Table 6.27 Calculation Sheet of Economic Benefit for Alternative Study of Crop Intensity

(1) Huai Khon Kaen Area

Crop Intensity & Irrigable Area	Net Economic Return			Economic Benefit
	Without Project		With Project	
	ha t/ha $/t		ha t/ha $/t	
CI = 100%	Paddy 3,900 x 0.7 x 3.0 x 320 x 0.7 =	1,835,000$	L.V 3,050 x 4.0 x 320 x 0.8 =	3,123,000$
IA = 6,100 ha	Maize 2,200 x 0.7 x 2.0 x 200 x 0.7 =	431,000	H.Y.V 3,050 x 4.5 x 350 x 0.8 =	3,843,000
(Ex.P.F 3,900 ha, Ex.U.A 2,200 ha)	Total	2,266,000$	Total	6,966,000$
				4,700,000$
CI = 125%	Paddy 2,600 x 0.7 x 3.0 x 320 x 0.7 =	1,223,000	L.V 2,300 x 4.0 x 320 x 0.8 =	2,355,000
IA = 4,600 ha	Maize 2,000 x 0.7 x 2.0 x 200 x 0.7 =	392,000	H.Y.V 2,300 x 4.5 x 350 x 0.8 =	2,898,000
(Ex.P.F 2,600 ha, Ex.U.A 2,000 ha)	Total	1,615,000$	Bean 1,150 x 2.0 x 600 x 0.8 =	1,104,000
			Total	6,357,000$
				4,742,000$
CI = 150%	Paddy 1,900 x 0.7 x 3.0 x 320 x 0.7 =	894,000	L.V 1,700 x 4.0 x 320 x 0.8 =	1,741,000
IA = 3,400 ha	Maize 1,500 x 0.7 x 2.0 x 200 x 0.7 =	294,000	H.Y.V 1,700 x 4.5 x 350 x 0.8 =	2,142,000
(Ex.P.F 1,900 ha, Ex.U.A 1,500 ha)	Total	1,188,000$	Bean 1,700 x 2.0 x 600 x 0.8 =	1,632,000
			Total	5,515,000$
				4,327,000$
CI = 175%	Paddy 1,900 x 0.7 x 3.0 x 320 x 0.7 =	894,000	L.V 1,350 x 4.0 x 320 x 0.8 =	1,382,000
IA = 2,700 ha	Maize 800 x 0.7 x 2.0 x 200 x 0.7 =	157,000	H.Y.V 1,350 x 4.5 x 350 x 0.8 =	1,701,000
(Ex.P.F 1,900 ha, Ex.U.A 800 ha)	Total	1,051,000$	Bean 2,050 x 2.0 x 600 x 0.8 =	1,944,000
			Total	5,027,000$
				3,976,000$
CI = 200%	Paddy 1,900 x 0.7 x 3.0 x 320 x 0.7 =	894,000	L.V 1,100 x 4.0 x 320 x 0.8 =	1,126,000
IA = 2,200 ha	Maize 300 x 0.7 x 2.0 x 200 x 0.7 =	59,000	H.Y.V 1,100 x 4.5 x 350 x 0.8 =	1,386,000
(Ex.P.F 1,900 ha, Ex.U.A 300 ha)			Bean 2,200 x 2.0 x 600 x 0.8 =	2,112,000
	Total	953,000$	Total	4,624,000$
				3,671,000$

Note: Ex.P.F - Existing Paddy Field
Ex.U.A - Existing Upland Area
L.V - Local Variety
H.Y.V - High Yield Variety

Table 6.27 Calculation Sheet of Economic Benefit for Alternative Study of Crop Intensity

(2) Huai Yai Area

Crop Intensity & Irrigable Area	Net Economic Return		Economic Benefit
	Without Project	With Project	
CI = 100% IA = 2,100 ha	Paddy 2,100 x 0.7 x 3.0 x 320 x 0.7 = 988,000$	L.V 1,050 x 4.0 x 320 x 0.8 = 1,075,000$ H.Y.V 1,050 x 4.5 x 350 x 0.8 = 1,323,000 Total 2,398,000$	1,410,000$
CI = 125% IA = 1,400 ha	Paddy 1,400 x 0.7 x 3.0 x 320 x 0.7 = 659,000$	L.V 700 x 4.0 x 320 x 0.8 = 717,000 H.Y.V 700 x 4.5 x 350 x 0.8 = 882,000 Bean 350 x 2.0 x 600 x 0.8 = 336,000 Total 1,935,000$	1,276,000$
CI = 150% IA = 1,000 ha	Paddy 1,000 x 0.7 x 3.0 x 320 x 0.7 = 470,000$	L.V 500 x 4.0 x 320 x 0.8 = 512,000 H.Y.V 500 x 4.5 x 350 x 0.8 = 630,000 Bean 500 x 2.0 x 600 x 0.8 = 480,000 Total 1,622,000$	1,152,000$
CI = 175% IA = 800 ha	Paddy 800 x 0.7 x 3.0 x 320 x 0.7 = 376,000$	L.V 400 x 4.0 x 320 x 0.8 = 410,000 H.Y.V 400 x 4.5 x 350 x 0.8 = 504,000 Bean 600 x 2.0 x 600 x 0.8 = 576,000 Total 1,490,000$	1,114,000$
CI = 200% IA = 650 ha	Paddy 650 x 0.7 x 3.0 x 320 x 0.7 = 306,000$	L.V 325 x 4.0 x 320 x 0.8 = 333,000 H.Y.V 325 x 4.5 x 350 x 0.8 = 410,000 Bean 650 x 2.0 x 600 x 0.8 = 624,000 Total 1,367,000$	1,061,000$

Table 6.27 Calculation Sheet of Economic Benefit for Alternative Study of Crop Intensity

(3) Khlong Chaliang Lab Area

Crop Intensity & Irrigable Area	Net Economic Return		Economic Benefit
	Without Project (ha t/ha $/t)	With Project (ha t/ha $/t)	
CI = 100% IA = 350 ha	Paddy 350 x 0.7 x 3.0 x 320 x 0.7 = 165,000$	L.V 175 x 4.0 x 320 x 0.8 = 179,000$ H.Y.V 175 x 4.5 x 350 x 0.8 = 221,000 Total 400,000$	235,000$
CI = 125% IA = 230 ha	Paddy 230 x 0.7 x 3.0 x 320 x 0.7 = 108,000$	L.V 115 x 4.0 x 320 x 0.8 = 118,000 H.Y.V 115 x 4.5 x 350 x 0.8 = 145,000 Bean 58 x 2.0 x 600 x 0.8 = 56,000 Total 319,000$	211,000$
CI = 150% IA = 150 ha	Paddy 150 x 0.7 x 3.0 x 320 x 0.7 = 71,000$	L.V 75 x 4.0 x 320 x 0.8 = 77,000 H.Y.V 75 x 4.5 x 350 x 0.8 = 95,000 Bean 75 x 2.0 x 600 x 0.8 = 72,000 Total 244,000$	173,000$
CI = 175% IA = 100 ha	Paddy 100 x 0.7 x 3.0 x 320 x 0.7 = 47,000$	L.V 50 x 4.0 x 320 x 0.8 = 51,000 H.Y.V 50 x 4.5 x 350 x 0.8 = 63,000 Bean 75 x 2.0 x 600 x 0.8 = 72,000 Total 186,000$	139,000$
CI = 200% IA = 80 ha	Paddy 80 x 0.7 x 3.0 x 320 x 0.7 = 38,000$	L.V 40 x 4.0 x 320 x 0.8 = 41,000 H.Y.V 40 x 4.5 x 350 x 0.8 = 50,000 Bean 80 x 2.0 x 600 x 0.8 = 77,000 Total 168,000$	130,000$

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(1) Huai Khon Kaen: Crop Intensity 100% - IA = 6,100 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	2,731	-	2,731	-	-2,731
2	5,462	27	5,489	-	-5,489
3	8,193	82	8,275	-	-8,275
4	8,193	164	8,357	671	-7,686
5	2,732	246	2,978	1,343	-1,635
6	-	273	273	2,014	1,741
7	-	273	273	2,686	2,413
8	-	273	273	3,357	3,084
9	-	273	273	4,029	3,756
10	-	273	273	4,700	4,427
⋮	⋮	⋮	⋮	⋮	⋮
55	-	273	273	4,700	4,427
Total	27,311	14,169	41,480	230,300	188,820

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(2) Huai Khon Kaen: Crop Intensity 125% - IA = 4,600 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	2,520	-	2,520	-	-2,520
2	5,039	25	5,064	-	-5,064
3	7,559	76	7,635	-	-7,635
4	7,559	151	7,710	677	-7,033
5	2,518	227	2,745	1,355	-1,390
6	-	252	252	2,032	1,780
7	-	252	252	2,710	2,458
8	-	252	252	3,387	3,135
9	-	252	252	4,065	3,813
10	-	252	252	4,742	4,490
⋮	⋮	⋮	⋮	⋮	⋮
55	-	252	252	4,742	4,490
Total	25,195	13,079	38,274	232,358	194,084

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(3) Huai Khon Kaen: Crop Intensity 150% - IA = 3,400 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	2,350	-	2,350	-	-2,350
2	4,700	24	4,724	-	-4,724
3	7,050	71	7,121	-	-7,121
4	7,050	141	7,191	618	-6,573
5	2,351	212	2,563	1,236	-1,327
6	-	235	235	1,854	1,619
7	-	235	235	2,473	2,238
8	-	235	235	3,091	2,856
9	-	235	235	3,709	3,474
10	-	235	235	4,327	4,092
⋮	⋮	⋮	⋮	⋮	⋮
55	-	235	235	4,327	4,092
Total	23,501	12,198	35,699	212,023	176,324

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(4) Huai Khon Kaen: Crop Intensity 175% - IA = 2,700 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	2,251	-	2,251	-	-2,251
2	4,503	23	4,526	-	-4,526
3	6,754	68	6,822	-	-6,822
4	6,754	135	6,889	568	-6,321
5	2,252	203	2,455	1,136	-1,319
6	-	225	225	1,704	1,479
7	-	225	225	2,272	2,047
8	-	225	225	2,840	2,615
9	-	225	225	3,408	3,183
10	-	225	225	3,976	3,751
⋮	⋮	⋮	⋮	⋮	⋮
55	-	225	225	3,976	3,751
Total	22,514	11,679	34,193	194,824	160,631

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(5) Huai Khon Kaen: Crop Intensity 200% - IA = 2,200 ha

(Unit: x10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	2,181	-	2,181	-	-2,181
2	4,362	22	4,384	-	-4,384
3	6,542	65	6,607	-	-6,607
4	6,542	131	6,673	524	-6,149
5	2,181	196	2,377	1,049	-1,328
6	-	218	218	1,573	1,355
7	-	218	218	2,098	1,880
8	-	218	218	2,622	2,404
9	-	218	218	3,147	2,929
10	-	218	218	3,671	3,453
55	-	218	218	3,671	3,453
Total	21,808	11,314	33,122	179,879	146,757

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(6) Huai Yai: Crop Intensity 100% - IA = 2,100 ha

(Unit: x10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	1,110	-	1,110	-	-1,110
2	1,998	11	2,009	-	-2,009
3	1,331	31	1,362	201	-1,161
4	-	44	44	403	359
5	-	44	44	604	560
6	-	44	44	806	762
7	-	44	44	1,007	963
8	-	44	44	1,209	1,165
9	-	44	44	1,410	1,366
10	-	44	44	1,410	1,366
⋮	⋮	⋮	⋮	⋮	⋮
53	-	44	44	1,410	1,366
Total	4,439	2,242	6,681	67,680	60,999

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(7) Huai Yai: Crop Intensity 125% - IA = 1,400 ha

(Unit: x10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	989	-	989	-	-989
2	1,779	10	1,789	-	-1,789
3	1,186	28	1,214	182	-1,032
4	-	40	40	365	325
5	-	40	40	547	507
6	-	40	40	729	689
7	-	40	40	911	871
8	-	40	40	1,094	1,054
9	-	40	40	1,276	1,236
10	-	40	40	1,276	1,236
⋮	⋮	⋮	⋮	⋮	⋮
53	-	40	40	1,276	1,236
Total	3,954	2,038	5,992	61,248	55,256

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(8) Huai Yai: Crop Intensity 150% - IA = 1,000 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	919	-	919	-	-919
2	1,655	9	1,664	-	-1,664
3	1,103	26	1,129	165	-964
4	-	37	37	329	292
5	-	37	37	494	457
6	-	37	37	658	621
7	-	37	37	823	786
8	-	37	37	987	950
9	-	37	37	1,152	1,115
10	-	37	37	1,152	1,115
⋮	⋮	⋮	⋮	⋮	⋮
53	-	37	37	1,152	1,115
Total	3,677	1,885	5,562	55,296	49,734

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(9) Huai Yai: Crop Intensity 175% - IA = 800 ha

(Unit: x10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	885	-	885	-	-885
2	1,592	9	1,601	-	-1,601
3	1,061	25	1,086	159	-927
4	-	35	35	318	283
5	-	35	35	477	442
6	-	35	35	637	602
7	-	35	35	796	761
8	-	35	35	955	920
9	-	35	35	1,114	1,079
10	-	35	35	1,114	1,079
⋮	⋮	⋮	⋮	⋮	⋮
53	-	35	35	1,114	1,079
Total	3,538	1,784	5,322	53,472	48,150

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(10) Huai Yai: Crop Intensity 200% - IA = 650 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	859	-	859	-	-859
2	1,545	9	1,554	-	-1,554
3	1,030	24	1,054	152	-902
4	-	34	34	303	269
5	-	34	34	455	421
6	-	34	34	606	572
7	-	34	34	758	724
8	-	34	34	909	875
9	-	34	34	1,061	1,027
10	-	34	34	1,061	1,027
⋮	⋮	⋮	⋮	⋮	⋮
53	-	34	34	1,061	1,027
Total	3,434	1,733	5,167	50,928	45,761

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(11) Khlong Chaliang Lab: Crop Intensity 100% - IA = 350 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	498	-	498	-	-498
2	896	5	901	-	-901
3	597	14	611	34	-577
4	-	20	20	67	47
5	-	20	20	101	81
6	-	20	20	134	114
7	-	20	20	168	148
8	-	20	20	201	181
9	-	20	20	235	215
10	-	20	20	235	215
⋮	⋮	⋮	⋮	⋮	⋮
53	-	20	20	235	215
Total	1,991	1,019	3,010	11,280	8,270

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(12) Khlong Chaliang Lab: Crop Intensity 125% - IA = 230 ha

(Unit: x10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	480	-	480	-	-480
2	864	5	869	-	-869
3	576	13	589	30	-559
4	-	19	19	60	41
5	-	19	19	90	71
6	-	19	19	121	102
7	-	19	19	151	132
8	-	19	19	181	162
9	-	19	19	211	192
10	-	19	19	211	192
⋮	⋮	⋮	⋮	⋮	⋮
53	-	19	19	211	192
Total	1,920	968	2,888	10,128	7,240

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(13) Khlong Chaliang Lab: Crop Intensity 150% - IA = 150 ha

(Unit: x10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	468	-	468	-	-468
2	843	5	848	-	-848
3	562	13	575	25	-550
4	-	19	19	49	30
5	-	19	19	74	55
6	-	19	19	99	80
7	-	19	19	124	105
8	-	19	19	148	129
9	-	19	19	173	154
10	-	19	19	173	154
⋮	⋮	⋮	⋮	⋮	⋮
53	-	19	19	173	154
Total	1,873	968	2,841	8,304	5,463

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(14) Khlong Chaliang Lab: Crop Intensity 175% - IA = 100 ha

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	461	-	461	-	-461
2	829	5	834	-	-834
3	553	13	566	20	-546
4	-	18	18	40	22
5	-	18	18	60	42
6	-	18	18	79	61
7	-	18	18	99	81
8	-	18	18	119	101
9	-	18	18	139	121
10	-	18	18	139	121
⋮	⋮	⋮	⋮	⋮	⋮
53	-	18	18	139	121
Total	1,843	918	2,761	6,672	3,911

Table 6.28 Economic Cost and Benefit Flow for Alternative Study of Crop Intensity

(15) Khlong Chaliang Lab: Crop Intensity 200% - IA = 80 ha

(Unit: x10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	458	-	458	-	-458
2	824	5	829	-	-829
3	549	13	562	19	-543
4	-	18	18	37	19
5	-	18	18	56	38
6	-	18	18	74	56
7	-	18	18	93	75
8	-	18	18	111	93
9	-	18	18	130	112
10	-	18	18	130	112
⋮	⋮	⋮	⋮	⋮	⋮
53	-	18	18	130	112
Total	1,831	918	2,749	6,240	3,491

Table 6.29 Proposed Irrigation Plan

(1) Huai Saduang Yai Area

(1) Service Area: 37,460 rai (5,990 ha)

Sri Chan Irrigation Project - 6,000 rai (960 ha)
Pasak Left Bank Irrigation Project - 31,460 rai (5,030 ha)

(2) Recommendable Cropping Pattern: Crop Intensity 135%

Wet season

Paddy: Local Variety - 50%
High Yield Variety - 50%

Dry season

Upland crop (bean) - 35%

(3) Irrigation Water Requirement:

48,192,000 m^3/year (803 mm/year)

(4) Irrigation System:

Utilization of the existing irrigation systems is Sri Chan Irrigation Project and Pasak Left Bank Irrigation Project.

Table 6.29 Proposed Irrigation Plan

(2) Huai Khon Kaen Area

(1) Service Area: 27,500 rai (4,400 ha)

(2) Recommendable Cropping Pattern: Crop Intensity 135%

Wet season

Paddy: Local Variety - 50%

High Yield Variety - 50%

Dry season

Upland crop (bean) - 35%

(3) Irrigation Water Requirement:

35,340,000 m^3/year (803 mm/year)

(4) Irrigation Canal System:

Name of Canal	Canal Length			Command Area	Maximum Design Discharge
	New	Existing	Total		
	(km)	(km)	(km)	(ha)	(m^3/sec)
RMC	6.9	0.0	6.9	1,100	1.10
1L-RMC	0.4	7.2	7.6	770	0.77
1L-1L-RMC	0.0	7.1	7.1	360	0.36
LMC	35.1	0.0	35.1	3,300	3.30
1R-LMC	0.5	5.1	5.6	930	0.93
1L-1R-LMC	1.1	5.8	6.9	610	0.61
1L-1L-1R-LMC	2.3	3.3	5.6	310	0.31
2R-LMC	2.3	0.0	2.3	280	0.28
3R-LMC	2.0	1.0	3.0	130	0.13
4R-LMC	2.2	0.0	2.2	320	0.32
5R-LMC	2.0	0.0	2.0	180	0.18
Total	54.8	29.5	84.3	4,400	4.40

Table 6.29 Proposed Irrigation Plan

(3) Huai Yai Area

(1) Service Area: 9,380 rai (1,500 ha)

(2) Recommendable Cropping Pattern: Crop Intensity 125%

Wet season

Paddy: Local Variety - 50%

High Yield Variety - 50%

Dry season

Upland Crop (bean) - 25%

(3) Irrigation Water Requirement:

10,684,000 m^3/year (712 mm/year)

(4) Irrigation Canal System:

Name of Canal	Canal Length			Command Area	Maximum Design Discharge
	New	Existing	Total		
	(km)	(km)	(km)	(ha)	(m^3/sec)
MC	6.7	5.6	12.3	1,500	1.50
1R-MC	3.7	6.1	9.8	680	0.68
1R-1R-MC	2.5	1.1	3.6	200	0.20
2R-MC	0.6	2.3	2.9	260	0.26
Total	13.5	15.1	28.6	1,500	1.50

Table 6.29 Proposed Irrigation Plan

(4) Khlong Chaliang Lab Area

(1) Service Area: 1,440 rai (230 ha)

(2) Recommendable Cropping Pattern: Crop Intensity 125%

Wet season

Paddy: Local Variety - 50%

High Yield Variety - 50%

Dry season

Upland crop (bean) - 25%

(3) Irrigation Water Requirement:

1,638,000 m^3/year (712 mm/year)

(4) Irrigation Canal System:

Name of Canal	Canal Length			Command Area	Maximum Design Discharge
	New	Existing	Total		
	(km)	(km)	(km)	(ha)	(m^3/sec)
MC	0.8	1.5	2.3	230	0.23
1R-MC	0.4	0.7	1.1	30	0.03
2R-MC	0.0	1.7	1.7	130	0.13
Total	1.2	3.9	5.1	230	0.23

Table 6.30 Dimensions of Irrigation Canals

(1) Huai Khon Kaen Area

Name of Canal	Max. Design Discharge (m^3/sec)	Canal Length (km)	New or Existing	Canal Type	Canal Dimension		
					B (m)	h (m)	H (m)
RMC	2.00	6.9	New	Lined	1.00	0.75	1.00
1L-RMC	0.77	0.4	"	Unlined	1.00	0.60	0.80
"	"	0.7	Existing	"	1.00	0.60	0.80
"	0.41	6.5	"	"	0.70	0.50	0.65
1L-1L-RMC	0.36	7.1	"	"	0.70	0.50	0.65
LMC	3.30	0.8	New	Lined	1.50	0.90	1.20
"	2.37	22.9	"	"	1.50	0.80	1.05
"	0.85	2.0	"	"	0.80	0.55	0.75
"	0.72	1.9	"	"	0.70	0.55	0.75
"	0.30	7.5	"	"	0.50	0.35	0.50
1R-LMC	0.93	0.5	"	Unlined	1.00	0.70	0.90
"	"	0.2	Existing	"	1.00	0.70	0.90
"	0.32	4.9	"	"	0.70	0.45	0.60
1L-1R-LMC	0.61	3.4	"	"	0.80	0.60	0.80
"	"	0.6	New	"	0.80	0.60	0.80
"	0.30	0.5	"	"	0.70	0.45	0.60
"	"	2.4	Existing	"	0.70	0.45	0.70
1L-1L-1R-LMC	0.31	3.3	"	"	0.80	0.55	0.70
"	"	2.3	New	"	0.80	0.55	0.70
2R-LMC	0.28	2.3	"	"	0.70	0.45	0.60
3R-LMC	0.13	2.0	"	"	0.50	0.35	0.50
"	"	1.0	Existing	"	0.50	0.35	0.50
4R-LMC	0.32	2.2	New	"	0.60	0.45	0.60
5R-LMC	0.18	2.0	"	"	0.60	0.40	0.55

Table 6.30 Dimensions of Irrigation Canals

(2) Huai Yai Area

Name of Canal	Max. Design Discharge (m^3/sec)	Canal Length (km)	New or Existing	Canal Type	Canal Dimension		
					B (m)	h (m)	H (m)
MC	1.50	0.7	New	Lined	1.00	0.65	0.90
"	0.82	0.6	Existing	"	0.80	0.55	0.75
"	"	3.0	New	"	0.80	0.55	0.75
"	"	3.4	Existing	"	0.80	0.55	0.75
"	"	0.3	New	"	0.80	0.55	0.75
"	"	1.1	Existing	"	0.80	0.55	0.75
"	0.30	1.4	New	"	0.50	0.35	0.50
"	"	0.5	Existing	"	0.50	0.35	0.50
"	"	1.3	New	"	0.50	0.35	0.50
1R-MC	0.68	0.9	"	Unlined	0.80	0.60	0.80
"	0.47	1.5	"	"	0.70	0.55	0.70
"	"	1.3	Existing	"	0.70	0.55	0.70
"	"	0.5	New	"	0.70	0.55	0.70
"	"	2.5	Existing	"	0.70	0.55	0.70
"	"	0.8	New	"	0.70	0.55	0.70
"	"	2.3	Existing	"	0.70	0.55	0.70
1R-1R-MC	0.20	2.5	New	"	0.50	0.40	0.55
"	"	1.1	Existing	"	0.50	0.40	0.55
2R-MC	0.26	0.6	New	"	0.60	0.40	0.55
"	"	2.3	Existing	"	0.60	0.40	0.55

Table 6.30 Dimensions of Irrigation Canals

(3) Khlong Chaliang Lab Area

Name of Canal	Max. Design Discharge (m^3/sec)	Canal Length (km)	New or Existing	Canal Type	Canal Dimension		
					B (m)	h (m)	H (m)
MC	0.23	0.8	New	Lined	0.50	0.35	0.50
"	"	1.5	Existing	"	0.50	0.35	0.50
1R-MC	0.03	0.4	New	Unlined	0.50	0.15	0.30
"	"	0.7	Existing	"	0.50	0.15	0.30
2R-MC	0.13	1.7	"	"	0.50	0.25	0.40

Table 6.31 List of Canal Structures

(Unit: Nos.)

	Project Area	Regulator	Turnout	Siphon	Culvert	Drop	Cross Drain
I.	Huai Khon Kaen						
	RMC	1	7	0	6	8	6
	1L-RMC	1	3	0	3	7	0
	1L-1L-RMC	0	6	0	3	3	0
	LMC	4	19	3	17	0	19
	1R-LMC	1	4	0	2	9	0
	1L-1R-LMC	1	3	0	2	6	0
	1L-1L-1R-LMC	0	3	0	4	0	3
	2R-LMC	0	2	0	0	2	0
	3R-LMC	0	2	0	1	1	0
	4R-LMC	0	2	0	1	2	0
	5R-LMC	0	2	0	1	2	0
	Total	8	53	3	40	40	28
II.	Huai Yai						
	MC	2	10	1	7	13	1
	1R-MC	1	8	0	3	10	2
	1R-1R-MC	0	2	0	1	6	2
	2R-MC	0	2	0	2	2	0
	Total	3	22	1	13	31	5
III.	Khlong Chaliang Lab						
	MC	1	1	0	1	4	0
	1R-MC	0	1	0	1	2	0
	2R-MC	0	2	0	1	1	0
	Total	1	4	0	3	7	0

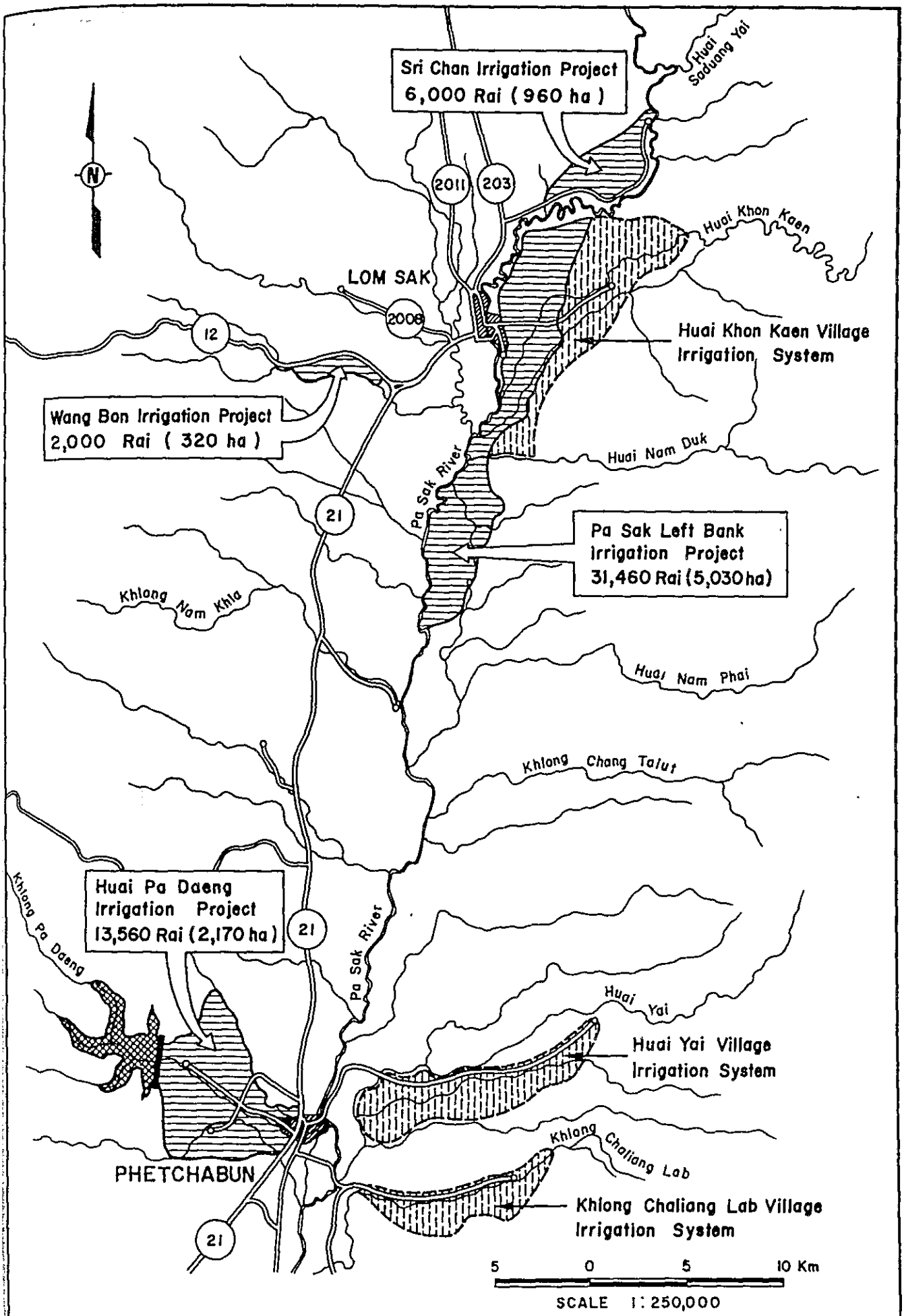


Fig. 6.1 LOCATION OF EXISTING IRRIGATION PROJECTS

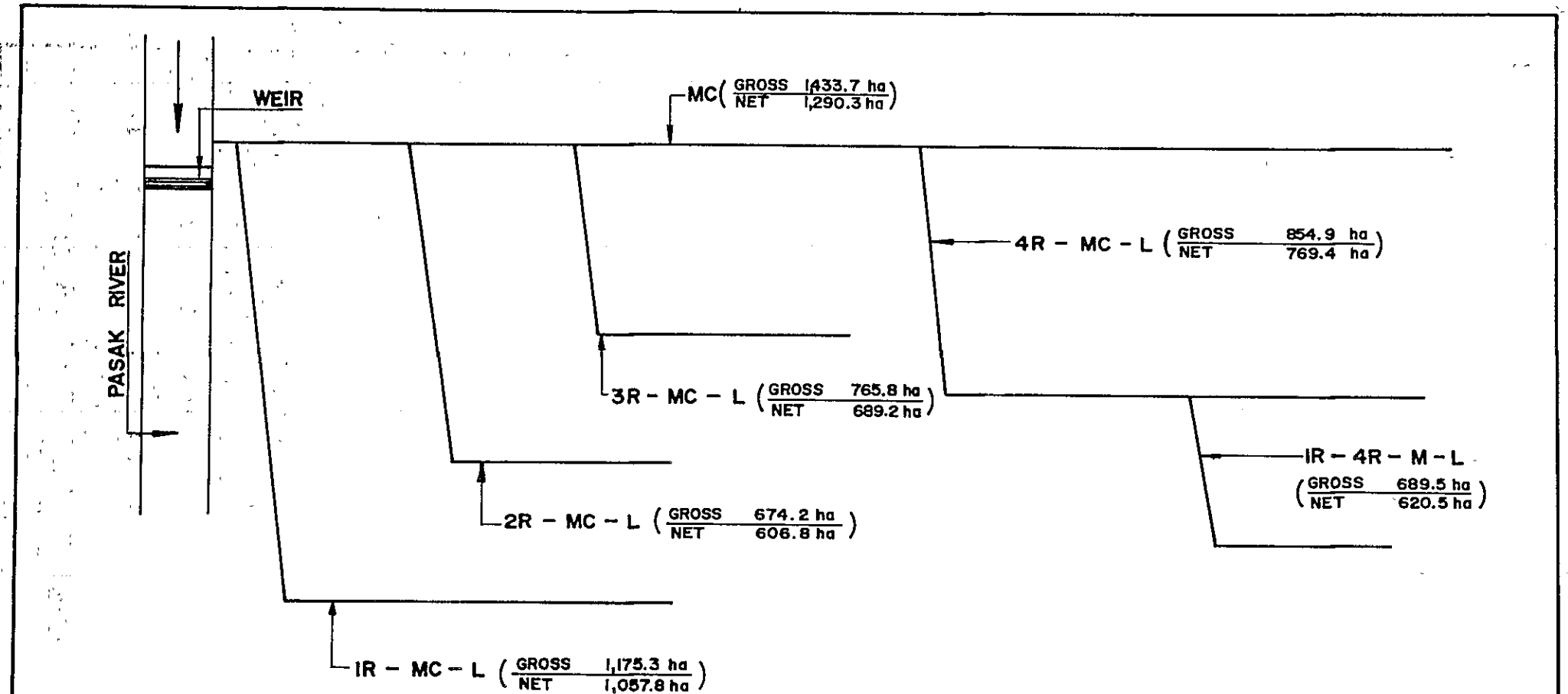


Fig. 6.2 SCHEMATIC IRRIGATION SYSTEM OF PASAK LEFT BANK IRRIGATION PROJECT

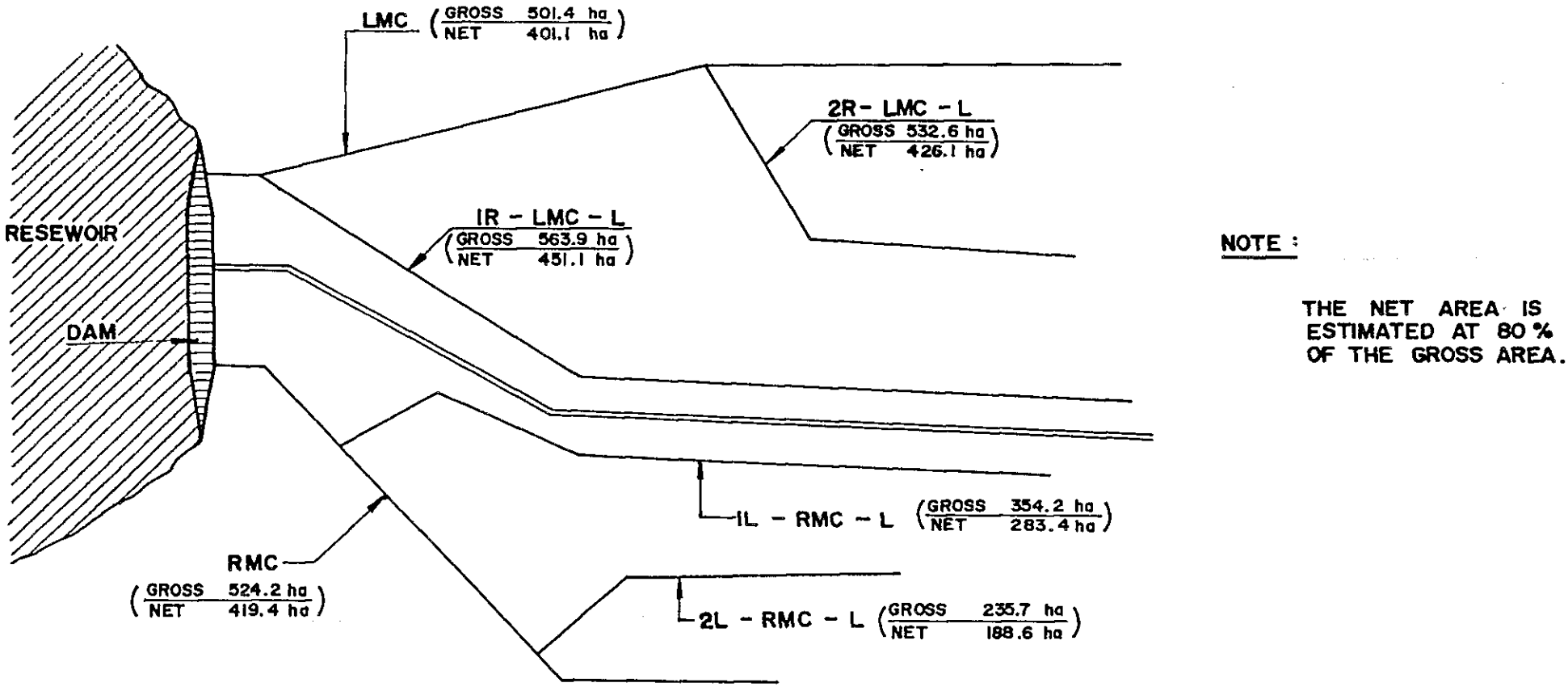
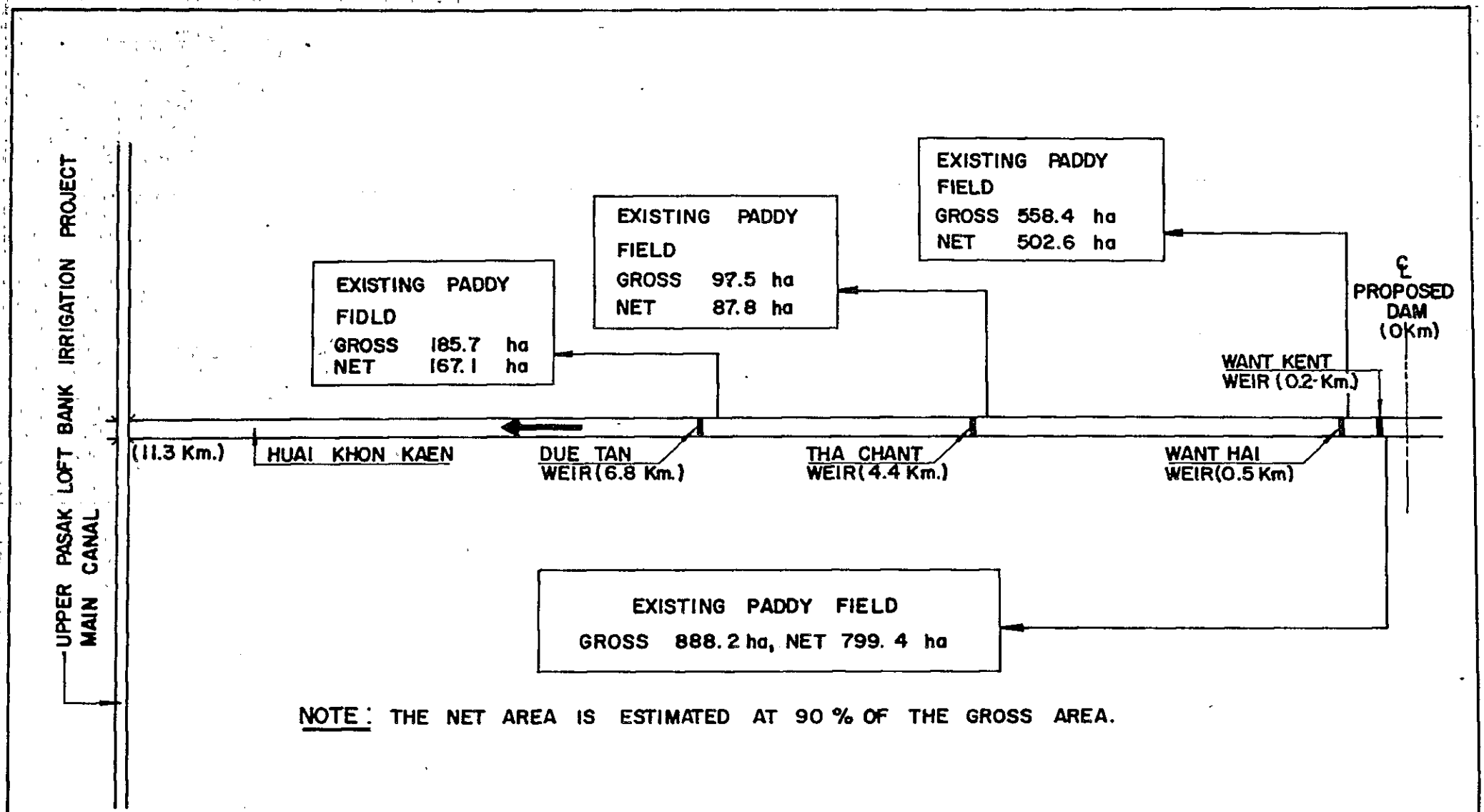
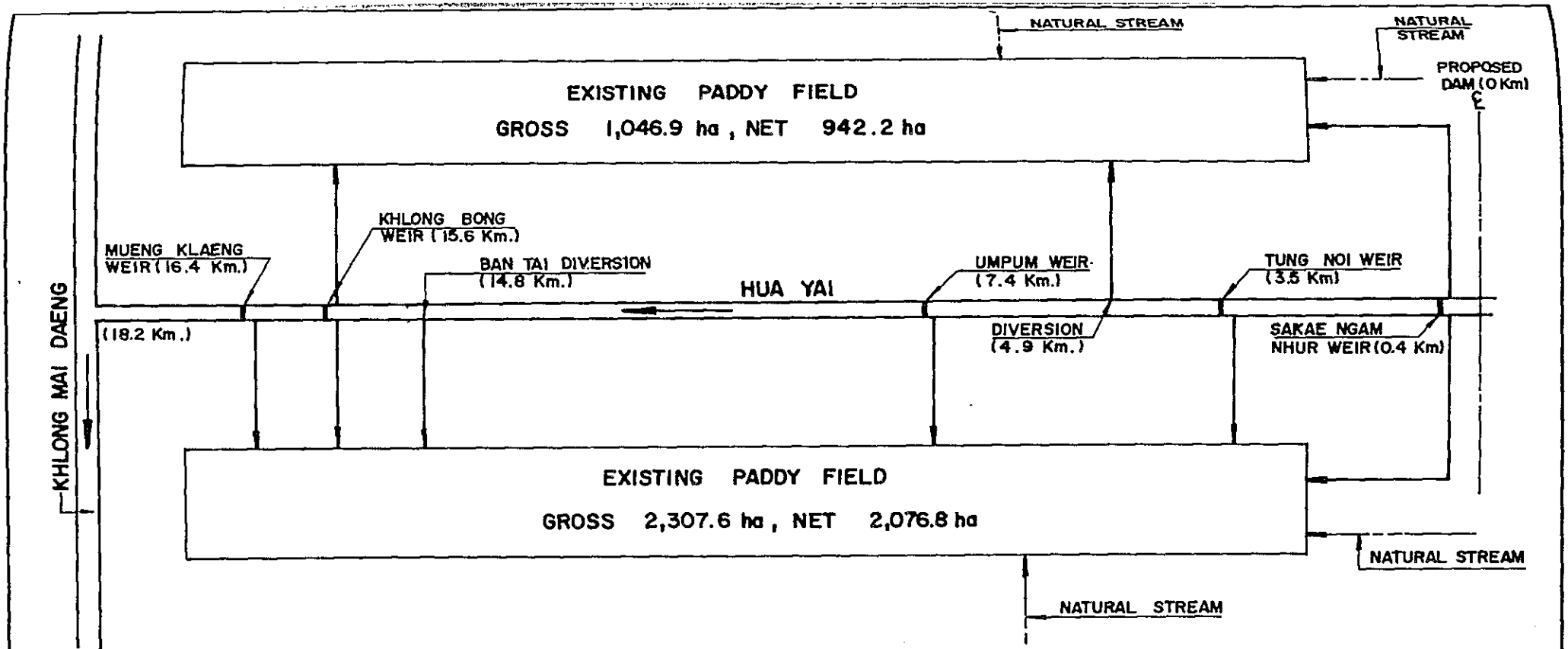


Fig. 6.3 SCHEMATIC IRRIGATION SYSTEM OF HUAI PA DAENG IRRIGATION PROJECT



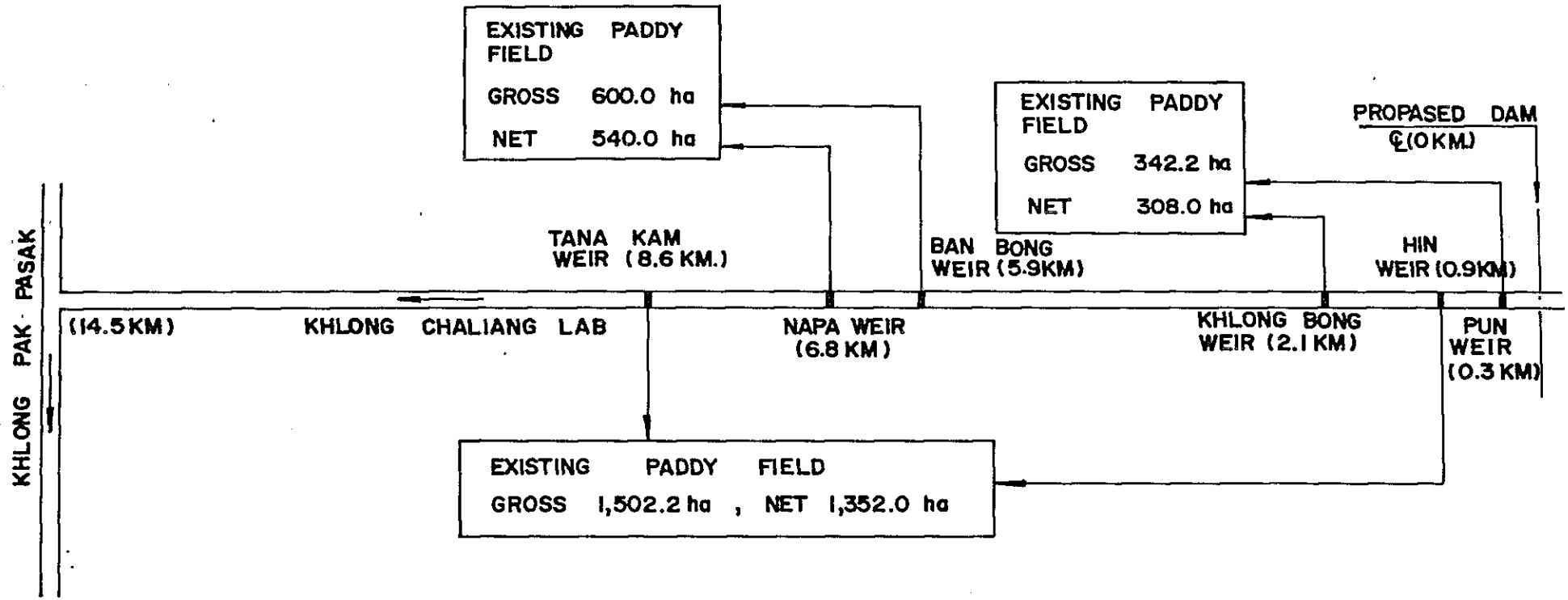
NOTE : THE NET AREA IS ESTIMATED AT 90 % OF THE GROSS AREA.

Fig. 6.4 SCHMATIC EXISTING IRRIGATION SYSTEM OF HUAI KHON KAEN AREA



NOTE : THE NET AREA IS ESTIMATED AT 90 % OF THE GROSS AREA.

Fig. 6.5 SCHEMATIC EXISTING IRRIGATION SYSTEM OF HUAI YAI AREA



NOTE : THE NET AREA IS ESTIMATED AT 90 % OF THE GROSS AREA.

Fig. 6.6 SCHEMATIC EXISTING IRRIGATION SYSTEM OF KHLONG CHALIANG LAB AREA

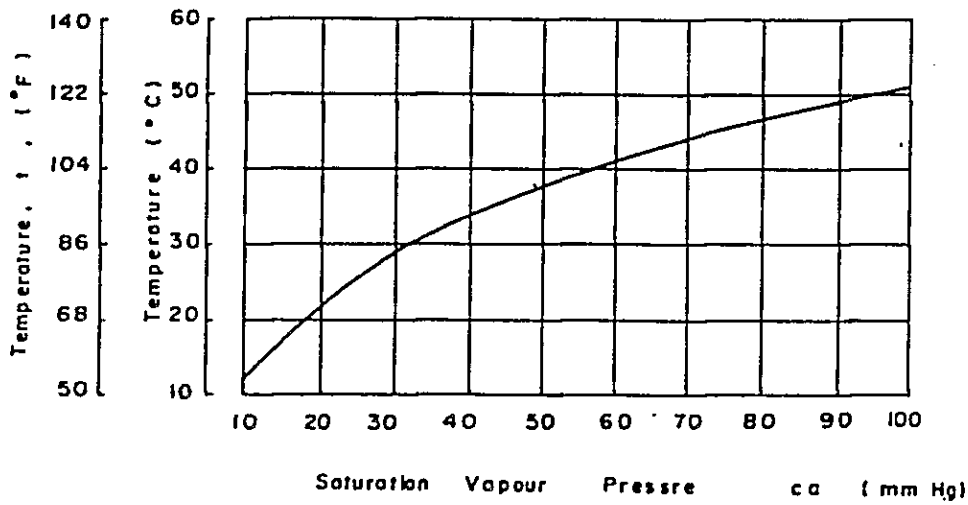


Fig. 6.7 SATURATION VAPOUR PRESSURE CURVE

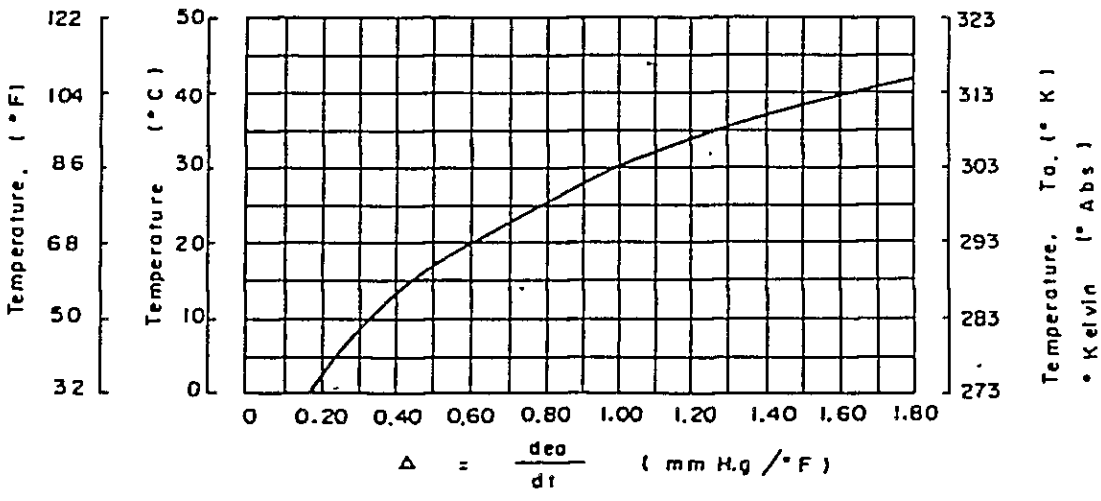


Fig. 6.8 SLOPE OF SATURATION VAPOUR PRESSURE CURVE

LEGEND

ETo : Potential evapotranspiration (mm/day)

Hm : Relative humidity (%)

U_2daytime : Daytime wind velocity at zm above

W : Weighting factor for effect of radiation

Rs : Solar radiation (mm H_2O/day)

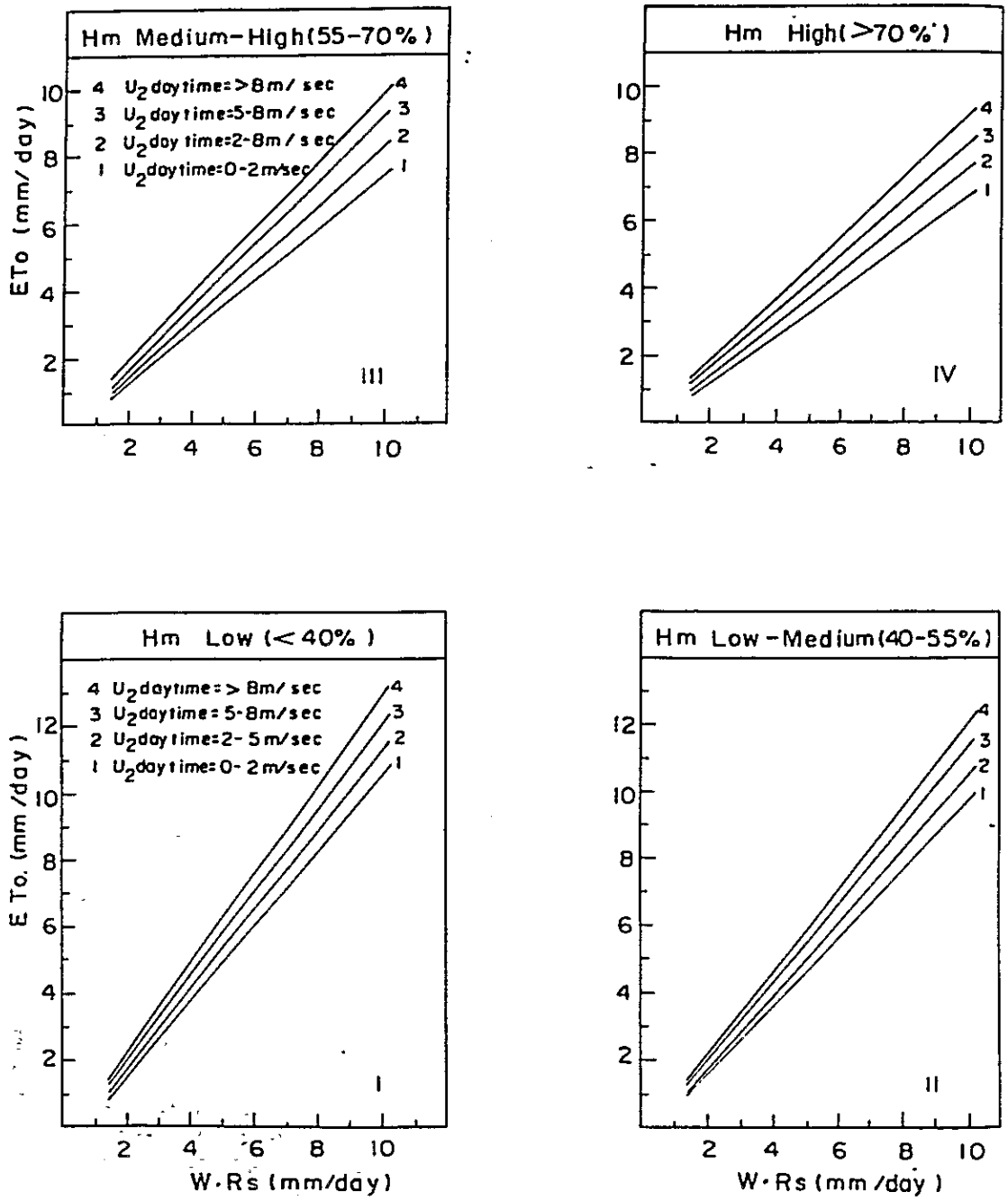


Fig. 6.9 PREDICTION OF ETo FROM W, Rs FOR EACH Hm AND U_2 DAYTIME

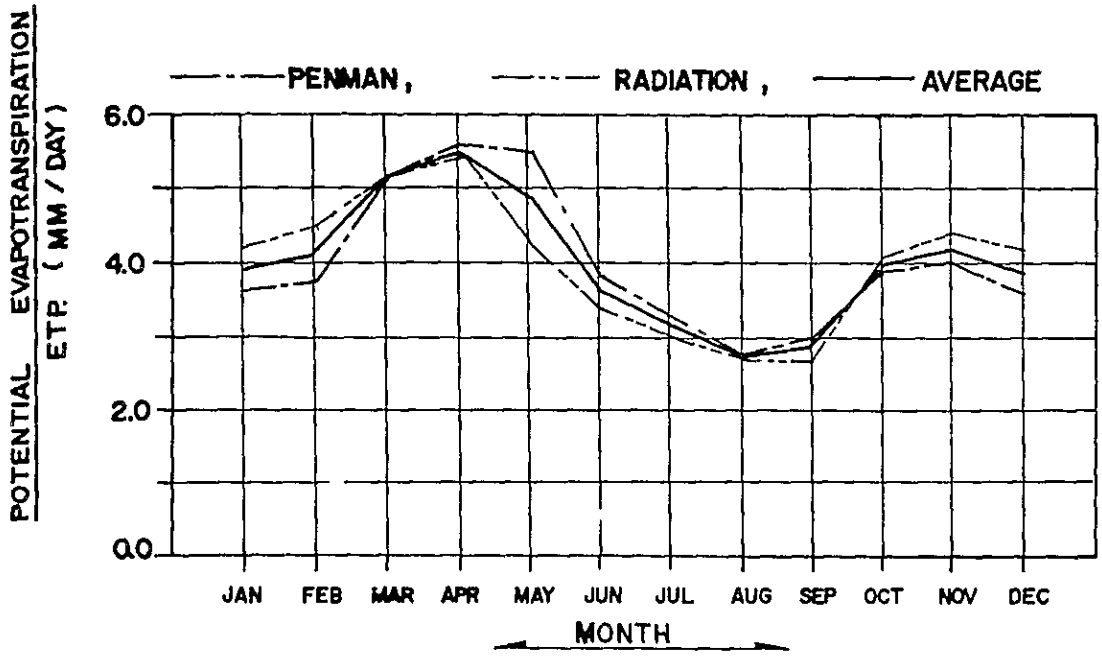


Fig. 6.10 POTENTIAL EVAPOTRANSPIRATION

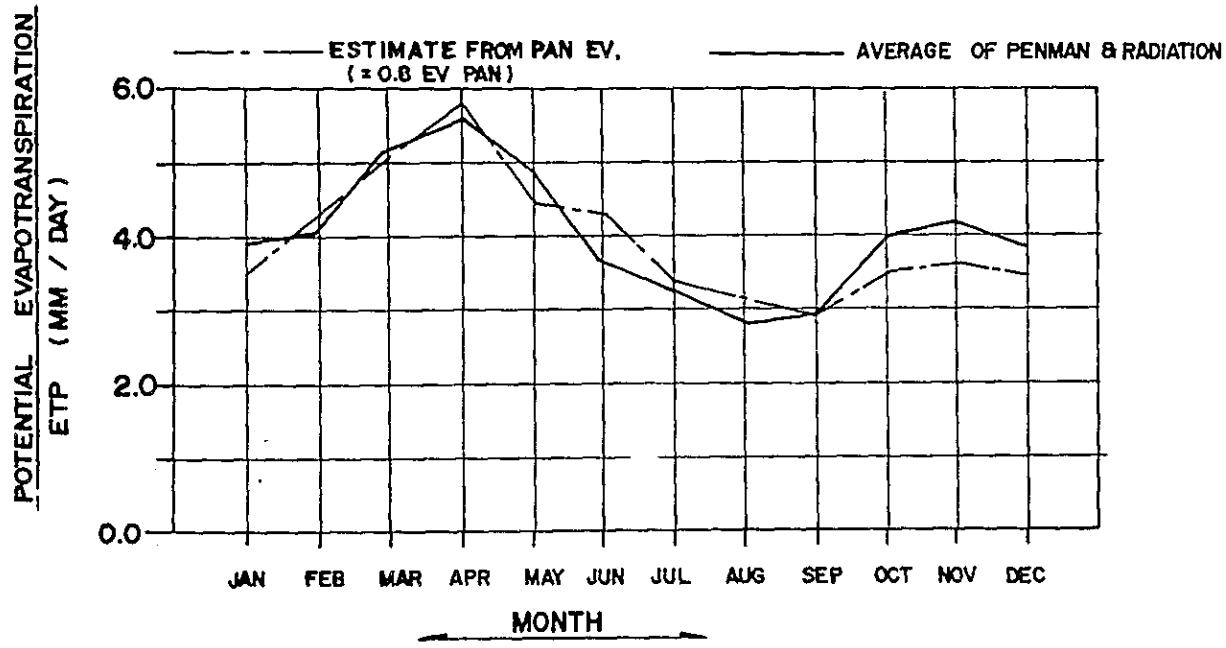


Fig. 6.11 COMPARISON BETWEEN AVERAGED EVAPOTRANSPIRATION AND RECORDED PAN EVAPORATION

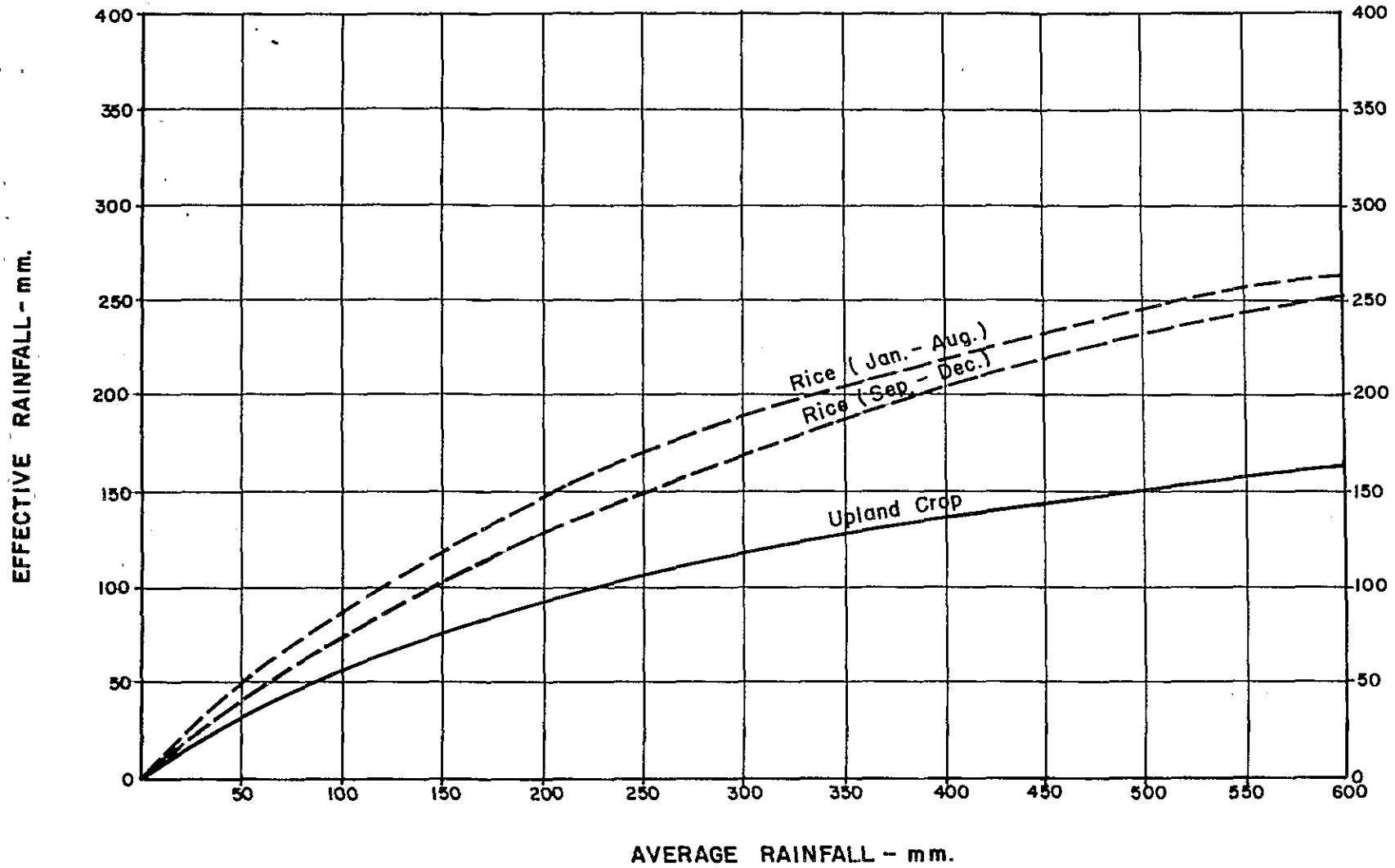


Fig. 6.12 EFFECTIVE RAINFALL CHART DEVELOPED BY RID

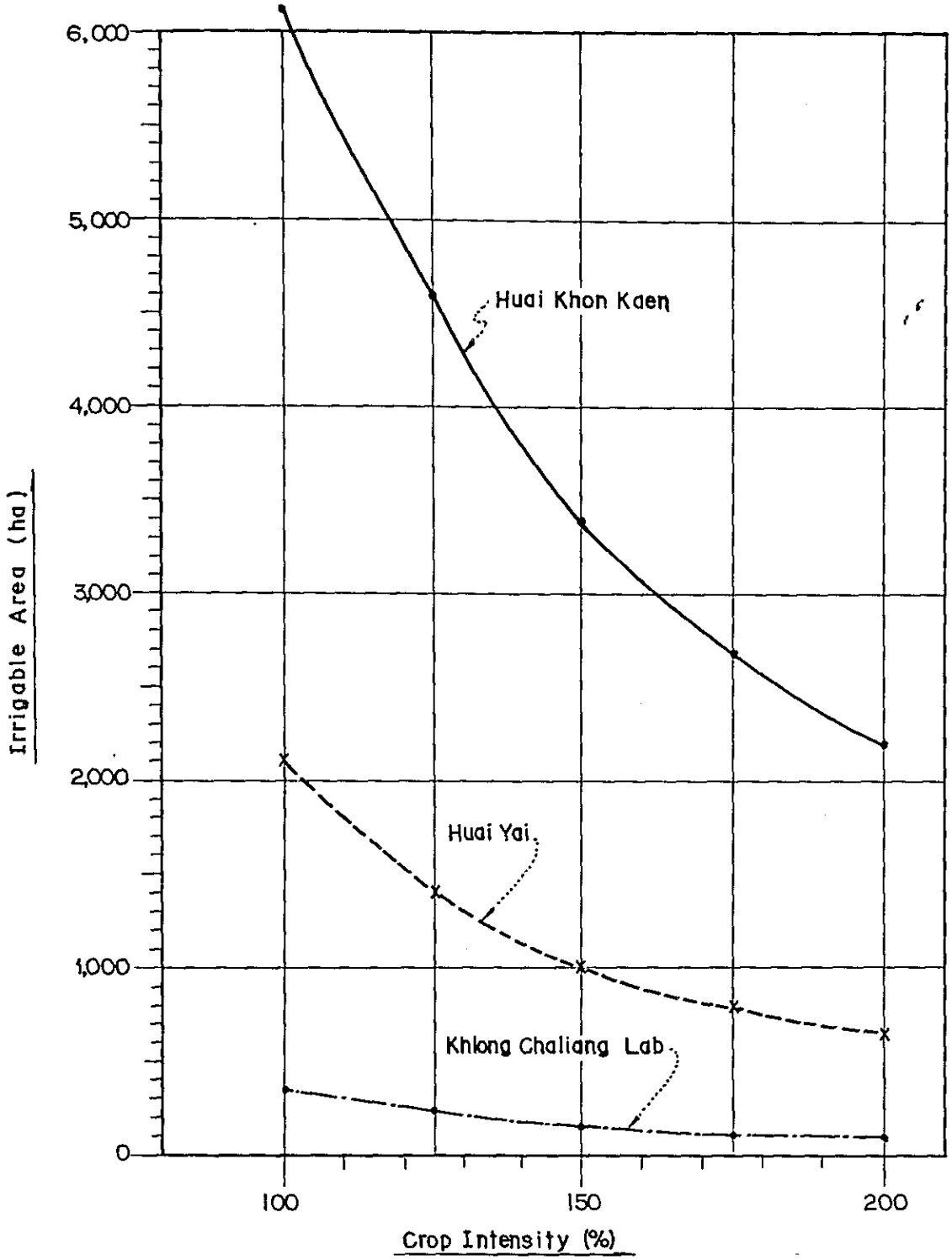


Fig. 6.13 RELATION BETWEEN CROP INTENSITY AND IRRIGABLE AREA FOR ALTERNATIVE STUDY OF CROP INTENSITY

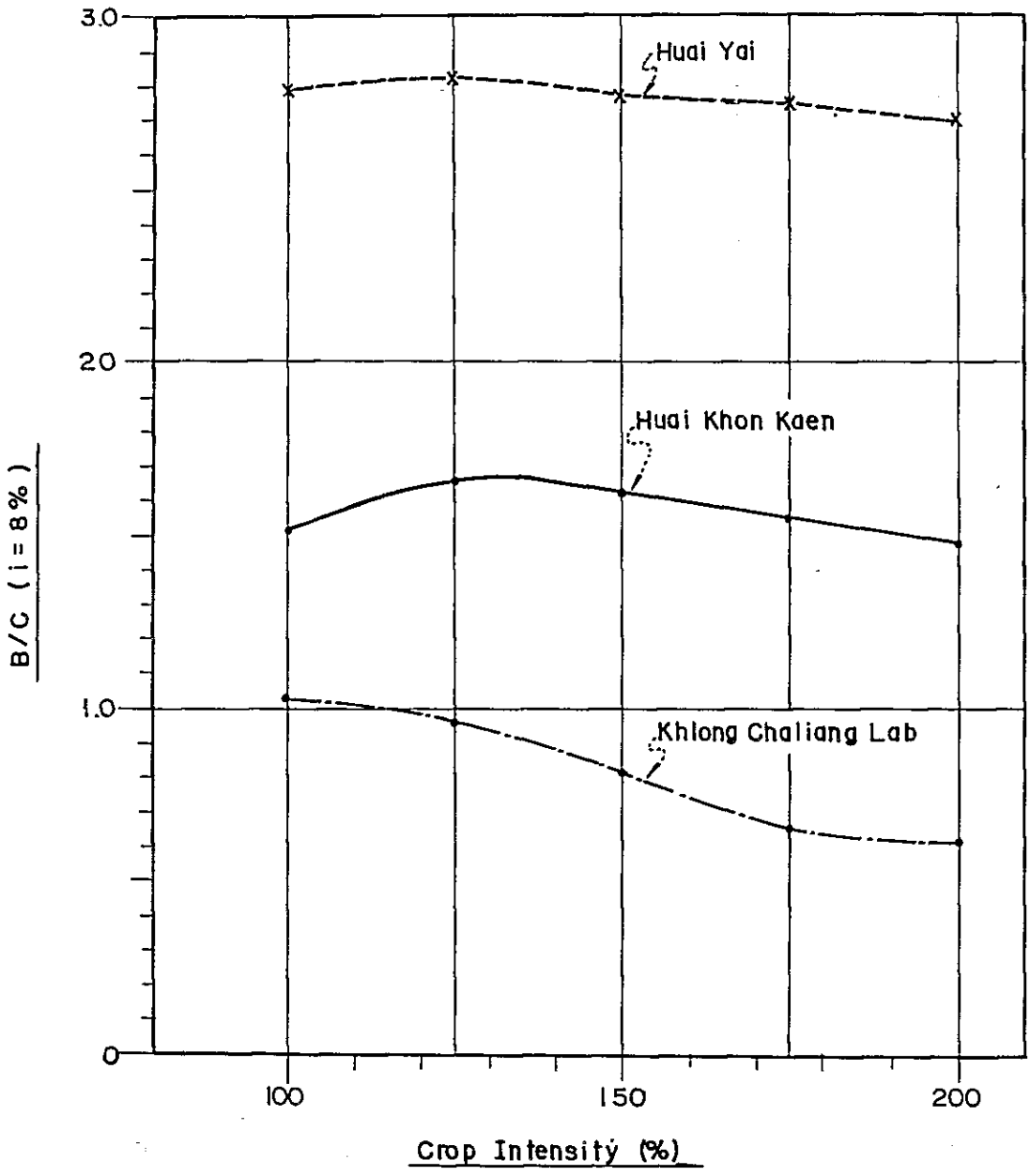


Fig. 6.14 RELATION BETWEEN CROP INTENSITY AND COST-BENEFIT RATIO FOR ALTERNATIVE STUDY OF CROP INTENSITY

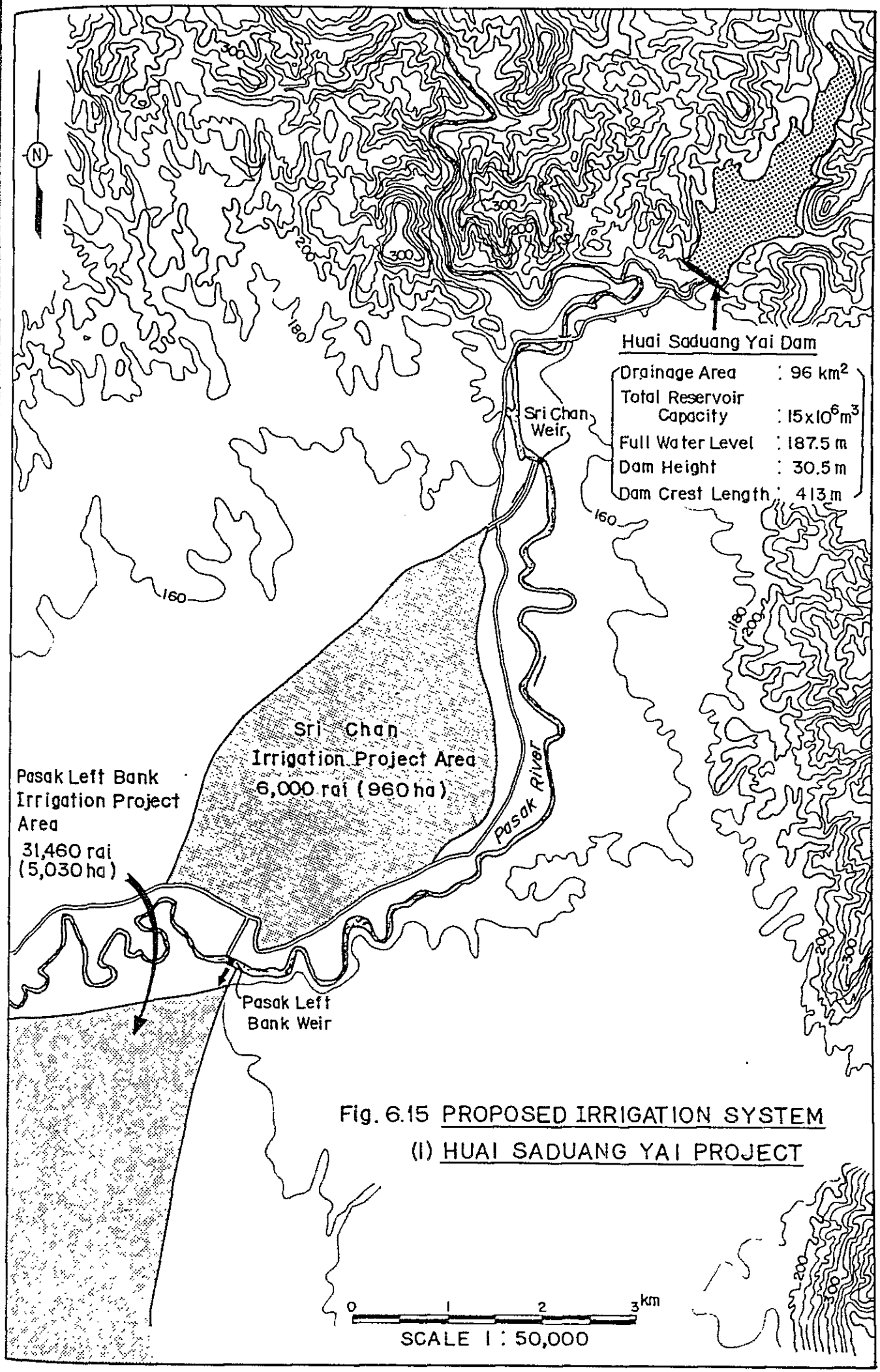
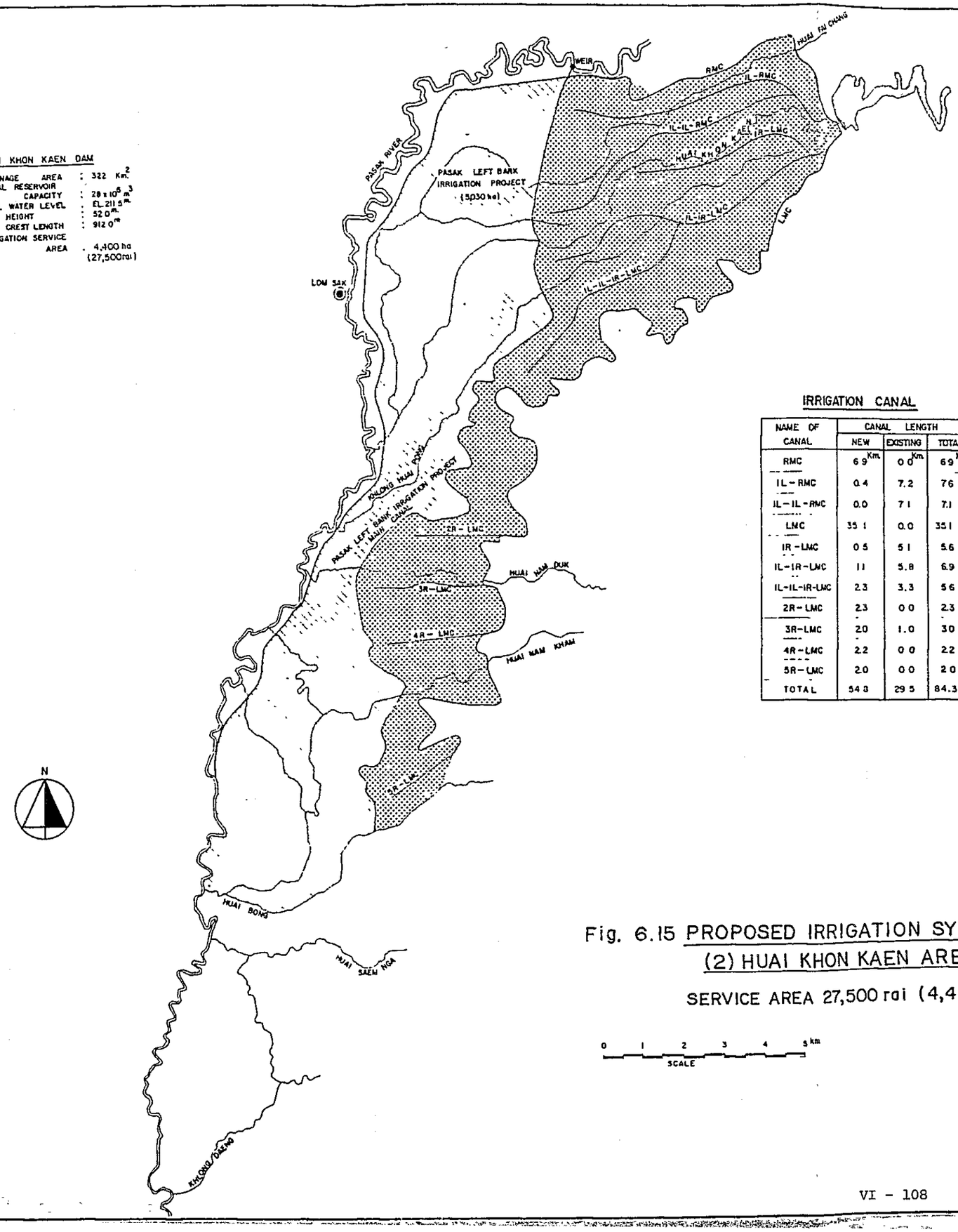


Fig. 6.15 PROPOSED IRRIGATION SYSTEM
(I) HUAI SADUANG YAI PROJECT

HUAI KHON KAEN DAM

DRAINAGE AREA	:	322 $Km.^2$
TOTAL RESERVOIR CAPACITY	:	$28 \times 10^6 m^3$
FULL WATER LEVEL	:	EL. 211.5 m.
DAM HEIGHT	:	52.0 m.
DAM CREST LENGTH	:	912.0 m
IRRIGATION SERVICE AREA	:	4,400 ha (27,500 rai)



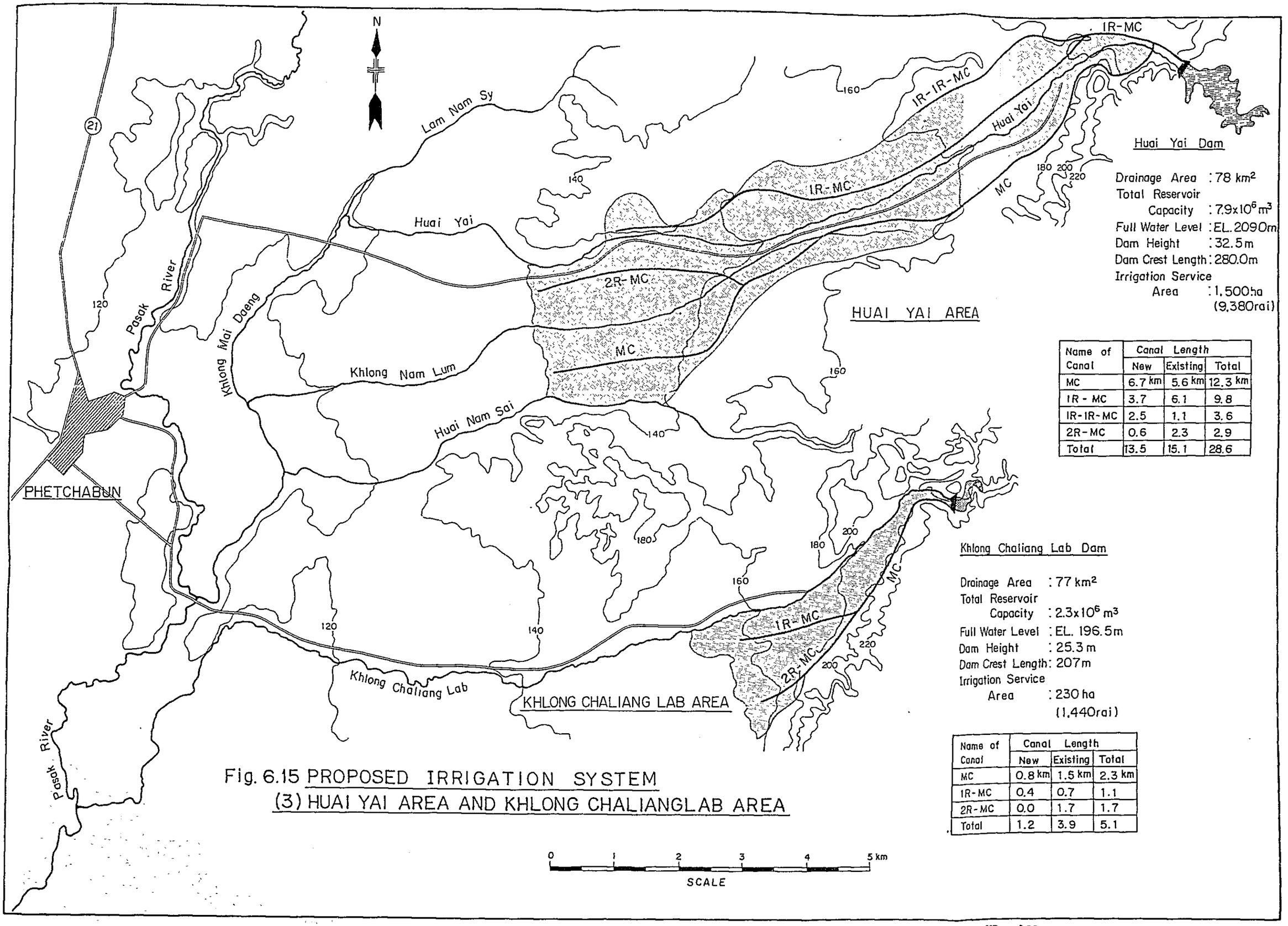
IRRIGATION CANAL

NAME OF CANAL	CANAL LENGTH		
	NEW	EXISTING	TOTAL
RMC	6.9 Km.	0.0 Km.	6.9 Km.
IL-RMC	0.4	7.2	7.6
IL-IL-RMC	0.0	7.1	7.1
LMC	35.1	0.0	35.1
IR-LMC	0.5	5.1	5.6
IL-IR-LMC	1.1	5.8	6.9
IL-IL-IR-LMC	2.3	3.3	5.6
2R-LMC	2.3	0.0	2.3
3R-LMC	2.0	1.0	3.0
4R-LMC	2.2	0.0	2.2
5R-LMC	2.0	0.0	2.0
TOTAL	54.8	29.5	84.3

Fig. 6.15 PROPOSED IRRIGATION SYSTEM
(2) HUAI KHON KAEN AREA

SERVICE AREA 27,500 rai (4,400 ha)

0 1 2 3 4 5 km
SCALE



Huai Yai Dam

Drainage Area : 78 km²
Total Reservoir Capacity : 7.9x10⁶ m³
Full Water Level : EL. 209.0m
Dam Height : 32.5 m
Dam Crest Length : 280.0m
Irrigation Service Area : 1,500 ha (9,380 rai)

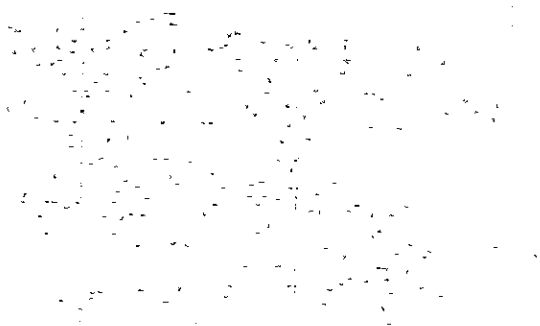
Name of Canal	Canal Length		
	New	Existing	Total
MC	6.7 km	5.6 km	12.3 km
IR - MC	3.7	6.1	9.8
IR-IR-MC	2.5	1.1	3.6
2R-MC	0.6	2.3	2.9
Total	13.5	15.1	28.6

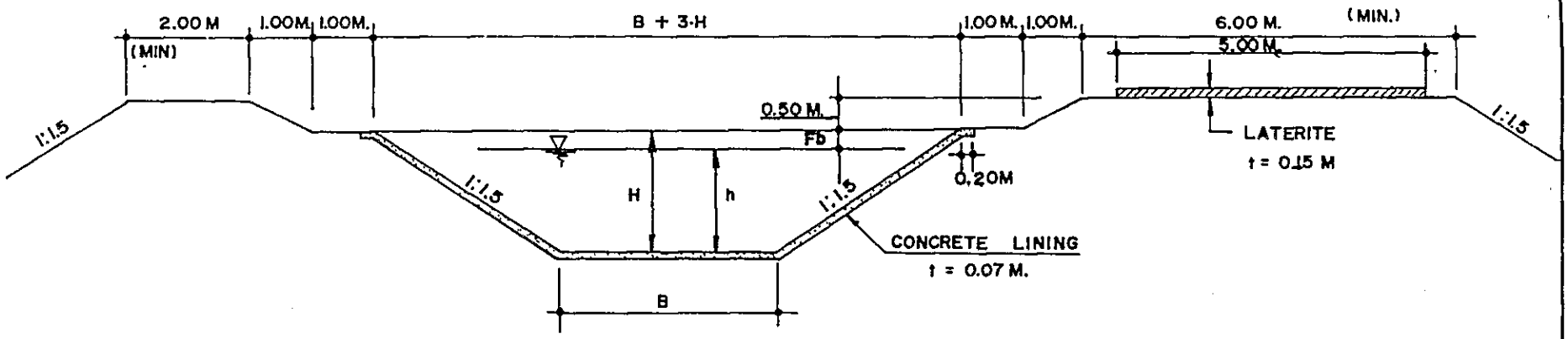
Khlong Chaliang Lab Dam

Drainage Area : 77 km²
Total Reservoir Capacity : 2.3x10⁶ m³
Full Water Level : EL. 196.5m
Dam Height : 25.3 m
Dam Crest Length : 207m
Irrigation Service Area : 230 ha (1,440 rai)

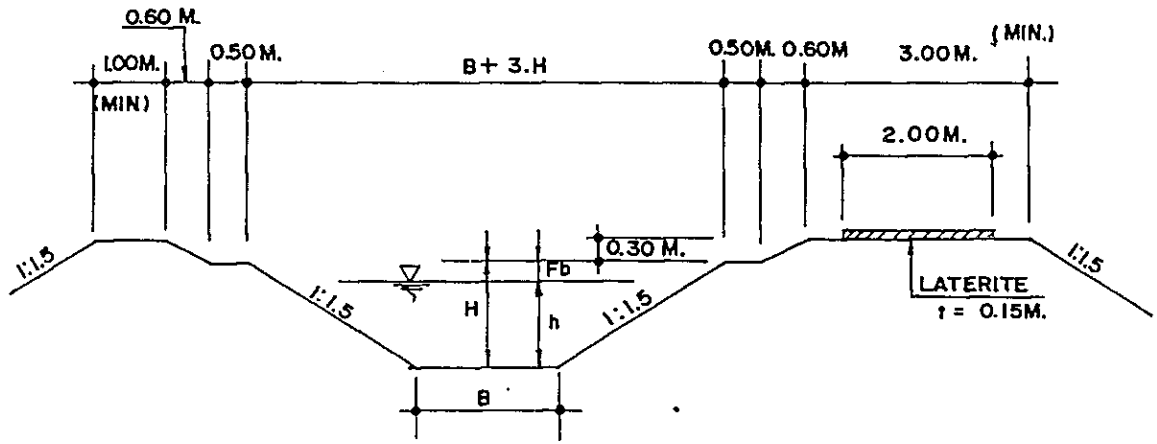
Name of Canal	Canal Length		
	New	Existing	Total
MC	0.8 km	1.5 km	2.3 km
IR-MC	0.4	0.7	1.1
2R-MC	0.0	1.7	1.7
Total	1.2	3.9	5.1

Fig. 6.15 PROPOSED IRRIGATION SYSTEM
(3) HUAI YAI AREA AND KHLONG CHALIANGLAB AREA





MAIN CANAL



SCALE = 1 : 100

LATERAL CANAL

Fig. 6.16 TYPICAL CROSS SECTION OF IRRIGATION CANAL

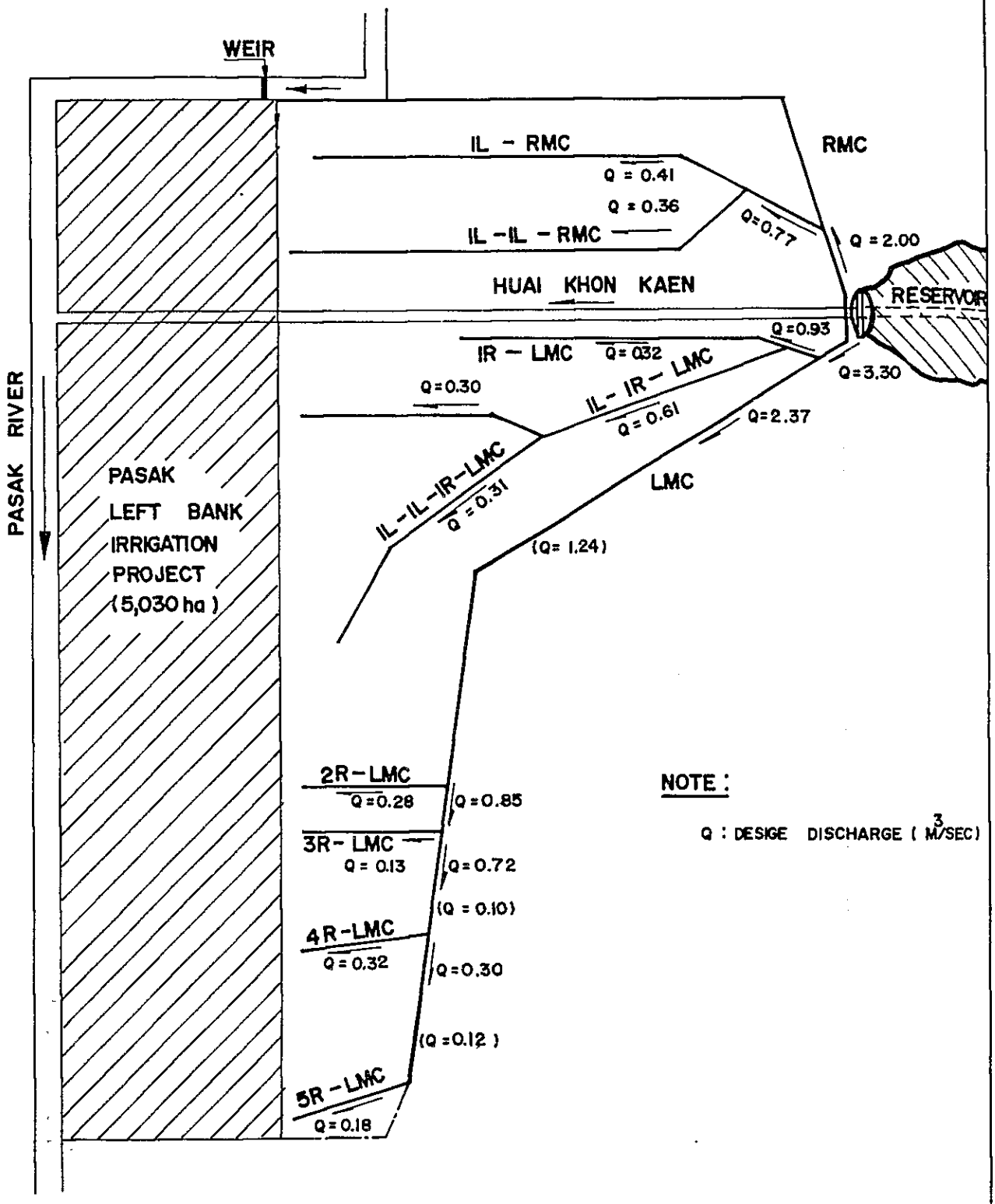


Fig. 6.17 SCHEMATIC IRRIGATION CANAL SYSTEM

(1) HUAI KHON KAEN AREA

SERVICE AREA : 27,500 rai (4,400 ha)

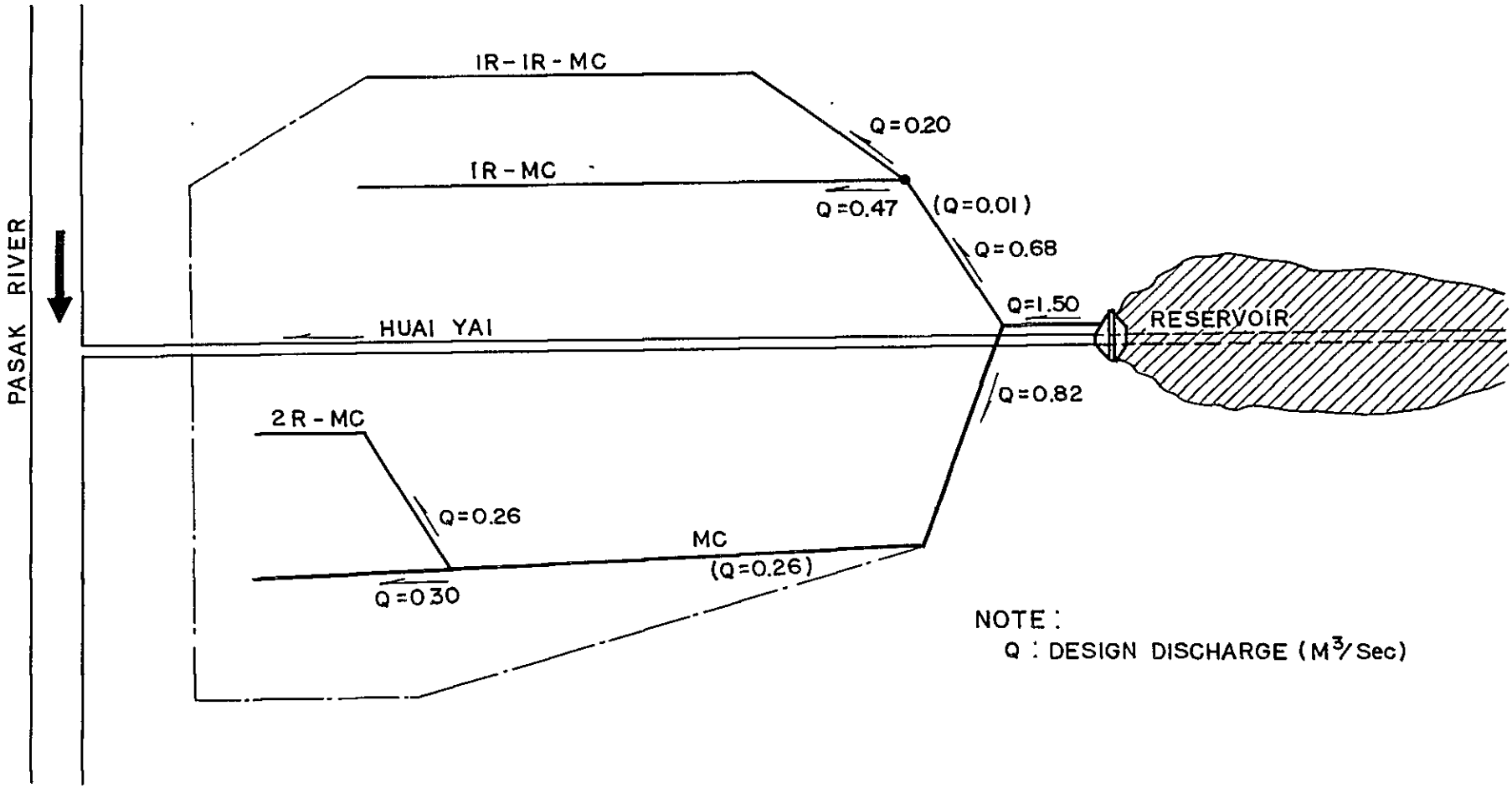


Fig. 6.17 SCHEMATIC IRRIGATION CANAL SYSTEM

(2) HUAI YAI AREA

SERVICE AREA : 9,380 rai (1,500 ha)

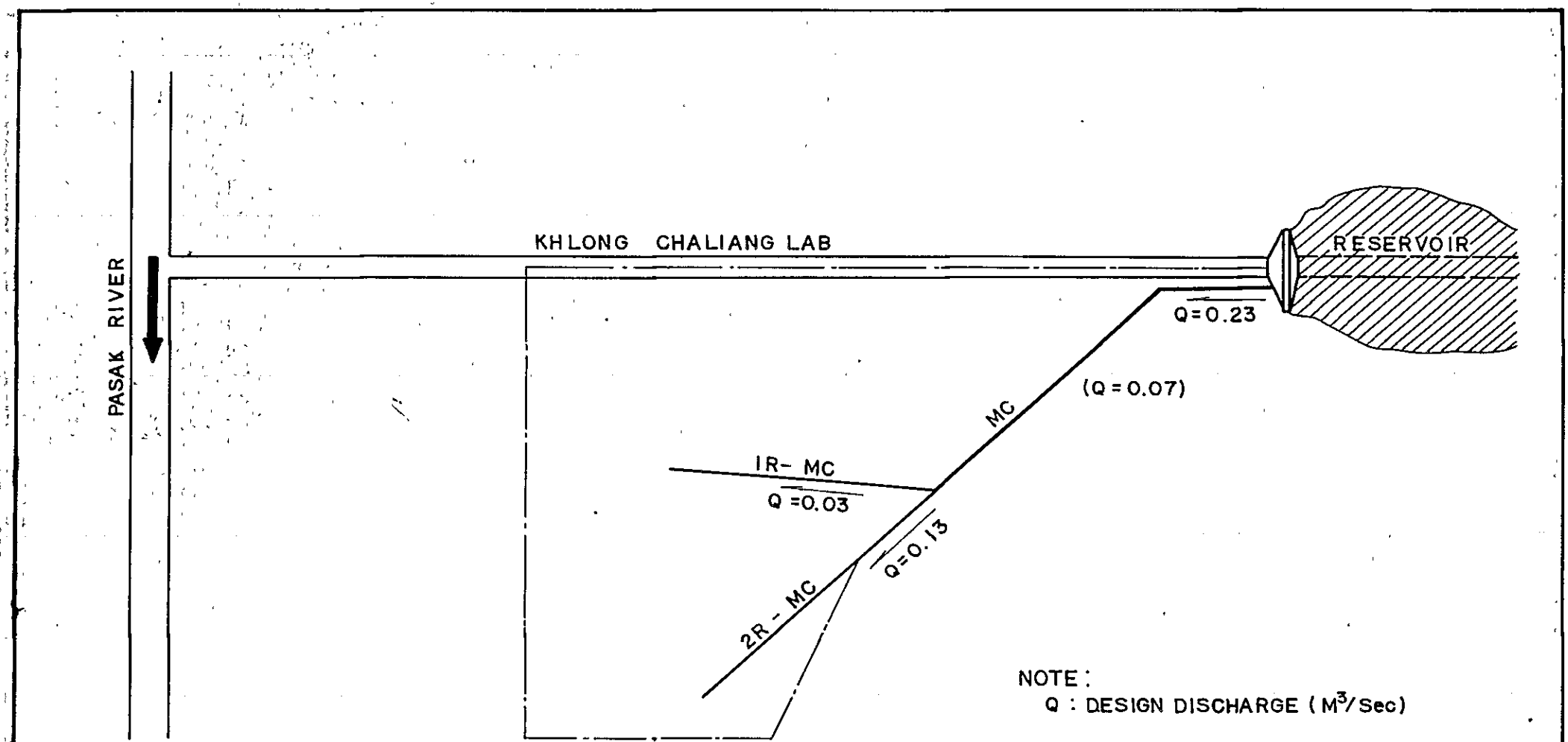


Fig. 6.17 SCHEMATIC IRRIGATION CANAL SYSTEM

(3) KHLONG CHALIANG LAB AREA
SERVICE AREA : 1,440rai (230 ha)

ANNEX VII

COST ESTIMATE

ANNEX VII COST ESTIMATE

TABLE OF CONTENTS

LIST OF TABLES

7.1 GENERAL

The project cost comprises construction cost of dam and irrigation works, engineering and administration cost and physical contingency. All the construction works would be executed by full contract basis. The construction cost is calculated based on the unit price analysed by RID shown in Table 7.1. The engineering and administration cost is estimated to be 15 percent of the total construction cost. Physical contingency of 20 percent is allowed on the total of construction cost and engineering and administration cost.

The conversion rate between Baht and U.S. doller is assumed at US$1.00 = Baht 22.

7.2 COST ESTIMATE

The cost estimate is made according to the above assumptions and the calculation result for each project is summarized as shown below. The breakdowns of the construction costs for dam and irrigation works are shown in Table 7.2 and 7.3.

The construction cost of irrigation works for the Huai Saduang Yai Project is estimated at Baht 1,400 per rai (400 US$/ha) in due consideration of some improvement works for the existing irrigation facilities of the Sri Chan Irrigation Project and the Pasak Left Bank Irrigation Project.

Summary of Cost Estimate

(Unit: $x10^3$ ฿)

Work Item	Name of Project			
	Huai Saduang Yai	Huai Khon Kaen	Huai Yai	Khlong Chaliang Lab
I. Civil Works	155,390	406,010	88,210	44,670
1. Preliminary Works	7,396	19,335	4,196	2,127
2. Dam Works	95,194	299,549	60,654	39,170
3. Irrigation Works	52,800	87,126	23,360	3,373
II. Engineering and Administration Cost	23,310	60,900	13,230	6,700
III. Physical Contingency	35,740	93,380	20,290	10,270
Total	214,440 ($9,747x10^3$$)	560,290 ($25,468x10^3$$)	121,730 ($5,533x10^3$$)	61,640 ($2,802x10^3$$)

Table 7.1 List of Unit Cost

(Mid. 1981)

(Unit: Baht)

Item	Unit	RID Basic Rate	Total Unit Cost including Contractor's Overhead & Profit of 20%
Site clearance	Rai	300 - 650	360 - 780
Topsoil stripping	m^3	10	12
Bulk excavation	"	19.5	24
Channel excavation	"	26	32
Excavation of decomposed rock	"	150	180
Compacted fill from borrow pit	"	50	60
Compacted fill from excavation	"	26	32
Compacted Laterite	"	50	60
Rip-rap	"	220	264
Gravel filter or gravel drain	"	190	228
Rockfill	"	200	240
Concrete lining	"	1,600	1,920
Reinforced concrete	"	2,980	3,576
Unreinforced concrete	"	1,300	1,560
Sodding	m^2	10	12
Canal structures			
Regulator	nos.	150,000	180,000
Turnout	"	7,000	8,400
Siphon	"	300,000	360,000
Culvert	"	120,000	144,000
Drop	"	60,000	72,000
Cross drain	"	50,000	60,000

Table 7.2 Construction Cost of Dam Works

(1) Huai Saduang Yai Dam

Work Item	Unit	Unit Cost (฿)	Quantity	Amount (฿)
1. Dam				56,962,000
a) Access road	km	120,000	1	120,000
b) Site clearance	rai	600	80	48,000
c) Excavation of Soil	m^3	18	64,800	1,166,000
d) Excavation of weathered rock	"	180	16,200	2,916,000
e) Impervious zone embankment	"	60	118,000	7,080,000
f) Semi-pervious zone embankment	"	60	503,000	30,180,000
g) Rip-rap	"	264	20,000	5,280,000
h) Sand and gravel	"	228	24,800	5,654,000
i) Rock	"	240	200	48,000
j) Lateral pavement of crest	"	60	1,700	102,000
k) Sodding	m^2	12	24,000	288,000
l) Curtain grout	L.S			4,080,000
2. Spillway				28,272,000
a) Excavation of soil	m^3	18	91,000	1,638,000
b) Excavation of weathered rock	"	180	39,000	7,020,000
c) Concrete	"	1,920	10,000	19,200,000
d) Back-fill	"	23	18,000	414,000
3. Outlet Structure				
a) Intake tower	L.S			9,960,000
b) Water way	"			2,520,000
c) Access bridge and gate	"			4,320,000
d) Pier	"			240,000
Total				95,194,000

Table 7.2 Construction Cost of Dam Works

(2) Huai Khon Kaen Dam

Work Item	Unit	Unit Cost (฿)	Quantity	Amount (฿)
1. Dam				217,863,000
a) Access road	km	120,000	2	240,000
b) Site clearance	rai	600	180	108,000
c) Excavation of soil	m^3	18	230,400	4,147,000
d) Excavation of weathered rock	"	180	57,600	10,368,000
e) Impervious zone embankment	"	60	428,000	25,680,000
f) Semi-pervious zone embankment	"	60	2,137,000	128,220,000
g) Rip-rap	"	264	76,000	20,064,000
h) Sand and gravel	"	228	82,300	18,764,000
i) Rock	"	240	700	168,000
j) Lateral pavement of crest	"	60	4,600	276,000
k) Sodding	m^2	12	69,000	828,000
l) Curtain grout	L.S			9,000,000
2. Spillway				52,286,000
a) Excavation of soil	m^3	18	111,300	2,003,000
b) Excavation of weathered rock	"	180	47,700	8,586,000
c) Concrete	"	1,920	20,000	38,400,000
d) Back-fill	"	23	39,000	897,000
e) Emergency spillway	L.S			2,400,000
3. Outlet Structure				29,400,000
a) Intake tower	L.S			3,480,000
b) Water way	"			21,600,000
c) Access bridge and gate	"			3,960,000
d) Pier	"			360,000
Total				299,549,000

Table 7.2 Construction Cost of Dam Works

(3) Huai Yai Dam

Work Item	Unit	Unit Cost (฿)	Quantity	Amount (฿)
1. Dam				29,788,000
a) Access road	km	120,000	0.5	60,000
b) Site clearance	rai	600	50	30,000
c) Excavation of soil	m^3	18	36,000	648,000
d) Excavation of weathered rock	"	180	9,000	1,620,000
e) Impervious zone embankment	"	60	56,000	3,360,000
f) Semi-pervious zone embankment	"	60	244,000	14,640,000
g) Rip-rap	"	264	11,000	2,904,000
h) Sand and gravel	"	228	15,200	3,466,000
i) Rock	"	240	300	72,000
j) Lateral pavement of crest	"	60	1,200	72,000
k) Sodding	m^2	12	13,000	156,000
l) Curtain grout	L.S			2,760,000
2. Spillway				17,906,000
a) Excavation of soil	m^3	18	50,400	907,000
b) Excavation of weathered rock	"	180	21,600	3,888,000
c) Concrete	"	1,920	6,000	11,520,000
d) Back-fill	"	23	17,000	391,000
e) Emergency spillway	L.S			1,200,000
3. Outlet Structure				12,960,000
a) Intake tower	L.S			2,520,000
b) Water way	"			6,120,000
c) Access bridge and gate	"			3,960,000
d) Pier	"			360,000
Total				60,654,000

Table 7.2 Construction Cost of Dam Works

(4) Khlong Chaliang Lab Dam

Work Item	Unit	Unit Cost (฿)	Quantity	Amount (฿)
1. Dam				14,854,000
a) Access road	km	120,000	0.5	60,000
b) Site clearance	rai	600	25	15,000
c) Excavation of soil	m^3	18	14,400	259,000
d) Excavation of weathered rock	"	180	3,600	648,000
e) Impervious zone embankment	"	60	26,000	1,560,000
f) Semi-pervious zone embankment	"	60	111,000	6,660,000
g) Rip-rap	"	264	5,000	1,320,000
h) Sand and gravel	"	228	8,000	1,824,000
i) Rock	"	240	400	96,000
j) Lateral pavement of crest	"	60	800	48,000
k) Sodding	m^2	12	7,000	84,000
l) Curtain grout	L.S			2,280,000
2. Spillway				14,596,000
a) Excavation of soil	m^3	18	28,700	517,000
b) Excavation of weathered rock	"	180	12,300	2,214,000
c) Concrete	"	1,920	6,000	11,520,000
d) Back-fill	"	23	15,000	345,000
3. Outlet Structure				9,720,000
a) Intake tower	L.S			2,280,000
b) Water way	"			3,840,000
c) Access bridge and gate	"			3,360,000
d) Pier	"			240,000
Total				39,170,000

Table 7.3 Construction Cost of Irrigation Works

(1) Huai Khon Kaen Area

Work Items	Unit	Unit Cost (฿)	Quantity	Amount (฿)
1. Land Acquisition	m^2	10	978,200	9,782,000
2. Canal Works				48,511,000
a) Excavation	m^3	32	186,000	5,952,000
b) Embankment	"	32	87,400	2,797,000
	"	60	87,400	5,244,000
c) Concrete lining	"	1,920	14,300	27,456,000
d) Laterite pavement	"	60	44,200	2,652,000
e) Others	L.S			4,410,000
3. Canal Structure Works				15,942,000
a) Regulator	nos.	180,000	8	1,440,000
b) Turnout	"	8,400	53	445,000
c) Siphon	"	360,000	3	1,080,000
d) Culvert	"	144,000	40	5,760,000
e) Drop	"	72,000	40	2,880,000
f) Cross drain	"	60,000	28	1,680,000
g) Other structures	L.S			2,657,000
4. Other Works	L.S			12,891,000
Total				87,126,000

Table 7.3 Construction Cost of Irrigation Works

(2) Huai Yai Area

Work Item	Unit	Unit Cost (฿)	Quantity	Amount (฿)
1. Land Acquisition	m^2	10	257,700	2,577,000
2. Canal Works				10,732,000
a) Excavation	m^3	32	39,400	1,261,000
b) Embankment	"	32	18,450	590,000
	"	60	18,450	1,107,000
c) Concrete lining	"	1,920	3,100	5,952,000
d) Lateral pavement	"	60	14,100	846,000
e) Others	L.S			976,000
3. Canal Structure Works				6,587,000
a) Regulator	nos.	180,000	3	540,000
b) Turnout	"	8,400	22	185,000
c) Siphon	"	360,000	1	360,000
d) Culvert	"	144,000	13	1,872,000
e) Drop	"	72,000	31	2,232,000
f) Cross drain	"	60,000	5	300,000
g) Other structures	L.S			1,098,000
4. Other Works	L.S			3,464,000
Total				23,360,000

Table 7.3 Construction Cost of Irrigation Works

(3) Khlong Chaliang Lab Area

Work Item	Unit	Unit Cost (฿)	Quantity	Amount (฿)
1. Land Acquisition	m^2	10	40,900	409,000
2. Canal Works				1,312,000
a) Excavation	m^3	32	5,300	170,000
b) Embankment	"	32	2,500	80,000
	"	60	2,500	150,000
c) Concrete lining	"	1,920	310	595,000
d) Laterite pavement	"	60	3,300	198,000
e) Others	L.S			119,000
3. Canal Structure Works				1,265,000
a) Regulator	nos.	180,000	1	180,000
b) Turnout	"	8,400	4	34,000
c) Siphon	"	360,000	0	0
d) Culvert	"	144,000	3	432,000
e) Drop	"	72,000	7	504,000
f) Cross drain	"	60,000	0	0
g) Other structures	L.S			115,000
4. Other Works	L.S			387,000
Total				3,373,000

ANNEX VIII

PROJECT ECONOMY

ANNEX VIII PROJECT ECONOMY

TABLE OF CONTENTS

LIST OF TABLE

8.1 GENERAL

The project economic study is made for estimating the economic internal rate of return and net present value for four projects i.e. Huai Saduang Yai, Huai Khon Kaen, Huai Yai and Khlong Chaliang Lab.

The following assumptions are adopted for the study.

(1) Project life is 50 years after completion of the construction works,

(2) Construction period for each project is as follows,

Huai Saduang Yai Project	4 years
Huai Khon Kaen Project	5 years
Huai Yai Project	3 years
Khlong Chaliang Lab Project	3 years

(3) Economic cost of the project is obtained by deducting the transfer payment from the direct construction cost. The transfer payment is assumed to be equivalent to 20% of the project cost. Price contingency is not be incorporated in the economic cost,

(4) Direct benefit accrues from the increased crop production due to stable irrigation water supplies. This benefit is estimated as the difference of the annual net crop production values under with and without project conditions. The anticipated benefit gradually increases after commencement of the partial operation of the project. The full development stage is assumed to be attained in 5 years after completion of the construction works for three projects i.e. Huai Saduang Yai, Huai Yai and Khlong Chaliang Lab, since these project areas wholly consist of the existing paddy fields. For the Huai Khon Kaen project, 6 years of build-up period after completion of the construction works are taken into account as the project area includes the existing upland and plantation areas, and

(5) Secondary benefits are also considered for this economic study as the additional case. These benefits denote value added to activities influenced by the project through economic rather than technological linkages, and comprise "stemming-from" benefits and "induced-by" benefits. The "stemming-from" benefits result from forward production linkages that increase the net income of those who process project output. The "induced-by" benefit result from backward production linkages which increase the net income of those who provide goods and services to the prcject area. To estimate these benefits, the criteria prepared by the Bureau of Reclamation (USBR) are applied as described in the following paragraph 8.3.

8.2 ECONOMIC COST

The economic cost of each project is estimated by applying a conversion factor of 0.8 for the estimated project cost excluding price contingency in Annex-VII. According to the construction time schedule mentioned in the previous paragraph, the economic cost of each project is distributed as shown below.

Construction Year	Name of Project			
	Huai Saduang Yai	Huai Khon Kaen	Huai Yay	Khlong Chaliang Lab
	($x10^3$฿)	($x10^3$฿)	($x10^3$฿)	($x10^3$฿)
1	25,733	44,823	24,346	12,328
2	51,466	112,058	38,954	19,725
3	60,043	134,470	34,084	17,259
4	34,310	112,058	-	-
5	-	44,823	-	-
Total	171,552 ($7,798x10^3$$)	448,232 ($20,374x10^3$$)	97,384 ($4,426x10^3$R)	49,312 ($2,242x10^3$$)

The operation and maintenance cost comprises personal cost, depreciation cost of O/M equipment, vehicle, office equipment and quarter, and consumable expenses. The economic operation and maintenance cost of each project is estimated as follows assuming to be 1.0% of the economic construction cost.

Huai Saduang Yai Project	1,716 x 10^3 ฿/year (78 x 10^3 $/year)
Huai Khon Kaen Project	4,482 x 10^3 ฿/year (204 x 10^3 $/year)
Huai Yai Project	974 x 10^3 ฿/year (44 x 10^3 $/year)
Khlong Chaliang Lab Project	493 x 10^3 ฿/year (22 x 10^3 $/year)

8.3 ECONOMIC BENEFIT

8.3.1 Direct Benefit

The direct benefit is estimated as the difference of the annual net crop production values under with and without project conditions. The net crop production value is calculated based on the crop productions, forecast prices of crops and production costs discussed in Annex-V "Agriculture and Agro-Economy".

The calculation sheets of the annual direct benefits for four projects at the full development stage are shown in Table 8.1(1) to (4) and the results are summarized as follows.

Name of Project	Net Production Value		Annual Direct Benefit
	Without Project	With Project	
	(x10^3฿)	(x10^3฿)	(x10^3฿)
Huai Saduang Yai	157,542 (7,161x$10^3$$)	201,564 (9,162x$10^3$$)	44,022 (2,001x$10^3$$)
Huai Khon Kaen	34,606 (1,573x$10^3$$)	147,818 (6,719x$10^3$$)	113,212 (5,146x$10^3$$)
Huai Yai	15,268 (694x$10^3$$)	47,674 (2,167x$10^3$$)	32,406 (1,473x$10^3$$)
Khlong Chaliang Lab	2,354 (107x$10^3$$)	7,326 (333x$10^3$$)	4,972 (226x$10^3$$)

8.3.2 Secondary Benefits

As mentioned in the previous paragraph, the secondary benefits are estimated based on the criteria prepared by the USBR.

The USBR has estimated the secondary benefits associated with the production of agricultural crops as a percentage of direct benefits.

(1) The stemming-from benefits accrued from production of rice are assumed to be 18 percent of direct benefits,

(2) The stemming-from benefits accrued from production of beans are assumed to be 28 percent of direct benefits, and

(3) A uniform percentage of 18 percentage of direct benefits is recommended for induced-by benefits.

According to the above criteria, the annual secondary benefits for each project are estimated as follows.

Name of Project	Annual Secondary Benefits		
	Stemming-from Benefit	Induced-from Benefit	Total
	($x10^3$฿)	($x10^3$฿)	($x10^3$฿)
Huai Saduang Yai	10,521 ($478x10^3$$)	7,924 ($360x10^3$$)	18,445 ($838x10^3$$)
Huai Khon Kaen	23,208 ($1,055x10^3$$)	20,378 ($926x10^3$$)	43,586 ($1,981x10^3$$)
Huai Yai	6,514 ($296x10^3$$)	5,833 ($265x10^3$$)	12,347 ($561x10^3$$)
Khlong Chaliang Lab	999 ($45x10^3$$)	895 ($41x10^3$$)	1,894 ($86x10^3$$)

8.4 ECONOMIC INTERNAL RATE OF RETURN

The economic internal rate of return (IRR) is estimated on the basis of the economic cost and benefit obtained from the previous paragraphs. For estimating the IRR, the following two cases are taken into account.

Case 1 : Benefit consists of the direct benefit only.

Case 2 : Benefit consists of the direct benefit and secondary benefits.

The economic cost and benefit flows in case 1 for four projects are shown in Table 8.2(1) to (4) and the IRR is estimated as follows.

Economic Internal Rate of Return

(Case 1 : Benefit = Direct Benefit only)

Name of Project	IRR
Huai Saduang Yai	16.1%
Huai Khon Kaen	14.2
Huai Yai	21.0
Khlong Chaliang Lab	7.4

Table 8.3(1) to (4) presents the economic cost and benefit flows in case 2 for four projects, and based on these tables, the IRR is estimated as shown below.

Economic Internal Rate of Return

(Case 2 : Benefit = Direct Benefit + Secondary Benefits)

Name of Project	IRR
Huai Saduang Yai	20.8%
Huai Khon Kaen	17.9
Huai Yai	26.8
Khlong Chaliang Lab	10.1

8.5 NET PRESENT VALUE

For estimating the net present value, the accounting rate of interest is taken to be 12 percent per year. This value is the rate used by the World Bank for evaluating irrigation projects in Thailand.

The net present values in case 1 and case 2 are estimated as shown below for four projects. The proposed projects of Huai Khon Kaen, Huai Yai and Huai Saduang Yai would result in large net present values. These three projects therefore appear to economically attractive. The Khlong Chaliang Lab Project would yield negative net present values at 12 percent of accounting rate of interest in both cases 1 and 2.

Net Present Value

(Accounting Rate of Interest: 12%)

Name of Project	Case 1	Case 2
	($\times 10^3$ ฿)	($\times 10^3$ ฿)
Huai Saduang Yai	60,126 (2,733$\times 10^3$\$)	143,748 (6,534$\times 10^3$\$)
Huai Khon Kaen	87,318 (3,969$\times 10^3$\$)	255,090 (11,595$\times 10^3$\$)
Huai Yai	81,202 (3,691$\times 10^3$\$)	143,902 (6,541$\times 10^3$\$)
Khlong Chaliang Lab	-16,962 (-771$\times 10^3$\$)	-7,304 (-332$\times 10^3$\$)

Note: Case 1 Benefit = Direct Benefit only

Case 2 Benefit = Direct Benefit + Secondary Benefits

Table 8.1 Calculation of Direct Benefit

(1) Huai Saduang Yai Project

Description		Paddy Local Variety	Paddy High Yield Variety	Beans	Total
1. Without Project					
(a) Area	(ha)	6,000x0.5 = 3,000	6,000x0.5 = 3,000	6,000x0.15 = 900	6,900
(b) Unit Yield /1	(t/ha)	3.4	4.5	1.5	-
(c) Production (a) x (b)	(t)	10,200	13,500	1,350	25,050
(d) Price	($/t)	330	350	500	-
(e) Total Value (c) x (d)	($)	3,366,000	4,725,000	675,000	8,766,000
(f) Unit Production Cost	($/ha)	230	260	150	-
(g) Total Production Cost (a)x(f)	($)	690,000	780,000	135,000	1,605,000
(h) Net Return (e) - (g)	($)	2,676,000	3,945,000	540,000	7,161,000
2. With Project					
(A) Area	(ha)	6,000x0.5 = 3,000	6,000x0.5 = 3,000	6,000x0.35 = 2,100	8,100
(B) Unit Yield	(t/ha)	4.0	5.0	2.0	-
(C) Production (A) x (B)	(t)	12,000	15,000	4,200	31,200
(D) Price	($/t)	330	350	500	-
(E) Total Value (C) x (D)	($)	3,960,000	5,250,000	2,100,000	11,310,000
(F) Unit Production Cost	($/ha)	260	330	180	-
(G) Total Production Cost (A)x(F)	($)	780,000	990,000	378,000	2,148,000
(H) Net Return (E) - (G)	($)	3,180,000	4,260,000	1,722,000	9,162,000
3. Benefit (H) - (h)	($)	504,000	315,000	1,182,000	2,001,000

Note: /1 - Unit yield without project is estimated in due consideration of the existing conditions in the Sri Chan and Pasak Left Bank Irrigation Project Areas.

Table 8.1 Calculation of Direct Benefit

(2) Huai Khon Kaen Project

Description		Paddy Local Variety	Paddy High Yield Variety	Maize	Beans	Total
1. Without Project						
(a) Area	(ha)	2,400x0.7 = 1,680	-	2,000x0.7 = 1,400	-	3,080
(b) Unit Yield	(t/ha)	2.7	-	2.4	-	-
(c) Production (a) x (b)	(t)	4,536	-	3,360	-	7,896
(d) Price	($/t)	330	-	200	-	-
(e) Total Value (c) x (d)	($)	1,496,880	-	672,000	-	2,168,880
(f) Unit Production Cost	($/ha)	230	-	150	-	-
(g) Total Production Cost (a)x(f)	($)	386,400	-	210,000	-	596,400
(h) Net Return (e) - (g)	($)	1,110,480	-	462,000	-	1,572,480
2. With Project						
(A) Area	(ha)	4,400x0.5 = 2,200	4,400x0.5 = 2,200	-	4,400x0.35 = 1,540	5,940
(B) Unit Yield	(t/ha)	4.0	5.0	-	2.0	-
(C) Production (A) x (B)	(t)	8,800	11,000	-	3,080	22,880
(D) Price	($/t)	330	350	-	500	-
(E) Total Value (C) x (D)	($)	2,904,000	3,850,000	-	1,540,000	8,294,000
(F) Unit Production Cost	($/ha)	260	330	-	180	-
(G) Total Production Cost (A)x(F)	($)	572,000	726,000	-	277,200	1,575,200
(H) Net Return (E) - (G)	($)	2,332,000	3,124,000	-	1,262,800	6,718,800
3. Benefit (H) - (h)	($)	1,221,520	3,124,000	-462,000	1,262,800	5,146,320

Table 8.1 Calculation of Direct Benefit

(3) Huai Yai Project

Description		Paddy Local Variety	Paddy High Yield Variety	Beans	Total
1. Without Project					
(a) Area	(ha)	1,500x0.7 = 1,050	-	-	1,050
(b) Unit Yield	(t/ha)	2.7	-	-	-
(c) Production (a) x (b)	(t)	2,835	-	-	2,835
(d) Price	($/t)	330	-	-	-
(e) Total Value (c) x (d)	($)	935,550	-	-	935,550
(f) Unit Production Cost	($/ha)	230	-	-	-
(g) Total Production Cost (a)x(f)	($)	241,500	-	-	241,500
(h) Net Return (e) - (g)	($)	694,050	-	-	694,050
2. With Project					
(A) Area	(ha)	1,500x0.5 = 750	1,500x0.5 = 750	1,500x0.25 = 375	1,875
(B) Unit Yield	(t/ha)	4.0	5.0	2.0	-
(C) Production (A) x (B)	(t)	3,000	3,750	750	7,500
(D) Price	($/t)	330	350	500	-
(E) Total Value (C) x (D)	($)	990,000	1,312,500	375,000	2,677,500
(F) Unit Production Cost	($/ha)	260	330	180	-
(G) Total Production Cost (A)x(F)	($)	195,000	247,500	67,500	510,000
(H) Net Return (E) - (G)	($)	795,000	1,065,000	307,500	2,167,500
3. Benefit (H) - (h)	($)	100,950	1,065,000	307,500	1,473,450

Table 8.1 Calculation of Direct Benefit

(4) Khlong Chaliang Lab Project

Description		Paddy Local Variety	Paddy High Yield Variety	Beans	Total
1. Without Project					
(a) Area	(ha)	230x0.7 = 161	-	-	161
(b) Unit Yield	(t/ha)	2.7	-	-	-
(c) Production (a) x (b)	(t)	435	-	-	435
(d) Price	($/t)	330	-	-	-
(e) Total Value (c) x (d)	($)	143,550	-	-	143,550
(f) Unit Production Cost	($/ha)	230	-	-	-
(g) Total Production Cost (a)x(f)	($)	37,030	-	-	37,030
(h) Net Return (e) - (g)	($)	106,520	-	-	106,520
2. With Project					
(A) Area	(ha)	230x0.5 = 115	230x0.5 = 115	230x0.25 = 58	288
(B) Unit Yield	(t/ha)	4.0	5.0	2.0	-
(C) Production (A) x (B)	(t)	460	575	116	1,151
(D) Price	($/t)	330	350	500	-
(E) Total Value (C) x (D)	($)	151,800	201,250	58,000	411,050
(F) Unit Production Cost	($/ha)	260	330	180	-
(G) Total Production Cost (A)x(F)	($)	29,900	37,950	10,440	78,290
(H) Net Return (E) - (G)	($)	121,900	163,300	47,560	332,760
3. Benefit (H) - (h)	($)	15,380	163,300	47,560	226,240

Table 8.2 Economic Cost and Benefit Flow

(Case 1 : Benefit = Direct Benefit only)

(1) Huai Saduang Yai Project

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	1,170	-	1,170	-	-1,170
2	2,339	12	2,351	-	-2,351
3	2,729	35	2,764	-	-2,764
4	1,560	62	1,622	334	-1,288
5	-	78	78	667	589
6				1,001	923
7				1,334	1,256
8				1,668	1,590
9				2,001	1,923
54	-	78	78	2,001	1,923

Table 8.2 Economic Cost and Benefit Flow

(Case 1 : Benefit = Direct Benefit only)

(2) Huai Khon Kaen Project

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	2,037	-	2,037	-	-2,037
2	5,094	20	5,114	-	-5,114
3	6,112	71	6,183	-	-6,183
4	5,094	132	5,226	-	-5,226
5	2,037	183	2,220	735	-1,485
6	-	204	204	1,470	1,266
7				2,205	2,001
8				2,941	2,737
9				3,676	3,472
10				4,411	4,207
11				5,146	4,942
55	-	204	204	5,146	4,942

Table 8.2 Economic Cost and Benefit Flow

(Case 1 : Benefit = Direct Benefit only)

(3) Huai Yai Project

(Unit: $x10^3$ US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	1,107	-	1,107	-	-1,107
2	1,770	11	1,781	-	-1,781
3	1,549	29	1,578	246	-1,332
4	-	44	44	491	447
5				737	693
6				982	938
7				1,228	1,184
8				1,473	1,429
53	-	44	44	1,473	1,429

Table 8.2 Economic Cost and Benefit Flow

(Case 1 : Benefit = Direct Benefit only)

(4) Khlong Chaliang Lab Project

(Unit: x 10^3 US$)

Year	Cost			Benefit	Balance
	Construction Cost	O&M Cost	Total		
1	561	-	561	-	-561
2	897	6	903	-	-903
3	784	15	799	38	-761
4	-	22	22	75	53
5				113	91
6				151	129
7				188	166
8				226	204
53	-	22	22	226	204

Table 8.3 Economic Cost and Benefit Flow

(Case 2: Benefit = Direct Benefit + Secondary Benefits)

(1) Huai Saduang Yai Project

(Unit: $x10^3$ US$)

Year	Cost			Benefit			Balance
	Construction Cost	O&M Cost	Total	Direct Benefit	Secondary Benefits	Total	
1	1,170	-	1,170	-	-	-	-1,170
2	2,339	12	2,351	-	-	-	-2,351
3	2,729	35	2,764	-	-	-	-2,764
4	1,560	62	1,622	334	140	474	-1,148
5	-	78	78	667	279	946	868
6				1,001	419	1,420	1,342
7				1,334	559	1,893	1,815
8				1,668	698	2,366	2,288
9				2,001	838	2,839	2,761
54	-	78	78	2,001	838	2,839	2,761

Table 8.3 Economic Cost and Benefit Flow

(Case 2: Benefit - Direct Benefit + Secondary Benefits)

(2) Huai Khon Kaen Project

(Unit: $x10^3$ US$)

Year	Cost			Benefit			Balance
	Construction Cost	O&M Cost	Total	Direct Benefit	Secondary Benefits	Total	
1	2,037	-	2,037	-	-	-	-2,037
2	5,094	20	5,114	-	-	-	-5,114
3	6,112	71	6,183	-	-	-	-6,183
4	5,094	132	5,226	-	-	-	-5,226
5	2,037	183	2,220	735	283	1,018	-1,202
6	-	204	204	1,470	566	2,036	1,832
7				2,205	849	3,054	2,850
8				2,941	1,132	4,073	3,869
9				3,676	1,415	5,091	4,887
10				4,411	1,698	6,109	5,905
11				5,146	1,981	7,127	6,923
55	-	204	204	5,146	1,981	7,127	6,923

Table 8.3 Economic Cost and Benefit Flow

(Case 2: Benefit - Direct Benefit + Secondary Benefits)

(3) Huai Yai Project

(Unit: $x10^3$ US$)

Year	Cost			Benefit			Balance
	Construction Cost	O&M Cost	Total	Direct Benefit	Secondary Benefits	Total	
1	1,107	-	1,107	-	-	-	-1,107
2	1,770	11	1,781	-	-	-	-1,781
3	1,549	29	1,578	246	94	340	-1,238
4	-	44	44	491	187	678	634
5				737	281	1,018	974
6				982	374	1,356	1,312
7				1,228	468	1,696	1,652
8				1,473	561	2,034	1,990
53	-	44	44	1,473	561	2,034	1,990

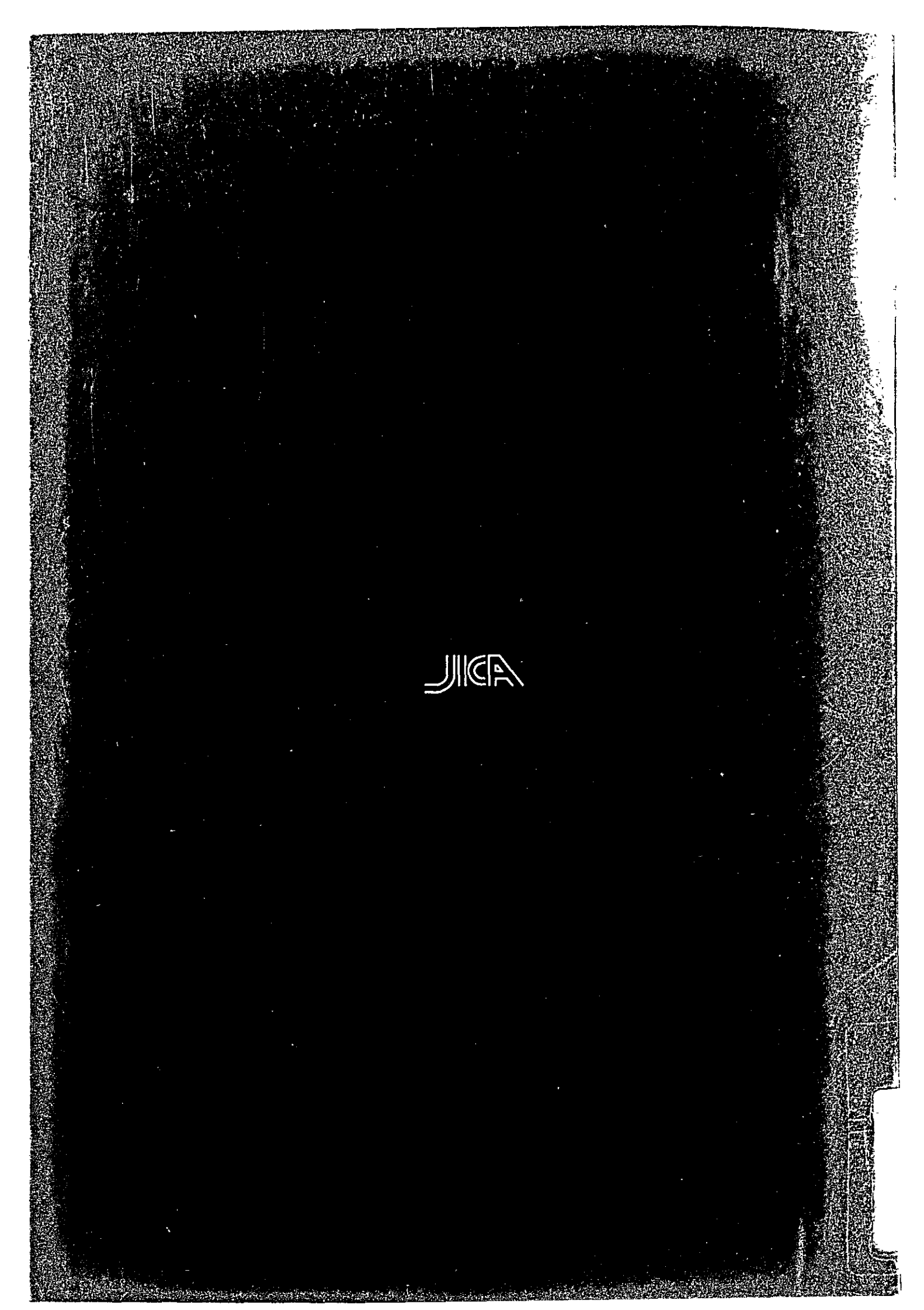
Table 8.3 Economic Cost and Benefit Flow

(Case 2: Benefit = Direct Benefit + Secondary Benefits)

(4) Khlong Chaliang Lab Project

(Unit: $x10^3$ US$)

Year	Cost			Benefit			Balance
	Construction Cost	O&M Cost	Total	Direct Benefit	Secondary Benefits	Total	
1	561	-	561	-	-	-	-561
2	897	6	903	-	-	-	-903
3	784	15	799	38	14	52	-747
4	-	22	22	75	29	104	82
5				113	43	156	134
6				151	57	208	186
7				188	72	260	238
8				226	86	312	290
53	-	22	22	226	86	312	290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