050	486.3	510.6	1,100	555.8	611.4
TOTAL	23,480		21,012.9	28,935		26,579.2

(Note) Unit prices of other fruits are applied the average value of palto and melocoton.

	With Project	Without Project
Palto	709.9	846.3
Melocoton	1,270.1	1,446.5
AVERAGE	990	1,146.4

Unit price of others is applied the average value of Chocho.

Table K-1-6 WATER WORKS BENEFIT

In case of substitution;

Huaral	..... length:	6 km	capacity: 100 l/s
Chancay	..... length:	4 km	capacity: 35 l/s

Concrete	1,000 m^3	x US$45.33	=	US$45,330
Stone pitching	3,000 m^3	x 20.17	=	60,510
Excavation	6,000 m^3	x 0.60	=	3,600
Embankment	20,000 m^3	x 1.09	=	21,800
				US$131,240

In case of allocation;

Huaral	217,512 x 0.1/1.46	= 8,734
Chancay	177,075 x 0.035/5.76	= 1,076
	67,931 x 0.035/3.25	= 732
		US$10,542

Table K-1-7(1) Annual Costs & Benefits
(Case 1) Original

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,284	-	-	-	-		-	-	-
2	4,210	-	-	-	-		-	-	-
3	7,352	-	-	-	-		-	-	-
4	8,692	-	-	-	-		-	-	-
5	8,348	-	-	105	-		-	-	-
6	7,231	-	-	-	89		15	-	-
7	3,357	2,783	-	-	89		15	-	-
8	-	5,566	-101	-	89	39 + 34	15	4,833	262
9	-	5,566	-101	-	89	27	15	9,666	268
10 (1995)	-	5,566	-101	-	89	27	15	14,499	273
11	-	5,566	-101	-	89	10	15	19,332	279
12	-	5,566	-101	-	89	10	15	24,166	284
13	-	5,566	-101	-	-	10	-	24,166	284
.....				(- do -)					
30 (2015)	3,322	5,566	-101	-	-	10	-	24,166	284
31	3,730	5,566	-101	-	-	10	-	24,166	284
32	-	5,566	-101	-	-	10	-	24,166	284
.....				(- do -)					
50 (2035)	-	5,566	-101	-	-	10	-	24,166	284

Table K-1-7(2) Annual Costs & Benefits
(Case 2) A four year construction periods

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,613	-	-	-	-	-	-	-	-
2	11,829	-	-	105	-	-	-	-	-
3	15,632	-	-	-	89	-	15	-	-
4	14,728	2,783	-	-	89	-	15	-	-
5	-	5,566	-101	-	89	39 + 34	15	4,833	262
6	-	5,566	-101	-	89	27	15	9,666	268
7	-	5,566	-101	-	89	27	15	14,499	273
8	-	5,566	-101	-	89	10	15	19,332	279
9	-	5,566	-101	-	89	10	15	24,166	284
10 (1995)	-	5,566	-101	-	-	10	-	24,166	284
.....									
30 (2015)	3,322	5,566	-101	-	-	10	-	24,166	284
31	3,730	5,566	-101	-	-	10	-	24,166	284
32	-	5,566	-101	-	-	10	-	24,166	284
.....									
50 (2035)	-	5,566	-101	-	-	10	-	24,166	284

Table K-1-7(3) Annual Costs & Benefits
(Case 3) A 10% increase in construction Cost

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,512	-	-	-	-	-	-	-	-
2	4,631	-	-	-	-	-	-	-	-
3	8,087	-	-	-	-	-	-	-	-
4	9,561	-	-	-	-	-	-	-	-
5	9,182	-	-	116	-	-	-	-	-
6	7,954	-	-	-	89	-	15	-	-
7	3,692	2,783	-	-	89	-	15	-	-
8	-	5,566	-101	-	89	39 + 34	15	4,833	262
9	-	5,566	-101	-	89	27	15	9,666	268
10 (1995)	-	5,566	-101	-	89	27	15	14,499	273
11	-	5,566	-101	-	89	10	15	19,332	279
12	-	5,566	-101	-	89	10	15	24,166	284
13	-	5,566	-101	-	-	10	-	24,166	284
.....									
30 (2010)	3,322	5,566	-101	-	-	10	-	24,166	284
31	3,730	5,566	-101	-	-	10	-	24,166	284
32	-	5,560	-101	-	-	10	-	24,166	284
.....									
50 (2035)	-	5,566	-101	-	-	10	-	24,166	284

Table K-1-7(4) Annual Costs & Benefits
(Case 4) A 5% reduction in Products

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,284	-	-	-	-	-	-	-	-
2	4,210	-	-	-	-	-	-	-	-
3	7,352	-	-	-	-	-	-	-	-
4	8,692	-	-	-	-	-	-	-	-
5	8,348	-	-	105	-	-	-	-	-
6	7,231	-	-	-	89	-	15	-	-
7	3,357	2,783	-	-	89	-	15	-	-
8	-	5,566	-101	-	89	39 + 34	15	4,107	254
9	-	5,566	-101	-	89	27	15	8,214	259
10 (1995)	-	5,566	-101	-	89	27	15	12,322	264
11	-	5,566	-101	-	89	10	15	16,430	269
12	-	5,566	-101	-	89	10	15	20,537	274
13	-	5,566	-101	-	-	10	-	20,537	274
.....									
30 (2015)	3,322	5,566	-101	-	-	10	-	20,537	274
31	3,730	5,566	-101	-	-	10	-	20,537	274
32	-	5,566	-101	-	-	10	-	20,537	274
.....									
50 (2035)	-	5,566	-101	-	-	10	-	20,537	274

Table K-1-7(5) Annual Costs & Benefits
(Case 5) A combination of (3) and (4)

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,512	-	-	-	-	-	-	-	-
2	4,631	-	-	-	-	-	-	-	-
3	8,087	-	-	-	-	-	-	-	-
4	9,561	-	-	-	-	-	-	-	-
5	9,182	-	-	116	-	-	-	-	-
6	7,954	-	-	-	89	-	15	-	-
7	3,692	2,783	-	-	89	-	15	-	-
8	-	5,566	-101	-	89	39 + 34	15	4,107	254
9	-	5,566	-101	-	89	27	15	8,214	259
10 (1995)	-	5,566	-101	-	89	27	15	12,322	264
11	-	5,566	-101	-	89	10	15	16,430	269
12	-	5,566	-101	-	89	10	15	20,537	274
13	-	5,566	-101	-	-	10	-	20,537	274
.....									
30 (2015)	3,654	5,566	-101	-	-	10	-	20,537	274
31	4,103	5,566	-101	-	-	10	-	20,537	274
32	-	5,566	-101	-	-	10	-	20,537	274
.....									
50 (2035)	-	5,566	-101	-	-	10	-	20,537	274

Table K-1-7(6) Annual Costs & Benefits
(Case 6) A two-year delay in Benefits

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,284	-	-	-	-	-	-	-	-
2	4,210	-	-	-	-	-	-	-	-
3	7,352	-	-	-	-	-	-	-	-
4	8,692	-	-	-	-	-	-	-	-
5	8,348	-	-	105	-	-	-	-	-
6	7,231	-	-	-	89	-	15	-	-
7	3,357	2,783	-	-	89	-	15	-	-
8	-	5,566	-101	-	89	39 + 34	15	-	-
9	-	5,566	-101	-	89	27	15	-	-
10 (1995)	-	5,566	-101	-	89	27	15	4,833	262
11	-	5,566	-101	-	89	10	15	9,666	268
12	-	5,566	-101	-	89	10	15	14,499	273
13	-	5,566	-101	-	89	10	-	19,332	279
14	-	5,566	-101	-	-	10	-	24,166	284
.....									
30 (2015)	3,322	5,566	-101	-	-	10	-	24,166	284
31	3,730	5,566	-101	-	-	10	-	24,166	284
32	-	5,566	-101	-	-	10	-	24,166	284
.....									
50 (2035)	-	5,566	-101	-	-	10	-	24,166	284

Table K-1-7(7) Annual Costs & Benefits
(Case 7) A combination of (3) and (4)

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,512	-	-	-	-	-	-	-	-
2	4,631	-	-	-	-	-	-	-	-
3	8,087	-	-	-	-	-	-	-	-
4	9,561	-	-	-	-	-	-	-	-
5	9,182	-	-	116	-	-	-	-	-
6	7,954	-	-	-	89	-	15	-	-
7	3,692	2,783	-	-	89	-	15	-	-
8	-	5,566	-101	-	89	39 + 34	15	-	-
9	-	5,566	-101	-	89	27	15	-	-
10 (1995)	-	5,566	-101	-	89	27	15	4,833	262
11	-	5,566	-101	-	89	10	15	9,666	268
12	-	5,566	-101	-	89	10	15	14,499	273
13	-	5,566	-101	-	-	10	-	19,332	279
14	-	5,566	-101	-	-	10	-	24,166	284
.....									
30 (2010)	3,654	5,566	-101	-	-	10	-	24,166	284
31	4,103	5,566	-101	-	-	10	-	24,166	284
32	-	5,566	-101	-	-	10	-	24,166	284
.....									
50 (2035)	-	5,566	-101	-	-	10	-	24,166	284

Table K-1-7(8) Annual Costs & Benefits
(Case 8) A combination of (4) and (5)

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,284	-	-	-	-	-	-	-	-
2	4,210	-	-	-	-	-	-	-	-
3	7,352	-	-	-	-	-	-	-	-
4	8,692	-	-	-	-	-	-	-	-
5	8,348	-	-	105	-	-	-	-	-
6	7,231	-	-	-	89	-	15	-	-
7	3,357	2,783	-	-	89	-	15	-	-
8	-	5,566	-101	-	89	39 + 34	15	-	-
9	-	5,566	-101	-	89	27	15	-	-
10 (1995)	-	5,566	-101	-	89	27	15	4,107	254
11	-	5,566	-101	-	89	10	15	8,214	259
12	-	5,566	-101	-	89	10	15	12,322	264
13	-	5,566	-101	-	-	10	-	16,430	269
14	-	5,566	-101	-	-	10	-	20,537	274
.....									
30 (2015)	3,322	5,566	-101	-	-	10	-	20,537	274
31	3,730	5,566	-101	-	-	10	-	20,537	274
32	-	5,566	-101	-	-	10	-	20,537	274
.....									
50 (2035)	-	5,566	-101	-	-	10	-	20,537	274

Table K-1-7(9) Annual Costs & Benefits
(Case 9) A combination of (5) and (6)

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1986)	2,512	-	-	-	-	-	-	-	-
2	4,631	-	-	-	-	-	-	-	-
3	8,087	-	-	-	-	-	-	-	-
4	9,561	-	-	-	-	-	-	-	-
5	9,182	-	-	116	-	-	-	-	-
6	7,954	-	-	-	89	-	15	-	-
7	3,692	2,783	-	-	89	-	15	6,579	-
8	-	5,566	-101	-	84	39 + 34	15	-	-
9	-	5,566	-101	-	89	27	15	-	-
10 (1995)	-	5,566	-101	-	89	27	15	4,107	254
11	-	5,566	-101	-	89	10	15	8,214	259
12	-	5,566	-101	-	89	10	15	12,322	264
13	-	5,566	-101	-	-	10	-	16,430	269
14	-	5,566	-101	-	-	10	-	20,537	274
.....									
30 (2015)	3,654	5,566	-101	-	-	10	-	20,537	274
31	4,103	5,566	-101	-	-	10	-	20,537	274
32	-	5,566	-101	-	-	10	-	20,537	274
.....									
50 (2035)	-	5,566	-101	-	-	10	-	20,537	274

Table K-1-7(10) Annual Costs & Benefits
(Case 10) A two-year delay in the commencement of construction work

Year	Cost							Benefit	
				Promotion					
	Construction Cost	Increased Production Cost	O & M Cost	Housing & Equipment	Running Cost	Chemical Amendment and Leaching	Demonstration Farm	Increased Production Benefit	Road Benefit
1 (1987)	2,398	-	-	-	-	-	-	-	-
2	0	-	-	-	-	-	-	-	-
3	0	-	-	-	-	-	-	-	-
4	4,640	-	-	-	-	-	-	-	-
5	8,102	-	-	-	-	-	-	-	-
6	9,584	-	-	-	-	-	-	-	-
7	9,202	-	-	-	-	-	-	-	-
8	7,971	-	-	105	-	-	-	-	-
9	3,703	2,783	-	-	89	-	15	-	-
10	-	5,566	-101	-	89	39 + 34	15	4,833	262
11 (1995)	-	5,566	-101	-	89	27	15	9,666	268
12	-	5,566	-101	-	89	27	15	14,499	273
13	-	5,566	-101	-	89	10	15	19,332	279
14	-	5,566	-101	-	89	10	15	24,166	284
.....									
32 (2015)	3,322	5,566	-101	-	-	10	-	24,166	284
33	3,730	5,566	-101	-	-	10	-	24,166	284
34	-	5,560	-101	-	-	10	-	24,166	284
.....									
50 (2035)	-	5,566	-101	-	-	10	-	24,166	284

Note: Concerning the investment during construction, it is considered increasing price contingency due to delay of commencement.

TABLE K-2-1(1) Repayment Schedule (Estimation)

[Unit: US$1,000]

CASE	ITEM	YEAR												
		'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	
	(1)	1,105	2,154	4,027	4,802	4,586	4,070	1,840						
A-I	(2)	77.4	228.2	510.1	813.5	1,134.4	1,433.9	1,660.4	1,758.6	1,875.3	1,987.1	2,086.4	2,131.4	Same amount as continue
	(3)	1,179	2,056	3,325	3,890	376.2	3,161	1,517						
	(4)	1,256.4	2,284.2	3,835.1	4,703.5	4,896.4	4,594.9	3,177.4	1,758.6	1,875.3	1,987.1	2,086.4	2,131.4	
	(1)	1,105	2,154	4,027	4,841	4,584	4,070	1,843						
A-II	(2)	165.8	488.9	1,093	1,824.9	2,546.8	3,122.1	3,591.3	3,689.7	3,780.7	3,842.8	3,862.1	3,862.1	
	(3)	1,179	2,056	3,325	3,890	3,764	3,161	1,514						
	(4)	1,344.8	2,544.9	4,418	5,714.9	6,310.8	6,283.1	5,105.3	3,689.7	3,780.7	3,842.8	3,862.1	3,862.1	

CASE	ITEM	2,003	'04	'05	'06	'07	'08	'09	'10	'20	'21	'22	'23	'24	'25	'26
	(1)															
A-I	(2)									2,131.4	2,027.1	1,823.8	1,443.7	990.9	558.2	174
	(3)															
	(4)									2,131.4	2,027.1	1,823.8	1,443.7	990.9	558.2	174
	(1)															
A-II	(2)	3,862.1	3,767.6	3,489	2,960.5	2,205.7	1,403.1	663.2	157.6							
	(3)															
	(4)	3,862.1	3,767.6	3,489	2,960.5	2,205.7	1,403.1	663.2	157.6							

NOTE: (1) Financing (F/C)
(2) Repayment (")
(3) National Treasury Disbursement (L/C)
(4) State Contribution (2)+(3)

TABLE K-2-1(2) Repayment Schedule (Estimation)

[Unit: US$1,000]

CASE	ITEM	YEAR												
		'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	
	(1)	1,599	2,947	5,146	6,084	5,844	5,062	2,350						
B-I	(2)	111.9	318.2	678.4	1,104.3	1,513.4	1,906.6	2,142.7	2,267.8	2,415.6	2,557.6	2,680.6	2,737.7	Same amount as continue
	(3)	685	1,263	2,206	2,608	2,504	2,169	1,007						
	(4)	796.9	1,581.2	2,884.4	3,712.3	4,017.4	4,075.6	3,149.7	2,267.8	2,415.6	2,557.6	2,680.6	2,737.7	
	(1)	1,599	2,947	5,146	6,084	5,844	5,062	2,350						
B-II	(2)	239.9	682	1,453.9	2,383.2	3,307.6	4,151.8	4,622.2	4,747.5	4,862	4,939.8	4,964.5	4,964.5	
	(3)	685	1,263	2,206	2,608	2,504	2,169	1,007						
	(4)	924.9	1,945	3,659.9	4,991.2	5,811.6	6,302.8	5,629.2	4,747.5	4,862	4,939.8	4,964.5	4,964.5	

CASE	ITEM	2,003	'04	'05	'06	'07	'08	'09	'10	'20	'21	'22	'23	'24	'25	'26
	(1)															
B-I	(2)									2,737.7	2,586.9	2,309	1,823.7	1,250	698.9	221.6
	(3)															
	(4)									2,737.7	2,586.9	2,309	1,823.7	1,250	698.9	221.6
	(1)															
B-II	(2)	4,964.6	4,827.8	4,439.2	3,747.2	2,787	1,767.2	834.5	200.9							
	(3)															
	(4)	4,964.6	4,827.8	4,439.2	3,747.2	2,787	1,767.2	834.5	200.9							

NOTE: (1) Financing (F/C)
(2) Repayment (")
(3) National Treasury Disbursement (L/C)
(4) State Contribution (2)+(3)

TABLE K-2-1(3) Repayment Schedule (Estimation)

[Unit: US$1,000]

CASE	ITEM	YEAR									
		'86	'87	'88	'89	'90	'91	'92	'93	'94	
	(1)	1,216	6,491	8,711	8,543						
C-I	(2)	85.1	539.5	1,149.3	1,747.3	1,862	2,389	2,756	2,948	2,350	Same amount as continue
	(3)	1,397	5,338	6,921	6,185						
	(4)	1,482.1	5,877.5	8,070.3	7,932.3	1,862	2,389	2,756	2,948	2,350	
	(1)	1,216	6,491	8,711	8,543						
C-II	(2)	182.4	1,156.1	2,462.8	3,757.1	3,837.9	3,997.8	4,179.1	4,268.8	4,268.8	
	(3)	1,397	5,338	6,921	6,185						
	(4)	1,579.4	6,494.1	9,383.8	9,942.1	3,837.9	3,997.8	4,179.1	4,268.8	4,268.8	

		2,003	'04	'05	'06	'07	'20	'21	'22	'23
	(1)									
C-I	(2)						2,350	2,235.3	1,623.2	801.8
	(3)									
	(4)						2,350	2,235.3	1,623.2	801.8
	(1)									
C-II	(2)	4,268.8	4,164.9	3,505.9	2,205.9	730.4				
	(3)									
	(4)	4,268.8	4,164.9	3,505.9	2,205.9	730.4				

NOTE: (1) Financing (F/C)
(2) Repayment (")
(3) National Treasury Disbursement (L/C)
(4) State Contribution (2)+(3)

TABLE K-2-1(4) Repayment Schedule (Estimation)

[Unit: US$1,000]

CASE	ITEM	'86	'87	'88	'89	'90	'91	'92	'93	'94	
	(1)	1,829	8,280	10,942	10,310						
D-I	(2)	128	707.6	1,473.5	2,195.2	2,367.9	3,021.5	3,474.8	3,682.2	2,960.5	Same amount as continue
	(3)	784	3,549	4,690	4,418						
	(4)	912	4,256.6	6,163.5	6,613.2	2,367.9	3,021.5	3,474.8	3,682.2	2,960.5	
	(1)	1,829	8,280	10,942	10,310						
D-II	(2)	274.4	1,516.4	3,157.8	4,723.4	4,829.5	5,031.4	5,254.6	5,362.5	5,362.8	
	(3)	784	3,549	4,690	4,418						
	(4)	1,058.4	5,065.4	7,847.8	9,141.4	4,829.5	5,031.4	5,254.6	5,362.8	5,362.8	

		2,003	'04	'05	'07		'20	'21	'22	'23
	(1)									
D-I	(2)						2,960.5	2,787.8	2,006.2	973.3
	(3)									
	(4)						2,960.5	2,787.8	2,006.2	973.3
	(1)									
D-II	(2)	5,362.8	5,206.4	4,342	2,698.5	881.5				
	(3)									
	(4)	5,362.8	5,206.4	4,342	2,698.5	881.5				

NOTE: (1) Financing (F/C)
(2) Repayment (")
(3) National Treasury Disbursement (L/C)
(4) State Contribution (2)+(3)

ANNEX L

OTHERS

C O N T E N T S

Annex L Others

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ANNEX L

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Fig. L-1-2 Geological Profile of Axis Near the Cacray Weir -- L - 5

Annex L Others

1. Practical use of lagoon water in the upper basin of the Chancay river

As described on 2-1-2 of main report, La Chalhuacacha (La Rahuite) and La Cacray among the lagoons under the control of Administracion Tecnica del Distrito Riego Chancay - Huaral has been damaged, so that no use for irrigation. If these lagoons would be rehabilitated, its available water in the draughty season is ; 3,800,000 m^3 in the La Cacray and 3,300,000 in the La Cholhuacacha (cf.Table A-2-3 of Annex A).

It is desire to be rehabilitated following the-increase of water demand in future. Concerning these rehabilitation, its views on the required survey are as followings ;

1) Geological aspect of the both lagoons
2) Proposed geological survey

1) Geological aspect of the both lagoons

Water runs off from the overflow Chalhuacocha-chica weir to the lower reservoir, the Chalhuacocha, by the overflow type weir. The Chalhuacocha-chica and the chalhuacocha weirs appear to no obstacles for foundation engineering as of their foundation are based on bedrock. The Chalhuacocha weir body, is cracked, decreasing the effective height of the weir. Gate opening and closing operation are hampered by sediment and poor gate movement. Water in the reservoir is leaking through the bottom of the reservoir and springing back up into lower stream.

The right side of the foundation of the Cacray weir is based on Cretaceous sedimentary rock, but left side of the same is on debris or morains, and seepage is developing flow under the weir and on the left side slope. Seepage flows have eroded the left half of the foundation of the weir and the weir has settled about 50cm damaging the body. The same has been repaired but repairs on foundation are incomplete and future leakage may be expected (cf. Fig.L-1-1,2).

After investigations of leakage through the reservoir, the

reservoir bottom of the Chalhuacocha and Chungar weirs, it is recommended that a watertight plan will be considered at another opportunity, although not in this study.

Effective utilization of the Charhuacha weir maximized after repairing the rock and improving the gate.

Water level of the Cacray reservoir is presently controlled under a certain level for fear if collapse of the weir, and consequently effective height of the same is not fully utilized.

Construction of a new weir on the upper or lower side of the existing weir has therefore been proposed. Fig.L-1-1 shows the geological profile of the proposed axis of a new weir on the upper side from this, it appears that the unsuitable because geological profiles are similar to the geological profile of the axis of the existing weir and thus similar trouble may be expected to arise.

Instead chemical grouting in the foundation under the weir to keep the weir body watertight increasing bearing capacity of the foundation and repairing normal use of the weir is recommended for secondary consideration. The gelling time should be less than 30 seconds, because velocity of the seepage flow under the weir is very rapid. However,as an alternative plan, construction of a net in site reinforced concrete pile (Italian patent), is also recommended.

2) Proposed geological survey

A detailed study of the weir body and a seepage survey should be conducted for the Charhuacocha weir in the Andes mountains to study and design dam rehabilitation and seepage policy. With regard to the Cacray weir, a detailed field study of surface geology, survey, boring,seismic survey and lugeon test are required and a functional rehabilitation plan for the weir should be formulated.

Study of the Charhuacocha weir body should focus on measurement and survey of cracks, identifying deformation on the weir body, subsidence, etc., and at the same time determining crack locations, dimensions, the existence of any opening, width of the same, depth, etc. Possible currence of deformation in the conduit and functional abnormalities in

the same should also be investigated. Using the dye method, etc. the seepage survey should include determination of seepage, if any, and the degree of the same, and the location of seepage and spring discharge. If necessary, core samples could be taken from the weir body deterioration of the concrete.

Study of the Cacray weir should include geological field survey to clearly identify geological structures and surface geology and formulation of geological maps (1/5000). Survey should also be undertaken to determine weir shape, deformation, suboidence, shifting and deformation and settling of the conduit. Boring should be conducted at 4 sites; namely, above the dam axis, in the vicinity of the conduit, 15m from the conduit on the right bank, and 20m and 40m from the conduit on left bank. Bore diameter should be 66mm with a depth of 30m. Permeability tests should be conducted on the moraine layer using the bore holes. The tests should be undertaken in two location at each borehole at a depth of 3m and 6m below the upper surface of the moraine layer. In places on the left bank where the mosaine layer is less than 6m only one test need be conducted. Maximum hydraulic pressure during should be 1.0 - 1.5kg/cm^2 and 0.1kg/cm^2 during the first stage. When hydraulic pressure exceeds the yielding pressure during testing, hydraulic pressure should be reduced after increasing the same to 0.2kg/cm^2 greater than the yielding pressure.

Seismic survey should be conducted above the dam axis at a point 50m from the conduit on the left bank, 100m from the conduit on the right banks, and 50m upstream and downstream, with an extension of 350m. In addition, core samples should be taken from the weir body and tested for concrete deterioration if required.

From the above, the geological structure and composition of the foundation, as well as the characteristics, permeability of the moraine, etc., may be determined. Study results will subsequently from the basis for formulation of a weir rehabilitation plan and material for design work.

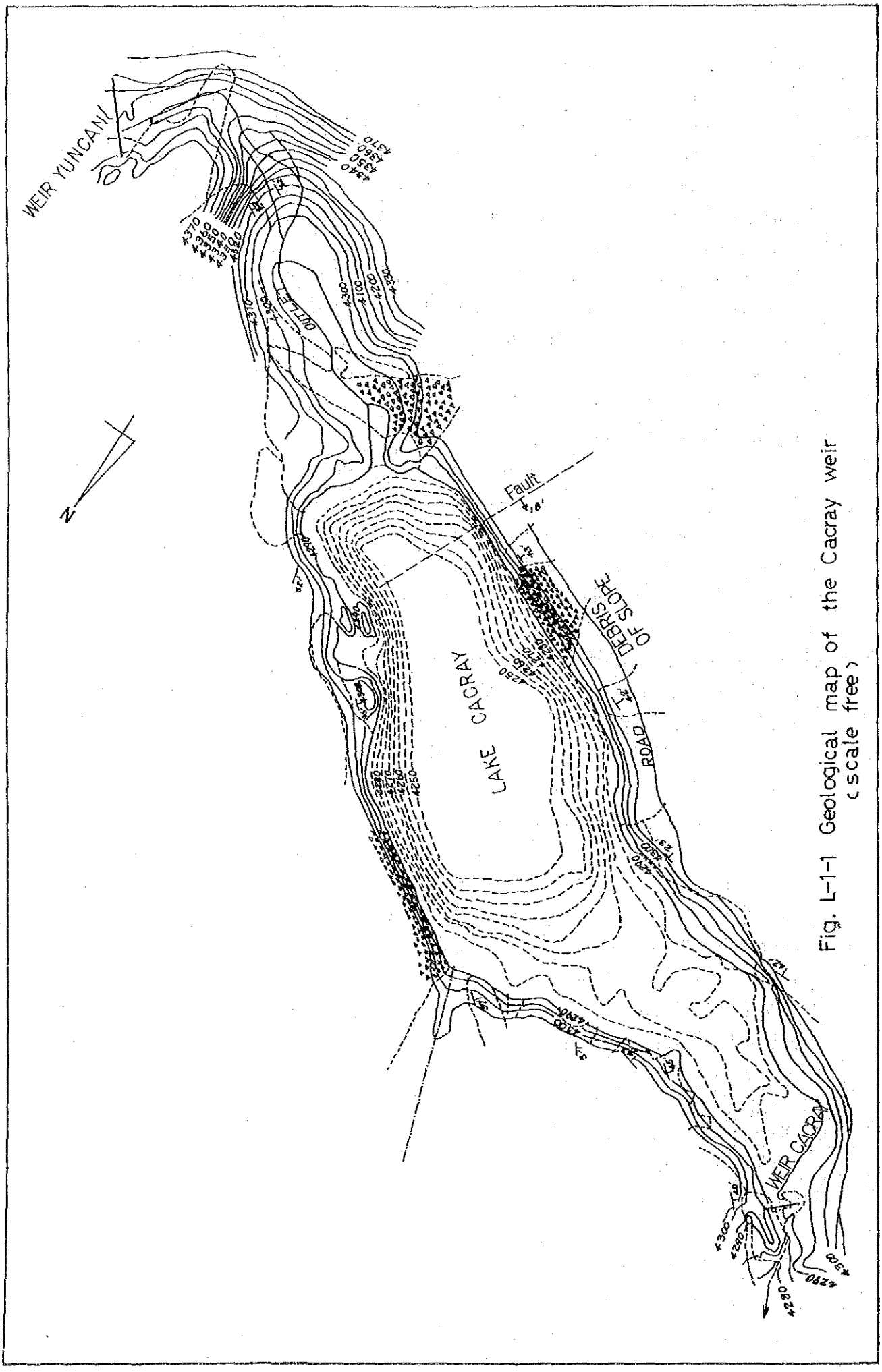

Fig. L-1-1 Geological map of the Cacray weir (scale free)

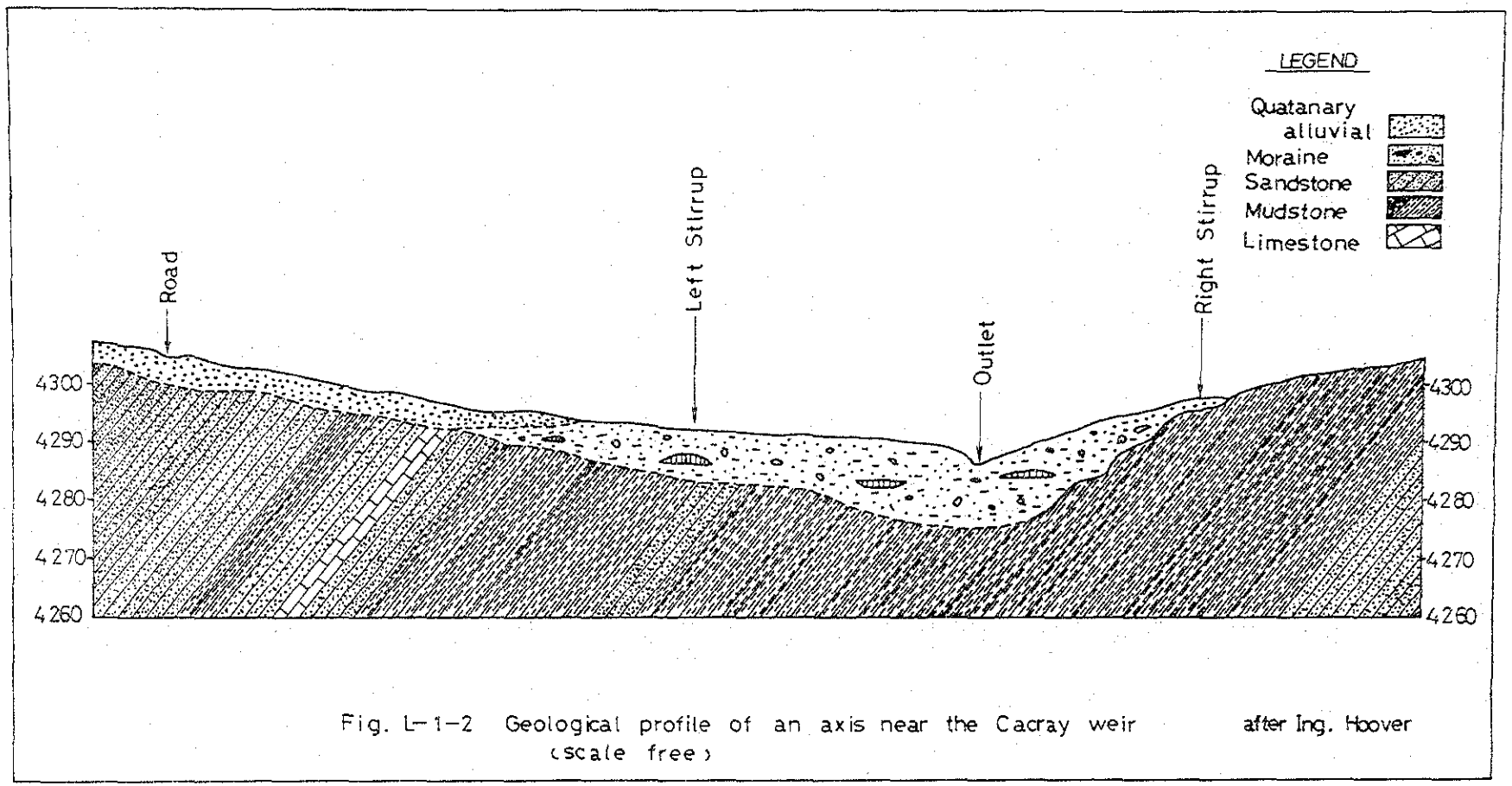

Fig. L-1-2 Geological profile of an axis near the Cacray weir (scale free) after Ing. Hoover

2. List of cooperated organizations

1 MINISTERIO DE AGRICULTURA (MAG)

- OFICINA SECTORIAL DE PLANIFICACION AGRARIA (OSPA)
- OFICINA SECTORIAL DE ESTADISTICA (OSE)
- DIRECCION GENERAL DE AGUAS, SUELOS Y IRRIGACIONES (DGASI)
- DIRECCION GENERAL DE AGROINDUSTRIA Y COMMERCIALIZACION (DGAIC)
- REGIONAL AGRARIA VI LIMA (RA VI - LIMA)
- OFICINA AGRARIA HUACHO
- LA ADMINISTRACION TECNICA DEL DISTRITO DE RIEGO CHANCAY - HUARAL (ATDR CHANCAY - HUARAL)
- LA ADMINISTRACION TECNICA DEL DISTRIO AGROPECUARIO HUARAL (ATDA HUARAL)

2 INSTITUTO NACIONAL DE AMPLIACION DE LA FRONTERA AGRICOLA (INAF)

3 INSTITUTO NACIONAL DE INVESTIGACION Y PROMOCION AGROPECUARIA (INIPA)

- CENTRO DE INVESTIGACION Y PROMOCION AGROPECUARIA (CIPA)
- ESTACION EXPERIMENTEAL AGROPECUARIA HUARAL - DONOSO

4 BANCO AGRARIO DEL PERU (BAP)

- SUCURSAL HUACHO
- AGENCIA HUARAL

5 INSTITUTO NACIONAL DE ESTADISTICA (INE)

6 INSTITUTO NACIONAL DE PLANIFICACION (INP)

7 SERVICIO NACIONAL DE EVALUACION DE RECURSOS NATURALES (ONERN)

8 SERVICIO NACIONAL DE METEOROLOGIA E HIDROLOGIA (SENAMHI)

9 SERVICIO NACIONAL DE MAQUINARIA AGRICOLA (SENAMA)

10 SERVICIO NACIONAL DE AGUA POTABLE Y ALCANTARILLADO (SENAPA)

11 EMPRESA NACIONAL DE COMERCIALIZACION DE INSYMOS (ENCI)

- AGENCIA HUARAL

12 ELECTRO PERU

13 UINIVERSIDAD NACIONAL AGRARIA DE LA MOLINA

14 CONSEJO PROVINCIAL DE HUARAL

15 INSTITUTO INTERAMERICANO DE CIENCIA AGRICOLA - OEA
(IICA - OEA)

16 BANCO CENTRAL DE RESERVA DEL PERU (BCR)

17 JUNTA DE USUARIOS DEL DISTRITO DE VALLE CHANCAY - HUARAL

JUNTA DE USUARIOS DEL DISTRITO DE CANETE

18 CENTRAL DE COOPERATIVAS DEL VALLE CHANCAY - HUARAL - AUCALLAMA

19 COOPERATIVAS AGRARIAS EN EL VALLE CHANCAY-HUARAL

20 COMITE DE PRODUCTORES DE ALGODON DEL VALLE CHANCAY - HUARAL - AUCALLAMA, ORGANIZACION NACIONAL AGRARIA

21 ASOCIACION PERUANO - JAPONES DE PROVINCIA HUARAL