DISBURSEMENT SCHEDULE FOR STAGE DEVELOPMENT

Description	1st			2nd			3rd			4th		
	F.C	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. Dam												
1) Preparatory Works												
2) Trans-Diversion Canal												
3) Trans-Diversion Tunnel (D=2.2m)												
4) Trans-Diversion Tunnel (D=2.0m)												
5) By-pass Tunnel (D=5.0m)												
6) Intake Structure												
7) Cofferdam												
8) Dam Excavation												
9) Dam Foundation Treatment												
10) Dam Embankment												
11) Spillway												
12) Trans-Diversion Related Facilities												
Subtotal												
2. Hydropower Station												
3. Domestic Water Supply												
4. Irrigation												
1) Preparatory Works				600.0	400.0	1,000.0						
2) Diversion Dam							2,959.0	1,328.0	4,287.0	12,281.0	6,810.0	19,091.0
3) Irrigation Canal							2,767.3	4,681.7	7,449.0	4,392.0	7,525.3	11,917.3
4) Drainage							287.3	528.8	816.1	218.4	405.9	624.3
5) On-Farm							108.5	1,278.3	1,386.8	113.0	1,428.6	1,541.6
6) Structures for Irrigation at Power Station												
Subtotal				600.0	400.0	1,000.0	6,122.1	7,816.8	13,938.9	17,004.4	16,169.8	33,174.2
5. Roads							3,859.4	6,296.2	10,155.6	1,182.1	1,928.6	3,110.7
6. ICC and Drying Yard							573.6	1,165.0	1,738.6	561.0	1,143.7	1,704.7
Total				600.0	400.0	1,000.0	10,555.1	15,278.0	25,833.1	18,747.5	19,242.1	37,989.6
8. Land Acquisition					7,200.0	7,200.0						
9. O & M Facilities				6,915.0	4,770.0	11,685.0						
10. Administration and Engineering	21,290.0	3,400.0	24,690.0	2,710.0	2,200.0	4,910.0	2,500.0	2,000.0	4,500.0	2,500.0	2,000.0	4,500.0
11. Agricultural Extension							460.0	-	460.0			
Total	21,290.0	3,400.0	24,690.0	10,225.0	14,570.0	24,795.0	13,515.1	17,278.0	30,793.1	21,247.5	21,242.1	42,489.6
12. Contingency	3,193.5	510.0	3,703.5	1,533.8	2,185.5	3,719.3	2,027.3	2,591.7	4,619.0	3,187.1	3,186.3	6,373.4
(Total)	24,483.5	3,910.0	28,393.5	11,758.8	16,755.5	28,514.3	15,542.4	19,869.7	35,412.1	24,434.6	24,428.4	48,863.0
13. Price Contingency	3,158.4	2,123.1	5,281.5	2,704.5	12,214.8	14,919.3	5,300.0	18,598.0	23,898.0	11,020.0	28,532.4	39,552.4
TOTAL	27,641.9	6,033.1	33,675.0	14,463.3	28,970.3	43,433.6	20,842.4	38,467.7	59,310.1	35,454.6	52,960.8	88,415.4

TABLE XIII-1
(1 of 3)

DISBURSEMENT SCHEDULE FOR STAGE DEVELOPMENT

Description	5th			6th			7th			8th		
	F.C	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. Dam												
1) Preparatary Works				2,040.0	1,360.0	3,400.0						
2) Trans-Diversion Canal	11,215.4	19,185.0	30,400.4									
3) Trans-Diversion Tunnel (D=2.2m)	3,117.6	1,824.3	4,941.9									
4) Trans-Diversion Tunnel (D=2.0m)				2,897.5	1,653.8	4,551.3						
5) By-pass Tunnel (D=5.0m)				15,003.2	9,215.6	24,218.8	2,747.2	1,528.7	4,275.9			
6) Intake Structure				283.9	181.0	464.9						
7) Cofferdam							10,360.5	4,640.5	15,001.0			
8) Dam Excavation							11,065.3	4,441.0	15,506.3			
9) Dam Foundation Treatment							7,288.0	4,976.7	12,264.7			
10) Dam Embankment										12,020.0	5,031.5	17,051.5
11) Spillway												
12) Trans-Diversion Related Facilities												
Subtotal	14,333.0	21,009.3	35,342.3	20,224.6	12,410.4	32,635.0	31,461.0	15,586.9	47,047.9	12,020.0	5,031.5	17,051.5
2. Hydropower Station												
3. Domestic Water Supply												
4. Irrigation												
1) Preparatary Works												
2) Diversion Dam	14,100.0	5,336.0	19,436.0									
3) Irrigation Canal	7,717.8	13,009.2	20,727.0									
4) Drainage	1,096.4	1,547.5	2,643.9									
5) On-Farm	123.7	1,741.4	1,865.1									
6) Structures for Irrigation at Power Station												
Subtotal	23,037.9	21,634.1	44,672.0									
5. Roads	1,602.8	2,615.0	4,217.8									
6. ICC and Drying Yard	561.0	1,143.7	1,704.7									
Total	39,534.7	46,402.1	85,936.8	20,224.6	12,410.4	32,635.0	31,461.0	15,586.9	47,047.9	12,020.0	5,031.5	17,051.5
8. Land Acquisition		150.0	150.0		150.0	150.0						
9. O & M Facilities												
10. Administration and Engineering	2,500.0	2,000.0	4,500.0	2,500.0	2,000.0	4,500.0	2,500.0	2,000.0	4,500.0	2,500.0	2,000.0	4,500.0
11. Agricultural Extension												
Total	42,034.7	48,552.1	90,586.8	22,724.6	14,560.4	37,285.0	33,961.0	17,586.9	51,547.9	14,520.0	7,031.5	21,551.5
12. Contingency	6,305.2	7,282.8	13,588.0	3,408.7	2,184.1	5,592.8	5,094.2	2,638.0	7,732.2	2,178.0	1,054.7	3,232.7
(Total)	48,339.9	55,834.9	104,174.8	26,133.3	16,744.5	42,877.8	39,055.2	20,224.9	59,280.1	16,698.0	8,086.2	24,784.2
13. Price Contingency	26,538.6	79,788.1	106,326.7	16,777.6	28,800.5	45,578.1	28,900.8	41,380.1	70,280.9	14,093.1	19,503.9	33,597.0
TOTAL	74,878.5	136,723.0	210,501.5	42,910.9	45,545.0	88,455.9	67,956.0	61,605.0	129,561.0	30,791.1	27,590.1	58,381.2

TABLE XIII-1
(3 of 3)

DISBURSEMENT SCHEDULE FOR STAGE DEVELOPMENT

Description	9th			10th			Total		
	F.C	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1. Dam									
1) Preparatary Works							2,040.0	1,360.0	3,400.0
2) Trans-Diversion Canal				20,151.1	34,733.7	54,884.8	31,366.5	53,918.7	85,285.2
3) Trans-Diversion Tunnel (D=2.2m)							3,117.6	1,824.3	4,941.9
4) Trans-Diversion Tunnel (D=2.0m)							2,897.5	1,653.8	4,551.3
5) By-pass Tunnel (D=5.0m)				1,708.1	1,795.6	3,503.7	19,458.5	12,539.9	31,998.4
6) Intake Structure							283.9	181.0	464.9
7) Cofferdam							10,360.5	4,640.5	15,001.0
8) Dam Excavation	11,602.6	4,814.2	16,416.8	11,602.6	4,814.1	16,416.7	34,270.5	14,069.3	48,339.8
9) Dam Foundation Treatment							7,288.0	4,976.7	12,264.7
10) Dam Embankment	12,020.0	5,031.5	17,051.5	12,008.3	5,025.5	17,034.8	36,048.3	15,089.5	51,137.8
11) Spillway	14,114.7	16,692.3	30,807.0	14,114.7	16,692.4	30,807.1	28,229.4	33,384.7	61,614.1
12) Trans-Diversion Related Facilities				16,351.7	3,545.3	19,897.0	16,351.7	3,545.3	19,897.0
Subtotal	37,737.3	26,538.0	64,275.3	75,936.5	66,607.6	142,544.1	191,712.4	147,183.7	338,896.1
2. Hydropower Station				35,951.5	6,196.1	42,147.6	35,951.5	6,196.1	42,147.6
3. Dom-stic Water Supply				965.0	223.0	1,188.0	965.0	223.0	1,188.0
4. Irrigation									
1) Preparatary Works							600.0	400.0	1,000.0
2) Diversion Dam							29,340.0	13,474.0	42,814.0
3) Irrigation Canal	5,143.4	8,710.0	13,853.4	4,823.2	8,071.8	12,895.0	24,843.7	41,998.0	66,841.7
4) Drainage	1,266.6	2,123.5	3,390.1	246.0	449.6	695.6	3,114.7	5,055.3	8,170.0
5) On-Farm	115.8	1,578.8	1,694.6	111.9	1,538.3	1,650.2	572.9	7,565.4	8,138.3
6) Structures for Irrigation at Power Station				1,642.3	2,668.2	4,310.5	1,642.3	2,668.2	4,310.5
Subtotal	6,525.8	12,412.3	18,938.1	6,823.4	12,727.9	19,551.3	60,113.6	71,160.9	131,274.5
5. Roads	1,185.4	1,933.8	3,119.2	1,583.9	2,584.3	4,168.2	9,413.6	15,357.9	24,771.5
6. ICC and Drying Yard	561.0	1,143.7	1,704.7	561.0	1,143.7	1,704.7	2,817.6	5,739.8	8,557.4
Total	46,009.5	42,027.8	88,037.3	121,821.3	89,482.6	211,303.9	300,973.7	245,861.4	546,835.1
8. Land Acquisition							-	7,500.0	7,500.0
9. O & M Facilities				5,555.0	50.0	5,605.0	12,470.0	4,820.0	17,290.0
10. Administration and Engineering	2,500.0	2,000.0	4,500.0	2,500.0	2,000.0	4,500.0	44,000.0	21,600.0	65,600.0
11. Agricultural Extension							460.0	-	460.0
Total	48,509.5	44,027.8	92,537.3	129,876.3	91,532.6	221,408.9	357,903.7	279,781.4	637,685.1
12. Contingency	7,276.4	6,604.2	13,880.6	19,481.4	13,729.9	33,211.3	53,685.6	41,967.2	95,652.8
(Total)	55,785.9	50,632.0	106,417.9	149,357.7	105,262.5	254,620.2	411,589.3	321,748.6	733,337.9
13. Price Contingency	53,275.5	142,832.9	196,108.4	160,111.5	345,261.0	505,372.5	321,880.0	719,034.8	1,040,914.8
TOTAL	109,061.4	193,464.9	302,527.3	309,469.2	450,523.5	759,992.7	733,469.3	1,040,783.4	1,774,252.7

PROJECT ECONOMIC COST STREAM
(STAGE DEVELOPMENT)

(Unit: 000B)

Items	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	Total
A. Financial Cost						(Stage II)					
1. Dam	-	-	-	-	35,342	32,635	47,048	17,052	64,275	142,544	338,896
2. Hydropower Station	-	-	-	-	-	-	-	-	-	42,147	42,147
3. Sara Waterworks	-	-	-	-	-	-	-	-	-	1,188	1,188
4. Irrigation	-	1,000	13,939	33,174	44,672	-	-	-	18,938	19,552	131,275
5. Roads	-	-	10,156	3,111	4,219	-	-	-	3,119	4,167	24,772
6. Integrated Community Center	-	-	703	702	702	-	-	-	702	702	3,511
7. Dry Yard	-	-	1,036	1,003	1,002	-	-	-	1,003	1,002	5,046
8. Land Acquisition	-	7,200	-	-	150	150	-	-	-	-	7,500
9. Facilities for O & M	-	11,685	-	-	-	-	-	-	-	5,605	17,290
10. Administration & Engineering											
- Stage I	11,163	2,220	2,035	2,035	2,033	-	-	-	-	-	19,486
- Stage II	13,527	2,690	2,465	2,465	2,467	4,500	4,500	4,500	4,500	4,500	46,114
Subtotal	24,690	4,910	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	65,600
11. Facilities for Agri-Extension	-	-	460	-	-	-	-	-	-	-	460
12. Contingency											
- Stage I	3,294	3,308	4,108	5,668	12,085	-	-	-	-	-	28,463
- Stage II	410	411	511	705	1,503	5,593	7,732	3,233	13,880	33,212	67,190
Subtotal	3,704	3,719	4,619	6,373	13,588	5,593	7,732	3,233	13,880	33,212	95,653
Total - Stage I	14,457	25,413	32,437	45,693	100,205	-	-	-	-	-	218,205
- Stage II	13,937	3,101	2,976	3,170	3,970	42,878	59,280	24,785	106,417	254,619	515,133
TOTAL	28,394	28,514	35,413	48,863	104,175	42,878	59,280	24,785	106,417	254,619	733,338
B. Economic Cost											
1. Dam	-	-	-	-	26,489	27,406	40,480	14,932	53,092	114,476	276,875
2. Hydropower Station	-	-	-	-	-	-	-	-	-	39,470	39,470
3. Sara Waterworks	-	-	-	-	-	-	-	-	-	1,092	1,092
4. Irrigation	-	832	10,659	26,389	35,594	-	-	-	13,730	14,215	101,419
5. Roads	-	-	7,435	2,278	3,088	-	-	-	2,283	3,053	18,137
6. Integrated Community Center	-	-	483	483	483	-	-	-	483	486	2,418
7. Dry Yard	-	-	751	727	727	-	-	-	727	728	3,660
8. Land Acquisition	-	-	-	-	-	-	-	-	-	-	-
9. Facilities for O & M	-	9,624	-	-	-	-	-	-	-	5,584	15,208
10. Administration & Engineering											
- Stage I	9,435	1,609	1,477	1,477	1,478	-	-	-	-	-	15,476
- Stage II	13,786	2,351	2,159	2,159	2,158	3,636	3,636	3,636	3,636	3,636	40,793
Subtotal	23,221	3,960	3,636	3,636	3,636	3,636	3,636	3,636	3,636	3,636	56,269
11. Facilities for Agri-Extension	-	-	460	-	-	-	-	-	-	-	460
12. Contingency											
- Stage I	3,191	2,541	3,204	4,516	9,623	-	-	-	-	-	23,075
- Stage II	293	234	295	481	819	4,650	6,592	2,777	11,027	27,280	54,448
Subtotal	3,484	2,775	3,499	4,997	10,442	4,650	6,592	2,777	11,027	27,280	77,523
Total - Stage I	12,626	14,606	24,469	35,870	77,482	-	-	-	-	-	165,053
- Stage II	14,079	2,585	2,454	2,640	2,977	35,692	50,708	21,345	84,978	210,020	427,478
TOTAL	26,705	17,191	26,923	38,510	80,459	35,692	50,708	21,345	84,978	210,020	592,531

ECONOMIC COST STREAM OF OPERATION AND MAINTENANCE
(STAGE DEVELOPMENT)

(Unit: 000P)

Year	Stage I						Stage II						Incremental Cost (Overall)
	Without Project	With Project				Incremental Cost	Without Project	With Project				Incremental Cost	
		O & M Area (ha)	O & M Cost	Replacement	Sub-total			O & M Area (ha)	O & M Cost	Replacement	Sub-total		
1987	-	-	-	-	-	-	-	-	-	-	-	-	-
1988	1,146	(1,360)	443	-	443	-703	-	-	-	-	-	-	-703
1989	1,146	(1,880)	612	-	612	-534	-	-	-	-	-	-	-534
1990	1,146	(2,270)	739	-	739	-407	-	-	-	-	-	-	-407
1991	1,146	(2,270)	739	-	739	-407	-	-	-	-	-	-	-407
1992	1,146	(2,270)	739	-	739	-407	-	-	-	-	-	-	-407
1993	1,146	(2,270)	739	-	739	-407	-	-	-	-	-	-	-407
1994	1,146	(2,270)	739	-	739	-407	-	-	-	-	-	-	-407
1995 ~2035	1,146	(2,270)	739	-	739	-407	-	(4,490)	1,462	-	1,462	1,462	1,055
1997	1,146	(2,270)	739	2,020	2,759	1,613	-	(4,490)	1,462	-	1,462	1,462	1,055
2005 (Every 10 year)	1,146	(2,270)	739	-	739	-407	-	(4,490)	1,462	3,995	5,457	5,457	5,050
2020 (Every 25 year)	1,146	(2,270)	739	7,638	8,377	7,231	-	(4,490)	1,462	41,392	42,854	42,854	50,085

TABLE XIII-4

CROP BENEFIT STREAM
(STAGE DEVELOPMENT : STAGE I)

(Unit: Area...ha, NPV...000P)

Sub-Project	Crops		1988	1989	1990	1991	1992	1993	1994	1995~
I. With Project										
I-1 Areas not yet under construction										
A. Ordinary Service Area	- Paddy	• Area	1,760	838	359	-	-	-	-	-
		• NPV	9,580	4,579	1,972	-	-	-	-	-
	- Others	• Area	186	89	38	-	-	-	-	-
		• NPV	1,661	795	343	-	-	-	-	-
	(total)	• Area	1,946	927	397	-	-	-	-	-
		• NPV	11,241	5,374	2,315	-	-	-	-	-
B. Serruco Area	- Paddy	• Area	370	-	-	-	-	-	-	-
		• NPV	2,559	-	-	-	-	-	-	-
Subtotal		• NPV	13,800	5,374	2,315	-	-	-	-	-
I-2 Areas with construction in-progress										
A. Ordinary Service Area	- Paddy	• Area	-	1,000	1,520	1,910	1,910	1,910	1,910	1,910
		• NPV	-	12,183	21,785	29,747	32,325	33,567	33,903	34,101
B. Serruco Area	- Paddy	• Area	-	360	360	360	360	360	360	360
		• NPV	-	4,183	5,262	5,792	5,975	6,097	6,097	6,097
Subtotal		• NPV	-	16,366	27,047	35,539	38,300	39,664	40,000	40,198
Total		• NPV	13,800	21,740	29,362	35,539	38,300	39,664	40,000	40,198
II. Without Project		• NPV	13,800	13,976	14,150	14,326	14,500	14,676	14,850	15,026
Benefit			0	7,764	15,212	21,213	23,800	24,988	25,150	25,172

CROP BENEFIT STREAM
(STAGE DEVELOPMENT : STAGE II)

(Unit: Area...ha, NPV...000P)

Sub-Project	Crops		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I. With Project															
I-1 Areas not yet under construction															
A. Ordinary Service Area	- Paddy	Area	3,728	3,728	3,728	3,728	3,728	3,728	3,728	3,728	-	-	-	-	-
		NPV	20,292	20,397	20,502	20,607	20,712	20,817	20,922	21,027	-	-	-	-	-
	- Others	Area	394	394	394	394	394	394	394	394	-	-	-	-	-
		NPV	3,519	3,519	3,519	3,519	3,519	3,519	3,519	3,519	-	-	-	-	-
	(total)	Area	4,122	4,122	4,122	4,122	4,122	4,122	4,122	4,122	-	-	-	-	-
		NPV	23,811	23,916	24,021	24,126	24,231	24,336	24,441	24,546	-	-	-	-	-
B. Serruco	- Paddy	Area	330	330	330	330	330	330	330	330	-	-	-	-	-
		NPV	2,269	2,401	2,496	2,609	2,724	2,836	2,950	3,063	-	-	-	-	-
C. Kabsaka Area	- Paddy	Area	132	132	132	132	132	132	132	132	-	-	-	-	-
		NPV	1,040	1,103	1,165	1,225	1,287	1,350	1,413	1,475	-	-	-	-	-
D. Catipayan Drum Area	- Paddy	Area	4	4	4	-	-	-	-	-	-	-	-	-	-
		NPV	20	20	20	-	-	-	-	-	-	-	-	-	-
Subtotal		NPV	27,140	27,420	27,702	27,960	28,242	28,522	28,804	29,084	-	-	-	-	-
I-2 Areas with construction in-progress															
A. Ordinary Service Area	- Paddy	Area	-	-	-	-	-	-	-	-	3,635	3,635	3,635	3,635	3,635
		NPV	-	-	-	-	-	-	-	-	44,570	56,069	61,722	63,671	64,382
	- Others	Area	-	-	-	-	-	-	-	-	410	410	410	410	410
		NPV	-	-	-	-	-	-	-	-	7,968	12,421	14,793	15,605	15,924
	(total)	Area	-	-	-	-	-	-	-	-	4,045	4,045	4,045	4,045	4,045
		NPV	-	-	-	-	-	-	-	-	52,538	68,490	76,515	79,276	80,306
B. Serruco	- Paddy	Area	-	-	-	-	-	-	-	-	320	320	320	320	320
		NPV	-	-	-	-	-	-	-	-	3,718	4,677	5,149	5,312	5,420
C. Kabsaka Area	- Paddy	Area	-	-	-	-	-	-	-	-	125	125	125	125	125
		NPV	-	-	-	-	-	-	-	-	1,452	1,827	2,011	2,075	2,117
Subtotal		NPV	-	-	-	-	-	-	-	-	57,708	74,994	83,675	86,663	87,843
Total		NPV	24,140	27,420	27,702	27,960	28,242	28,522	28,804	29,084	57,708	74,994	83,675	86,663	87,843
II. Without Project		NPV	27,140	27,420	27,702	27,981	28,263	28,543	28,825	29,105	29,387	29,667	29,867	29,967	30,017
Benefit Stage II			0	0	0	-21	-21	-21	-21	-21	28,321	45,327	53,808	56,696	57,826
(Stage I)			0	7,764	15,212	21,213	23,800	24,988	25,150	25,172	25,172	25,172	25,172	25,172	25,172
(Overall)			0	7,764	15,212	21,192	23,779	24,967	25,129	25,151	53,493	70,499	78,980	81,868	82,998

BENEFIT OF WATER SUPPLY IN THE INTEGRATED COMMUNITY CENTER (STAGE DEVELOPMENT)

Year	Number of ICC Constructed		Benefitted Households		Willingness to Pay (= Benefit) 000₱		
	I	II	I	II	I	II	Total
~1987	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-
1989	20	-	1,000	-	84	-	84
1990	28	-	1,400	-	118	-	118
1991	46	-	2,300	-	193	-	193
1992	46	-	2,300	-	193	-	193
1993	46	-	2,300	-	193	-	193
1994	46	-	2,300	-	193	-	193
1995	46	-	2,300	-	193	-	193
1996~	46	54	2,300	2,700	193	227	420

FARM ROAD BENEFIT STREAM
(STAGE DEVELOPMENT)

Year	Percent Trend of Paddy Production With Project (%)		1. Field to Drying Yard				2. Drying Yard to Existing Main Road				Total Benefit (000 ₱)		
			Transportation Volume (tons)		Benefit *1 (000 ₱)		Transportation Volume (tons)		Benefit *2 (000 ₱)				
	Stage I	Stage II	Stage I	Stage II	Stage I	Stage II	Stage I	Stage II	Stage I	Stage II	Stage I	Stage II	Overall
~1988	-	-	-	-	-	-	-	-	-	-	-	-	-
1989	35.74		6,468	-	329	-	4,109	-	303	-	632	-	632
1990	58.78	-	10,638	-	541	-	6,759	-	499	-	1,040	-	1,040
1991	85.92	-	15,550	-	791	-	9,879	-	729	-	1,520	-	1,520
1992	94.15	-	17,039	-	867	-	10,825	-	799	-	1,666	-	1,666
1993	94.32	-	17,070	-	869	-	10,845	-	800	-	1,669	-	1,669
1994	99.44	-	17,997	-	916	-	11,434	-	843	-	1,759	-	1,759
1995	100.00	-	18,098	-	921	-	11,498	-	848	-	1,769	-	1,769
1996	100.00	68.60	18,098	13,157	921	670	11,498	8,359	848	617	1,769	1,287	3,056
1997	100.00	86.30	18,098	16,552	921	842	11,498	10,516	848	776	1,769	1,618	3,387
1998	100.00	95.00	18,098	18,221	921	927	11,498	11,576	848	854	1,769	1,781	3,550
1999	100.00	98.00	18,098	18,796	921	957	11,498	11,941	848	881	1,769	1,838	3,607
2000~	100.00	100.00	18,098	19,180	921	976	11,498	12,185	848	899	1,769	1,875	3,644

Note: *1 ..... 50.89 ₱/ton
*2 ..... 73.77 ₱/ton

TABLE XIII-7

TABLE XIII-8

PROJECT ECONOMIC BENEFIT STREAM
(STAGE DEVELOPMENT)

(Unit: 000₹)

Year	Stage I				Stage II							TOTAL
	Agriculture				Agriculture							
	Crops	ICC	Farm Road	Total	Crops	ICC	Farm Road	Sub-total	Power Plant	Sara Water works	Total	
~1988	-	-	-	-	-	-	-	-	-	-	-	-
1989	7,764	84	632	8,480	-	-	-	-	-	-	-	8,480
1990	15,212	118	1,040	16,370	-	-	-	-	-	-	-	16,370
1991	21,213	193	1,520	22,926	-21	-	-	-21	-	-	-21	22,905
1992	23,800	193	1,666	25,659	-21	-	-	-21	-	-	-21	25,638
1993	24,988	193	1,669	26,850	-21	-	-	-21	-	-	-21	26,829
1994	25,150	193	1,759	27,102	-21	-	-	-21	-	-	-21	27,081
1995	25,172	193	1,769	27,134	-21	-	-	-21	-	-	-21	27,113
1996	25,172	193	1,769	27,134	28,321	227	1,287	29,835	9,414	205	39,454	66,588
1997	25,172	193	1,769	27,134	45,327	227	1,618	47,172	9,414	205	56,791	83,925
1998	25,172	193	1,769	27,134	53,808	227	1,781	55,816	9,414	205	65,435	92,569
1999	25,172	193	1,769	27,134	56,696	227	1,838	58,761	9,414	205	68,380	95,514
2000~	25,172	193	1,769	27,134	57,826	227	1,875	59,928	9,414	205	69,547	96,681

PROJECT COST AND BENEFITS
(STAGE DEVELOPMENT : STAGE I)

(UNIT : MILLION PESOS)

YEAR	PROJECT COST			BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE					
						10 %		12 %		14 %	
	CAPITAL	O & M	TOTAL			(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1 1986	12.626	0.0	12.626	0.0	-12.626	12.626	0.0	12.626	0.0	12.626	0.0
2 1987	14.606	0.0	14.606	0.0	-14.606	12.071	0.0	11.644	0.0	11.239	0.0
3 1988	24.469	-0.703	23.766	0.0	-23.766	17.856	0.0	16.916	0.0	16.041	0.0
4 1989	35.870	-0.534	35.336	8.480	-26.856	24.135	5.792	22.457	5.389	20.922	5.021
5 1990	77.482	-0.407	77.075	16.370	-60.705	47.858	10.165	43.735	9.289	40.031	8.502
6 1991	0.0	-0.407	-0.407	22.926	23.333	-0.230	12.941	-0.206	11.615	-0.185	10.445
7 1992	0.0	-0.407	-0.407	25.659	26.066	-0.209	13.167	-0.184	11.607	-0.163	10.254
8 1993	0.0	-0.407	-0.407	26.850	27.257	-0.190	12.526	-0.164	10.844	-0.143	9.413
9 1994	0.0	-0.407	-0.407	27.102	27.509	-0.173	11.494	-0.147	9.773	-0.125	8.334
10 1995	0.0	-0.407	-0.407	27.134	27.541	-0.157	10.461	-0.131	8.736	-0.110	7.319
11 1996	0.0	-0.407	-0.407	27.134	27.541	-0.143	9.510	-0.117	7.800	-0.096	6.420
12 1997	0.0	1.613	1.613	27.134	25.521	0.514	8.646	0.414	6.965	0.335	5.632
13 1998	0.0	-0.407	-0.407	27.134	27.541	-0.118	7.860	-0.093	6.218	-0.074	4.940
14 1999	0.0	-0.407	-0.407	27.134	27.541	-0.107	7.145	-0.083	5.552	-0.065	4.334
15 2000	0.0	-0.407	-0.407	27.134	27.541	-0.097	6.496	-0.074	4.957	-0.057	3.801
16 2001	0.0	-0.407	-0.407	27.134	27.541	-0.089	5.905	-0.066	4.426	-0.050	3.335
17 2002	0.0	-0.407	-0.407	27.134	27.541	-0.081	5.368	-0.059	3.952	-0.044	2.925
18 2003	0.0	-0.407	-0.407	27.134	27.541	-0.073	4.880	-0.053	3.529	-0.038	2.566
19 2004	0.0	-0.407	-0.407	27.134	27.541	-0.067	4.437	-0.047	3.150	-0.034	2.251
20 2005	0.0	-0.407	-0.407	27.134	27.541	-0.060	4.033	-0.042	2.813	-0.030	1.974
21 2006	0.0	-0.407	-0.407	27.134	27.541	-0.055	3.667	-0.038	2.512	-0.026	1.732
22 2007	0.0	1.613	1.613	27.134	25.521	0.198	3.333	0.133	2.242	0.090	1.519
23 2008	0.0	-0.407	-0.407	27.134	27.541	-0.045	3.030	-0.030	2.002	-0.020	1.333
24 2009	0.0	-0.407	-0.407	27.134	27.541	-0.041	2.755	-0.027	1.788	-0.018	1.169
25 2010	0.0	-0.407	-0.407	27.134	27.541	-0.038	2.504	-0.024	1.596	-0.015	1.025
26 2011	0.0	-0.407	-0.407	27.134	27.541	-0.034	2.277	-0.021	1.425	-0.013	0.899
27 2012	0.0	7.231	7.231	27.134	19.903	0.552	2.070	0.339	1.272	0.210	0.789
28 2013	0.0	-0.407	-0.407	27.134	27.541	-0.028	1.882	-0.017	1.136	-0.010	0.692
29 2014	0.0	-0.407	-0.407	27.134	27.541	-0.026	1.711	-0.015	1.014	-0.009	0.607
30 2015	0.0	-0.407	-0.407	27.134	27.541	-0.023	1.555	-0.014	0.906	-0.008	0.533
31 2016	0.0	-0.407	-0.407	27.134	27.541	-0.021	1.414	-0.012	0.809	-0.007	0.467
32 2017	0.0	1.613	1.613	27.134	25.521	0.076	1.285	0.043	0.722	0.024	0.410
33 2018	0.0	-0.407	-0.407	27.134	27.541	-0.018	1.168	-0.010	0.645	-0.005	0.359
34 2019	0.0	-0.407	-0.407	27.134	27.541	-0.016	1.062	-0.009	0.576	-0.005	0.315
35 2020	0.0	-0.407	-0.407	27.134	27.541	-0.014	0.966	-0.008	0.514	-0.004	0.277
36 2021	0.0	-0.407	-0.407	27.134	27.541	-0.013	0.878	-0.007	0.459	-0.004	0.243
37 2022	0.0	-0.407	-0.407	27.134	27.541	-0.012	0.798	-0.006	0.410	-0.003	0.213
38 2023	0.0	-0.407	-0.407	27.134	27.541	-0.011	0.725	-0.005	0.366	-0.003	0.187
39 2024	0.0	-0.407	-0.407	27.134	27.541	-0.010	0.659	-0.005	0.327	-0.002	0.164
40 2025	0.0	-0.407	-0.407	27.134	27.541	-0.009	0.600	-0.004	0.292	-0.002	0.144
41 2026	0.0	-0.407	-0.407	27.134	27.541	-0.008	0.545	-0.004	0.260	-0.002	0.126
42 2027	0.0	1.613	1.613	27.134	25.521	0.029	0.495	0.014	0.232	0.007	0.111
43 2028	0.0	-0.407	-0.407	27.134	27.541	-0.007	0.450	-0.003	0.208	-0.001	0.097
44 2029	0.0	-0.407	-0.407	27.134	27.541	-0.006	0.409	-0.003	0.185	-0.001	0.085
45 2030	0.0	-0.407	-0.407	27.134	27.541	-0.006	0.372	-0.002	0.165	-0.001	0.075
46 2031	0.0	-0.407	-0.407	27.134	27.541	-0.005	0.338	-0.002	0.148	-0.001	0.065
47 2032	0.0	-0.407	-0.407	27.134	27.541	-0.005	0.308	-0.002	0.132	-0.001	0.057
48 2033	0.0	-0.407	-0.407	27.134	27.541	-0.004	0.280	-0.002	0.118	-0.001	0.050
49 2034	0.0	-0.407	-0.407	27.134	27.541	-0.004	0.254	-0.002	0.105	-0.001	0.044
50 2035	0.0	-0.407	-0.407	27.134	27.541	-0.003	0.231	-0.001	0.094	-0.001	0.039
TOTAL	165.053	-4.241	160.812	1239.881	1079.069	113.660	178.850	106.579	139.276	100.146	111.293

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.57 (10%), 1.31 (12%), 1.11 (14%)
INTERNAL RATE OF RETURN (IRR) = 15.5 %

PROJECT COST AND BENEFITS
(STAGE DEVELOPMENT: STAGE II)

(UNIT : MILLION PESOS)

YEAR	PROJECT COST			BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE					
						10 %		12 %		14 %	
	CAPITAL	O & M	TOTAL			(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1 1986	14.079	0.0	14.079	0.0	-14.079	14.079	0.0	14.079	0.0	14.079	0.0
2 1987	2.585	0.0	2.585	0.0	-2.585	2.136	0.0	2.061	0.0	1.989	0.0
3 1988	2.454	0.0	2.454	0.0	-2.454	1.844	0.0	1.747	0.0	1.656	0.0
4 1989	2.640	0.0	2.640	0.0	-2.640	1.803	0.0	1.678	0.0	1.563	0.0
5 1990	2.977	0.0	2.977	0.0	-2.977	1.848	0.0	1.689	0.0	1.546	0.0
6 1991	35.692	0.0	35.692	-0.021	-35.713	20.147	-0.012	18.083	-0.011	16.261	-0.010
7 1992	50.708	0.0	50.708	-0.021	-50.729	26.021	-0.011	22.938	-0.009	20.265	-0.008
8 1993	21.345	0.0	21.345	-0.021	-21.366	9.958	-0.010	8.621	-0.008	7.483	-0.007
9 1994	84.978	0.0	84.978	-0.021	-84.999	36.039	-0.009	30.644	-0.008	26.132	-0.006
10 1995	210.020	1.462	211.482	-0.021	-211.503	81.536	-0.008	68.092	-0.007	57.047	-0.006
11 1996	0.0	1.462	1.462	39.454	37.992	0.512	13.829	0.420	11.342	0.346	9.336
12 1997	0.0	1.462	1.462	56.791	55.329	0.466	18.096	0.375	14.577	0.303	11.788
13 1998	0.0	1.462	1.462	65.435	63.973	0.423	18.954	0.335	14.996	0.266	11.914
14 1999	0.0	1.462	1.462	68.380	66.918	0.385	18.007	0.299	13.992	0.233	10.921
15 2000	0.0	1.462	1.462	69.547	68.085	0.350	16.649	0.267	12.706	0.205	9.743
16 2001	0.0	1.462	1.462	69.547	68.085	0.318	15.136	0.238	11.345	0.180	8.547
17 2002	0.0	1.462	1.462	69.547	68.085	0.289	13.760	0.213	10.129	0.158	7.497
18 2003	0.0	1.462	1.462	69.547	68.085	0.263	12.509	0.190	9.044	0.138	6.577
19 2004	0.0	1.462	1.462	69.547	68.085	0.239	11.372	0.170	8.075	0.121	5.769
20 2005	0.0	5.457	5.457	69.547	64.090	0.811	10.338	0.566	7.210	0.397	5.060
21 2006	0.0	1.462	1.462	69.547	68.085	0.198	9.398	0.135	6.437	0.093	4.439
22 2007	0.0	1.462	1.462	69.547	68.085	0.180	8.544	0.121	5.748	0.082	3.894
23 2008	0.0	1.462	1.462	69.547	68.085	0.163	7.767	0.108	5.132	0.072	3.416
24 2009	0.0	1.462	1.462	69.547	68.085	0.148	7.061	0.096	4.582	0.063	2.996
25 2010	0.0	1.462	1.462	69.547	68.085	0.135	6.419	0.086	4.091	0.055	2.628
26 2011	0.0	1.462	1.462	69.547	68.085	0.123	5.836	0.077	3.653	0.048	2.305
27 2012	0.0	1.462	1.462	69.547	68.085	0.112	5.305	0.069	3.261	0.043	2.022
28 2013	0.0	1.462	1.462	69.547	68.085	0.101	4.823	0.061	2.912	0.037	1.774
29 2014	0.0	1.462	1.462	69.547	68.085	0.092	4.384	0.055	2.600	0.033	1.556
30 2015	0.0	5.457	5.457	69.547	64.090	0.313	3.986	0.182	2.321	0.107	1.365
31 2016	0.0	1.462	1.462	69.547	68.085	0.076	3.623	0.044	2.073	0.025	1.197
32 2017	0.0	1.462	1.462	69.547	68.085	0.069	3.294	0.039	1.851	0.022	1.050
33 2018	0.0	1.462	1.462	69.547	68.085	0.063	2.995	0.035	1.652	0.019	0.921
34 2019	0.0	1.462	1.462	69.547	68.085	0.057	2.722	0.031	1.475	0.017	0.808
35 2020	0.0	42.854	42.854	69.547	26.693	1.525	2.475	0.812	1.317	0.437	0.709
36 2021	0.0	1.462	1.462	69.547	68.085	0.047	2.250	0.025	1.176	0.013	0.622
37 2022	0.0	1.462	1.462	69.547	68.085	0.043	2.045	0.022	1.050	0.011	0.546
38 2023	0.0	1.462	1.462	69.547	68.085	0.039	1.859	0.020	0.938	0.010	0.479
39 2024	0.0	1.462	1.462	69.547	68.085	0.036	1.690	0.018	0.837	0.009	0.420
40 2025	0.0	5.457	5.457	69.547	64.090	0.121	1.537	0.059	0.747	0.029	0.368
41 2026	0.0	1.462	1.462	69.547	68.085	0.029	1.397	0.014	0.667	0.007	0.323
42 2027	0.0	1.462	1.462	69.547	68.085	0.027	1.270	0.013	0.596	0.006	0.283
43 2028	0.0	1.462	1.462	69.547	68.085	0.024	1.155	0.011	0.532	0.005	0.249
44 2029	0.0	1.462	1.462	69.547	68.085	0.022	1.050	0.010	0.475	0.005	0.218
45 2030	0.0	1.462	1.462	69.547	68.085	0.020	0.954	0.009	0.424	0.004	0.191
46 2031	0.0	1.462	1.462	69.547	68.085	0.018	0.867	0.008	0.379	0.004	0.168
47 2032	0.0	1.462	1.462	69.547	68.085	0.017	0.789	0.007	0.338	0.003	0.147
48 2033	0.0	1.462	1.462	69.547	68.085	0.015	0.717	0.006	0.302	0.003	0.129
49 2034	0.0	1.462	1.462	69.547	68.085	0.014	0.652	0.006	0.270	0.002	0.113
50 2035	0.0	5.457	5.457	69.547	64.090	0.046	0.592	0.019	0.241	0.008	0.099
TOTAL	427.478	117.314	544.792	2733.647	2188.855	203.343	246.054	174.900	171.449	151.640	122.551

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.21 (10%), 0.98 (12%), 0.81 (14%)
INTERNAL RATE OF RETURN (IRR) - 11.8 %

PROJECT COST AND BENEFITS
(STAGE DEVELOPMENT: OVERALL)

(UNIT : MILLION PESOS)

YEAR	PROJECT COST			BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE					
						10 %		12 %		14 %	
	CAPITAL	O & M	TOTAL			(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1 1986	26.705	0.0	26.705	0.0	-26.705	26.705	0.0	26.705	0.0	26.705	0.0
2 1987	17.191	0.0	17.191	0.0	-17.191	14.207	0.0	13.705	0.0	13.228	0.0
3 1988	26.923	-0.703	26.220	0.0	-26.220	19.700	0.0	18.663	0.0	17.698	0.0
4 1989	38.510	-0.534	37.976	8.480	-29.496	25.938	5.792	24.134	5.389	22.485	5.021
5 1990	80.459	-0.407	80.052	16.370	-63.682	49.706	10.165	45.424	9.289	41.577	8.502
6 1991	35.692	-0.407	35.285	22.905	-12.380	19.918	12.929	17.877	11.604	16.075	10.435
7 1992	50.708	-0.407	50.301	25.638	-24.663	25.813	13.156	22.754	11.597	20.102	10.246
8 1993	21.345	-0.407	20.938	26.829	5.891	9.768	12.516	8.457	10.836	7.340	9.405
9 1994	84.978	-0.407	84.571	27.081	-57.490	35.867	11.485	30.497	9.766	26.006	8.328
10 1995	210.020	1.055	211.075	27.113	-183.962	81.379	10.453	67.961	8.730	56.937	7.314
11 1996	0.0	1.055	1.055	66.588	65.533	0.370	23.339	0.303	19.143	0.250	15.756
12 1997	0.0	3.075	3.075	83.925	80.850	0.980	26.741	0.789	21.542	0.638	17.420
13 1998	0.0	1.055	1.055	92.569	91.514	0.306	26.814	0.242	21.215	0.192	16.854
14 1999	0.0	1.055	1.055	95.514	94.459	0.278	25.152	0.216	19.544	0.168	15.255
15 2000	0.0	1.055	1.055	96.681	95.626	0.253	23.145	0.193	17.663	0.148	13.545
16 2001	0.0	1.055	1.055	96.681	95.626	0.230	21.041	0.172	15.771	0.130	11.881
17 2002	0.0	1.055	1.055	96.681	95.626	0.209	19.128	0.154	14.081	0.114	10.422
18 2003	0.0	1.055	1.055	96.681	95.626	0.190	17.389	0.137	12.572	0.100	9.142
19 2004	0.0	1.055	1.055	96.681	95.626	0.173	15.808	0.122	11.225	0.088	8.020
20 2005	0.0	5.050	5.050	96.681	91.631	0.751	14.371	0.524	10.023	0.367	7.035
21 2006	0.0	1.055	1.055	96.681	95.626	0.143	13.065	0.098	8.949	0.067	6.171
22 2007	0.0	3.075	3.075	96.681	93.606	0.378	11.877	0.254	7.990	0.172	5.413
23 2008	0.0	1.055	1.055	96.681	95.626	0.118	10.797	0.078	7.134	0.052	4.748
24 2009	0.0	1.055	1.055	96.681	95.626	0.107	9.816	0.070	6.370	0.045	4.165
25 2010	0.0	1.055	1.055	96.681	95.626	0.097	8.923	0.062	5.687	0.040	3.654
26 2011	0.0	1.055	1.055	96.681	95.626	0.089	8.112	0.055	5.078	0.035	3.205
27 2012	0.0	8.693	8.693	96.681	87.988	0.663	7.375	0.408	4.534	0.253	2.811
28 2013	0.0	1.055	1.055	96.681	95.626	0.073	6.704	0.044	4.048	0.027	2.466
29 2014	0.0	1.055	1.055	96.681	95.626	0.067	6.095	0.039	3.614	0.024	2.163
30 2015	0.0	5.050	5.050	96.681	91.631	0.289	5.541	0.169	3.227	0.099	1.898
31 2016	0.0	1.055	1.055	96.681	95.626	0.055	5.037	0.031	2.881	0.018	1.665
32 2017	0.0	3.075	3.075	96.681	93.606	0.146	4.579	0.082	2.573	0.046	1.460
33 2018	0.0	1.055	1.055	96.681	95.626	0.045	4.163	0.025	2.297	0.014	1.281
34 2019	0.0	1.055	1.055	96.681	95.626	0.041	3.784	0.022	2.051	0.012	1.124
35 2020	0.0	42.447	42.447	96.681	54.234	1.510	3.440	0.804	1.831	0.433	0.986
36 2021	0.0	1.055	1.055	96.681	95.626	0.034	3.128	0.018	1.635	0.009	0.865
37 2022	0.0	1.055	1.055	96.681	95.626	0.031	2.843	0.016	1.460	0.008	0.758
38 2023	0.0	1.055	1.055	96.681	95.626	0.028	2.585	0.014	1.303	0.007	0.665
39 2024	0.0	1.055	1.055	96.681	95.626	0.026	2.350	0.013	1.164	0.006	0.584
40 2025	0.0	5.050	5.050	96.681	91.631	0.112	2.136	0.054	1.039	0.027	0.512
41 2026	0.0	1.055	1.055	96.681	95.626	0.021	1.942	0.010	0.928	0.005	0.449
42 2027	0.0	3.075	3.075	96.681	93.606	0.056	1.765	0.026	0.828	0.013	0.394
43 2028	0.0	1.055	1.055	96.681	95.626	0.018	1.605	0.008	0.740	0.004	0.346
44 2029	0.0	1.055	1.055	96.681	95.626	0.016	1.459	0.007	0.660	0.003	0.303
45 2030	0.0	1.055	1.055	96.681	95.626	0.014	1.326	0.006	0.590	0.003	0.266
46 2031	0.0	1.055	1.055	96.681	95.626	0.013	1.206	0.006	0.526	0.003	0.233
47 2032	0.0	1.055	1.055	96.681	95.626	0.012	1.096	0.005	0.470	0.002	0.205
48 2033	0.0	1.055	1.055	96.681	95.626	0.011	0.997	0.005	0.420	0.002	0.179
49 2034	0.0	1.055	1.055	96.681	95.626	0.010	0.906	0.004	0.375	0.002	0.157
50 2035	0.0	5.050	5.050	96.681	91.631	0.043	0.824	0.017	0.335	0.007	0.138
TOTAL	592.531	113.073	705.604	3973.528	3267.924	317.003	424.904	281.479	310.725	251.787	233.844

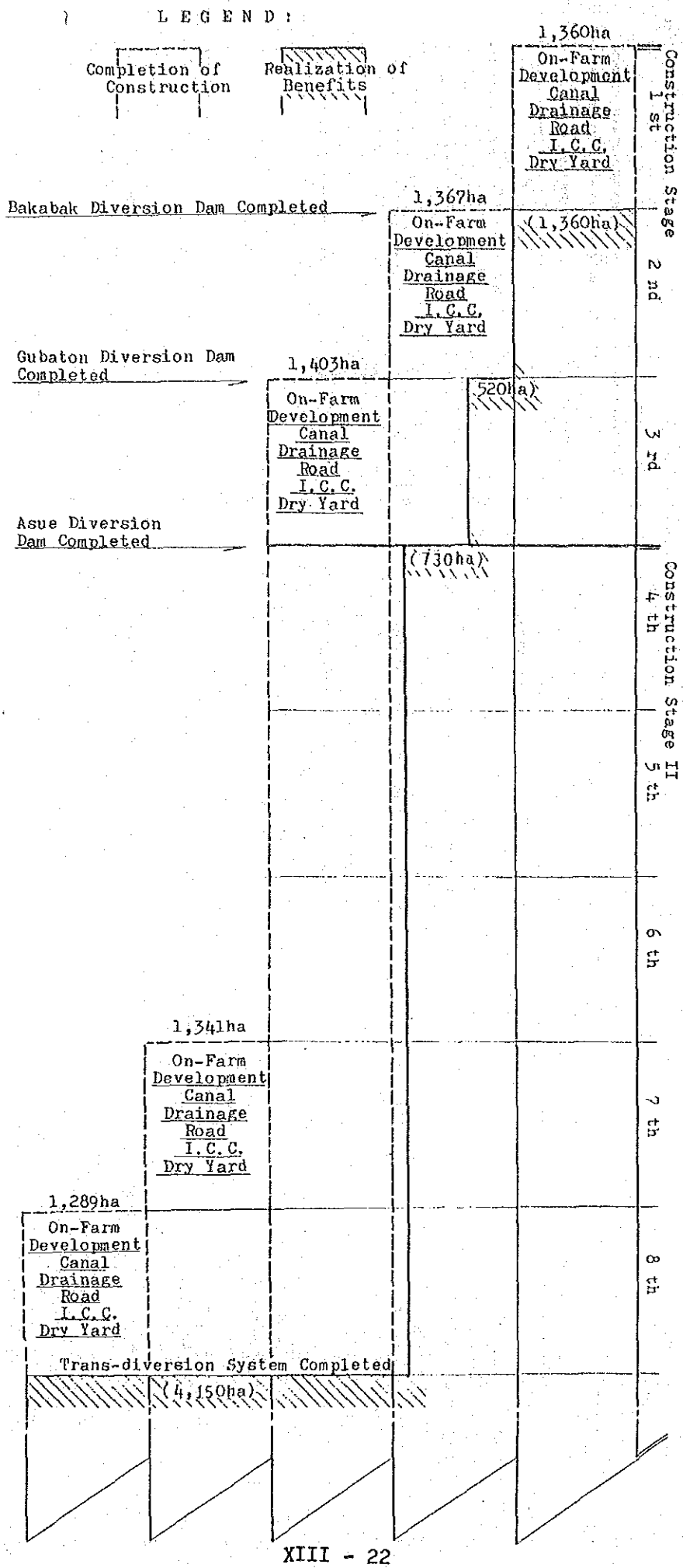
BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.34 (10%), 1.10 (12%), 0.93 (14%)
INTERNAL RATE OF RETURN (IRR) = 13.1 %

IMPLEMENTATION SCHEDULE FOR STAGE DEVELOPMENT

Item	STAGE I					STAGE II				
	Pre-Project Stage		Construction Stage			Construction Stage				
	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
1) Dam										
Diversion Tunnel										
Cofferdam										
Excavation										
Embankment										
Spillway										
Trans-diversion Canal										
Tunnel										
2) Hydropower Station										
3) Domestic Water Supply										
4) Irrigation and Drainage										
Diversion Dam			Bakabak D.D	Gubaton D.D	Asue D.D					
Irrigation Canal	Detail Design	Preparation Works								
Main Canal			5,780 m	8,430 m	8,380 m				6,160 m	1,120 m
Lateral Canal			7,430 m	10,820 m	14,640 m				11,870 m	20,110 m
Drainage										
New Drainage Canal			6,400 m	5,300 m	2,500 m				2,100 m	5,200 m
Excavation of Creeks					1,500 m				4,500 m	
Drainage Structure					2 nos.				4 nos.	
Rehabil. for Up. of Asue R.					650 m					
Removal of Ex. Wiers										
On-Farm Development			1,360 ha	1,367 ha	1,403 ha				1,341 ha	1,289 ha
Facilities at H.P. Station										
5) Road (Excluding of Service Road)										
New Road			6,750 m	1,350 m	900 m				2,400 m	3,900 m
Rehabil. for Ex. Road			3,700 m	800 m	1,400 m				100 m	
Related Structures			11 nos.	1 nos.	2 nos.				2 nos.	3 nos.
Enlargement of S. Road			2,160 m	1,910 m	5,620 ha				2,910 m	
Along the Serruco CIS Canal			16,110 m							
6) Integrated Community Center			20 nos.	20 nos.	20 nos.				20 nos.	20 nos.
7) Dry Yard			31 nos.	30 nos.	30 nos.				30 nos.	30 nos.

FIG. XIII-2

AGRICULTURAL BENEFIT REALIZATION FOR STAGE DEVELOPMENT



APPENDIX XIV

WATERSHED MANAGEMENT

APPENDIX XIV

WATERSHED MANAGEMENT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX XIV

WATERSHED MANAGEMENT

1. GENERAL

The total watershed area at the proposed Catipayan dam site is approximately 4,400ha. About 84% of this total area is open grassland with scattered trees and savanna forest. Virgin forest does not exist and secondary forest occupies only about 5% of the total area or about 200ha. Generally, rainfall intensity in the area is low and the soil texture is classified as fine loamy to clayey type with 30-40% silt content; therefore, eroidability of the soil is considered to be slight. The topography of the area is undulating, rough and broken, and slope gradients vary from steep to very steep.

Grassland is affected by the present shifting cultivation and the natural vegetation is threaten with deterioration in the future. To ensure long-term and effective utilization of the Catipayan dam, the following three items should be taken into consideration.

- protection against soil erosion
- minimization of flood discharge and sedimentation in the reservoir
- conservation of water holding capacity

A watershed management and soil conservation plan should be carried out simultaneously with the Asue River Basin Agricultural Development Project. During the feasibility study, the Team carried out soil and land use surveys to establish watershed management measures.

Generally, there are three main components of watershed management as follows:

- reforestation
- protection against erosion
- construction of debris barrier

Reforestation will facilitate both conservation of water resources and prevention of soil erosion. Erosion prevention works and the debris barrier, on the other hand, will effectively facilitate land conservation. Based on the results of the surveys, reforestation should be ranked as the highest priority work. A reforestation plan was accordingly formulated by the Team.

Further detailed survey and study, however, are required for formulation of a watershed management plan. There is a possibility that the addition of such a component may detract from the Project's economic feasibility. It is therefore recommended that the watershed management plan should be undertaken independently.

2. LOCATION AND ACCESSIBILITY

The dam site is located on the Catipayan River, which is a tributary of the Panay River. The Panay River is the largest river on Panay Island. The watershed area of the Catipayan dam covers a length of 3-6km from east to west and about 10km from north to south. The aera is located between northern latitudes of 11°18' and 11°24' and eastern longitudes of 122°00' and 122°10', and is bordered by such mountains as Mt.Agudo and Mt.Alapusio in the north and covers a total land area of about 4,400ha. The watershed area includes the administrative units of Barangay Tady, Juniza and Aposaga in Sara Municipality and Barangay Taro-ato, Pangi in San Dionisio.

There are about 280 households with a population of approximately 1,700. Though there are many roads or footpaths, road conditions are generally poor and many are impassable by vehicle. Villagers must ford their way across rivers as there are no bridges. Areas at EL. 200m along the ENE and the western divides are highly populated and comprise large areas of arable land. Road conditions in this area are comparatively well developed and small vehicle transport is possible along roads travelling into and out of the Project area. This area is also accessible from each poblacion. The location of the watershed area and the road network are shown in FIG. XIV-1.

3. TOPOGRAPHY

The basin is fairly long, extending about 10km with a north-south trend and a width of about 4km with an east-west trend. The area extends northwards to the southern foot of the south facing mountain slopes (EL = 700-800m) of Mount Agudo and Mount Alpasco in the north (EL = 200m).

For proposed dam site C, the basin area is about 44.2km^2 with a dam reservoir area of about 2.72km^2. The average elevation is about 500m in the north and about 150m in the south, indicating that the area is moderately inclined to the south. The height of undulation is from 300 to 600m in the north and from 100m to 200m in the south. The south area is topographically flat.

4. SOILS AND PRESENT LAND USE

4.1 General

During the feasibility study period, the Team carried out soil and land use surveys in cooperation with NIA counterpart staff. Soil analysis was conducted by the Soils and Water Laboratory Services, Research and Development Department, NIA.

The main objectives of the survey were: a) to provide basic soil data to establish land use capability such as physical and chemical characteristics, the potential extent of agricultural and non-agricultural lands and information on the physical structure of the land and b) to investigate soil erodibility in order to recommend future soil conservation measures.

The survey in the watershed area was executed on a less detailed level (reconnaissance) than is customary for feasibility studies. Three sample areas were preselected to represent the different physiographical units. A total of 16 master pits were hand dug and 45 soil samples were collected for physical and chemical analysis. Furthermore, about 60 auger borings were completed both inside and outside the sample areas, permitting conclusions regarding homogenity of the soils. However, it is recommended that a more detailed supplementary study be conducted prior to implementation of the future management plan.

Soils in the watershed area are not complex, as shown by the homogeneity of parent material and surface configuration and by the relative slopes and dissection. Accordingly, landform of physiographyic position was chosen as the main criteria for delineation of the soil mapping units. In the initial stage, land characteristics were defined on the basis of their physical features such as slope lengths and degree of dissection as deduced from aerial photos. These physical features were the basis for systematic data interpretation, and map delineation. The Slope classification and the extreme variability of the terrain are important determinants for difference in soil type, depth and extremes of soil erosion.

4.2 Soils of the Watershed Area

4.2.1 General

Soil characteristics are an important factor in soil erosion in addition to precipitation and relief. The soils in this watershed area have developed from andestic and basaltic pyroclastic rocks and valcanic flows (Sibala Formation). The aim of this study was to identify the intensity against soil erosion based on field investigation, analysis of soil samples and review of past studies.

The present report deals with the physical and chemical characteristics of soil.

4.2.2 Physical and Chemical Characteristics

Limitations on the physical and chemical properties of soil can only be evaluated on the basis of field appraisal and laboratory results (TABLE XIV-1). The implications of the physical and chemical characteristics of the soil and their related limitations are briefly summarized below and the typical profiles in this area are compiled in FIG. XIV-2.

(1) Soil Texture

Assessment of soil texture is essential because of the influence on various features such as soil aeration, tillage, moisture retension and water movement. The soil textures did not

show significant differences between soils in the different landforms and slope position. Fine textures were found in the footpaths and local valley bottoms; on the other hand, those in sideslopes show relatively coarse topsoil due to subsequent soil erosion, and generally cayey subsoil.

(2) Soil Depth

Soil depth is an important factor because of its effect on root development and water holding capacity. Deep soils provide adequate root zone and greater capacity to store moisture and plant nutrients. Without regard to slope position and landform, the depth of soils in the watershed area is considerably deep or very deep except in extreme places where outcrops, boulders and intrusions are present. Shallower soils are often found on the very steep slopes of mapping units 4 and 5.

(3) Acidity

In most tropical soils, a low pH value (high acidity) may often indicate the occurence of exchangeable alluminum and manganese in toxic quantities and enhance low cation exchange capacity (CEC) and lower base saturation percentage. The low CEC in the soils maybe explained by the fact that the low pH values permit the leaching of silica (SiO2) from the profile.

Results compiled from t'e laboratory analysis suggested pH values of the soils are moderately strong to slightly acidic (pH 4.6-6.0). The pH values obtained at the soils in the lower slope (0-8%) appear to be more acidic than those in the better leached side slopes.

(4) Sum of Exchangeable Bases and Organic Matter Content

A general indication or index of natural soil fertility is the sum of exchangeable phosphorous, potassium (K) and the organic matter (O.M.) content of the soil.

Results of laboratory analysis reveal that the present levels of available phosphorus in the surface soils are low 6.5-18.5ppm. Organic matter is still available at moderate levels but not in

sufficient quantities for optimum plant growth. Considering these as the index, the natural fertility of the soils in the watershed area is generally low. Although crops may still benefit from the moderate amount of organic matter initially, the natural fertility will tend to decline sharply in the near future unless an adequate fertilization program is adopted.

4.2.3 Soil Mapping Units and Land Classification

The soil profiles investigation indicates that the soil characteristics are greatly influenced by the parent material, and almost all the features of soil profiles are similar. Since there are no distinct soil differences, attention was focused on other factors such as topography and landforms. These factors were found to pose more limitations on land use than soil characteristics. Land classification was based on the following:

a) Geomorphological characteristics of the landscape; and,

b) The degree of dissection within the different landforms (i.e. the density of the tertiary drainage system.)

Watershed management is directly affected by the physical configuration of the land. Thus, classification of land base on the degree of dissection and physiographic characteristics would be a practical guide to assess the limitation on future land use and soil conservation measures. Land classification for the Catipayan dam watershed area is presented in FIG. XIV-3. The delineated physiographic units are described in the table on the following page.

Classification Unit	Description	Area (ha)
Undulating to Hilly Areas		
H1	High hills with undulating ridges and long continuous slopes, slight to moderately dissected	893
H2	Medium to high hills mostly of parallel ridges, moderate to highly dissected	1,033
H3	Undulating to low hilly areas with short slopes and isolated alluvial terraces, slightly dissected	408
Rugged to Mountainous Areas		
R1	Rugged to very rugged deeply incised V-shaped valleys along meandering rivers, highly dissected	998
R2	High mountains with long continuous steep slopes, moderate to highly dissected	1,468

These physiographic features are also characterized by rapidly changing slopes and constant removal of the topsoil by erosion. In the more eroded landforms (very steep slopes), the soils are relatively shallow and have less organic matter than those in the foot of slopes. Rock outcrops and boulders are often associated with these areas. They are better aerated and more oxidized.

The soils of the lower slopes and local valley bottoms are generally deep to very deep and are less oxidized as evidenced by the presence of reddish mottling and concretions. Differences in soil depth were also noted in the various slope classes. In the watershed area, it is the slope range and the degree of dissection that will determine the suitability of the lands for appropriate land use.

4.3 Present Land use in the Watershed Area

Natural vegetation and present land use in the watershed area reflect the interaction of climate, soil and, most significant, the past and present activities of the inhabitants. As a result of this interaction, only a very limited stand of the original vegetation cover

remains. Natural succession of regrowth has been hindered by the continued increase in population which has accelerated land clearing for cultivaiton and cutting of trees for firewood and building purposes. In areas where cultivation is not so intensive, several stages of regrowth from shrub to tree savanna exist.

The vegetation in the watershed area indicates a limited botanical composition. The dominant vegetation is grasses, mostly cogon (Imperata cylindrica) and talahib (Scharum spontaneum). Sparse forest is mostly located on steep slopes and along drainage channels. Common tree species are Tiga (Tristania decorticata), Dao (dracontamelum dao), Binayoyo (Antidesma ghaesembilla) and Guava (Psidium guajava).

The watershed area has limited potential for agricultural use. The different land uses in the area are open grassland, isolated patches of low density secondary forest, scattered swidden or kaingin clearings, mixed composition of low trees (mostly Binayoyo) and grasses, unimproved pasture and lowland rice cultivation on isolated alluvial terraces along river channels and local valley bottoms. Field crops are lowland and upland rice, corn, sweet potato, peanuts, cassava, sesame and vegetables. Fruit trees and other tree crops (mostly ipil-ipil) are likewise associated with the different land uses. The present land use pattern is presented in FIG. XIV-4 and the extent or coverage is indicated in the following table.

PRESENT LAND USE AND VEGETATION IN THE WATERSHED AREA

Land Use/Vegetation	Area (ha)	%
Open grassland with scattered trees	2,885	65.3
Savanna forest (60% grass - 40% trees)	830	18.8
Secondary forest	200	4.5
Shifting cultivation	210	4.8
Lowland paddy fields	145	3.3
Orchard	4	0.05
Range	140	3.2
Residential area	6	0.05
Total	4,420	100.00

5. SOIL CONSERVATION PLAN

Soil erosion is one of the major problems in the watershed area. Other than the loss of fertile topsoil through sheet and rill erosion, residential area is progressively expanding due to the pressures of population growth. On the other hand, cultivated land area is fast decreasing because of the advanced stage of soil erosion (dissection by hills and gullies).

5.1 Severity of Soil Erosion

The severity of erosion is in great part due to physical factors. The terrain is undulating, rough and broken and the slopes are generally steep to very steep. During the course of the survey, it was estimated that about 30% of the entire watershed area has a slope gradient of steeper than 40% and a further 45% of the area is in the 15-40% bracket. Rainfall intensity is generally low and the soils are mostly of fine loamy to clayey, indicating a fairly low to moderate erodibility hazard.

However, human activity has also been a major contributory factor to soil loss through erosion. Clearing and cultivation of open grassland is rapidly progressing without regard for topography. Land use in the area is inappropriate and cultivation is not guided by preventive and conservation measures. Other contributory factors are the present state of natural vegetation, undesirable land management practices such as burning, clearing and cultivation on steep to very steep slopes and the practice of shifting cultivation.

Effective control of the present erosion hazard is dependent on the formulation and adoption of a proper land use and soil conservation scheme.

5.2 Crop and Land Management Approach to Soil Conservation

In developing soil conservation measures for the watershed area, various preventive approaches are recommended such as the adoption of proper agro-forestry techniques and introduciton of proper land use. The pattern should be based on features of the terrain, the degree of slope and combined effect of crop and land management.

Considering the effect of slope gradient on erosion hazard combined with the effect of soil cover, the critical gradient permitted for the cultivation of arable field crops (especially row crops) in the watershed should be 15°. Steeper slopes (16-40°) may be used for non-tilled orchards (mango, kasoy, etc.) and other commercial tree crops (Ipil-ipil, etc.) so long as they are planted along the contour. The steepest slopes (40% or more) should be designated as forest or permanent pasture.

Based on the above recommendations, the future land use patterns in the watershed area (as deduced from photo interpretation & field appraisal of five sample areas) are as follows:

a) About 25% of the total area is suitable for cultivated agriculture: 10% without any significant limitation on land use (slope bracket 0-5°) and 15% in the 6-15° slope bracket, thus, requiring simple conservation measures, especially for slopes of more than 12°.

b) About 45% is classified as suitable only for non-tilled fruit trees and commercial forest (16-40° slope).

c) The remaining 30% (slopes exceeding 40°) should be designated as permanent forest or grassland.

When cultivated slopes are exposed to erosive rain, the protection provided by crops or standing vegetation must be supplemented by additional measures that will reduce runoff velocity, to reduce soil erosion. Recommended conservation practices for field crops are contour cultivation on gradients of 3-8°, and contour-strip cropping and planting of protective vegetation belts (Ipil-ipil) on slopes between 9-15°. To ensure cultivation along contour lines, it is recommended that permanent contour base lines be established by planting single rows of Ipil-ipil or fruit trees at appropriate distances along the contour.

Conservation measures recommended on slopes of 16-40° are planting of permanent fruit trees and other tree crops along the contour lines and refraining from tillage so as to permit the development of dense grasses (perferably cogon), which should be cut periodically and left as a protective covering. Where grasses cannot be used to provide soil cover, protective vegetation belts should be established.

For lands with slopes exceeding 40°, the growing of commercial crops should be completely prohibited. These steep or very steep areas should be put under dense forest which shall be left undisturbed for some

time. Protection of gullies and local depressions will likewise be done by planning several meters of protective tree belts along the gully boundary and above the gully head.

6. WATERSHED MANAGEMENT PLAN

6.1 Watershed Management Plan

The Watershed Management Plan is an integrated development plan which includes overall measures for conservation of water and land resources. Items which should be carried out under the Watershed Management Plan are:

- Water resource conservation
- Erosion prevention measures
- Reforestation
- Agro-forestation
- Erosion protection works
- Construction of a debris barrier

Reforestation and agro-forestation contribute to conservation and development of water resources, control of soil erosion, minimization of destructive stream and reservoir sedimentation, and maintenance of water quality.

According to the results of the study, it is apparent that if no watershed management measures are carried out, farming practices in the watershed area will cause accelerated soil erosion and will reduce the storage or carrying capacity and serviceable life of the reservoir due to sedimentation.

As mentioned before, reforestation is the most effective watershed management measure in terms of both water resource conservation and soil conservation in comparison with other methods. Therefore, the highest and most immediate priority should be given to reforestation for the Catipayan watershed management. Reforestation and land use plans in the watershed area are established as follows based on the results of the soil conservation study.

(1) Delineation of the Watershed Management Area

The watershed area may be classfied into the following categories.

Forest

Secondary forest

Open grassland

Drainage channels (reservoir bank)

Alienable or disposable area

Farm and other rural areas

Settlements

As described in Section 4.2.3., moreover, watershed area is delineated into the following five units based on physiographic features.

1) Hilly area
   a) H1 : High hilly area
   b) H2 : Medium hilly area
   c) H3 : Low hilly area
2) Mountainous area
   a) R1 : Rugged deeply incised V-shaped valley area
   b) R2 : High mountain area

6.2 Land Use Plan

The land use plan with respect to conservation of water and land resources and protection of the reservoir is shown in FIG. XIV-5 and the following tables.

LAND USE PLAN

Elevation (M)	Area (ha)	%	Proposed Land Use
EL 85-125	220	5	Reservoir
125-150	370	8.4	Forest
150-175	660	14.9	Agro-forest, pasture, cultivation
175-200	1,000	22.6	Agro-forest, cultivation
220-250	1,260	28.5	Agro-forest, cultivation
250-300	340	7.7	Forest
more than 300	570	12.9	Forest

LAND USE AREA CLASSIFIED BY GRADIENT

Gradient (%)	Area (ha)	%	Proposed Land Use
More than 40	1,326	30	Forest
40-15	1,989	45	Forest, agro-forest, pasture
15- 6	663	15	Agro-forest, cultivation
Less than 5	442	10	Cultivation

Suitable species for reforestation

Three plantations may be established for the production of fruit trees or trees which can be used for fuel wood, timber/veneer-timber, pulp and poles. Favored species include ipil-ipil (madre de cacao) and mimosa for fuel wood; narra and bagras for poles; and mango, cashew, jackfruit, coffee, and cacao for fruits and nuts.

6.3 Related Agencies

The watershed area includes the mountainous forest zone in the municipalities of Sara and San Dionisio. Municipalities have delineated the said areas, although actual activities have been delayed up to date. Iloilo Province is promoting acceleration of reforestation and rehabilitation based on the policy of BFD, and hence watershed area development will be implemented by BFA, NIA and other government agencies all of which have a stake in plantation development. Water management in V-shaped valleys along meandering rivers will be executed by NIA because rehabilitation and plantation directly mitigates erosion and controls sedimentation in the reservoir.

In the agro-forest areas and pasture, rows of trees or hedges are planted to conserve soil by NIA and other government agencies as well as by corporations which are involved in plantation development. The development and management of tree plantations in the remaining open land will be undertaken by farmers' associations or cooperatives according to plans made by NIA, BFD and other government agencies.

Central nursery establishment, technical services, farm road development and low-interest financing, etc. will be supported by the government for effective promotion of tree plantation development in the private sector.

6.4 Management Schedule

Gross watershed area is approximate 4,420ha. Of this area, 3,000ha is planned for reforestation or agro-forestation. Taking financial conditions, into consideration the number of relevant government agencies, availability of labor force, technology transfer, and training, five years is considered a suitable implementation period. In particular, conservation of soil is urgently required. Reforestation or agro-forestation should be executed according to the order of priority based on land conservation efficiency during the implementation period.

Top priority for reforestation or agro-forestation should be given to the forest zone along the reservoir, as there is a danger of accelerated soil erosion from variation in the water level of the reservoir. Tree-plantation and rehabilitation in the areas of EL125~150m should be carried out parallel to dam construction wherever possible.

Second priority is given to planting double rows of ipil-ipil along the contour lines in open land for soil conservation in existing uplands, pasture and paddy.

Third priority is for the areas with gradients over 15° and double or triple hedges should be planted in farmhands or pastures to conserve open land and to expand effective land use. Suitable contour interval for hedge row planting in the case of steep hills is 4 to 6m and if the slope becomes more gradual, an interval of 7~10m is required.

In the remaining area, planting of industrial trees, fruits or nuts is recommended.

7. PLANTATION STUDY

7.1 Plantation Plan

On the basis of present land use, and land classification, proposed land use of the watershed area was roughly categorized as presented on the following page.

Proposed Land Use	Features	Area(ha)
Forestation Area (I)	Reservoir basin, very steep slope EL.124-150-175m land classification R1	570
Forestation Area (II)	Mountain with long continuous, very steep slope EL.300-700m land classification R2	1,325
Agro-forestation Area	High to medium hills, slope 15°-40° EL.200-300m	1,170
Arable Land, Range and Residential Area	Undulating low hills, short slope and isolated terraces slope 0-15° EL.150-200m	1,105

Each area for the plantation plan was estimated as follows:

Forestation Area (I) — Ipil-ipil would be planted at the rate of 6,000/ha for 450ha, 70% of the total plan area.

Forestation Area (II) — Narra would be planted at the rate of 2,750/ha for 1,125ha, which excludes about 200ha of existing secondary forest.

Agro-Forestation Area — There are 2 kinds of tree plantation; mango tree plantations on slopes and ipil-ipil plantations.

Arable Land, Range and Residential Area — Ipil-ipil would be planted along the contour Residential Arealines to soil erosion in the area. Interval of the tree belt would be 2m.

The interval of row tree plantation is 7m in the 16-30° slope gradient and 4m in the 30-40° slope gradient, respectively. Mango plantations would be planted at the rate of 120ha.

7.2 Cost Estimation

The cost estimation for each tree plantation was made based on the data collected from BFA. The estimated total planting costs[1/] and breakdown are as follows:

1/ The estimated total planting cost is only for planting and cost for facilities is excluded.

(1) Cost

Unit cost per hectare for each tree plantation is as given below.

Ipil-Ipil

1) Seeds

The assumption was made that 7kg of seeds/ha are necessary. As the unit cost of seeds is ₱65 per 1kg, required cost is ₱65 x 7kg = ₱455.

2) Fertilizer

The assumption was made that 2 bags of fertilizer/ha are necessary. Unit cost of fertilizer is ₱280/bag and required cost is thus ₱280 x 2 bags = ₱560/ha.

3) Labor

Required labor is estimated as 90 man-day/ha based on the following assumptions.

- Seedbed preparation	4
- Seeding & seedling cultivation	8
- Land clearing	20
- Drainage	20
- Planting	16
- Fertilization/Cultivation	12
- Others	10

The required labor cost is calculated with a unit labor cost at ₱54.4/man-day, ₱54.4 x 90 man-day = ₱4,896/ha.

4) Ipil-Ipil planting

Required cost for ipil-ipil planting is ₱5,911/ha.

Nara

1) Seeds

The assumption was made that 2,750 seeds/ha (27.5ℓ) is required. As the unit cost of seeds is ₱3.5/l (approximately 100 seeds/ℓ), required cost is ₱3.5 x 27.5ℓ = ₱96.25/ha.

2) Fertilizer

The assumption was made that 2 bags of fertilizer/ha is required. Cost for fertilizer is therefore ₱280 x 2 bags = ₱560/ha.

3) Polyethylene pots for seedlings

The unit cost of polyethylene pots is ₱0.065 and required cost is therefore ₱0.065 x 2,750 pots = ₱178.75/ha.

4) Labor

Required labor is estimated at 136 man-day/ha based on the following assumptions.

- Seedbed preparation	4
- Seeding & seedling cultivation	50
- Land clearing	18
- Drainage	18
- Planting	18
- Fertilizaiton/cultivation	18
- Others	10

The required labor cost is thus ₱54.4 x 136 man-day = ₱7,398.4/ha.

5) Planting

Required cost for Nara planting is ₱8,233.4/ha.

Mango

1) Seeds

The assumption was made that 120 seeds/ha are required. As the unit cost of seeds is ₱5/seed, required cost is ₱5 x 120 seeds = ₱600/ha.

2) Fertilizer

The assumption was made that 2 bags of fertilizer/ha are necessary. Required cost for fertilizer is therefore ₱280 x 2 bags = ₱560/ha.

3) Polyethylene pots for seedlings

Required cost is ₱0.065 x 120 pots = ₱8.19/ha.

4) Labor

Required labor is estimated as 38 man-day/ha based on the assumptions on the following page.

Work	Man-days/ha
Seedbed preparation	3
Seeding & seedling cultivation	5
Land clearing	15
Staking/digging/planting	5
Cultivation/fertilization	5
Others	5

The required labor cost is therefore ₱2,067.2/ha.

5) Planting

Required cost for mango planting is ₱3,235.39/ha.

(2) Planting cost

Total tree planting cost is estimated at ₱16,357,854 and is summarized below.

1) Ipil-Ipil

Proposed planted area for each classified area is calculated as tabulated below.

Classified Area	Area (ha)
Forestation (I) Area	570x0.7 = 400ha
Agro-forestation Area	
Slope 15-30°	750x14x100x2 = 210
Slope 30-40°	420x25x100x2 = 210
Arable land, Range and Residential Area	(2x200)x1,105 ± 44.2
Total	864.2

Planting cost for Ipil-Ipil is calculated as ₱5,911 x 864.2ha = ₱5,108,286.

2) Nara

Proposed planted area is 1,125ha (excluding existing secondary forest of about 200ha).

Planting cost for Nara is calculated as ₱8,233.4 x 1,125ha = ₱9,262,575.0.

3) Mango

Proposed planted area is calculated at 750.0ha.

Planting cost for mango is calculated as ₱3,235.39 x 750ha = ₱2,426.550.

Therefore, total planting cost for Ipil-Ipil, Nara and Mango is ₱16,797,411 ($933,190).

Allowing 15% of direct planting cost for administration cost and physical contingency respectively, the total cost for watershed conservation development is as follows:

Classified Area	Area (ha)
Direct cost	₱16,797,411.0
Physical Contingency	2,519,611.6
Administration Cost	2,519,611.6
Total Cost	₱21,836,634 ($1,213,146)

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOIL IN THE WATERSHED AREA

Pit No.	Depth (cm)	Physiographic Position	Slope	Texture	Effective Soil Depth	Soil Drainability	Silt Fraction (Topsoil)	Erosion	PH	O.M. Content	Available P	Lime Content	C.EC	BSP	Exchange Acidity
1	0- 50 50-150	Sideslope	8%	CL-C C	Very Deep	Somewhat portly drained	34%	Slightly Eroded	5.6 5.9	3.46 1.51	13.7 9.5	o	23.82 32.38	56.75 71.51	10.29 8.04
2	0- 50 50-150	Midslope	45%	CL-C C	Very Deep	Somewhat portly drained	28%	Moderately Eroded	5.7 5.8	1.29 1.06	18.5 11.0	o	36.80 42.36	72.53 79.25	10.04 8.79
3	0- 50 50-150	Crest	3%	CL-C C	Very Deep	Somewhat portly drained	25%	Slightly Eroded	5.1 5.1	2.39 1.07	10.0 7.5	o	18.29 28.25	42.25 61.55	10.55 10.04
4	0- 50 50-150	Midslope	38%	CL CL	Very Deep	Well drained	35%	Moderately Eroded	5.2 5.5	3.31 1.14	8.8 7.5	o	20.23 27.90	47.86 69.39	10.50 8.54
5	0- 50 50-150	Footslope	8%	CL-C C	Very Deep	Somewhat portly drained	55%	Slightly Eroded	4.9 5.0	2.18 0.90	10.5 7.5	o	9.77 7.83	24.88 16.60	7.23 6.53
6	0- 50 50-150	Sideslope	12%	CL C	Moderately Deep	Moderately well drained	44%	Slightly Eroded	5.3 5.7	2.70 0.52	9.3 7.0	o	16.78 14.13	61.20 71.55	6.07 4.02
7	0- 50 50-150	Upper Sideslope	34%	CL SCL	Moderately Deep	Well drained	29%	Moderately Eroded	5.4 5.0	2.51 0.92	10.5 9.4	o	30.81 39.16	66.30 76.92	10.05 9.04
8	0- 50 50-150	Midslope	38%	SCL-C C	Very Deep	Somewhat portly drained	38%	Moderately Eroded	4.8 5.3	2.45 0.92	7.6 6.5	o	12.97 8.66	16.87 13.05	10.80 7.53
9	0- 50 50-150	Footslope	4%	CL-C C	Very Deep	Somewhat portly drained	48%	Slightly Eroded	4.8 5.3	2.28 1.04	6.5 6.0	o	10.15 10.10	10.40 20.40	8.02 8.04
10	0- 50 50-150	Crest	8%	CL-C C	Very Deep	Moderately well drained	40%	Slightly Eroded	4.8 5.2	2.91 1.47	7.5 6.0	o	12.94 12.15	14.04 17.16	11.05 10.05
11	0- 50 50-150	Midslope	45%	CL CL	Moderately Deep	Well drained	39%	Moderately Eroded	5.2 5.5	2.85 1.16	13.6 8.0	o	13.47 10.14	42.09 40.53	7.78 6.03
12	0- 50 50-150	Valley Bottom	2%	SCL-C C	Very Deep	Moderately well drained	38%	No Erosion	5.2 5.5	2.43 1.28	10.4 9.5	o	9.57 9.52	37.16 42.02	6.02 5.52

TABLE XIV-1

TOPOGRAPHICAL MAP OF WATERSHED AREA

0 1 2 km

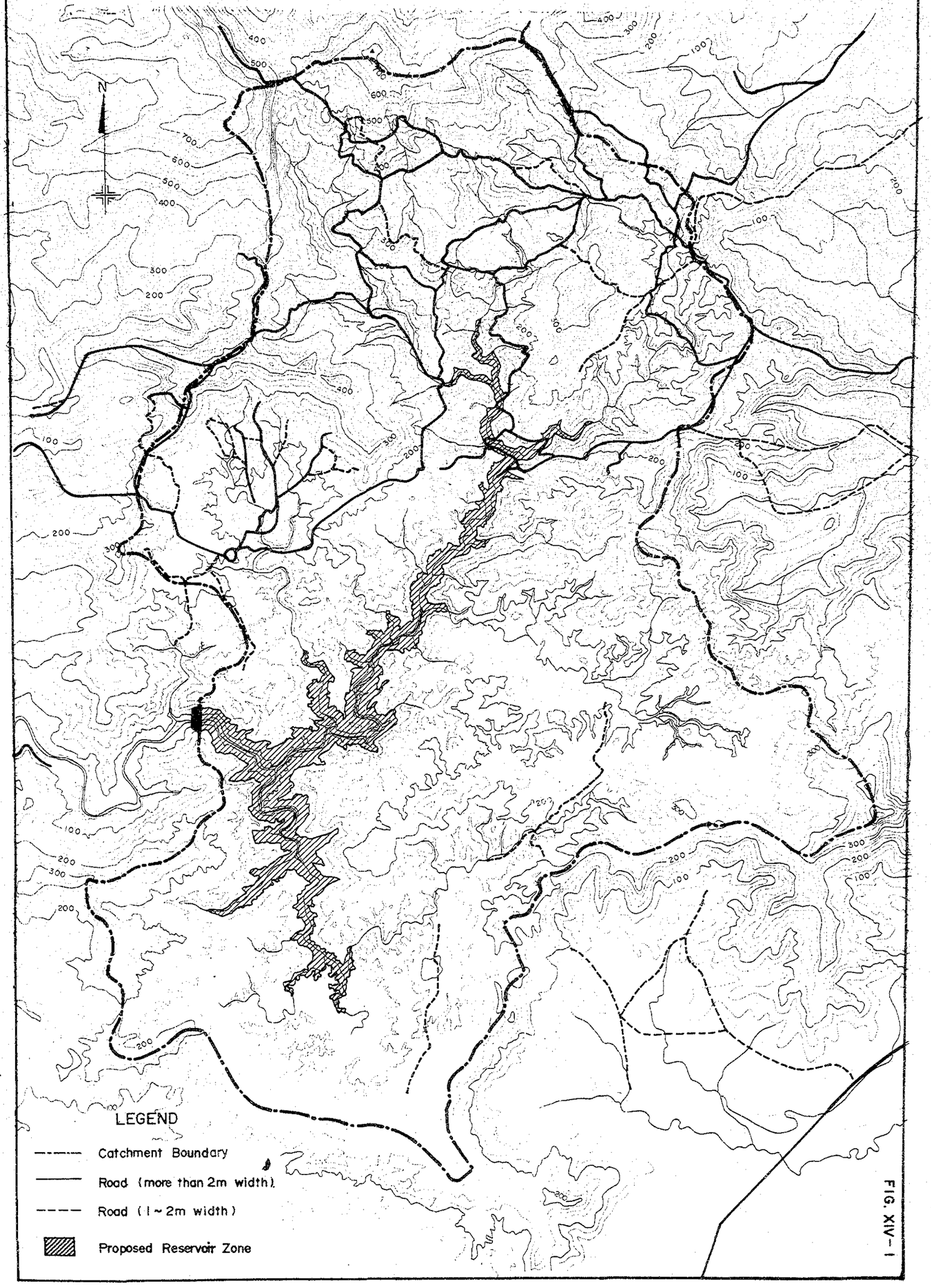
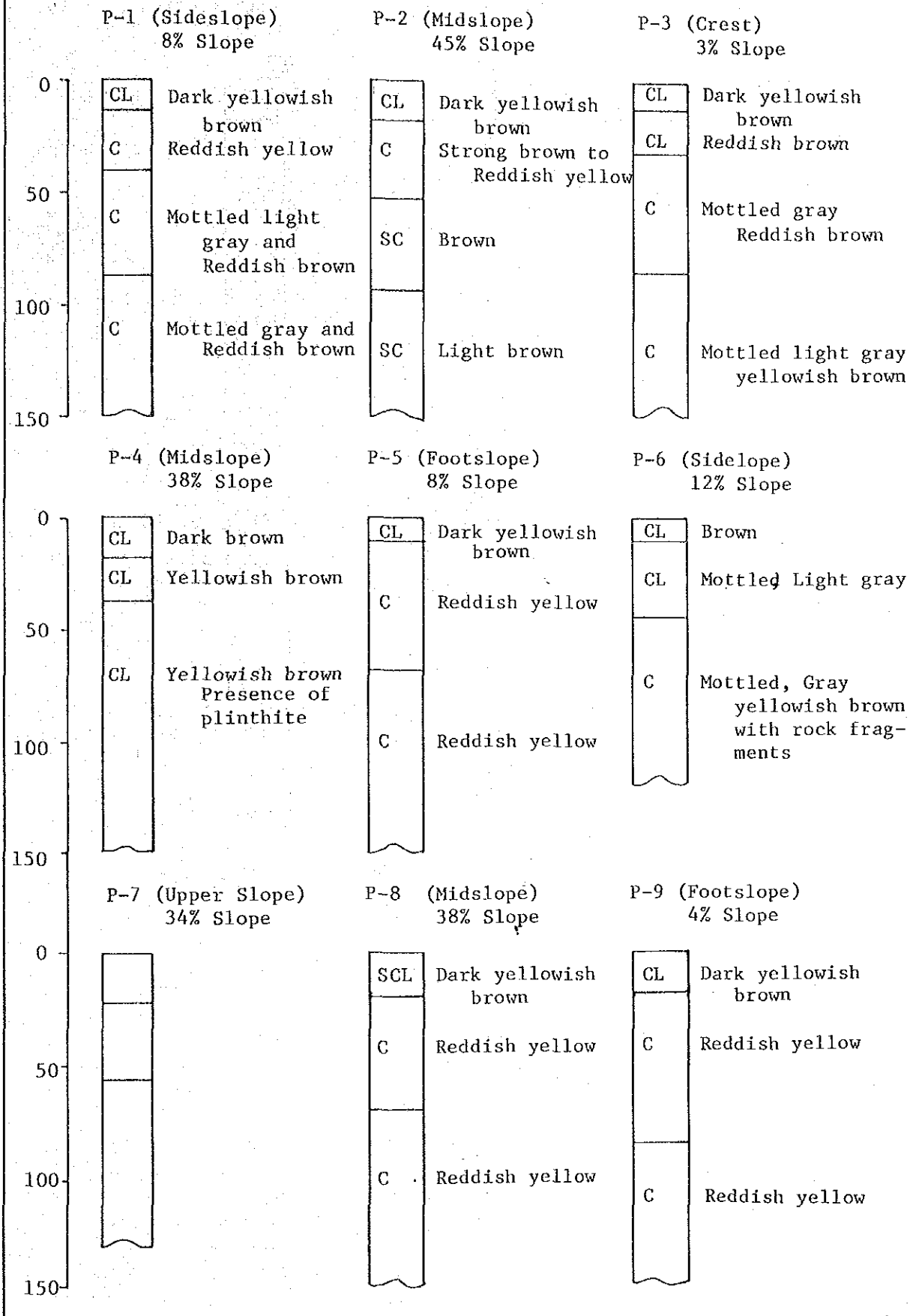


FIG. XIV-1

FIG XIV-2
(1 of 2)

COLUMNAR SECTION OF SOIL PROFILES IN CATIPAYAN WATERSHED AREA



COLUMNAR SECTION OF SOIL PROFILES IN CATIPAYAN WATERSHED AREA

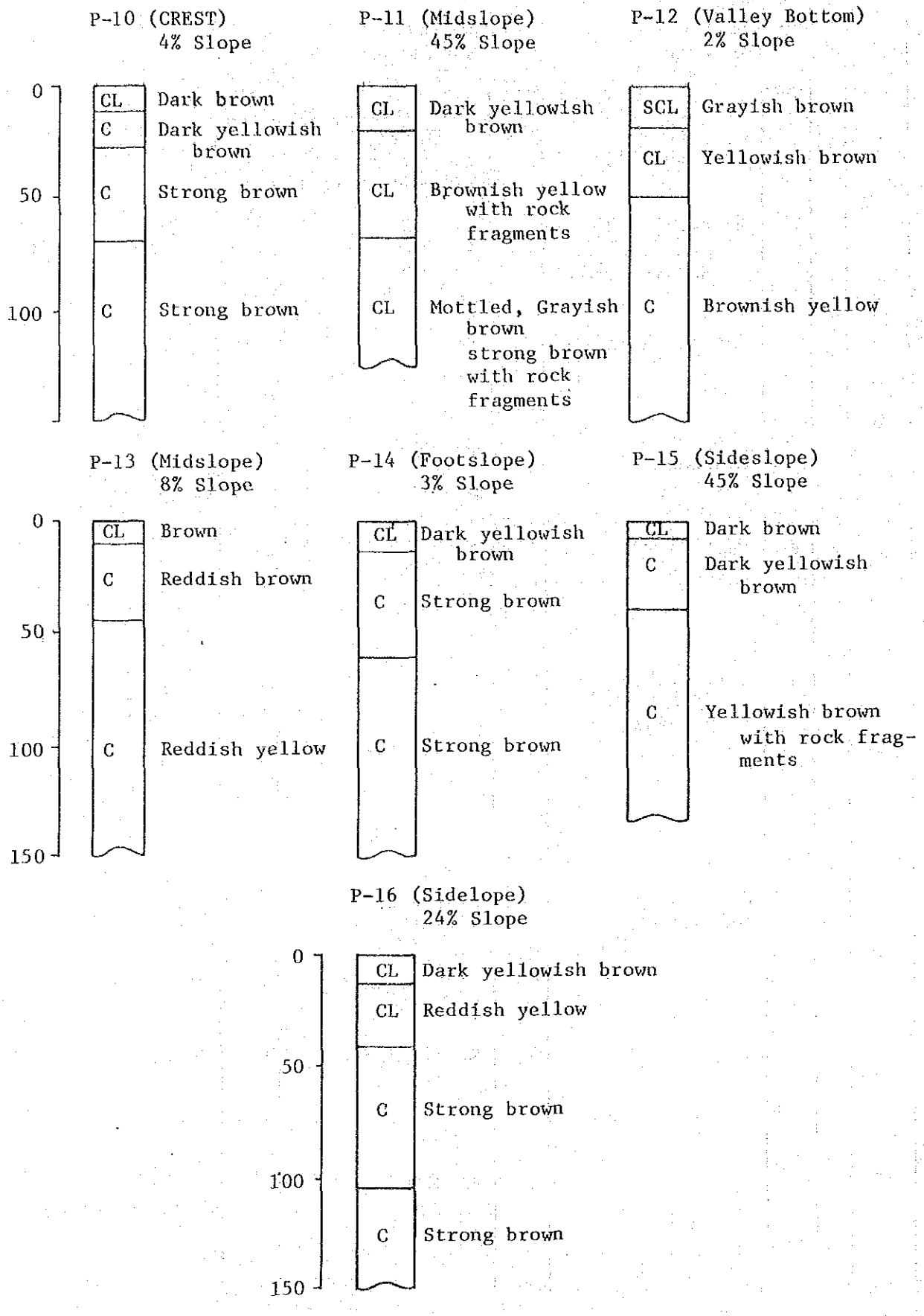
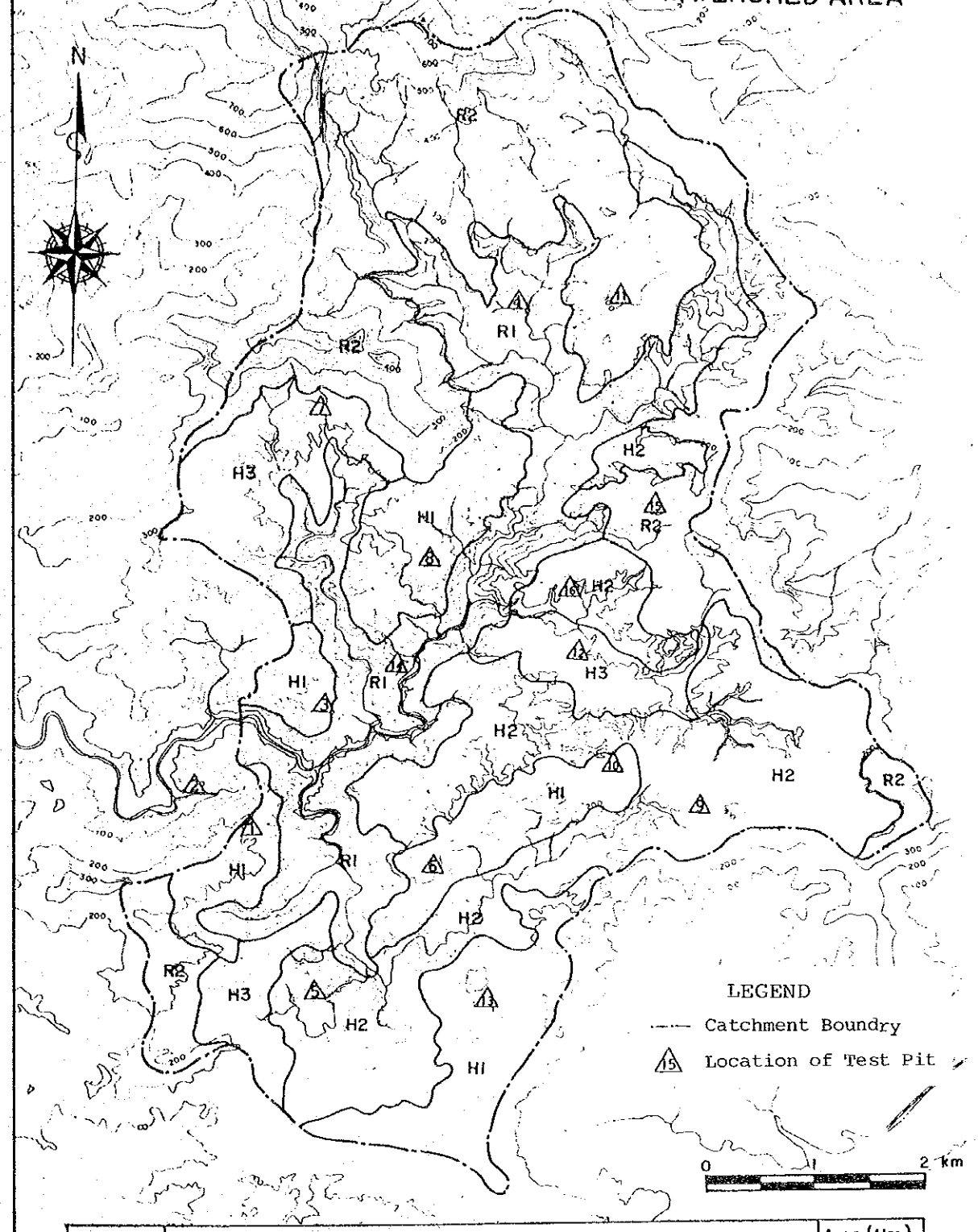


FIG XIV-3

LAND CLASSIFICATION MAP OF THE WATERSHED AREA



Mapping Unit	Description	Area (Has)
H1	High hills with undulating ridges and long continuous slopes, slight to moderately dissected.	765
H2	Medium to high hills mostly of parallel ridges, moderate to highly dissected.	991
H3	Undulating to low hilly areas with short slopes and isolated alluvial terraces, slightly dissected.	383
R1	Rugged to very rugged deeply incised V-shape valleys along meandering rivers, highly dissected.	843
R2	High mountains with long continuous steep slopes, moderate to highly dissected.	1,438

PRESENT CONDITION OF CATIPAYAN WATERSHED AREA

0 1 2 km

N

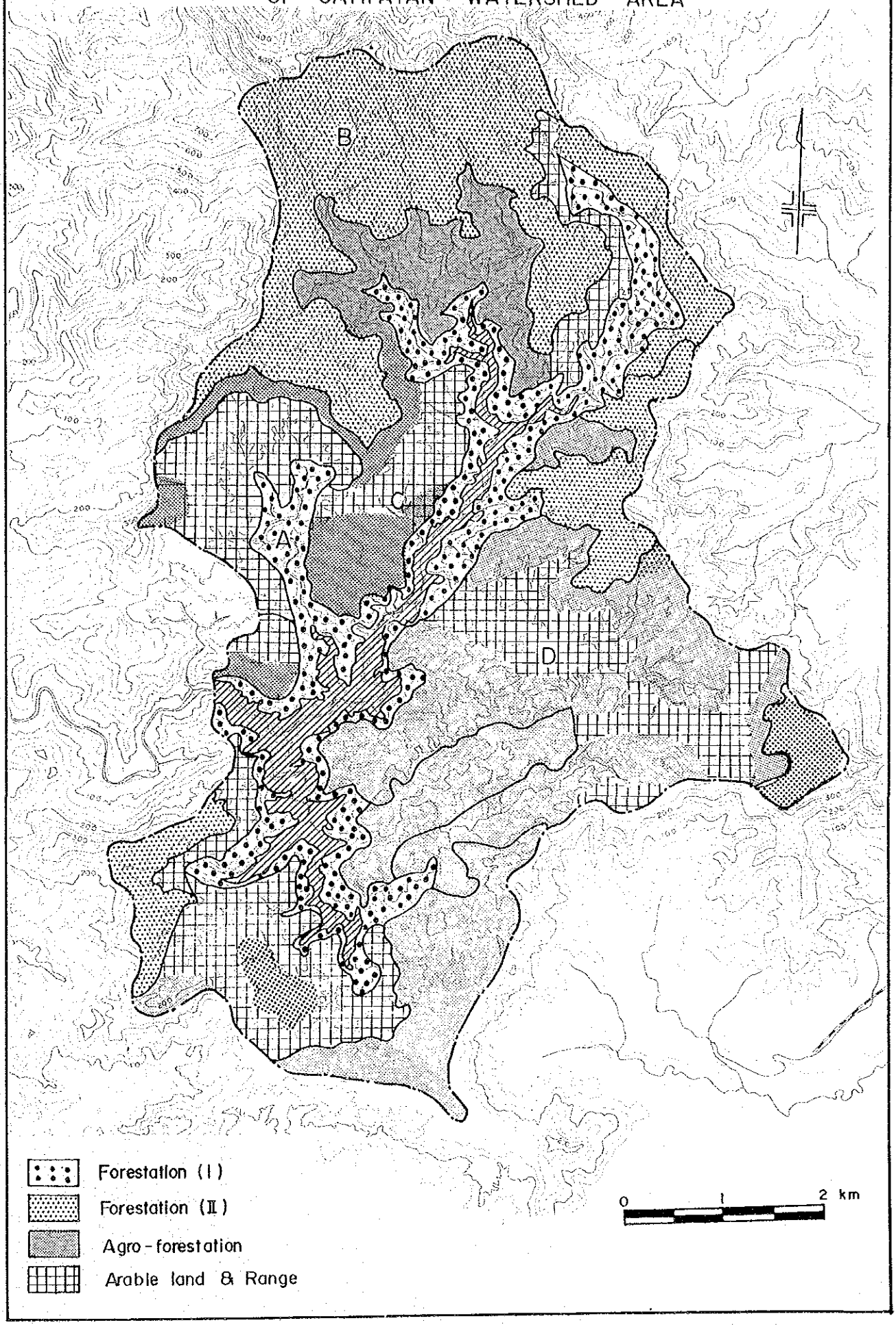
LEGEND

- Open grassland with scattered trees
- Savanna forest (60 % grass- 40 % trees)
- Secondary forest
- Shifting cultivation
- Lowland paddy fields
- Range

FIG. XIV-4

FIG. XIV-5

PROPOSED LAND USE AND REFORESTATION PLAN OF CATIPAYAN WATERSHED AREA



APPENDIX XV

ENVIRONMENTAL IMPACT

APPENDIX XV

ENVIRONMENTAL IMPACT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

APPENDIX XV

ENVIRONMENTAL IMPACT

1. GENERAL

The features of the proposed Project are as presented below, and the location is shown in FIG. XV-1.

Project Features	Location	Details
Catipayan Dam	Catipayan River	Type: Center core rock-fill Height: 48.5m Embankment volume: 796,000m^3
Reservoir	Catipayan	Catchment area: 44.2km^2 Full water reservoir area: 2.2km^2 Full water level: EL. 124.0m
Hydropower Plant	Dam site & trans--diversion canal route	640 and 740kW
Diversion Dam	Asue - Asue River Bakabak - Asue River Gubaton - Gubaton River	Dam up height: 2.30m 3.00m 5.00m
Irrigation & Drainage	In the Project Area	Unlined trapezoidal earth canal Main: 8 line ≒ 33,600m in total Lateral: 26 line ≒ 67,000m Drainage: 22,000m
O/M Road	In the Project Area Along the trans-diversion canal	≒ 110.0km ≒ 7.5km
Trans-Diversion	From Catipayan River to Asue River Basin	Canal: 7.7km Tunnel: 475m
Domestic Water Supply	At Asue River Head	For Sara Poblacion
Introduction and Expansion of New Irrigation Farming Practices	Project Area	

2. PRESENT ENVIRONMENTAL CONDITIONS

2.1 Dam Site, Reservoir and Watershed Area

The dam site is situated about 8km north of Poblacion Sara and can be reached via a 16km access road along the Catipayan River and connecting with the provincial road near Barangay Malapaya and Barangay Ardemil. The route is traversible by vehicle as far as 1.5km downstream from the dam site. The dam site vicinity is accessible from the Project area by other routes as well, but passage of vehicles is impossible due to the rugged terrain and steep incline.

Near the dam site, riverbed elevation is about 87.0m and river width is 20.0m. The average riverbed slope is 1/125-1/140 and both banks are steeply inclined forming a V-shaped valley with elevations of about 150-175m. Catchment area at the dam site is aproximately 44.2km^2 extending in a rectangular shape 4-6km from east to west and about 8km from north to south (upstream to downstream). A mountainous area forms the divide with elevations of 400-700m in the north to northwest portion, 300-400m on the west side and 150-200m on the east and south sides.

The watershed area is dissected into more than 10 sections over an undulating terrain. The elevation of the left bank ranges from 150-175m while that of the right bank is 200-225m, forming a comparatively gently inclined plateau covered by numerous residences and paddy fields. There are about 280 households and 1,700 residents in the entire watershed area, the majority of whom are engaged in agriculture. Residences on the plateau are joined by small to large access roads.

The area downstream of the dam site is an eroded valley. Due to this factor and the steep slope along the river, construction of river crossing structures for roads is difficult. In the upstream area, however, there are roads with simple bridge structures and a road system passable by two-wheeled vehicles. A portion of the road near Barangay Tady on the west side and along the east side of the divide is passable by small four-wheeled vehicles. Roads beyond the divide, however, tend to be poorly maintained and crossing structures at numerous small and large ravines are no longer functional.

Road conditions near the dam site in the downstream area are generally poor while those on the east and west sides of the divide and in the upstream area above elevations of 200m are comparatively developed. As for river navigation, residences on the plateau are not easily accessible by river and, as navigation by large raft is difficult due to nature of the river course, the river is unsuitable for frieght or transportation and is seldom used.

2.2 Catipayan Downstream Area

The Catipayan River flows into the plain at a transition area 2-3km downstream from the dam site. The transition portion extends for about 10km downstream and follows a natural meandering river course joining four tributaries, two from each bank. The banks along the transition portion have formed an eroded plateau (EL. 50-100m) due to the action of the Catipayan river and its tributaries. The plateau is used for paddy and upland crop cultivaiton.

Residents of the area are concentrated along each river and at elevations of about 100m on the plateau. Although residents living along the river use the river water for washing, bathing, etc., drinking water is obtained from dugwells or mountain torrents. Paddy fields in the area are generally rainfed. There are also paddy fields which have canals deriving their water source from the abundant small flows of the hilly catchment area.

Development of the (Catipayan River which has the most abundant flow of all rivers in the area) for irrigation water supply of paddy along the river is difficult due to topographical constraints. Consequently, the Catipayan has never been developed for irrigation. In some cases, direct intake of Catipayan flow by portable pump is practiced during land preparation and transplanting, but this is limited to only a portion of paddy where the difference between bank and riverbed elevation is a relatively small 4-5m and alluvial or flood terraces have formed. The majority of residents along the river in the downstream area obtain drinking water from open wells. Some of these wells are set up in the major bed of the Catipayan River and are located so as to collect permeation water from the river terrace.

Catchment area at the dam site is about 44.2km, while 2km downstream the catchment area is 48km^2, and at 3km it is 50.2km^2. At 5.5km downstream, it is double that of the dam site, that is 90km^2, and at 10km downstream, catchment area is more than 4 times that at the dam site. River slope above and below the dam site is steep ranging from 1/125 - 1/150 and the river is a rapid flowing mountain torrent. Due to the swift flow, algae upon which various fish species feed is scarce, and the river is inhabitated by few natural fish species consequently.

2.3 Fish Ponds

The coastal areas facing Bagacay Bay in the lower reaches of the northeastern Hasohoy and Tabagay rivers and Asue Bay in the downstream portion of the Project area is characterized by extensive fish culture. The water in most of these fish ponds is brackish and aquaculture includes such species as milk-fish tilapia, catfish, crap, murrel, and shrimp.

Fish pond areas located at elevations from less than 1.20-1.30m and canals allow intake of salt or fresh water via gates. Changes in tide at Ajuy Bay according to actual measurements show that the high tide elevation is about 2.0m which is higher than the foundation elevation of fish ponds. Water source for dilution is derived from rivers flowing through the fish pond area.

2.4 Asue River Basin

Flow conditions, present flow capacity, etc. for each river, in particular for the Asue River are presented in detail under METEOROLOGY AND HYDROLOGY in APPENDIX II, and IRRIGATION AND DRAINAGE in APPENDIX VII.

2.5 Present Farming Practices

Agricultural production and present farming practices are presented in detail under AGRICULTURE AND AGRO-ECONOMY in APPENDIX V.

3. ENVIRONMENTAL IMPACT WITH PROJECT IMPLEMENTATION

3.1 Proposed Works

The main objective of the Project is agricultural development and the major component is irrigation development. Project works and features which are foreseen to affect the environment are as follows:

1) Dam	Preparatory work Excavation and embankment material and transport Dam up, storage, operation and control
2) Hydropower Plant	Construction Operation
3) Irrigation Facilities	Construction of irrigation canal Operation of irrigation, transdiversion, main and lateral canals
Diversion Dam	Construction Operation
4) New Farm Practices	Application of agro-chemicals and fertilizer

3.2 Effects of Dam Construction

The Catipayan dam is the key to water resources and irrigation development in the Asue River basin. The dam will be constructed to divert about 50% of the annual runoff occuring at the dam site on the Catipayan River to the Asue River basin. Gross storage capacity of the dam is planned at 28.2 million m^3 and effective storage capacity is approximately 21.5 million m^3. Dam height is 48.5m and design full water level is 127.0m.

With dam construction, land below the design full water level of 124.5m will be submerged, while those areas below the design flood water level of 127.0m will be affected by backwater during floods. The surface area at full water level is aproximately 2.2km^2 and the reservoir will be long and narrow with a ponding width of 150-250m and a ponding length of about 6km.

Two residences, about 4ha of paddy and about 11.5ha of upland crop fields, will be submerged due to construction of the dam. In addition, more than 15 roads including footpaths will be submerged. Of these, 4 roads are in the upstream area and equipped with simple bridge structures.

According to the water resources development and utilization plans, diverted water will be at a maximum rate of 6.0m^3/s with an annual diversion volume of 49.3MCM which is 5.7% of the total flow volume occuring at the dam site. Remaining flow will be discharged into the Catipayan River directly from the spillway. Surplus water and number of days of discharge for the design standard year are as shown in APPENDIX VI, WATER RESOURCES DEVELOPMENT.

Discharge from the dam will be regulated during low water periods and downstream flow will be reduced. Reduction of downstream flow however, is not expected to have a large impact on water use in downstream areas. Numerous large and small mountain torrents flow through the Catipayan and the catchment area is greatly increased.

The storage area is a deep V-shaped gorge formed by river erosion and, excluding an open valley portion, vegetation is poor and composed predominantly of savanna forest. Vegetation on the slopes of the open valley portion is relatively lush with broad leaf bush cover, etc. Devastation due to erosion is completed and all slopes are stable. The effects of ponding and increased water level are expected to be minimal.

3.3 Effects of Irrigation Development

With Project implementation, 4 diversion dams (1 of which is existing) and canals to convey intake water to the outer reaches of the service area will be constructed. Moreover, approximately 50 integrated communal ponds will be established to ensure stable domestic water supply to local residents, and to prevent contamination and soiling of the water supply resulting from direct use of canal water. Water will be diverted from the Catipayan dam and conveyed to the Asue River basin via a canal to be constructed along the left bank downstream of the dam. A hydropower plant will be constructed both at the head and the tail of the trans-diversion canal.

Various improvements in the life style and living environment of the local people are expected through development of canals to convey water to areas of water shortage. On the other hand, design discharge of over 5m^3/s results in a large cross-sectional area and possibility of accidents if residents enter the canals. In addition, as all planned

diversion dams are over 2m in height, an error in management or operation could endanger residents and structures in both the lower and upper reaches of the river.

3.4 Effects of Proposed Farming Practices

3.4.1 Fertilizer

About 93% of the total paddy area in the Project area is cultivated by the direct seeding method. Typical fertilizer application per hectare at present is 37-13-10kg of N-P-K including 19-0-0kg/ha of top dressing. The estimated total fertilizer requirement to attain the target yield under the Project is as follows:

Basal fertilizer: seeding time, NPK:58-30-30kg/ha

Top dressing: 1 week before heading NPK=29-0-0kg/ha

Against the present NPK application of 37-13-10kg/ha of basal fertilizer including top dressing, the application amount proposed under the Project is 87-30-30kg/ha. Present and future total fertilizer requirements for one crop are presented in TABLE XV-1.

	Planted Area	N	P	K
Present	10,275ha	380,175kg (37kg/ha)	13,3575 (13kg/ha)	102,750 (10kg/ha)
With Project	12,400ha	1,078,800kg (87kg/ha)	372,000kg (30kg/ha)	372,000kg (30kg/ha)
Increasing Ratio	121%	284%	278%	362%

Total application per day is calculated at a maximum of 3658kg and a minimum of 35.3kg for the present, and at a maximum of 9208kg for the future.

3.4.2 Proposed Chemical Application

The proposed application plan for chemicals under the Project in comparison with present conditions for rainfed, direct seeded cultivation are presented in FIG. XV-5 and XV-6 , and summarized below.

Item	Present	Future
1) Pesticide		
Application period	1 month after seeding	-do-
Quantity	1.1 ℓ/h	3.0 ℓ/h
Name	Azodrin(Monocrotophas)	
	Hopcin (BPMC)	
	Nuvacron(Dimethyl phosphate)	-do-
2) Weedicide		
Application period	1 week after seeding	-do-
Quantity	0.57 ℓ/h	2 ℓ/h
Name	Rilf H(2-4D Isobutyl)	
	PPI 2.4D (2-4D Isobutyl)	-do-
	Hedonal (2-4D Isobutly)	
3) Total agro-chemical requirement in the Project area		
Planted area	111,600ha	122,000ha
Weedicide	6361.2 ℓ	24,400 ℓ 384% of present amount
Pesticide	12,276 ℓ	36,600 ℓ 298% of present amount
No. of days application in one cropping year	270	350
Application quantity per day		
Weedicide	Max 56.4 ℓ/day	317.5 ℓ/day
	Min 1.1 ℓ/day	25 ℓ/day
Pesticide	Max 108.8 ℓ/day	449.3 ℓ/day
	Min 2.1 ℓ/day	27 ℓ/day

3.4.3 Water Pollution from Agro-chemicals

The amount of agro-chemicals and fertilizers presently required per unit and in total is estimated to double with Project implementation. The amounts of fertilizers annually applied are estimated to increase to N-1,161,600kg, P-396,000kg, and K-396,000kg, while weedicide and pesticide application are to increase to 26,400ℓ and 39,600ℓ, respectively.

The ratio of fertilizer and agro-chemicals which are washed away after application is estimated at 25%. This loss is carried away by irrigation water into the drainage canal. At present, agro-chemicals and fertilizers flow along the rivers which function as the main drainage canals, as far as fish pond intakes.

The main water source for fish ponds in the downstream Project area is sea water. Although optimum salinity varies slightly depending on the species, the recommended salinity range is 10-25 PPt. River water is used to dilute sea water in about 1,000ha, about 70% of the total fish pond area. Daily water requirement for fish ponds is equivalent to daily evaporation while fish pond storage capacity is 10,000m^3/ha.

On the basis of the above conditions, the amount of agro-chemical and fertilizer inflow into fish ponds was estimated as presented in TABLE XV-1. From the said estimation, it was determined that even with the increases proposed under the Project, fertilizer and agro-chemicals will not cause contamination or pollution of fish culture ponds; in fact, the expected load is far below the maximum acceptable limit given by the Philippine Pollution Control Commission.

According to the Rules and Regulations of the National Pollution Control Commission (1978) Chapter IV, the criterea for Class C water for propagation of fish and other aquatic resources have been specified as given in TABLE XV-2.

4. MITIGATION OF ADVERSE EFFECTS

4.1 Environmental Effects

The envisioned effects of Project implementation on the natural and social environment both in the Project area and its surroundings area are as delineated below.

4.1.1 Favorable Effect

(1) Access Road Construction

- transportation by vehicle possible
- increased accessibility to town and market place
- increased sphere of activity available to local residents

(2) Catipayan Dam Construction

- transportation by boat possible
- new recreation area in form of artificial lake
- stocking of fish in reservoir, improving local diet

(3) Trans-diversion Canal

- elimination of water shortage in Asue Basin
- alleviation of drought in dry season

4.1.2 Adverse Effects

(1) Catipayan Dam Construction

- noise from machinery and blasting works
- possible pollution from excavation and washing of materials
- promotion of soil erosion and denuding of vegetation cover
- submerging of residences, cultivated land and roads
- migration of some residents
- obstruction of road network
- drastic decrease in domestic water supply to residents downstream of the dam

(2) Diversion Dam

- limitation of available flow due to increased water level from dam-up
- danger of sudden increase in flow volume downstream due to release of water from dam

(3) Trans-diversion

- possibility of flood or drainage problem due to malfunction of trans-diversion canal

(4) Agro-chemical and Fertilizer Application

- contamination of water supply
- destruction of aquatic life
- contamination of soil
- disruption of food chain
- inflow into fish culture ponds

4.2 Socioeconomic Impact of Dam Construction

4.2.1 Submerged Farm Households

Two residences and two rest houses are located within the area affected by the design flood water level and accordingly they will be submerged by dam construction. The rest houses, however, will no longer be necessary as the surrounding arable land will also be submerged. Moreover, transfer of the structures to another site is relatively easy.

The two residences will be evacuated in accordance with official decree in return for reasonable compensation. Although transfer of the residences to a nearby drained area is possible, both households own approximately 1ha of paddy reclaimed from the lowland area from which they derive the majority of their livelihood. Transfer to an area in which the same amount of lowland could be reclaimed is more difficult.

However, each household head comes from a different barangay located along different rivers. In the upstream portion, there are areas which could be reclaimed by terracing for paddy. If compensation were provided to cover the cost of reclamation, transfer would be comparatively easy.

4.2.2 Submerged Arable Land

Excluding river courses, the majority of the possible submerged area (2,200ha) is privately-owned. It is composed mainly of rugged on very rugged, deeply incised, V-shaped valleys along meandering rivers which are unsuitable for agriculture, and consists of savanna forest and open grassland with scattered trees. Arable lands to be submerged consist of only 4ha of lowland including 2ha owned by the above mentioned farm households, and about 14ha of upland area on which shifting cultivation is practiced.

Although the lowland area is valuable, the upland area is predominantly used as substitute land and consequently submergence is not considered to represent great financial loss to the farmers. Moreover, shifting cultivation of these steeply sloped areas is detrimental to soil and land conservation and should be prohibited in future.

4.2.3 Impact of Transportation

With construction of the storage dam, natural forces and river crossings on existing roads will be lost. However, although some roads in the more developed upstream area have simple bridge structures, the majority of east-west roads connecting the right and left banks are no longer functioning properly. Technically, construction of bridges necessary to maintain an adequate road network is possible; however, the required length and height are large and consequently construction is costly. As usage is limited, profits would be low and accordingly bridge construction is economically infeasible.

Other than detouring around the dam or reservoir, an alternative transportation network is to cross the storage area by boat. In future, development of a sufficient transportation system including both ferries and roads is envisioned.

4.3 Miscellaneous Impacts of Dam Construction

Water level in the downstream Catipayan River will decrease with construction of the dam. In terms of transportation, the low water level will allow safe river fording for the local residents. In terms of domestic water for bathing, washing and etc., on the other hand, a decrease in river flow could greatly affect the local people's daily life. However, numerous large and small mountain torrents flow through the downstream Catipayan River area and the majority of residents presently use the same for domestic water supply. Accordingly, only households located 2-3km downstream along the Catipayan River are expected to be directly affected by a decrease in Catipayan river flow.

The catchment area suddenly increases where the mountain torrents flow into the basin. As there is no large water consumption in the form of irrigation, maintenance flow is considered unnecessary in rainy season in a normal year. In dry season, however, small streams dry up and the Catipayan River becomes the sole water source. Maintenance supply for domestic use is feasible at a discharge of 4-5m^3/day and with flooding of depressions in the riverbed to form ponding. Moreover, in an abnormal drought year when domestic water supply dries up due to sudden decrease in flow, water can be discharged from the reservoir as required.

On the basis of the above factors, measures to prevent pollution of the living environment by dam construction are considered unnecessary.

4.4 Impact of Agro-chemicals on the Environment

Use of agro-chemicals and fertilizer proposed under the Project represent a potential source of pollution in fish ponds downstream. As aforementioned, this is not expected to have a severe environmental impact. However, accumulation of agro-chemicals such as Paration, DDT and BHC in soil and water could potentially affect, directly or indirectly, the physical well-being of local residents as well as disrupt the natural ecosystem through destruction of the food chain.

As the environmental threat is serious, the effect of chemical toxicity on the human body should be considered in selection of suitable agro-chemicals. For safe and effective use of these chemicals and prevention of environmental pollution, it is recommended that farmers be trained and guided by an agricultural extension service in the selection, storage, application and safe disposal of pesticides and weedicides. Moreover, if there is any danger of contamination of surrounding rivers, residential areas, or fish ponds by distribution of agro-chemicals, use should be prohibited. Careful attention must be given to application and training to ensure long-term, effective use.

AGRO-CHEMICAL/FERTILIZER INFLOW INTO FISH PONDS

	N	P	K	Weedicide	Pesticide
Maximum Farm Input					
Max input/day (kg)	9,208	4,763	4,763	318	476
Time	Late June	Late June	Late June	Early July	Late July
Amount of fertilizer washed into the river/day	2,186	1,191	1,191	64	95
Total runoff of rivers in Project area (C.A.: 190km^2)	25,583	25,583	25,830	332,940	410,000
PPM of river flow	9.00	4.66	4.66	0.064	0.072
Fish pond water requirement (m^3)	55,400	55,400	55,400	51,500	49,320
Inflow of chemicals into fish ponds (kg)	499	259	259	33	36
PPM in fish pond	0.0499	0.0259	0.0259	0.0033	0.0036
Minimum Runoff of Rivers in the Project Area					
Input/day (kg)	725	-	-	25	37.5
Time	April			March	April
Outflow/day (ℓ)	181.0			5	7.5
Runoff (m^3)	116,129			116,129	93,330
PPM	1.56			0.014	0.027
Fish pond water requirement (m^3)	66,870			66,870	70,567
Chemical inflow (kg)	104.3			0.94	1.90
PPM in fish pond	0.0104			0.000094	0.000191

Note: The original ppm content in fishponds or rivers was not considered in estimation of the above ppm.

QUALITY CRITERIA FOR CLASS"C" WATERS

Quality Parameter	Specification
1. Color, units	50
2. Temperature	The maximum rise above natural temperature shall not exceed 3°C outside the mixing zone as determined by the Commission.
3. Dissolved Oxygen	Not less than 5mg/ℓ
4. BOD (20°C)	Not more than 20mg/ℓ
5. pH	Not less than 6.3 nor more than 8.5. No change greater than 1.0 unit outside the estimated natural seasonal maximum and minimum.
6. Total Dissolved Solids	1,000mg/ℓ
7. Total Solids	2,000mg
8. Transparency	Secchi disk shall be visible at a minimum depth of 1m.
9. Bacteria	Bacteria of the celiform group shall not exceed a normally geometric average MPN of 5,000 per 100 nu., nor exceed this number in more than 20% of samples examined during the month, nor exceed 20,000 in more than 5% of the samples, except for commercial shell fishing in which the MPN of water does not exceed a geometric average MPN value of 100 per mi, nor exceed 400 in more than 5% of the samples examined during the month.
10. Phonoric Substances	0.02mg/ℓ
11. Trace Elements	Not to exceed the following limits:
Arsenic	0.05 mg/ℓ
Barium	0.05 mg/ℓ
Cadnium	0.01 mg/ℓ
Chromium	0.06 mg/ℓ
Copper	0.02 mg/ℓ
Cyanide	0.05 mg/ℓ
Lead	0.05 mg/ℓ
Mercury	0.002 mg/ℓ
Selenium	0.05 mg/ℓ
Silver	0.05 mg/ℓ
Zinc	2.0 mg/ℓ

QUALITY CRITERIA FOR CLASS"C" WATERS

Quality Parameter	Specification
12 Organic Chemicals	
Synthetic Detergents (MABS)	0.05 mg/ℓ
Oil and Grease	5 mg/ℓ
13. Persistent Pesticides	
Aldrin	0.01 ug/ℓ
DDT	0.02 ug/ℓ
Dieldrin	0.005 ug/ℓ
Chlordane	0.04 ug/ℓ
Endrin	0.002 ug/ℓ
Heptachlor	0.01 ug/ℓ
Lindane	0.02 ug/ℓ
Toxaphane	0.01 ug/ℓ
Methoxychlor	0.005 ug/ℓ
2. 4-D	4.0 ug/ℓ
14. Nutrients	Shall not be present in amounts to cause deleterious or abnormal biotic growth.

Source: Rules and Regulations of the National Pollution Control Commission (1978)

PRESENT CONDITION OF CATIPAYAN WATERSHED AREA

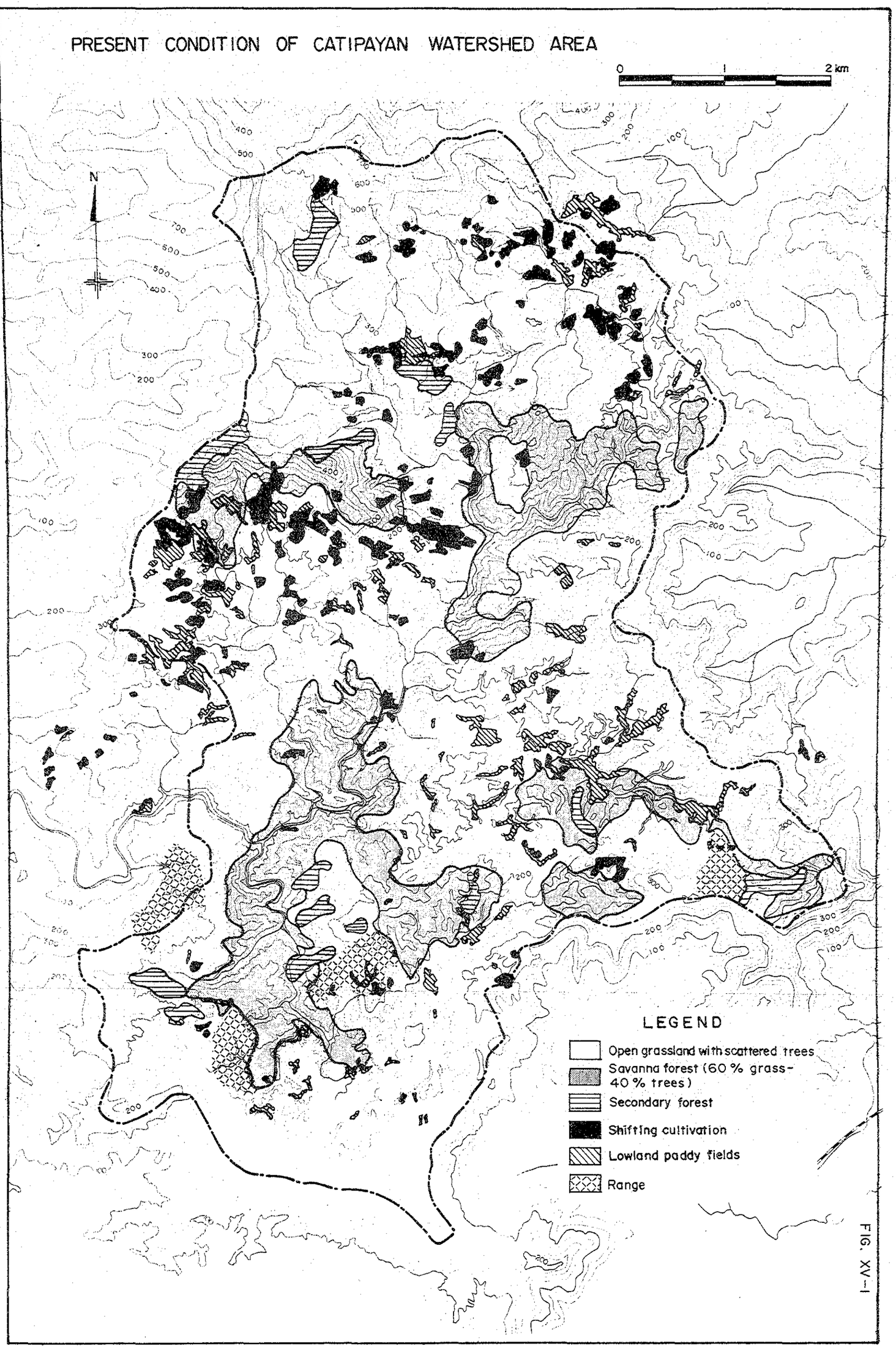


FIG. XV-1