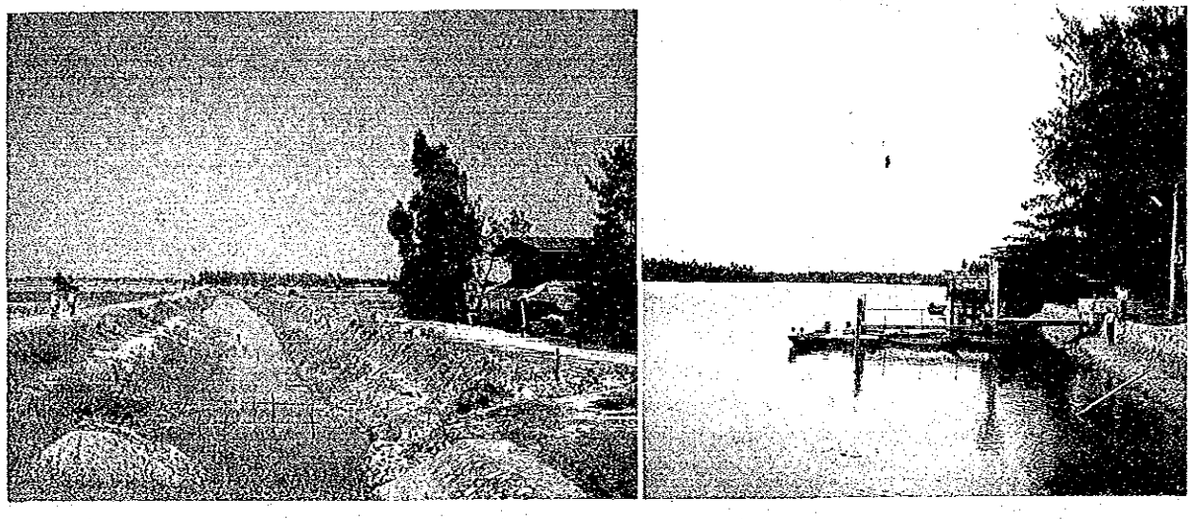
KINGDOM OF THAILAND
ROYAL IRRIGATION DEPARTMENT
MINISTRY OF AGRICULTURE AND COOPERATIVES

THE FEASIBILITY STUDY ON THE AGRICULTURAL WATER DEVELOPMENT PROJECT OF BANG PAKONG RIVER BASIN

Appendix (2)



OCTOBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

KINGDOM OF THAILAND
THE FEASIBILITY STUDY ON
THE AGRICULTURAL WATER DEVELOPMENT
PROJECT OF BANG PAKONG RIVER BASIN
Appendix (2)
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THE FEASIBILITY STUDY
ON
THE AGRICULTURAL WATER DEVELOPMENT PROJECT
OF
BANG PAKONG RIVER BASIN

APPENDIX (2)

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JAPAN INTERNATIONAL COOPERATION AGENCY

LIST OF APPENDIX

APPENDIX-F. AGRICULTURE

APPENDIX-F AGRICULTURE

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F.1 Target Yield of Mango

Target yield of mango was determined by the Data on Perennial Crops, and it's economic life year is estimated as 50 yen.

Yield by Year

Unit : kg/ha

year	1	2	3	4	5	6	7	8	9	10
Yield	Plant	-	-	1,563 (250)	2,344 (375)	4,688 (750)	7,375 (1,500)	15,625 (2,500)	15,625 (2,500)	15,625 (2,500)

( ) : kg/rai

Target yield is estimated from average of total production for 50 years.

50 years production 689.85 t

average production 13,800 kg

Source : Data on Perennial Crops 1989. Department of Agricultural Extension.

TABLE F-1 TRANSPLANTING METHOD OF PADDY (WET SEASON)

Province Amphoe	Transplanting (%)	G. Broadcasting (%)	Broadcasting (%)
Chon Buri	100	-	-
A. Muang	100	-	-
A. Phanat Nikhon	100	-	-
A. Ban Bung	100	-	-
A. Phan Thong	100	-	-
A. Bo Thong	100	-	-
Average	100	-	-
Chachoengsao			
A. Muang	2	98	-
A. Ban Khla	20	75	5
A. Ban Pho	75	15	10
A.Bang Pakon	47	50	3
A. Phanom Sarakham	47	10	43
A. Sanam C.K.	65	-	35
A. Plaeng Yao	65	5	30
K.A.Ratichasarn	65	-	35
Average	48	32	20
Prachin Buri			
a. Buang	20	20	40
A. Ban Sang	1	90	9
A. Khoh Pip	10	85	5
A. Simahaphot	34	20	46
A. Prachanta Kham	50	1	49
A. Kabin Buri	67	-	33
A. Nadi	100	-	-
A. Sakaeo	76	3	21
A. Wang Nam Yen	97	3	-
A. Watthana Khon	20	4	71
K.A.Klong Hat	80	-	20
Average	50	21	29
Nakhon Nayok			
A. Muang	71	10	19
A. Ban Na	83	6	11
A. Ongkharak	-	28	72
A. Pak Phli	47	11	42
Average	50	14	36

G.Broadcastin : broadcasting with germinated seed

TABLE F-2 CROP PRODUCTS BY IRRIGATION BLOCK

(1)

Block No.	Paddy					Soybean		Mungbean	
	Wet Season		Dry Season		Increaced Total Products (t)				
	Planted Area (ha)	Products (t)	Planted Area (ha)	Products (t)		Planted Area (ha)	Products (t)	Planted Area (ha)	Products (t)
1.LBP	53,400	80,695	9,600	43,200	123,895	8,000	15,000	5,500	6,189
2.KTL	3,300	6,884	700	3,150	10,034	1,600	3,000	600	676
3.UBP	115,100	242,328	16,400	73,800	316,128	23,500	44,063	8,800	9,900
4.MNN	76,400	137,937	11,500	51,750	189,687	-	-	-	-
5.MPP	15,500	36,115	-	-	36,115	5,500	10,313	1,500	1,688
6.MHN	21,600	46,937	-	-	46,937	10,700	20,063	1,700	1,913
7.KPS	21,700	39,555	-	-	39,555	8,000	15,000	3,200	3,600
8.UPP	32,600	64,513	-	-	64,513	12,700	23,813	3,700	4,163
Total	339,600 (2,122,500rai)	654,964	38,200 (238,750rai)	171,900	826,864	70,000 (437,500rai)	131,252	25,000 (156,250rai)	28,129

(Table F-2: continued) (2)

Block No.	Groundnuts		Orchard		Vegetables				
					Wet Season		Dry Season		Increaced Total Products (t)
	Planted Area (ha)	Products (t)	Planted Area (ha)	Products (t)	Planted Area (ha)	Products (t)	Planted Area (ha)	Products (t)	
1.LBP	5,400	10,127	4,900	43,053	8,600	21,270	8,600	73,100	94,370
2.KTL	500	938	2,000	27,600	-	-	-	-	-
3.UBP	8,800	16,500	8,800	56,244	13,000	50,150	13,000	110,500	160,650
4.MNN	-	-	-	-	-	-	-	-	-
5.MPP	1,500	2,813	-	-	500	700	500	4,250	4,950
6.MHN	1,700	3,188	2,900	40,020	500	4,250	500	4,250	8,500
7.KPS	3,200	6,000	2,100	227,414	2,400	7,620	2,400	20,400	28,020
8.UPP	3,900	7,313	3,500	48,300	1,700	10,900	3,000	25,500	36,400
Total	25,000 (156,250rai)	46,879	24,200 (151,250rai)	242,611	26,700 (166,875rai)	94,890	28,000 (175,000rai)	238,000	332,890

TABLE F-3 CROP CONVERSION PLAN

1. Conversion from paddy to orchad

Item	Area (ha)	Present Yield (kg/ha)	Decrease Product (t)
MHN -1	2,400	1,827	4,385
MHN -4	500	1,827	914
KPS -1	1,600	2,182	3,491
UPP -1	2,500	2,182	5,455
UPP -2	1,000	1,518	1,518
Total	8,000		15,763

2. Conversion from paddy to vegetable

Item	Area (ha)	Present Yield (kg/ha)	Decrease Product (t)
UPP -2	1,200	1,518	1,822

3. Conversion from cassava to maize

Item	Area (ha)	Present Yield (kg/ha)	Decrease Product (t)
LBP -8	1,100	14,442	15,886
LBP-10	1,100	14,442	15,886
KTL -4	700	15,232	10,662
KTL -7	1,000	15,232	15,232
MPP -1	700	12,372	8,629
MHN -1	3,400	12,552	42,677
KPS -1	2,400	11,855	28,452
KPS -2	1,400	13,875	19,425
UPP -1	3,200	11,855	37,936
UPP -2	1,400	11,855 (25%) 13,875 (75%)	4,149 14,569
Total	16,400		213,503

4. Conversion from cassava to vegetables (Table F-3: continued)

Item	Area (ha)	Present Yield (kg/ha)	Decrease Product (t)
LBP -8	1,100	14,442	14,442
LBP-10	300	14,442	4,333
Sub-total	1,300		18,775
UBP -1	2,00	11,587	23,174
UBP -2	200	11,587	2,317
UBP -3	2,300	12,327	28,352
Sub-total	4,500		53,843
MHN -1	500	12,552	6,276
KPS -1	200	11,855	2,371
KPS -2	400	13,875	5,550
Sub-total	600		7,921
Total	6,900		86,815

See Present Yield : Appendix ●

TABLE F-4 GRICULTURAL STATISTICS BY CHON BURI PROVINCE

Items	A. Phant Nikhon			A. Phan Thong			A. Ban Bung		
	Harvested Area (ha)	Production (t)	Yield (kg/ha)	Harvested Area (ha)	Production (t)	Yield (kg/ha)	Harvested Area (ha)	Production (t)	Yield (kg/ha)
Paddy(W.S.)	26,186	62,062	2,370	11,602	27,195	2,344	7,481	18,463	2,468
Cassava	9,596	138,585	14,442	580	8,176	14,096	9,377	142,437	15,190
Sugarcane	7,547	278,273	36,872	780	31,964	40,979	12,775	551,267	43,152
Groundnuts	80	95	1,191	-	-	-	215	313	1,456
Mumgbean	102	73	716	-	-	-	104	75	721
Para Rubbor	-	-	-	-	-	-	296	174	588
Coconuts	758	2,928	3,863	565	2,180	3,859	3,970	16,873	4,250
Mango	1,131	4,497	3,976	58	231	3,976	1,143	4,545	3,976
Jack Fruit	936	14,254	15,229	-	-	-	392	5,970	15,229
Banana	899	14,376	15,991	180	2,735	15,194	240	3,635	15,146

Source : Provincial Agri. Extension Office average of 1986/87-1987/88.

TABLE F-5 CHACHOENGSAO PROVINCE

(1)

Items	A. Muang			A. Bang Khal			A. Ban Pakong			A. Ban Pho		
	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)
Paddy												
Wet Season	24,345	84,891	3,487	19,235	51,588	2,682	11,520	37,187	3,228	15,923	43,502	2,732
Dry Season	21,982	84,081	3,825	3,554	11,455	3,223	1,971	6,538	3,317	3,246	11,342	3,494
Cassava	-	-	-	-	-	-	-	-	-	-	-	-
Maize	-	-	-	-	-	-	-	-	-	-	-	-
Soybean	-	-	-	-	-	-	-	-	-	-	-	-
Groundnuts	-	-	-	-	-	-	-	-	-	-	-	-
Sugarcone												
Mango	1,135	3,385	2,982	5,403	33,029	6,113	149	467	3,136	234	879	3,756
Coconut	1,458	7,614	5,222	2,157	11,922	5,527	879	3,849	4,379	679	2,924	4,307
Watermelon	-	-	483	10,477	21,692	-	-	-	-	-	-	-
Bamboo	-	-	-	-	-	-	-	-	-	-	-	-
Pumpkin	-	-	-	308	4,515	14,659	6	5	8,900	-	-	-
Vegetables	450	3.469	7.709	48	302	6.250	23	105	4.551	9	80	8.833

Source : Provincial Agri. Office Average figure of 1986/87-1988/89.

(Table F-5: continued) (2)

Items	A. Phanom Sarakham			A. Sanam Chai Khet			A. Plaeng Yao			K.A.Ratchasarn		
	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)
Paddy												
Wet Season	21,241	44,500	2,095	9,633	18,129	1,882	6,648	13,994	2,105	11,671	24,136	2,068
Dry Season	406	1,563	3,850	-	-	-	-	-	-	-	-	-
Cassava	21,251	301,913	14,207	41,520	632,433	15,232	4,592	71,020	15,466	-	-	-
Maize	275	543	1,976	1,974	4,384	2,221	-	-	-	-	-	-
Soybean	820	1,374	1,676	1,046	1,240	1,185	46	31	673	-	-	-
Groundnuts	-	-	-	231	404	1,747	32	52	1,632	-	-	-
Sugarcone	-	-	-	4,683	223,557	47,738	2,305	90,568	39,292	-	-	-
Mango	772	3,031	3,926	239	777	3,252	302	2,184	7,233	488	2,380	4,878
Coconut	162	1,091	6,733	190	1,013	5,334	158	979	6,197	-	-	-
Watermelon												
Bamboo	170	1,444	8,494	-	-	-	33	301	9,131	2	19	9,375
Pumpkin	-	-	-	-	-	-	24	400	16,653	-	-	-
Vegetables	107	717	6.698	104	807	7.755	96	867	9.035	-	-	-

Source : Provincial Agri. Office Average figure of 1986/87-1988/89.

TABLE F-6 PRACHIN BURI PROVINCE

(1)

Items	A. Muang			A. Bang Khal			A. Ban Pakong			A. Ban Pho		
	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)
Paddy	22,044	42,677	1,936	26,929	55,337	2,055	8,892	17,793	2,001	19,335	37,471	1,938
Maize	-	-	-	-	-	-	164	424	2,585	2,483	7,504	3,022
Cassava	-	-	-	-	-	-	1,159	13,429	11,587	5,031	61,021	12,129
Cotton												
Kenab	-	-	-	-	-	-	-	-	-	-	-	-
Groundnuts	-	-	-	-	-	-	162	349	2,153	400	782	1,954
Soybean	-	-	-	-	-	-	-	-	-	294	375	1,275
Mungbean	-	-	-	-	-	-	113	68	600	-	-	-
Mango	550	3,114	5,662	158	1,491	9,437	37	223	6,040	720	5,436	7,550
Coconut	29	109	3,750	28	258	9,180	-	-	-	317	669	2,110
Durian	1,283	14,967	11,666	-	-	-	-	-	-	-	-	-
Jack Fruit	437	9,013	20,625	-	-	-	-	-	-	46	201	4,375
Santol	410	19,475	47,500	-	-	-	-	-	-	-	-	-
Lime	469	5,863	12,500	-	-	-	-	-	-	52	813	15,625
Banana	-	-	-	74	2,590	35,000	-	-	-	240	960	4,000
Banboo	3,760	47,000	12,500	-	-	-	-	-	-	16	120	7,500

Source : Provincial Agri. Extension Office Average Figure of 1986/87-1988/89.

(Table F-6: continued) (2)

Items	A. Prachanta Kham			A. Kabin Buri			A. Nadi			A. Sakaeo		
	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)
Paddy	15,930	23,545	1,478	13,943	23,285	1,670	37,887	69,220	1,827	43,545	92,015	2,182
Maize	-	-	-	5,639	14,972	2,655	234	600	2,566	19,247	49,061	2,549
Cassava	40	473	11,833	12,502	500,000	12,327	6,252	78,475	12,552	40,168	476,192	11,855
Cotton	-	-	-	-	-	-	-	-	-	1,292	1,731	1,339
Kenab	9	11	1,205	587	881	1,501	-	-	-	3,315	3,315	1,979
Groundnuts	-	-	-	99	201	2,034	253	429	1,694	117	120	1,028
Soybean	-	-	-	324	314	970	-	-	-	1,363	1,349	990
Mungbean	-	-	-	117	78	665	39	28	730	312	249	799
Mango	581	2,193	3,775	386	4,371	11,324	38	430	11,324	333	4,274	12,834
Coconut	79	248	3,125	267	1,252	4,688	-	-	-	83	441	5,313
Durian	28	196	7,000	-	-	-	14	77	5,542	-	-	-
Jack Fruit	-	-	-	82	1,333	16,250	-	-	-	24	38	1,563
Santol	-	-	-	58	906	15,625	-	-	-			
Lime	-	-	-	83	1,297	15,625	-	-	-	31	387	12,500
Banana	31	1,392	45,000	248	3,100	12,500	31	678	21,875	55	1,650	30,000
Banboo	863	10,788	12,500	310	4,844	15,625	1,220	9,150	7,500	1,528	11,842	7,750

Source : Provincial Agri. Extension Office Average Figure of 1986/87-1988/89.

(Table F-6: continued) (3)

Items	A. Wang Nam Yen			A. Wattana Nakhon			K. A. Klong Hat		
	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)
Paddy	6,193	13,154	2,124	28,386	43,090	1,518	3,568	6,694	1,876
Maize	43,644	136,999	3,139	3,41	8,583	2,509	29,837	85,214	2,856
Cassava	3,278	63,498	19,371	12,745	176,837	13,875	2,009	33,962	16,905
Cotton	2,892	4,473	1,547	36	43	1,190	719	1,243	1,728
Kenab	1,069	2,238	2,042	816	1,089	1,334	288	384	1,335
Groundnuts	92	110	1,194	261	455	1,742	307	429	1,399
Soybean	3,071	3,927	1,279	1,783	2,735	1,534	978	1,005	1,028
Mungbean	1,372	1,180	861	337	203	601	724	542	748
Mango	112	350	3,132	-	-	-	-	-	-
Coconut	51	49	977	-	-	-	-	-	-
Durian	-	-	-	-	-	-	-	-	-
Jack Fruit	-	-	-	-	-	-	-	-	-
Santol	-	-	-	-	-	-	-	-	-
Lime	-	-	-	-	-	-	-	-	-
Banana	-	-	-	128	960	7,500	-	-	-
Banboo	-	-	-	-	-	-	-	-	-

Source : Provincial Agri. Extension Office Average Figure of 1986/87-1988/89.

TABLE F-7 NAKHON NAYOK PROVINCE

(1)

Items	A. Muang			A. Bang Khal			A. Ban Pakong			A. Ban Pho		
	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)	Harvest Area (ha)	Production (t)	Yield (kg/ha)
Paddy	32,884	80,073	2,435	18,265	43,434	2,378	25,775	65,700	2,549	41,089	73,303	1,784
Maize	-	-	-	-	-	-	345	699	2,027	-	-	-
Groundnuts	-	-	-	-	-	-	250	348	1,390	-	-	-
rush	-	-	-	-	-	-	-	-	-	429	1,695	3,951
Vegetables	273	-	-	92	-	-	1,052	-	-	55	-	-
Orange	23	405	17,609	-	-	-	384	7,040	18,333	451	8,613	19,098
Mango	399	2,208	5,534	364	2,043	5,614	466	2,563	5,500	441	2,408	5,460
Banboo	286	2,926	10,231	426	4,213	9,889	436	4,761	10,920	-	-	-
Durian	126	1,460	11,589	-	-	-	49	791	16,250	-	-	-
Banana	363	5,082	14,000	68	952	14,000	442	6,188	14,000	41	574	14,000

Source : Provincial Agri. Office.

TABLE F-8 VEGETABLE STATISTICS

Vegetables	Chon Buri			Chachoengsao			Prachin Buri			Prachin Buri		
	Area (ha)	Yield (kg/ha)	Produ. (t)	Area (ha)	Yield (kg/ha)	Produ. (t)	Area (ha)	Yield (kg/ha)	Produ. (t)	Area (ha)	Yield (kg/ha)	Produ. (t)
Chilli	163	2,411	393	38	1,105	42	22	1,000	22	-	-	-
Bird Pepper	195	2,862	558	61	1,262	77	124	1,226	152	-	-	-
Tomato	97	11,598	1,125	19	3,789	72	25	3,280	82	-	-	-
Cabbage	43	11,628	500	-	-	-	68	9,000	612	-	-	-
Long Yard Bean	298	7,953	2,370	52	3,135	163	174	5,874	1,022	39	2,821	110
Cucumber	251	6,733	1,690	48	6,250	300	209	9,368	1,958	42	7,548	317
Angled Loobah	145	4,841	702	-	-	-	44	3,909	172	-	-	-
Bitter Cucumber	268	5,448	1,460	-	-	-	-	-	-	32	2,344	75
Chinese Cabbage	-	-	-	-	-	-	53	7,755	411	-	-	-
Leaf Mustard	-	-	-	32	5,000	160	47	9,149	430	-	-	-
Kale	371	6,903	2,561	80	3,750	300	96	9,833	944	-	-	-
Pumpkin	113	8,699	983	-	-	-	609	13,034	7,938	-	-	-
White Gourd	54	9,333	504	-	-	-	46	13,043	600	27	12,667	342
Taro	45	4,044	182	-	-	-	49	9,837	482	-	-	-
Baby corn	38	2,421	92	48	5,000	240	-	-	-	-	-	-
Onion	254	5,449	1,383	40	2,500	100	45	7,000	315	-	-	-
Average	-	6,211	-		3,478	-	-	9,384	-	-	-	-
Average for three province		7,100										

Source : Department of Agricultural Extension 1986/87.

TABLE F-9 PROPOSED CROPPING AREA (1/4)

1. Existing Tha Lat Area

unit : ha

Item	Wet Season					Dry Season						
	Paddy	Maize	Orchard	Vegt.	Total	Paddy	Soy B.	G. Nuts	Mung B.	Orchard	Vegt.	Total
Chachaengsao province												
A. Sanam Chai Khet												—
A. phanom Sarakham	3,700	—	—	—	3,700	740	740	—	—	—	*(380) 250	(1,860) 1,730
K.A. Ratchasarn	2,000	—	—	—	2,000	400	—	—	—	—	(50) 30	(450) 430
A. Bang Khla	3,500	—	—	—	3,500	700	700	—	700	—	(530) 350	(2,630) 2,450
A. Plean Yao	3,000	—	—	—	3,000	600	600	600	—	—	(450) 300	(2,250) 2,100
A. Muang												—
A. Ban Pho	3,000	—	—	—	3,000	600	—	600	600	—	(450) 300	(2,250) 2,100
A. Bang Pakong												—
Chon Buri												—
A. Panat Nikkon	5,500	—	—	—	5,500	1,100	—	—	—	—	—	1,100
A. Phan Thon	400	—	—	—	400	80	—	—	80	—	(120) 80	(280) 240
Total	21,100	—	—	—	21,100	4,220	2,040	1,200	1,380	—	(1,980) 1,310	(10,820) 10,150

* planting area 1.5 times/year

Total Planting Area 31,920ha

TABLE F-9 PROPOSED CROPPING AREA (2/4)

2. Existing Bang Plkong Area

unit : ha

Item	Wet Season					Dry Season						
	Paddy	Maize	Orchard	Vegt.	Total	Paddy	Soy B.	G. Nuts	Mung B.	Orchard	Vegt.	Total
Chachaengsao province												
A. Sanam Chai Khet												
A. phanom Sarakham												
K.A. Ratchasarn												
A. Bang Khla	1,400	---	1,530	---	2,930	280	280	---	280	1,530	(210) 140	(2,580) 2,510
A. Plean Yao												
A. Muang	---	---	580	190	770	---	---	---	---	580	(290) 190	(870) 770
A. Ban Pho	4,600	---	---	---	4,600	920		920	920	---	(690) 460	(3,450) 3,220
A. Bang Pakong	1,000	---	100	---	1,100	200				100		300
Chon Buri												
A. Panat Nikkon								---	---		---	
A. Phan Thon	2,900	---	---	---	29,00	580		---	580		(870) 580	(2,030) 1,740
Total	9,900	---	2,210	190	12,300	1,980	280	920	1,780	2,210	(2,060) 1,370	(9,230) 8,540

TABLE F-9 PROPOSED CROPPING AREA (3/4)

3. Tha Lat Expansion Area

unit : ha

Item	Wet Season					Dry Season						
	Paddy	Maize	Orchard	Vegt.	Total	Paddy	Soy B.	G. Nuts	Maize	Orchard	Vegt.	Total
Chachaengsao province												
A. Sanam Chai Khet	2,300	700	3,000	—	6,000	460	P. 460 M. 350	P. 460 M. 350	P. 460	3,000	P(120) 80	(5,660) 5,620
A. Phanom Sarakham	1,100	—	—	—	1,100	220	220				(110) 70	(550) 510
K.A. Ratchasarn												
A. Bang Khla												
A. Plean Yao												
A. Muang												
A. Ban Pho												
A. Bang Pakong												
Chon Buri												
A. Panat Nikkon												
A. Phan Thon												
Total	3,400	700	3,000	—	7,100	680	1,030	810	460	3,000	(230) 150	(6,210) 6,130

P : record srop of paddy

M : record crop of maize

TABLE F-9 PROPOSED CROPPING AREA (4/4)

4. Bang Pakong Expansion Area

unit : ha

Item	Wet Season					Dry Season						
	Paddy	Maize	Orchard	Vegt.	Total	Paddy	Soy B.	G. Nuts	Mung B.	Orchard	Vegt.	Total
Chachaengsao province												
A. Sanam Chai Khet												
A. Phanom Sarakham												
K.A. Ratchasarn												
A. Bang Khla	—	—	500	—	500	—	—	—	—	500	—	500
A. Plean Yao			1,450	50	1,500	—	—	—	—	1,450	(80) 50	(1,530) 1,500
A. Muang												
A. Ban Pho												
A. Bang Pakong												
Chon Buri												
A. Panat Nikkon												
A. Phan Thon												
Total	—	—	1,950	50	2,000	—	—	—	—	1,950	(80) 150	(2,030) 2,000

TABLE F-10 VEGETABLES CROPPONG AREA

	Exis.Tha Lat	Exis.Bang P.	Tha Lat Exp.	Bang P. Exp.	Total
	ha	ha	ha	ha	ha
Chili	440	460	60	40 (20)*	1,000
Tomato	440	300	40	20 (10)*	800
Sweet corn	430	560 (100)*	50	40 (20)*	1,080
Baby corn	220	280	30	10	540
Chinese cabbage	220	280	30	10	540
Green bean	230	370 (90)*	20	10	630
Total	1,980	2,250	230	130	4,590

* wet season

TABLE F-11 VEGETABLES PRODUCTION

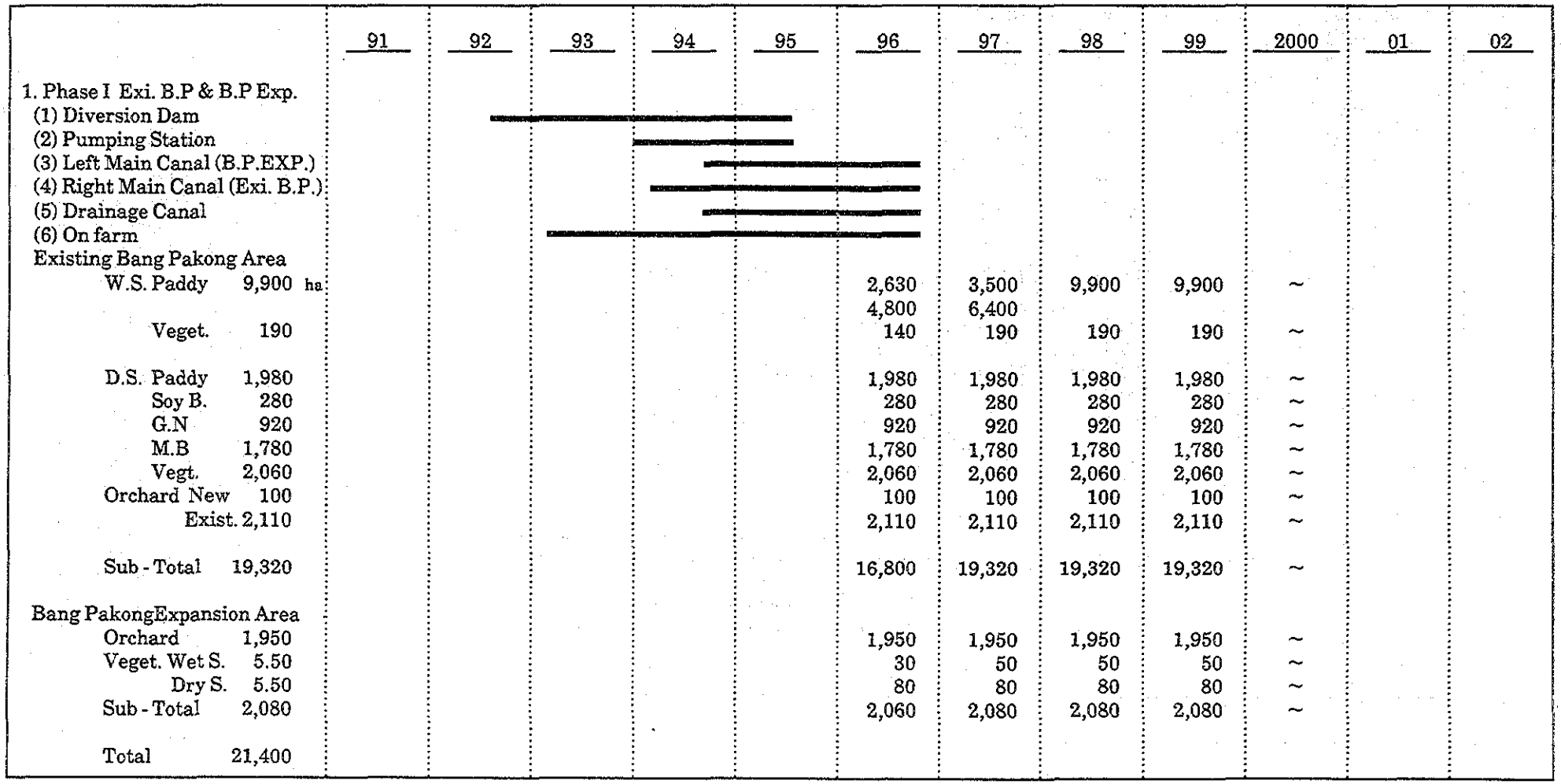
Crops	Area	Yield	Production
		t/ha	t
Chili	1,000	15.0	15,000
Tomato	800	18.8	15,040
Sweet corn	1,080	11.3	12,204
Baby corn	540	6.3	3,402
Chinese cabbage	540	18.8	10,152
Green bean	630	15.6	9,828
Total	4,590		65,626

TABLE F-12 AGRICULTURAL INPUT MATERIAL BY CROP

Seed	Qu't/ha(kg)	Area (ha)	Total Qu't	Remark
Paddy T.	63	30,960	1,950	
Paddy B.	94	10,320	970	
Total		41,280	2,920	
Maize W	19	700	13	
Maize D	19	460	9	
Total		1,160	22	
Soy bean	44	3,350	147	
Goundnuts	50	2,930	147	
Mungbean	19	3,160	60	
Vegetables	14	4,590	64	
Mang	278 tree	3,100	861,800 tree	new planting
Total		59,570	3,360 t,861,800 tree	
Fertilizer				
Paddy Compand				
Wet S	280	34,400	9,632	
Dry S	300	6,880	2,064	
Urea	63	41,280	2,600	
Total		41,280	11,696	
Maize (compund)				
Wet S	150	700	105	
Dry S	190	460	87	
Total			192	
Saybean (Comp.)	156	3,350	523	
Grondnuts (do)	156	2,930	457	
Mungbean (do)	156	3,160	493	
Vegetables (do)	380	4,590	1,744	
Mango (do)	110	7,160	788	bearing age
Urea	139	7,160	995	
Total			Urea 3,595t, Comp.15,893t	
Dung				
Vegetables	10 t	4,590	45,900	ploultry dung do
Mang	7	7,160	50,120	do
Total		11,750	96,020	
Lime				
Paddy	2.2 t	34,400	75,680	
Vegetables	2.2	240	528	only vegetable field
Total		34,640	76,208	
P_2O_5				
Paddy	0.6 t	34,400	20,640	
Vegetables	0.6	240	144	only vegetable field
Total		34,640	20,784	
Ago chemical				
Paddy	2.6 kg	41,280	1,073 t	
Vegetables	5 ℓ	3,060	15,300 ℓ	without chili, baby corn
Mango	5.5ℓ	7,160	39,380 ℓ	
Total		51,500	1,073t, 54,680ℓ	

TABLE F-13 IRRIGATION SCHEDULE BY IRRIGATION AREA 1/2

Unit : ha

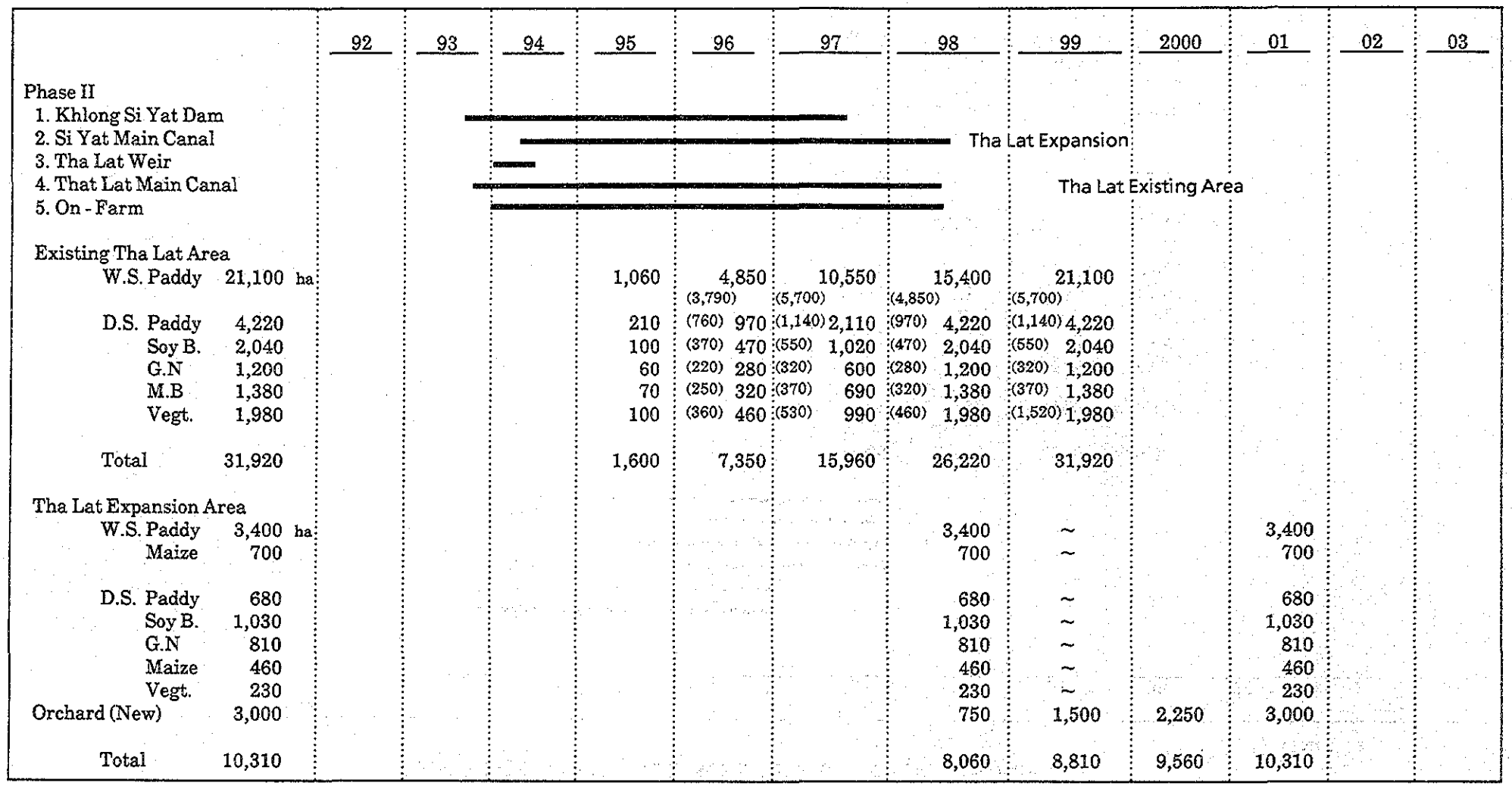


		91	92	93	94	95	96	97	98	99	2000	01	02
1. Phase I Exi. B.P & B.P Exp.													
(1) Diversion Dam													
(2) Pumping Station													
(3) Left Main Canal (B.P.EXP.)													
(4) Right Main Canal (Exi. B.P.)													
(5) Drainage Canal													
(6) On farm													
Existing Bang Pakong Area													
W.S. Paddy	9,900 ha						2,630	3,500	9,900	9,900	~		
							4,800	6,400					
Veget.	190						140	190	190	190	~		
D.S. Paddy	1,980						1,980	1,980	1,980	1,980	~		
Soy B.	280						280	280	280	280	~		
G.N	920						920	920	920	920	~		
M.B	1,780						1,780	1,780	1,780	1,780	~		
Vegt.	2,060						2,060	2,060	2,060	2,060	~		
Orchard New	100						100	100	100	100	~		
Exist.	2,110						2,110	2,110	2,110	2,110	~		
Sub - Total	19,320						16,800	19,320	19,320	19,320	~		
Bang PakongExpansion Area													
Orchard	1,950						1,950	1,950	1,950	1,950	~		
Veget. Wet S.	5.50						30	50	50	50	~		
Dry S.	5.50						80	80	80	80	~		
Sub - Total	2,080						2,060	2,080	2,080	2,080	~		
Total	21,400												

Left Main Canal : Irrigation starts from 1994, rate of irrigation area is 35% of Wet Season Paddy

TABLE F-13 IRRIGATION SCHEDULE BY IRRIGATION AREA 2/2

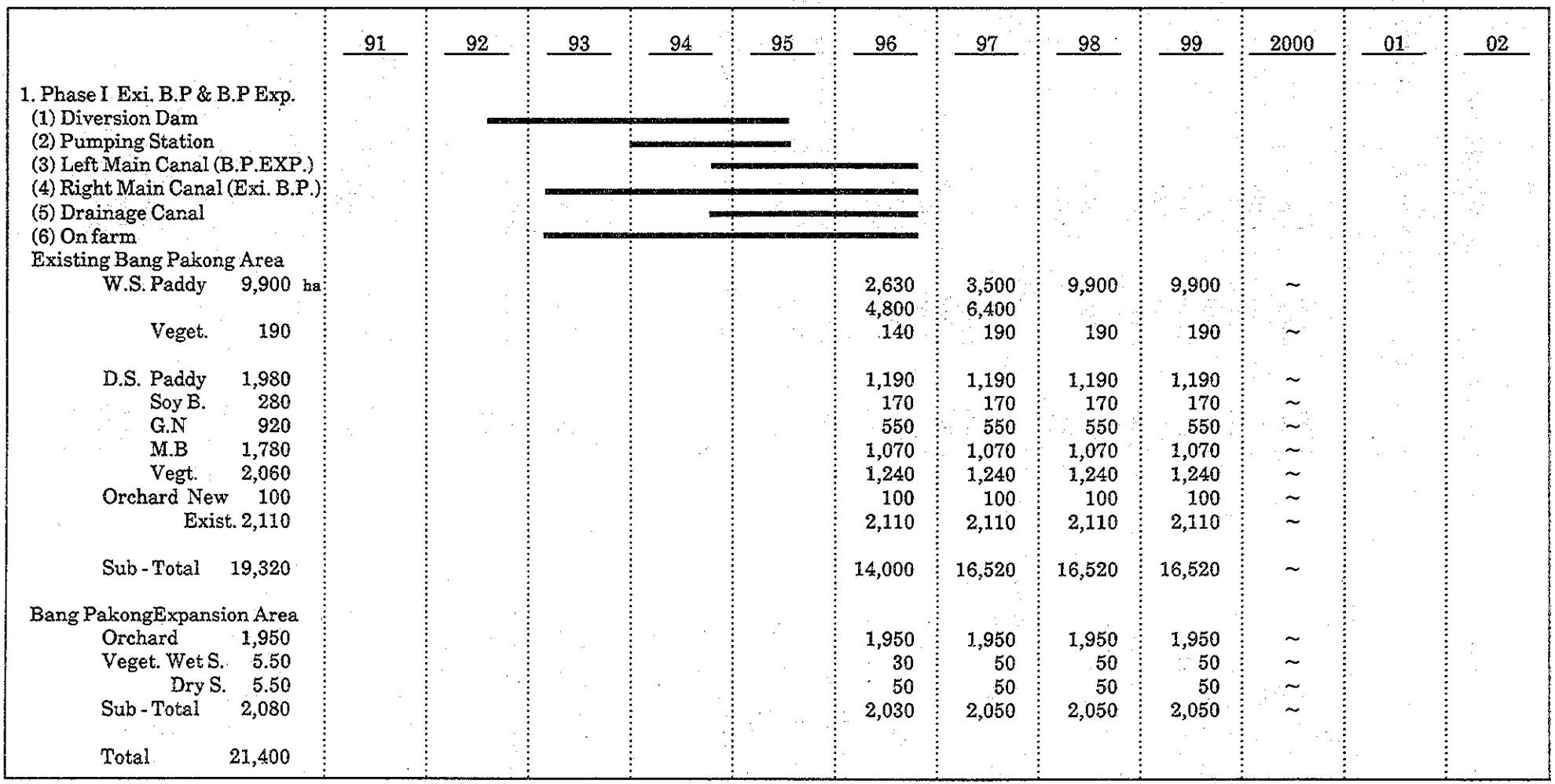
Unit : ha



			95	96	97	98	99	2000	01
Existing Tha Lat Area									
W.S. Paddy	21,100	ha	1,060	4,850 (3,790)	10,550 (5,700)	15,400 (4,850)	21,100 (5,700)		
D.S. Paddy	4,220		210	(760) 970	(1,140) 2,110	(970) 4,220	(1,140) 4,220		
Soy B.	2,040		100	(370) 470	(550) 1,020	(470) 2,040	(550) 2,040		
G.N	1,200		60	(220) 280	(320) 600	(280) 1,200	(320) 1,200		
M.B	1,380		70	(250) 320	(370) 690	(320) 1,380	(370) 1,380		
Vegt.	1,980		100	(360) 460	(530) 990	(460) 1,980	(1,520) 1,980		
Total	31,920		1,600	7,350	15,960	26,220	31,920		
Tha Lat Expansion Area									
W.S. Paddy	3,400	ha				3,400	~		3,400
Maize	700					700	~		700
D.S. Paddy	680					680	~		680
Soy B.	1,030					1,030	~		1,030
G.N	810					810	~		810
Maize	460					460	~		460
Vegt.	230					230	~		230
Orchard (New)	3,000					750	1,500	2,250	3,000
Total	10,310					8,060	8,810	9,560	10,310

TABLE F-13-1 IRRIGATION SCHEDULE BY IRRIGATION AREA
(Tentative Phase I)

Unit : ha



			91	92	93	94	95	96	97	98	99	2000	01	02
1. Phase I Exi. B.P & B.P Exp.														
(1) Diversion Dam														
(2) Pumping Station														
(3) Left Main Canal (B.P.EXP.)														
(4) Right Main Canal (Exi. B.P.)														
(5) Drainage Canal														
(6) On farm														
Existing Bang Pakong Area														
W.S. Paddy	9,900	ha						2,630	3,500	9,900	9,900	~		
								4,800	6,400					
Veget.	190							140	190	190	190	~		
D.S. Paddy	1,980							1,190	1,190	1,190	1,190	~		
Soy B.	280							170	170	170	170	~		
G.N	920							550	550	550	550	~		
M.B	1,780							1,070	1,070	1,070	1,070	~		
Vegt.	2,060							1,240	1,240	1,240	1,240	~		
Orchard New	100							100	100	100	100	~		
Exist.	2,110							2,110	2,110	2,110	2,110	~		
Sub - Total	19,320							14,000	16,520	16,520	16,520	~		
Bang PakongExpansion Area														
Orchard	1,950							1,950	1,950	1,950	1,950	~		
Veget. Wet S.	5.50							30	50	50	50	~		
Dry S.	5.50							50	50	50	50	~		
Sub - Total	2,080							2,030	2,050	2,050	2,050	~		
Total	21,400													

Left Main Canal : Irrigation starts from 1994, rate of irrigation area is 35% of Wet Season Paddy

TABLE F-14 PRESENT AGRICULTURAL PRODUCTION

Irrigation Block	Area	Yield	Production	Remark
	ha	kg/ha	t	
1. Existing The Lat Area				
Paddy Wet Season				
A. Phanom Sara.	3,700	2,095	7,752	
K. A. Ratchasarn	2,000	2,068	4,136	
A.Bang Khla	3,500	2,055	7,193	
A. Plean Yao	3,000	2,105	6,315	
A. Ban Pho	3,000	1,938	5,814	
A. Panat Nikhon	5,500	2,370	13,035	
A. Phan Thon	400	2,344	938	
Sub--total	21,100	2,141	45,183	
Paddy Dry Season				
A. Phanom Sara.	160	3,750	600	
Total	21,260	-	45,783	
2. Existing Bang Pakong Area				
Paddy Wet Season				
A. Bang Khla	1,400	2,055	2,877	
A. Ban Pho	4,600	1,938	8,915	
A. Bang Pakong	1,100	2,001	2,201	
A. Phan Thon	2,900	2,344	6,798	
Sub-total	10,000	2,079	20,791	
Orchard				
A. Bang Khla	1,380	6,113	8,436	Planting Area 1,530ha
A. Muang	550	2,982	1,640	Planting Area 580
Sub-total	1,930	5,221	10,076	
Vegetables				
A. Muang	190	8,000	4,560	3 times cultivation/year
Total	12,120	-	-	
3. Tha Lat Expansion Area				
Paddy Wet Season				
A. Sanam Chai Khet	2,510	1,882	4,724	
A. Phanom Sara.	1,100	2,095	2,305	
Sub-total	3,610	1,947	7,029	
Cassava				
A. Sanam Chai Khet	2,540	15,232	38,689	
Total	6,150	-	-	
4. Bang Pakong Expansion Area				
Orchard				
A. Bang Khla	450	6,113	2,751	Planting Area 500ha
A. Muang	1,360	2,982	4,056	Planating Area 1,450ha
Sub-total	1,810	3,761	6,807	
Vegetables				
A. Muang	50	8,000	1,200	3 times cultivation/year
Total	1,860	-	-	
Total (1~4)	41,390			
Cropping Area	41,550			
5. Grand Total				
Paddy	34,870		73,603	
Mango	3,740		16,883	
Cassava	2,540		38,689	
Vegetables	240		5,760	
Grand Total	41,390			

TABEL F-15 TRANSITION OF CROP PRODUCTION BY IRRIGATION AREA

Item		94	95	96	97	98	99	2000	01	02
Phase I										
Exsting Bang Pakong Area										
Paddy	11,880 ha	10,920	33,058	45,698	48,074	48,510	48,510	~		48,510
Soy Bean	280			336	392	420	420	~		420
Groundnuts	920			1,104	1,288	1,380	1,380	~		1,380
Mung Bean	1,780			1,602	1,780	1,958	1,958	~		1,958
Chili	460			4,830	6,210	6,900	6,900	~		6,900
Tomato	300			3,780	4,860	5,400	5,400	~		5,400
Sweet Corn	560	1,050	1,350	5,134	6,192	6,698	6,698	~		6,698
Baby Corn	280			1,232	1,596	1,764	1,764	~		1,764
Chinese Cabbage	280			3,696	4,732	5,264	5,264	~		5,264
Green Bean	370	981	1,260	4,456	5,324	5,772	5,772	~		5,772
Mango	2,210			15,403	19,792	33,135	33,213	33,448	33,917	34,536
Total	19,320									
				Full development year 2002						
Bang Pakong Expansion Area										
Mango	1,950			14,235	18,291	30,479	~			
Chili	40		210	480	570	600	~			
Tomato	20		126	288	342	360	~			
Sweet Corn	40		158	362	430	452	~			
Baby Corn	10			44	57	63	~			
Chinese Cabbage	10			132	169	188	~			
Green Bean	10			109	140	156	~			
Total	2,080									
				Full development year: 19						
Phase II										
Exsting Tha Lat Area										
Paddy	25,320	-	4,226	20,126	45,796	69,960	97,286	102,284	103,390	103,390
Soy Bean	2,040	-	125	584	1,328	2,039	2,848	3,005	3,060	3,060
Groundnuts	1,200	-	72	348	782	1,204	1,676	1,768	1,800	1,800
Mung Bean	1,380	-	63	295	657	1,010	1,412	1,481	1,518	1,518
Chili	440	-	210	1,110	2,640	4,170	5,910	6,420	6,600	6,600
Tomato	440	-	252	1,332	3,168	5,004	7,092	7,704	7,920	7,920
Sweet Corn	430	-	158	836	1,990	2,354	4,352	4,727	4,859	4,859
Baby Corn	220	-	44	233	555	877	1,242	1,350	1,386	1,386
Chinese Cabbage	220	-	132	687	1,656	2,614	3,705	4,022	4,136	4,136
Green Bean	230	-	109	576	1,370	2,165	3,179	3,476	3,588	3,588
Total	31,920	-	-	-	-	-	-	-	-	-
				Full development year 2001						

Item		98	99	2000	01	02	03	04	05	06	07	08
Tha Lat Expansion Area												
Paddy	4,080 ha	12,594	14,810	16,660	16,660							16,660
Maize	1,160	1,884	1,930	1,976	1,976							1,976
Soybean	1,030	1,236	1,442	1,545	1,545							1,545
Graoundnuts	810	972	1,134	1,215	1,215							1,215
Chili	60	630	810	900	900							900
Tomato	40	504	648	720	720							720
Sweet Corn	50	395	510	565	565							565
Baby Corn	30	132	171	189	189							189
Chinese Cabbage	30	396	507	564	564							564
Green Bean	20	218	280	312	312							312
Mango	3,000	-	-	-	1,170	2,925	6,443	13,478	24,031	33,999	42,204	46,892
1998 planting	750				1,170	1,755	3,518	7,035	11,723	11,723	11,723	11,723
1999 do	750					1,170	1,775	3,518	7,035	11,723	11,723	11,723
2000 do	750						1,170	1,755	3,518	7,035	11,723	11,723
2001 do	750							1,170	1,755	3,518	7,035	11,723
					Full development year 2008							

APPENDIX-G. SOCIO AND AGRO ECONOMY

APPENDIX G SOCIO AND AGRO ECONOMY

LIST OF CONTENTS

G.1 Gross Provincial Products by Industry in 1987
(Percentage %)

Province		Whole Kingdom	Bangkok Metropolis	Eastern Region	Chon Buri Province	Chachoen-gsao Province	Nakhon Nayok Province	Prachin-buri Province
Agriculture		16.1	1.7	17.7	7.4	21.4	27.6	33.9
- Crops		9.8	0.1	11.4	4.5	13.4	21.5	24.0
- Livestocks		1.8	0.2	1.7	1.1	2.8	2.5	4.2
- Fisheries		1.2	-	1.9	0.7	2.0	0.3	0.1
- Forestry		0.7	-	0.4	-	1.4	-	0.5
- Agricultural Services		0.6	-	0.9	0.5	0.9	-	2.4
- Processing Products		1.9	1.5	1.3	0.7	1.0	1.8	2.5
Mining and Quarrying		3.1	-	7.7	0.7	35.3	-	0.1
Manufacturing		23.9	35.7	23.2	39.0	5.6	1.8	7.9
Construction		5.1	5.0	2.8	2.6	1.8	5.0	5.4
Elect. and Water Supply		2.5	2.2	2.6	1.7	4.0	2.6	2.1
Trans. and Comm.		7.5	10.2	5.4	3.9	4.7	8.6	7.0
Trade		15.6	16.5	16.9	17.2	13.5	11.2	13.2
Banking		3.9	6.0	2.2	1.8	1.8	3.6	2.6
Ownership of Dwelling		4.0	2.6	3.2	1.6	3.1	7.3	8.3
Public Admin. and Defence		4.4	3.0	3.3	2.6	2.3	9.1	8.1
Services		13.9	17.1	15.0	21.3	6.6	23.3	11.4
Total : Gross Product		100.0	100.0	100.0	100.0	100.0	100.0	100.0
Growth rate (on base of 1981)	Gross Product	8.4	10.0	9.8	8.7	14.6	5.7	7.6
	Agricultural	3.3	3.0	3.8	12.4	2.0	0.6	4.0

Source : NESDB

G.2 The Growth Rate of GPP in 1981-1987 at current market price

Unit : %

	Chonburi	Chachoen-gsao	Prochin-buri	Nakon Nayok
Gross Provincial products	8.78	14.60	7.61	5.75
Agriculture	1.48	2.02	3.97	0.61
Crops	-0.24	1.04	3.08	0.42
Livestock	5.25	3.93	9.51	-0.22
Fisheries	4.16	-3.04	-2.47	-8.69
Forestry	-	-	6.21	-
Agricultural Services	0.31	4.65	2.51	-0.57
Simple agri-cultural proce-ssing products	7.51	7.52	6.68	9.07
Manufacturing	7.92	12.6	11.06	-12.96

Source: NESDB

G.3 Main Index of Socio-Economic Condition by Irrigation Block

Figure Unit : Percentage (%)

		LBP	KTL	UBP	MNN	MPP	MHM	KPS	UPP
Land Right Deed	possess	73.1	10.6	42.8	65.1	11.6	5.8	3.4	2.7
	Certification only	15.2	21.3	55.2	29.3	78.3	62.5	10.1	32.0
	nothing	11.7	68.1	2.0	5.6	14.5	31.7	79.8	65.3
Electricity Use	more than 50%	86.0	63.8	90.8	85.9	84.1	71.2	50.4	61.3
	less than 50%	9.2	10.6	7.4	6.7	11.6	16.3	21.8	20.0
	nothing	4.8	25.5	2.0	7.5	8.7	12.5	21.0	18.7
Drinking Water	more than 70%	42.9	36.2	27.4	32.0	14.5	11.5	10.11	9.3
	50-70 %	19.4	34.0	17.4	22.4	15.9	13.5	1.8	10.7
	less than 50%	37.7	29.8	55.4	45.3	73.9	75.0	72.3	80.0
Irrigation Water	can be supplied also in dry season	28.3	426.6	34.0	48.2	17.4	23.1	19.3	13.3
	Ponding flood water	4.6	-	4.0	4.3	1.4	6.7	2.5	5.3
	nothing	67.1	57.4	62.4	55.5	50.7	70.2	68.9	81.3
Hospital or Clinic	less than 30 min.	97.3	100.0	94.2	98.1	95.7	94.2	91.6	98.7
	30 min. - 1 hour	1.7	-	1.8	2.9	2.9	2.9	1.7	1.3
	more than 1 hour	1.0	-	4.0	0.5	1.4	1.9	0.8	-
Family Planning	70-100%	67.7	61.7	74.2	78.7	73.9	64.4	66.4	65.3
	60-69%	13.3	17.0	9.8	8.5	13.0	17.3	14.3	16.0
	less than 60%	19.0	21.3	14.0	13.3	17.4	18.3	10.1	18.7
Earning Income by Employee (more than 30.000B)	more than 70%	49.4	29.8	49.2	32.0	37.7	71.2	54.6	62.7
	50-70%	16.2	34.0	14.6	16.5	15.9	12.5	13.4	12.0
	less than 50%	34.4	36.2	35.6	51.5	52.2	16.3	25.2	24.0
Wage Level	more than 51B	38.7	4.3	14.4	20.8	1.4	2.9	-	-
	42 - 51B	23.1	6.4	30.2	35.5	7.2	5.8	1.7	1.3
	less than 42B	34.0	87.2	41.4	35.2	84.1	74.0	82.4	97.3

Source: Survey of NESDB's Fundamental Data of Village Level

G-4 Income classified Household Ratio
Comparision between Urban and Rural Area

	~6,000B	6,000B ~ 10,000B	10,000B ~ 20,000B	20,000B ~	Total
	%	%	%	%	%
Muang Chonburi	12.5	23.2	29.7	34.6	100.0
Non M. Chonburi	19.8	28.1	31.1	21.0	100.0
Muang Chachoengsao	15.9	31.9	30.3	21.9	100.0
Non M. Chachoengsao	24.0	29.1	26.6	20.3	100.0
Muang Prachinburi	22.4	30.5	21.7	25.4	100.0
Non M. Prachinburi	33.3	30.1	21.7	14.9	100.0
Muang Nakhun Nayok	26.4	29.8	25.2	18.6	100.0
Non M. Nakhon Nayok	20.9	32.0	25.2	21.9	100.0

Source: NSO's Socio-Economic Survey of Tambon Level

G.5 Production Cost of Major Crops in Agro-Economic Zone 13

Unit : Baht per rai

	Variable Cost	Labour Cost		Materials	Interest etc.	Fixed Cost (Land Rent, Tax etc.)	Total
		Growing	Harvesting				
Paddy (wet)	705.81	570.35	351.31	219.04	102.31	33.15	148.95	854.76
	(82.6)	(66.7)	(41.1)	(25.6)	(12.0)	(3.9)	(17.4)	(100.0)
Paddy (dry)	1,277.12	862.58	515.42	347.16	371.49	43.05	120.63	1,397.75
	(91.4)	(61.7)	(36.9)	(24.8)	(26.6)	(3.1)	(8.6)	(100.0)
Maize	650.02	538.61	437.41	146.20	44.81	21.60	93.27	743.29
	(87.5)	(78.5)	(58.8)	(19.7)	(6.0)	(2.9)	(12.5)	(100.0)
Cassava	809.93	652.52	456.25	196.27	75.83	81.58	112.33	922.26
	(87.8)	(70.8)	(49.5)	(21.3)	(8.2)	(8.8)	(12.2)	(100.0)
Sugarcane	1,406.90	875.19	457.11	419.42	378.09	153.62	209.73	1,616.63
	(87.0)	(54.1)	(28.3)	(25.9)	(23.4)	(9.5)	(13.0)	(100.0)
Mungbean	428.53	301.95	135.00	166.95	111.65	14.93	128.68	557.21
	(76.9)	(54.2)	(24.2)	(30.0)	(20.0)	(2.7)	(23.1)	(100.0)
Soybeans	775.34	521.87	358.56	163.31	225.32	28.165	115.04	890.37
	(87.1)	(58.6)	(40.3)	(18.3)	(25.3)	(3.2)	(12.9)	(100.0)
Groundnuts	990.58	686.60	371.60	315.01	261.73	42.25	124.65	1,115.22
	(88.8)	(61.6)	(33.3)	(28.2)	(23.5)	(3.8)	(11.2)	(100.0)

Note : Parenthesis ( ) are percentage

Source : Office of Agricultural Economics, MOAC

G.6 Crops Budget

(per Ha)

Crops	Yield Kg	Unit Price B/Kg	Gross Income (A) B	Production Cost (B) B	Net Production Value (C) B	(C)/(A) %	Labour day	Labour Income per day B
Paddy (wet season)	2,823	3.764	10,626	5,342	5,284	49.7	71.3	108
Paddy (dry season)	3,695	3.764	13,908	8,738	5,170	37.2	107.8	81
Soybean	1,171	8.76	10,258	5,794	4,464	43.5	70.2	81
Groundnuts	1,504	6.99	10,513	6,825	3,688	35.1	80.3	67
Mungbean	744	6.05	4,501	3,481	1,020	22.7	37.5	45
Maize	2,043	2.48	5,067	4,644	423	8.3	72.9	32
Cassava	13,741	0.61	8,382	5,763	2,619	31.2	81.6	58
Sugarcane	44,906	0.241	10,822	(a) 10,106	716	6.6	109.4	16
				(b) 8,269	2,553	23.6	91.9	36
Mango 16 tree/rai	4,386	7.0	30,702	24,325	6,377	20.8	200	82
Mango 30 tree/rai	9,588	7.0	67,116	33,863	33,253	49.5	200	216
Durian	8,604	13.5	116,154	(58,077)	(58,077)	(50.0)		
Pomelon	9,256	10.0	92,560	(46,280)	(46,280)	(50.0)		
Vegetables			26,530	10,348	16,182	61.0	87.7	245

Note : Sugacane production cost a) aveage cost 1st year to 3rd year, b) 2nd year

Source :1. Crop yields excluding fruits are average in Chachoengsao, based on Agri. Statistics, MOAC.

2. Unit Prices are farm gateprices based on Agri. Statistics, 1987/88, MOAC.

3. Production costs are these on central plain based on Agri. Statistics, 1987/88, MOAC.

4. Labor day by crop is estimated by use of wage rateB /50, based on Village Survey Data in Chachoengsao, 1987, NSO

5. Production cost of mango is based on Agri. Production Cost Survey, MOAC, durian and pometo are assumption.

6. Vegetables are based on Chaophraya Demonstration Project.
Long bean, baby corn, sweet corn, chili, tomato, chinease cabbage are cropped on three plots.

G.7 Major Exports

Line	1983	1984	1985	1986	1987	1988p
a. Principal Exports						
1 Rice.....Metric tons	3,476,480	4,615,803	4,615,803	4,523,597	4,443,301	5,267,008
Millions of Baht	20,157	25,932	22,524	20,315	22,703	34,636
2 Rubber .....Metric tons	555,060	591,919	689,964	760,857	885,913	936,945
Millions of Baht	11,787	13,004	13,567	15,116	20,539	25,984
3 Maize 1/.....Metric tons	2,658,679	3,144,605	2,781,994	4,013,243	1,649,179	1,151,242
Millions of Baht	8,486	10,147	7,700	9,261	3,928	3,662
4 Tapioca products .....Metric tons	5,196,751	6,569,728	7,088,393	6,318,565	6,210,912	8,068,558
Millions of Baht	15,387	16,600	14,969	19,086	20,661	21,685
5 Prawns .....Metric tons	20,150	19,4238	24,041	28,063	33,909	49,270
Millions of Baht	3,164	2,799	3,439	4,391	5,749	9,553
6 Tin .....Metric tons	17,724	16,455	17,965	18,869	13,723	13,100
Millions of Baht	5,265	5,280	5,647	3,096	2,344	2,242
7 Sugar .....Metric tons	1,536,891	1,241,959	1,724,377	1,960,635	2,025,759	1,804,243
Millions of Baht	6,338	5,222	6,247	7,271	8,573	9,394
8 Integrated circuits ....Thousand units	453,879	747,902	576,736	797,321	950,227	685,042
Millions of Baht	5,829	7,352	8,248	12.818	15,179	8,668
9 Textile products ..... Millions of Baht	14,351	19,155	23,578	31,,268	48,555	58,379
10 Precious stones .....Millions of Baht	6,214	6,350	6,350	8,150	11,550	13,772
11 Total principal exports .....Millions of Baht	96,978	111,620	112,269	130,772	159,781	187,975
12 Others .....Millions of Baht	49,494	63,717	81,097	102,611	140,072	214,863
13 Total .....Millions of Baht	146,472	175,237	193,366	233,383	299,853	402,838
b. Other Exports						
14Tobacco leaves ..... Metric tons	35,560	35,858	32,923	33,062	27,121	31,310
Millions of Baht	1,791	1,638	1,580	1,487	1,286	1,350
15Mung beans ..... Metric tons	156,859	172,426	233,523	145,847	197,111	158,084
Millions of Baht	1,552	1,778	2,284	1,463	1,518	1,613
16Frozen fowl .....Metric tons	22,926	34,217	37,839	64,796	81,905	97,376
Millions of Baht	946	1,420	1,467	3,121	4,020	5,009
17Sorghum .....Metric tons	228,279	219,232	316,887	267,298	145,967	22,664
Millions of Baht	790	809	1,048	657	353	76
18Fresh fruits .....Metric tons	51,104	45,673	57,280	52,372	44,617	53,510
Millions of Baht	525	567	684	736	600	630
19Natural orchids ..... Metric tons	7,940	7,481	7,780	6,054	7,090	9,054
Millions of Baht	354	391	490	387	408	495
20Raw cotton .....Metric tons	12,675	10,816	11,265	6,958	10,818	11,345
Millions of Baht	268	228	210	96	180	189
21Unworked feather .... Metric tons	1,269	1,509	1,156	2,11	2,392	2,217
Millions of Baht	366	357	384	485	398	323
22Coffee .....Metric tons	10,810	11,209	20,602	21,405	22,704	27,095
Millions of Baht	452	527	883	1,722	1,090	1,212

1/Including maize groats and meal.

G.8 Price of Major Agricultural Products

WORLD COMMODITY PRICES

Period	White rice 5% fob. BKK. (US$/Ton)	Maize No.2 Chicago (US$/Ton)	Tapioca Rotterdam (DM/Ton)	Rubber No.3 Singapore (S$/Ton)	Tin Kuala Lumpur (M$/kg)	Raw Sugar New York (Cents/Lb.)
1983	276	124	397	2,121	30.20	8.48
1984	253	114	361	1,922	20.16	5.19
1985	217	101	350	1,587	29.67	4.05
1986	210	74	346	1,676	15.50	6.07
1987	230	71	292	1,969	16.85	6.71
1988	302	100	291	2,280	18.45	10.22
1989						
Jan	271	109	281	2,052	20.15	9.68
Feb	275	107	272	2,001	21.49	10.48
Mar	284	110	275	1,965	22.97	11.54
Apr	295	106	273	1,974	27.71	12.14
May	315	107	277	1,787	27.34	11.91
Jun	337	103	288	1,713	26.90	13.63
Jul	369	97	284	1,721	25.75	14.01
Aug	365	91	291	1,647	23.25	13.97
Sept	351	92		1,635		

Source : Reuter
: Bank of Thailand

AVERAGE WHOLESALE PRICES OF COMMODITIES IN BANGKOK (Baht/ton)

Period	Paddy No.1	Rice 5%	Maize	Tapioca Pellets	Rubber Grade 3	Tin Concentrate	Black Matpe Bean
1983	3,228	5,488	3,154	2,511	17,750	197,151	9,152
1984	2,993	4,859	3,081	1,705	16,447	192,601	8,515
1985	2,759	4,610	2,839	1,798	16,160	212,997	7,702
1986	2,343	4,289	2,235	2,722	16,630	102,456	9,052
1987	3,0115	5,072	2,500	2,582	18,930	113,732	6,370
1988	3,933	6,441	3,155	2,145	23,873	118,522	9,871
1989							
Jan	3,910	6,214	3,313	1,908	21,410	125,239	9,000
Feb	3,988	6,408	3,294	1,950	22,530	133,350	9,043
Mar	4,070	6,585	3,527	1,905	21,941	150,403	8,587
Apr	4,189	7,008	3,982	1,880	21,810	175,982	8,500
May	4,245	7,400	4,711	1,905	20,690	176,520	8,500
Jun	4,402	7,957	4,382	1,850	19,560	168,689	8,500
Jul	4,672	8,311	3,963	1,850	19,500	161,855	8,500
Aug	4,277	7,818	3,513	1,870	18,890	146,098	8,500
Sept	4,023	7,815	3,247		18,770		8,500

Source : Bank of Thailand

G.9 Thailand's External Position (Billion Baht)

Period	Exports (f.o.b.)	Imports (c.i.f.)	Balance of Trade	Services & unrequited Transfers	Current account	Net Capital movements	Balance of Payments
1983	145.1	234.3	-89.2	23.1	-66.1	34.5	-18.1
1984	173.5	242.3	-68.8	19.3	-49.5	58.4	10.6
1985	191.7	253.4	-61.7	19.8	-41.9	51.4	12.5
1986	231.5	245.9	-14.4	20.9	6.5	11.4	33.6
1987	298.1	341.9	-43.8	34.5	-9.3	21.1	18.2
1988*	399.2	501.4	-102.2	59.2	-43.0	70.3	40.5
1989*							
Q1	116.1	148.6	-32.5	25.5	-7.0	30.8	33.5
Q2	130.9	159.6	-28.7	16.2	-12.5	36.1	23.0
Jul	41.0	52.5	-11.5	6.0	-5.5	11.4	4.9
Aug	45.0	55.0	-10.0	6.5	-3.5	20.0	19.6

Source : Bank of Thailand *estimates

Major Exchange Rates (Baht Per Currency Unit)

Period	U.S. Dollar	Pound Sterling	Deutsche Mark	100 Yen
1983	23.0500	35.0757	9.0600	9.7300
1984	23.6892	31.6500	8.3455	9.9948
1985	27.2094	35.2673	9.3146	11.5027
1986	26.3491	38.7173	12.2023	15.7794
1987	25.7859	42.2934	14.3850	17.9300
1988	25.3440	45.1918	14.4840	19.8740
1989				
Jan	25.3543	45.1133	13.8699	20.0376
Feb	25.4142	44.6149	13.7353	19.9379
Mar	25.5269	43.8789	13.7067	19.6185
Apr	25.5706	43.5672	13.7029	19.4045
May	25.8000	42.0298	13.2515	18.7103
Jun	25.9250	40.4503	13.1436	18.1144
Jul	25.8484	42.0462	13.6876	18.4316
Aug	25.9018	41.4600	13.4860	18.3984
Sept	26.0367	40.9979	13.3607	17.9699

Source : Bangkok Bank Limited

G.10 Outlook of Raddy Supply and Demand in 2000

1. Total Populations

1980	2000
46.718 million persons	64.389 million persons

Note: Population Census 1980,
NESDB: "Projection of Population in Thailand 1980-2015"
Medium Fertility Assumption

[High Fertility Assumption.....68.014 million persons
Low Fertility Assumption.....63.462 million persons]

2. Paddy Production

1980	16.800 million ton	
1988	20.060 million ton	Growth Rate ..... 2.2% (1980 - 1988)
2000	26.174 million ton.....	A

3. Rice Consumption

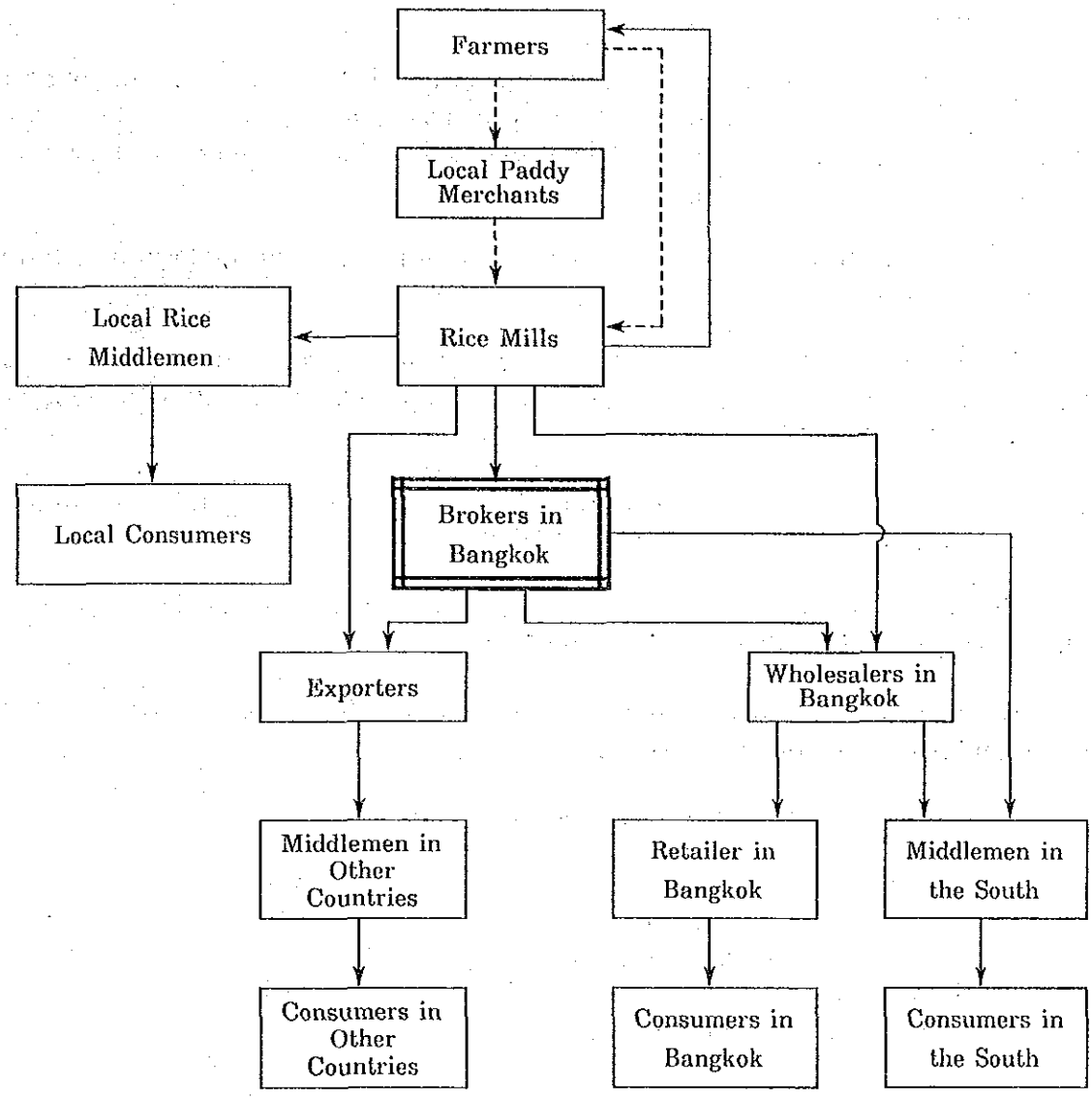
Number of Farmers in 2000 5.953 million Household..... a
Note: Number of Farmers in 1986
4.940 million household Growth Rate 1.34%
Number of Household Population per one Farmer 4.36 person ..... b
Number of Household Population (a×b) ... 25.995 million person
Paddy Consumption per one Farmer Household Person 328 kg/year..... c
Note: 230 kg for food, 5% for seeds, 3% for other use,
Harvesting Loss 17%, Storage for Export Loss 5% etc.
Farmers' Consumption (a × b × c) 8.514 million ton..... B
Non Farmers Consumption 8.648 million ton..... C
Note: Consumption per one person except farmer Rice 150 kg/year.
Non-Farmer Household Population
64.389 - 25.955 = 38.434 million person

4. Reserve for Export

Paddy Production - Rice Consumption (Farmer + Non Farmer Household)
26.174 - (8.514 + 8.648) = 9.012 million ton
Convert in Rice 9.012 x 66% = 5.948 million ton

[Ref.] Rice Export Record 5.267 million ton in 1988
5.900 million ton in 1989

G.11 Rice Marketing Channel



G.12 Cassava Marketing Structure

G.12-1 Marketing Method of Cassava

The most of cassava planters would normally sell fresh cassava immediately after plucking. Certain cases will transform into casava chips before selling. It was found that 81% would sell fresh cassava heads to the chips factory, pellets factory, flour mills, in 40%, 25%, 16% accordingly.

The rest will be sold in the form of cassava chips - 19% to the local merchants who collect the cassava head.

The flour mill will buy fresh cassava from farmer and merchant, and transform into flour for sale to Mr. Yong (in Bangkok) for export by 7.9%, the rest will be consumed in land by 8.2%.

The local merchants will buy from farmer, chips factory and merchant (in village), then sell to the pellets factory about 16.8%.

The pallets factory will buy from chips factory, farmer and local merchant and transform into pellets for sale to Mr. Yong by 73.7%.

Mr. Yong will buy from pellets factories, flour mills, chips factories and local merchant and so on, for sale to exporter by 85.9%.

1) Expenses for marketing at local merchant level

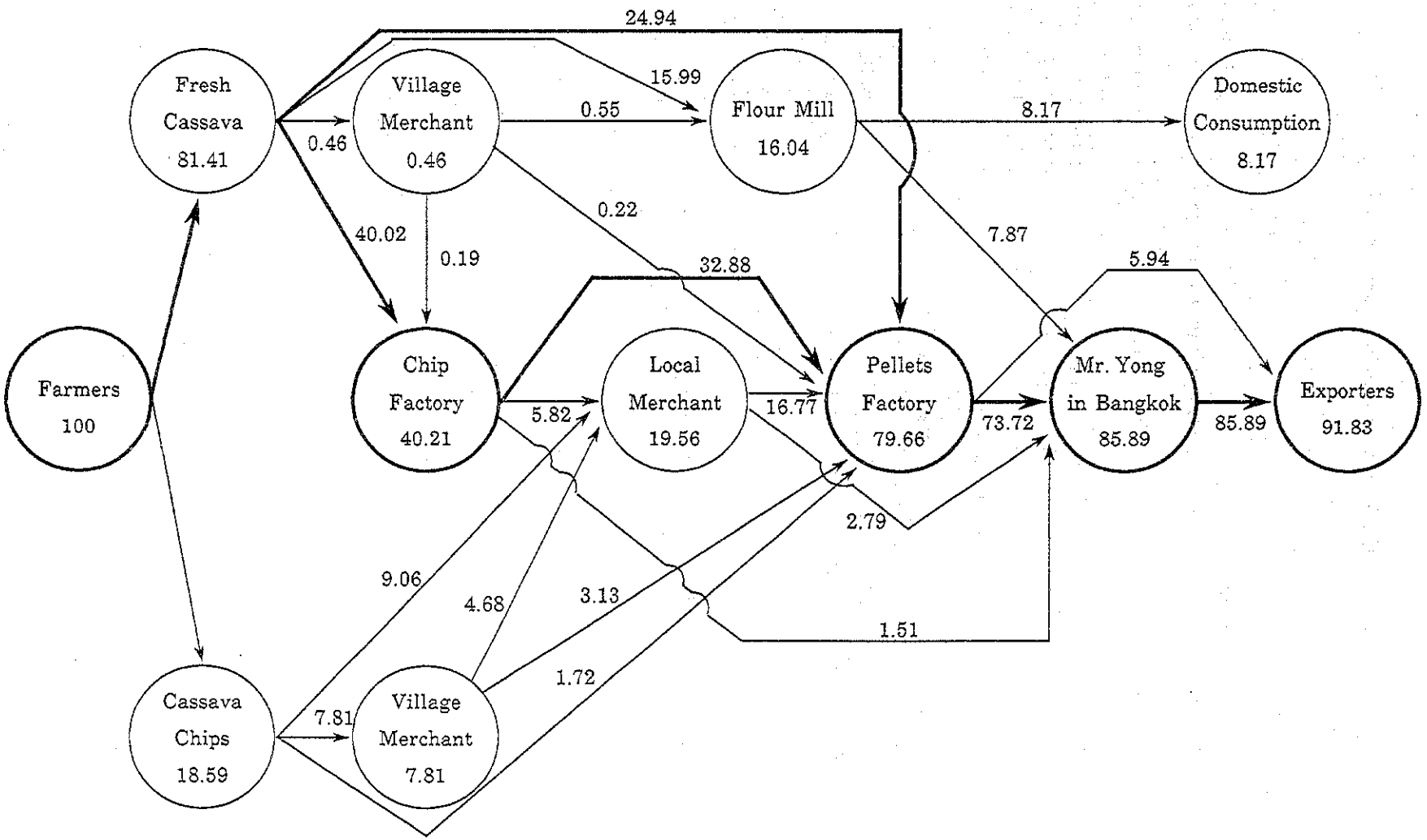
– market fee	0.60%
– Tax paid at point of payment	0.75%
– Rice separating and sellecting fee	2.28B/bag
– Transportation cost (from field to rice mill or storage)	7.00B/bag
– Sack cost	4~6B/bag
– Loading cost	6.75B/bag
Note; gross weight	101~101.5kg
net weight	100kg

2) Transportation charge from rice mill to Bangkok, depending on distance 100~200B

3) Payment

Exports would pay by credit check 3~4 days advance. Wholesaler would pay in cash except the permanent custom (by credit check 3~7 days advance).

G.12-2 Cycle of Cassava Market



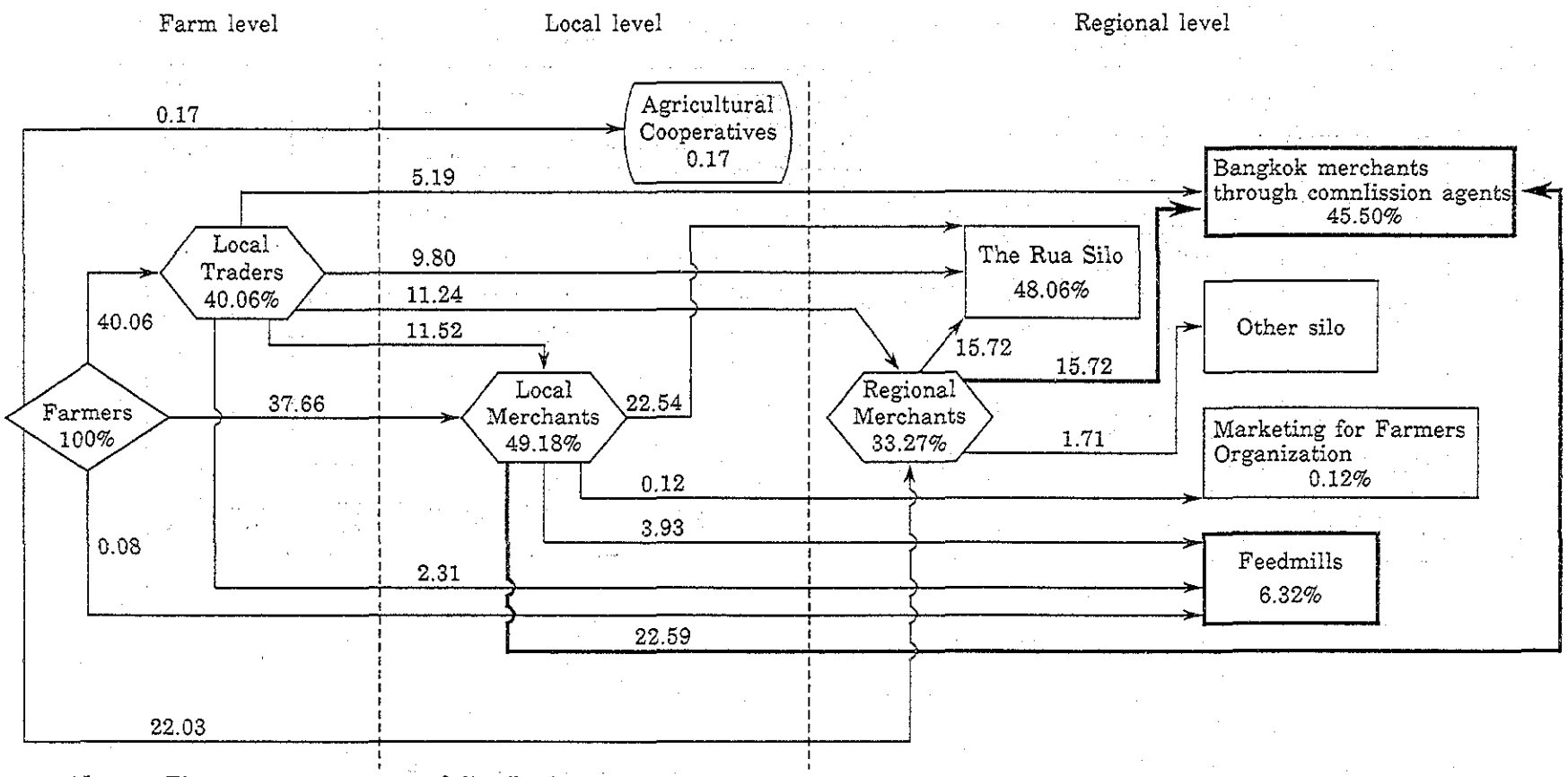
Note; Figures are percentage of distribution ratio

G.12-3 Expenditure on Cassava Marketing

Plantation Level	Fresh Cassava	
(1)	buying price	0.53 - 0.61 B/kg
(2)	transportation fee from field to buyers' source	0.10 - 0.20 B/kg
Local Level	Transforming cassava heads into chips	
(3)	brokers' commission	0.05 B/kg
(4)	cost for picking up by tracter or tiller	0.10 - 0.20 B/kg
(5)	transportation fee to chips factory	0.08 - 0.10 B/kg
(6)	commission for Mr. Yong	0.75 - 1.00 B/kg
(7)	Tax paid at point of payment	payment value x 0.75%
Regional Level	Pellets Factory	
(8)	brokers' commission	0.01 B/kg
(9)	transportation fee to pellets factory	0.09 B/kg
(10)	carrying charge up and down cassava bags	0.04 B/kg
		1.75 - 2.30 B/kg
	Tax	0.013 - 0.017 B/kg
	Total	1.763 - 2.317 B/kg

Source: Chachoengsao Provincial Office

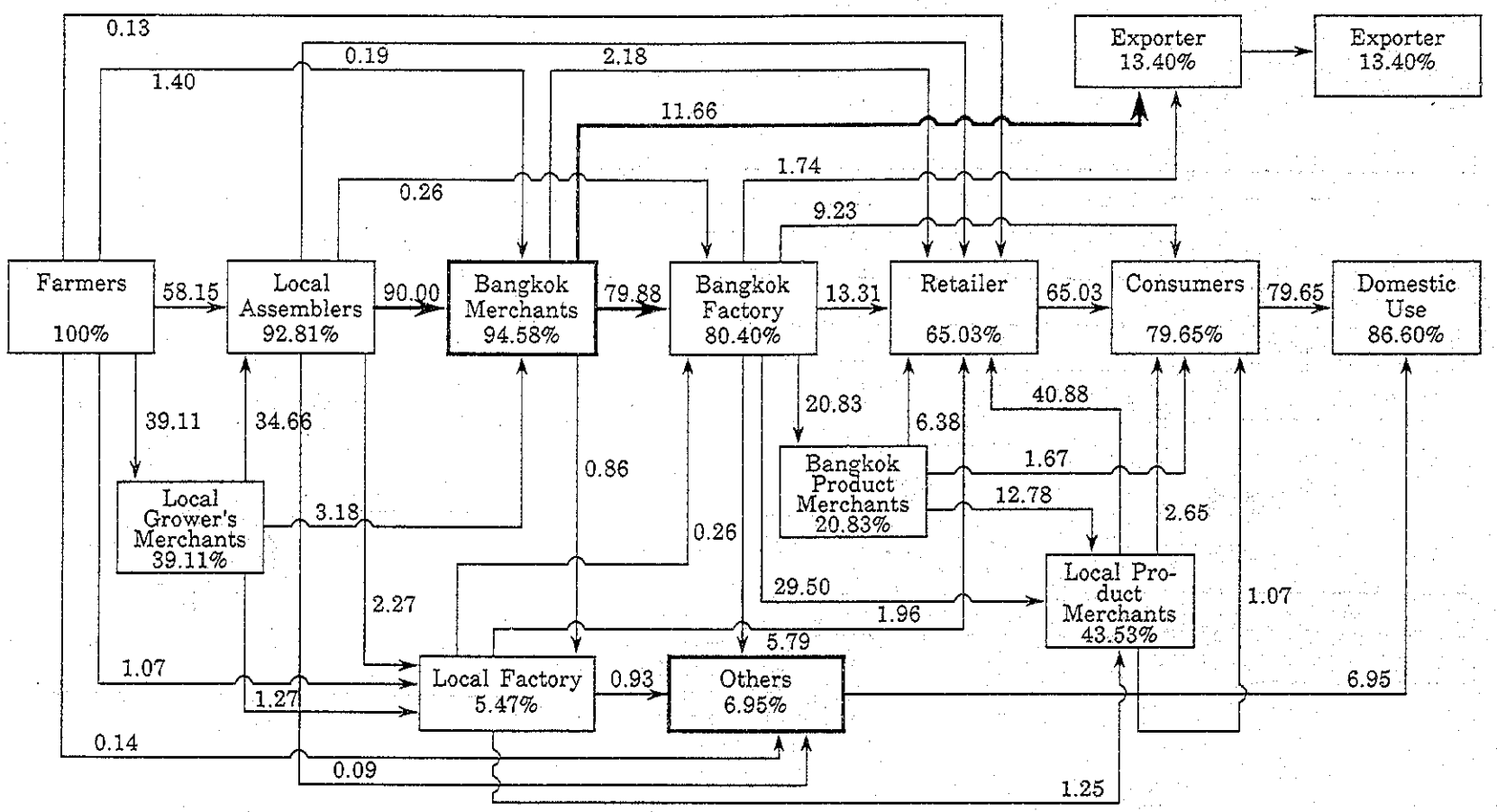
G.13 Marketing Channel of Maize in Central and West Regions, 1983



Note: Figures are percentage of distribution ration

Source: Chulalongkorn University Socinl Research Institute "Study on Improving Agricultural Marketing Systems" Paper presented to Department of Business Economics, September, 1984.

G.14 Soybean Marketing Channel



Note : 1) Figures are percentage of distribution ratio
2) Others included government offices, animal farm, animal feed factory, consumable food producer and other industries

Source : Office of Agricultural Economics, MOAC

G.15 Mango Marketing Structure

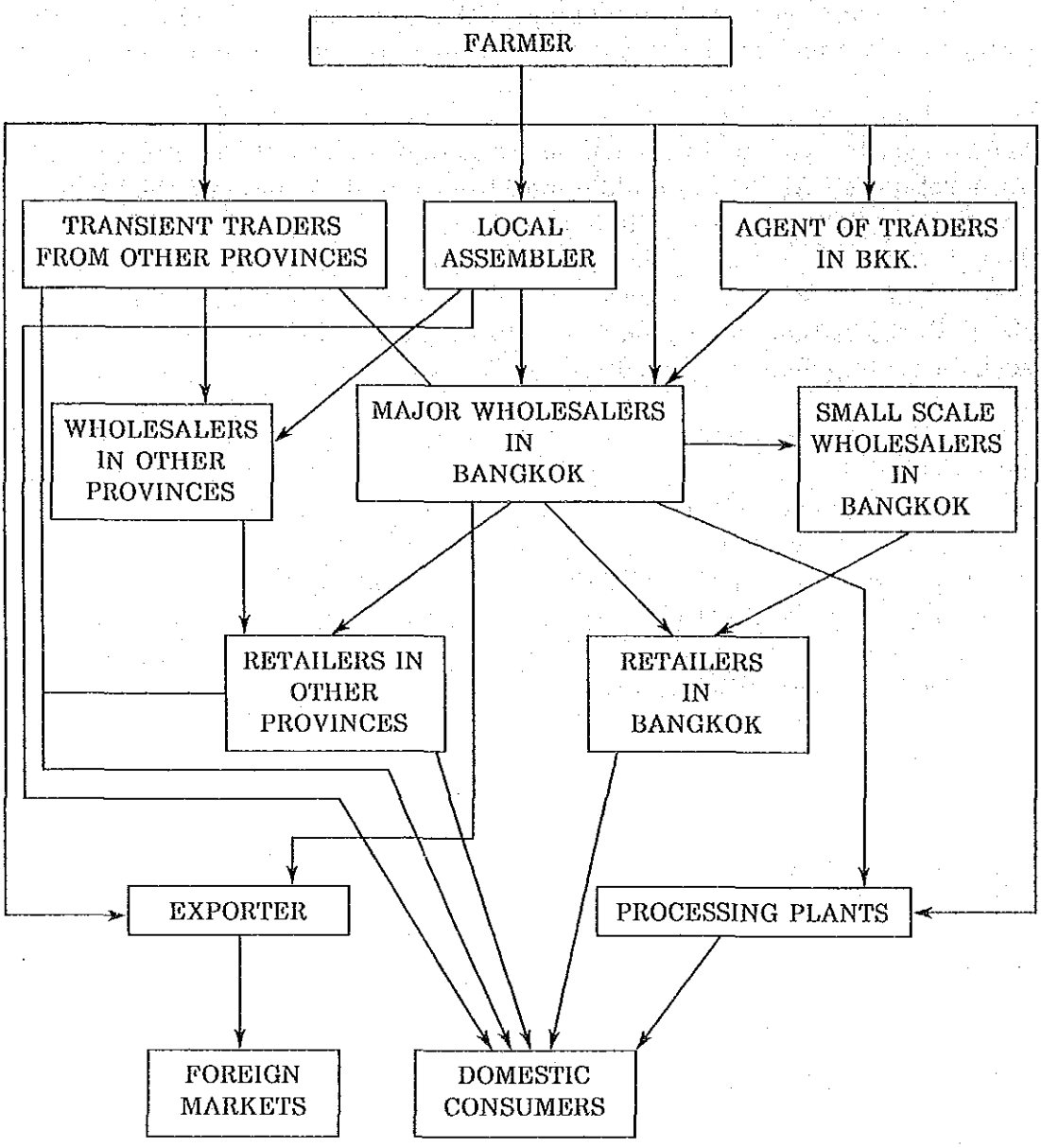
G.15-1 Mango Marketing Condition

As mango can easily be damaged, therefore the time to be distributed is very short or there will be very few middle men involved, unlike other crops.

A) Domestic Market ... There will be local merchant wholesaler here or from the nearby provinces who will buy the products from the planters for sale to the retailers. As for the middle men from Bangkok market, they usually come to the plantation with their own trucks to buy for sale at Mahanak Market or at Pak Klong Thalad Market in Bangkok to be distributed to the retailer and the consumers accordingly. There may be certain cases of planters who will collect their own products or from the nearby planters, and hire a truck for loading mangoes for a direct sale in Bangkok.

B) Overseas market ... Mangoes are very popular for consumption domestically, hence, there are very few left for export overseas. Also, it is due to the climate, therefore, the export volume is uncertain. The mangoes for export overseas are both raw and ripe, but majority are ripe, popular amongst the Asian countries, Japan and in Europe, i.e. 'Ok Rong' mango, 'Nan Dok Mai', 'Nang Klang Wan'. As for the raw mangoes, there is a low export volume, i.e. 'Pim Sen Mon' mango, 'Kiow Sawei', 'Ma Muary Kaew', etc. The markets are Malaysia, Singapore, Hong Kong, etc.

G.15-2 Marketing Channels for Fruits in Thailand



Source: Report on the Study for Improving the Agricultural Market System, September, 1984

G.15-3 Mango Packing Standard

The packing of mangoes for distributing domestically. The planters will place the mangoes in rattan baskets with approximately 35 kgs. in weight/basket or in plastic baskets which can contain 25 kgs by placing or bundling with banana leaves or newspapers and when the mangoes are full the cover will be closed ready for loading to the domestic market.

As regards packing for overseas market, the mangoes will be placed in wooden crates or plastic baskets or corrugated paper boxes by selecting the equal size mangoes, specifically, the European and the Middle-East markets; when mangoes are to be placed in corrugated paper box, the size of mangoes should be the same standard as that of the box, that is, 5 kgs. per box which can contain between 12 - 16 mangoes.

As an example Mango Packing Standard in Japanese market are cited as below:

Thai Product

Small size	20 pieces	net weight	6.6 ~ 7.0 kg	box w. 0.7 ~ 1.0 kg
		(one pec.	320 ~ 370 g)	
Medium size	16 pieces	net weight	6.8 ~ 7.5 kg	
		(one pec.	370 ~ 470 g)	
Large size	16 pieces	(one pec.	more than 430 g)	

The Philippine Product

1	carton	net weight	5 kg	
S	size	24	one pec.	200 g
M	size	20	one pec.	250 g
L	size	16	one pec.	320 g

Source; Tokyo Metropolitan, Kanda Central Market, in April, 1989

G.15-4 Mango Prices and Export Charges

By the Price Statistics of the A. E. O., seasonal farm gate price of Mango were easy to be fluctuated from 2.34 Baht/kg to 17.98 Baht/kg in 1988 depending on variety, meanwhile Mango export price (f. o. b. Bangkok) were 5.9 Baht/kg for Malaysia, 10.37 Baht/kg for France and 56.02 Baht/kg for Japan and so on..., total average price was 7.4 Baht/kg in 1988.

An example of Mango export price (f. o. b. Bangkok) for Japanese market is shown as follow:

unit: Baht per kg

a.	Exporter's buying price	32B
b.	Transportation fee as one truck (Chachoengsao - Bangkok, 1 ton unit)	1B
d.	Carton box cost (25 Baht for 5kg)	5B
d.	VHT charges (for Plant Quarantine at Bang Khen)	12B
e.	Repacking cost (4 Baht per one box)	0.8B
f.	Transportation fee (800 Baht) (Bang Khen - Bangkok Port, including Vanning charge to boat)	0.8B
g.	Certification fee (60~200 Baht)	0.13B
h.	Shippment Document (1,500 Baht per one shippment)	1.5B
i.	Cargo damaged loss (5%)	1.6B
	Total price (f. o. b. Bangkok)	54.83 Baht.

G.16 Lending Operations
Classified by Operating Region and Client Category in Fiscal Year 1988

Operating Province	Individual Client Farmers		Agricultural Cooperatives		Farmers' Associations		Total	
	Number of clients (families)	Disbursement (million baht)	Number of clients (families)	Disbursement (million baht)	Number of clients (families)	Disbursement (million baht)	Number of clients (families)	Disbursement (million baht)
Nakhon Nayok	14,039	219.5	4,136	44.2	967	-	19,142	263.7
Prachinburi	22,173	392.6	15,847	75.5	4,479	-	42,499	468.1
Chachoengsao	18,758	767.2	7,665	54.1	-	-	26,423	821.3
Chonburi	12,827	283.1	3,800	28.1	291	-	16,918	311.2

G.17 Paddy Pledging Scheme

	1988/1989			1989/1990 (target)		
	Number of farmers	Pawning paddy	Mortgaged value	Number of farmers	Pawning paddy	Mortgaged value
Nakhon Nayok	200	3,951	8,684	330	5,000	12,000
Prachinburi	-	2,412	6,963	-	3750	12,000
Chachoengsao	289	3,771	8,900	620	7,100	17,460
Chonburi	189	1,423	3,579	-	-	-

Source ; BAAC Branch Office

G.18 Farm Economic Survey at the Khlong Tha Lat Area

	Existing Irrigation Area (Paddy)		Water Conservation Area (Paddy + Mango)		New Expansion Area		Dum Storing Area		Total	
Sample Farming Household (H.H)	86		20		30		49		175	
Farmers Population (person)	458(5.3)		53(5.3)		150(5.0)		294(6.0)		955(5.5)	
Farm-Labour Population (person)	235(2.7)		30(3.0)		91(3.0)		176(3.6)		532(3.0)	
Land use area (rai)	2,787(32.4)		177(17.7)		1,084(36.0)		2,796(57.1)		6,844(39.1)	
Income from Crops (Baht)	2,458,639 (28,589)	33.0	449,950 (44,995)	50.2	448,242 14,941)	39.7	1,410,543 (28,787)	65.1	4,767,374 (27,242)	40.9
Income from Livestocks (Baht)	223,612 (2,600)	3.0	△200 (−)	−	44,523 (1,484)	3.9	128,586 (2,624)	5.9	396,521 (2,266)	3.4
Employed Farming Labour Income (Baht)	1,081,880 (12,580)	14.5	26,230 (2,623)	2.9	290,225 (9,674)	25.7	290,549 (5,930)	13.4	1,688,884 (9,651)	14.5
Income from non-Agriculture (Baht)	3,696,518 (42,982)	49.5	420,275 (42,028)	46.9	347,300 (11,577)	30.7	338,250 (6,903)	15.6	4,802,343 (27,442)	41.2
Farm Income (Baht)	7,460,649 (86,752)	100.0	896,255 (89,626)	100.0	1,130,290 (37,676)	100.0	2,167,928 (44,243)	100.0	11,655,122 (66,601)	100.0

Note : Farm Economic Survey 1989 at Khlong Tha Lat Area; RID Economic Section.

G.19 Farm Income per Household in 1988 by Irrigation Block

Block	Farmers Household	Number of districts related	Number of Tambon & Muban: Study area / All area	Number of Tambon & Muban: Study area / All area	Paddy (ha) (%) (kg) (kg)	Upland (ca): Cassava Ⓜ: Maize (ha)yield(%)(kg)	Orchard Ⓜ: Mango Ⓑ: Banbooshoot (ha)yield(%)(kg)	Land Use Area ( ): Planted area ratio	Gross Income (Baht)
LBP	46,000	Chonburi 4 Chachoengsao 7	83/117	520/927	(wet) 1.90×90×2.567=4,390 (dry) 0.66×90×3.542=2,210	1.25×(ca)14.453×90=16,372	0.53×Ⓜ4.340×90=2,070	3.68ha (90%)	47,910
KTL	12,263	Chachoengsao 2 Chachoengsao 3	5/12	47/113	1.03×89×1.88=1,725	5.40×(ca)15.232×89=73,205	0.39	6.82ha (89%)	48,920
UBP	37,816	Prachinburi 6	54/78	500/723	3.27×66×2.690=5,806	—	0.55×Ⓑ12.500×66=4,538	3.82ha (66%)	38,960
MNN	18,136	Nakhon Nayok 4	39/39	375/375	4.05×83×2.287=7,788	—	—	4.05ha (83%)	32,059
MPP	6,854	Prachinburi 1	7/14	69/144	3.17×66×1.670=5,294	1.38×(ca)12.327×66=11,227	0.20×Ⓢ7.500×66=990	4.75ha (66%)	31,581
MHN	14,811	Prachinburi 4	10/40	104/444	2.38×66×1.827=2,870	2.06×(ca)12.552×66=17,066	0.84×Ⓑ7.350×66=4,297	5.28ha (66%)	35,490
KPS	20,063	Prachinburi 3	10/21	119/301	1.45×66×1.941=1,858	3.73×1/2×Ⓜ2.844×66=5,304 3.73×1/2×(ca)11,855×66=22,110	—	5.18ha (66%)	33,602
UPP	10,058	Prachinburi 3	7/35	75/387	3.43×66×1.790=4,052	2.86×2/3×(ca)11.855×66=22,604 2.86×1/3×Ⓜ2.844×66=2,711	—	6.29ha (66%)	36,441
Study area (total)	166,001	37 districts	215/356	1,809/3,414					

Note ; Farm gate price

Paddy 4.170 B/ton, Cassava 0.56 - 0.57 B/kg, Maize 2.54 //kg, Mango 5.4 B/kg

G.20 Labour Force Required in Target Year by Crops

	Paddy			Soybean	Mungbean	Groundnut	Orchard	Vegetable	
	Wet Trans-plant	Broad-cast	Dry Broad-cast						
Working times (man)	128^{2}	110^{3}	110^{3}	56^{1}	52^{9}	64^{3}			
(machine)	12^{3}	12^{2}	12^{2}	6^{1}	5^{0}	8^{1}			
man/day per hectar	140^{5}	122^{5}	122^{5}	62^{2}	57^{9}	72^{4}	258^{2}	64^{0}	
Planted area (ha)	169.800	169.800	38.200	70.000	25.000	25.000	24.200	54.700	
Total working times (,000day)	23.856^{9}	20.800^{5}	4.679^{5}	4.354^{0}	1.447^{5}	1.810^{0}	6.248^{44}	3.500^{8}	$66.697.^{64}$

Note; Assumption..... one person work 300 day per year.

Labour force requested; 66,697,640 day ÷ 300 day/year = 222,326 person/year

G.21 Net Products Value in 2000 by Irrigation Block

Unit ; million Baht

	LBP	KTL	UBP	MNN	MPP	MHN	KPS	UPP	Study Area
Paddy	88.48	3.95	384.83	137.12	42.13	42.08	20.56	59.24	778.39
Maize	1.03	-	-	-	0.33	1.60	1.78	2.16	6.91
Cassava	-8.43	-	-	-	-1.74	-8.92	-10.08	-11.37	-40.54
Soybean	32.78	6.56	96.28	-	22.53	43.84	32.78	52.03	286.80
Mungbean	5.82	0.64	9.32	-	1.59	1.80	3.39	3.92	26.48
Groundnuts	9.75	0.90	15.88	-	2.71	3.07	5.78	7.04	45.13
Orchard	164.00	87.64	240.38	-	-	128.24	87.85	154.70	862.81
Vegetables	330.54	-	553.90	-	17.60	28.30	97.32	122.31	1,149.97
Total	624	100	1.300	137	85	240	239	1.149	3,115

G.22 Net Products Value of Major Crops in 1988

	Production volume (ton)	×	Farm gate price (B)	×	Net Profit Ratio (%)	Net Product value 1,000 B
Paddy wet	921,935	×	4,170	×	49,7	1,903,012
Paddy dry	44,979	×	4,170	×	37,2	69,773
						1,972,785
Soybean	9.431	×	8.920	×	43.5	36.594
Mungbean	2.498	×	7.510	×	22.7	4.293
Groundnuts	1.615	×	5.000	×	35.1	2.834
Mango	70.373	×	5.400	×	35.2	133.765
						2.150.271

Production volume ; Each Provincial Extension Office
Net Profit Ratio ; Statistics of Production Cost, Agricultural Economics Office, MOAC.

TABLE G-23 PLANTED AREA OF MAIN CROP, THAILAND

Unit : 1,000 rai

Crop Year	Major Rice	Second Rice	Maize	Cassava	Sugacane	Mung Bean	Sorgum	Soybeans	Groundnuts	Coconut
1979/80	56,868	2,103	9,529	7,250	2,730	2,652	1,182	679	609	2,347
1980/81	56,882	3,228	8,960	7,940	2,927	2,796	1,546	788	658	2,363
1981/82	56,392	3,578	9,766	7,726	3,857	3,040	1,749	797	768	2,373
1982/83	56,171	3,963	10,494	8,552	3,645	3,034	1,534	778	761	2,443
1983/84	58,115	4,481	10,552	8,780	3,607	3,022	1,657	1,008	783	2,451
1984/85	57,915	4,415	11,355	9,230	3,424	3,280	1,838	1,253	820	2,511
1985/86	59,437	3,985	12,377	7,748	3,443	3,426	1,935	1,524	779	2,593
1986/87	57,943	3,628	12,194	8,820	3,370	3,172	1,212	1,799	790	2,586
1987/88	54,324	4,564	10,941	9,879	3,664	2,900	1,105	2,260	763	2,545
1988/89	59,372	5,306	11,471	10,136	4,113	2,964	1,126	2,508	771	2,490

Crop Year	Cotton	Kenaf	Kabok	Pineapple	Garlic	Onion	Tabacco	SesameSeed	Para Rubber	Total
1979/80	750	1,418	335	629	163		215	228	9,576	99,263
1980/81	949	1,068	347	800	167		220	245	9,615	101,499
1981/82	967	1,166	353	519	192		304	257	9,867	103,667
1982/83	715	1,357	357	434	200	10,173	278	214	10,001	115,104
1983/84	638	1,343	355	423	229	9,732	244	195	10,143	117,758
1984/85	451	1,022	385	382	229	12,705	195	230	10,254	121,894
1985/86	519	1,454	392	466	172	11,309	184	273	10,288	122,304
1986/87	315	1,283	325	441	177	12,351	160	318	10,346	121,230
1987/88	412	1,005	291	395	216	15,055	135	283	10,399	121,136
1988/89	412	874	299	440	233	17,067	138	314	10,577	130,611

Source : Agricultural Statistics of Thailand, MOAC

TABLE G-24 COMPOSITION OF PLANTED AREA OF MAIN CROP, THAILAND

Unit : %

Crop Year	Major Rice	Second Rice	Maize	Cassava	Sugacane	Mung Bean	Sorgum	Soybeans	Groundnuts	Coconut
1982/83	48.8	3.4	9.1	7.4	3.2	2.6	1.3	0.7	0.7	2.1
1983/84	49.4	3.8	9.0	7.5	3.1	2.6	1.4	0.9	0.7	2.1
1984/85	47.5	3.6	9.3	7.6	2.8	2.7	1.5	1.0	0.7	2.1
1985/86	48.6	3.3	10.1	6.3	2.8	2.8	1.6	1.2	0.6	2.1
1986/87	47.8	3.0	10.1	7.3	2.8	2.6	1.0	1.4	0.7	2.1
1987/88	44.8	3.8	9.0	8.2	3.0	2.4	0.9	1.9	0.6	2.1
1988/89	45.5	4.1	8.8	7.8	3.1	2.3	0.9	1.9	0.6	1.9

Crop Year	Cotton	Kenaf	Kabok	Pineapple	Garlic	Onion	Tabacco	Sesame Seed	Para Rubber	Total
1982/83	0.6	1.2	0.3	0.4	0.2	8.8	0.2	0.2	8.8	100.0
1983/84	0.5	1.1	0.3	0.4	0.2	8.3	0.2	0.2	8.7	100.0
1984/85	0.4	0.8	0.3	0.3	0.2	10.4	0.2	0.2	8.4	100.0
1985/86	0.4	1.2	0.3	0.4	0.1	9.2	0.2	0.2	8.5	100.0
1986/87	0.3	1.1	0.3	0.4	0.1	10.1	0.1	0.3	8.5	100.0
1987/88	0.3	0.8	0.2	0.3	0.2	12.4	0.1	0.2	8.6	100.0
1988/89	0.3	0.7	0.2	0.3	0.2	13.0	0.1	0.2	8.1	100.0

Source : Agricultural Statistics of Thailand, MOAC

TABLE G-25 FARM VALUE OF MAIN CROPS, THAILAND

Unit : Million bahts

Crop Year	Major Rice	Second Rice	Maize	Cassava	Sugacane	Mung Bean	Sorgum	Soybeans	Groundnuts	Coconut
1979/80	39,194	3,466	5,984	12,405	4,968	1,196	381	537	624	2,003
1980/81	48,265	6,704	7,285	8,162	12,623	1,527	531	578	1,030	2,089
1981/82	45,839	5,277	7,518	9,072	14,427	1,861	722	896	966	2,555
1982/83	43,466	6,108	6,125	14,052	7,517	1,972	610	581	1,043	1,997
1983/84	46,711	7,740	8,846	13,190	8,283	2,039	883	1,087	1,096	3,163
1984/85	39,714	6,572	9,846	7,705	7,642	2,269	846	1,479	912	3,529
1985/86	41,597	5,037	8,980	11,899	5,710	2,070	736	1,884	1,218	2,148
1986/87	40,517	5,091	6,894	17,403	7,042	1,774	311	2,192	844	2,273
1987/88	59,343	10,007	6,897	13,607	8,919	2,122	448	2,705	1,129	2,715
1988/89	73,172	12,436	12,249	13,588	12,099	2,857	486	4,372	1,261	3,769

Crop Year	Cotton	Kenaf	Kabok	Pineapple	Garlic	Onion	Tabacco	SesameSeed	Para Rubber	Total
1979/80	1,306	814	178	4,623	1,052		1,004	245	7,673	87,653
1980/81	1,849	919	328	7,082	1,497		1,582	339	7,434	109,824
1981/82	1,738	830	332	1,814	910		1,019	289	6,717	100,482
1982/83	1,232	852	270	1,655	1,411	247	1,054	221	9,567	99,980
1983/84	1,383	848	331	2,200	1,606	254	1,219	202	8,688	109,769
1984/85	936	1,430	294	2,765	1,106	402	867	258	9,109	97,681
1985/86	861	999	254	2,406	1,044	239	590	284	11,402	99,358
1986/87	689	740	226	2,012	913	105	574	283	12,653	102,536
1987/88	951	710	253	2,990	2,214	204	363	253	16,187	132,017
1988/89	1,155	808	278	2,408	1,764	162	389	286	18,753	162,292

Source : Agricultural Statistics of Thailand, MOAC

TABLE G-26 COMPOSITON OF FARM VALUE OF MAIN CROP, THAILAND

Unit :

Crop Year	Major Rice	Second Rice	Maize	Cassava	Sugacane	Mung Bean	Sorgum	Soybeans	Groundnuts	Coconut
1982/83	43.5	6.1	6.1	14.1	7.5	2.0	0.6	0.6	1.0	2.0
1983/84	42.6	7.1	8.1	12.0	7.5	1.9	0.8	1.0	1.0	2.9
1984/85	40.7	6.7	10.1	7.9	7.8	2.3	0.9	1.5	0.9	3.6
1985/86	41.9	5.1	9.0	12.0	5.7	2.1	0.7	1.9	1.2	2.2
1986/87	39.5	5.0	6.7	17.0	6.9	1.7	0.3	2.1	0.8	2.2
1987/88	45.0	7.6	5.2	10.3	6.8	1.6	0.3	2.0	0.9	2.1
1988/89	45.1	7.7	7.5	8.4	7.5	1.8	0.3	2.7	0.8	2.3

Crop Year	Cotton	Kenaf	Kabok	Pineapple	Garlic	Onion	Tabacco	Sesame Seed	Para Rubber	Total
1982/83	1.2	0.9	0.3	1.7	1.4	0.2	1.1	0.2	9.5	100.0
1983/84	1.3	0.8	0.3	2.0	1.5	0.2	1.1	0.2	8.0	100.0
1984/85	1.0	1.5	0.3	2.8	1.1	0.4	0.9	0.3	9.3	100.0
1985/86	0.9	1.0	0.3	2.4	1.1	0.2	0.6	0.3	11.5	100.0
1986/87	0.7	0.7	0.2	2.0	0.9	0.1	0.6	0.3	12.3	100.0
1987/88	0.7	0.5	0.2	2.3	1.7	0.2	0.3	0.2	12.3	100.0
1988/89	0.7	0.5	0.2	1.5	1.1	0.1	0.2	0.2	11.6	100.0

Source : Agricultural Statixtics of Thailand

TABLE G-27 TREND OF POPULATION

Province	Destrict	1979	1983	1988	1983/1979	1988/1983	1988/1979
Chachoengsao	Sanam Chiket	39,795	46,935	71,606	1.81	1.53	1.80
	Panam Srakom	70,348	66,771	72,907	0.95	1.09	1.04
	K. Ratchasan	10,691	11,084	12,233	1.04	1.10	1.14
	Bang Khla	56,935	56,917	60,879	1.00	1.07	1.07
	PleanYao	23,178	25,857	29,876	1.12	1.16	1.29
	Muang	117,923	120,403	132,447	1.02	1.10	1.12
	Ban Pho	41,896	42,809	45,022	1.02	1.05	1.07
	Bnag Pakong	62,732	66,697	73,099	1.06	1.10	1.17
	Sub - Total	(423,498)	(437,473)	(498,069)	(1.03)	(1.14)	(1.18)
Chonburi	Phanat Nikhon	122,257	130,067	143,908	1.06	1.11	1.18
	Phan Thong	37,779	39,764	43,555	1.05	1.10	1.15
	Sub - Total	(160,036)	(169,831)	(187,463)	(1.06)	(1.10)	(1.17)
	Total	583,534	607,304	685,532	1.04	1.13	1.17
	Average growth rate				1.00%	2.47%	1.76%

Note : As regard population in last ten years, population by Amphoe in 1978 shows an irregular figure in comparison with trend of population in previous year. Then, population in 1979 is used as the first year in this study.

Source : Population statistics.

TABLE G-28 POPULATION AND FARM-HOUSEHOLD

Province	Destrict	Population			General Household		Farm - Household	
		District (1988)	Project Area Total	Farm	District (1987)	Project Area	District (1987)	Project Area
Chachoengsao	Sanam Chiket	71,606	5,730	4,930	12,164	1,359	10,440	1,169
	Panam Srakom	72,907	10,060	6,340	11,587	1,992	7,579	1,255
	K. Ratchasan	12,233	1,315	1,185	1,762	296	1,576	266
	Bang Khla	60,879	9,335	8,960	8,095	1,715	7,783	1,646
	PleanYao	29,876	5,200	4,055	4,861	1,015	3,788	792
	Muang	132,447	22,015	13,650	12,096	3,452	7,497	2,140
	Ban Pho	45,022	14,445	9,100	6,863	2,448	4,314	1,542
	Bnag Pakong	73,099	6,280	2,700	9,350	960	4,046	413
	Sub - Total	(498,069)	(74,380)	(50,920)	(66,788)	(13,237)	(47,023)	(9,223)
Chonburi	Phanat Nikhon	143,908	37,030	27,400	17,529	6,231	13,010	4,613
	Phan Thong	*43,555*	*9,465*	*5,490*	*5,906*	*1,662*	*3,444*	*964*
	Sub - Total	(187,463)	(46,495)	(32,890)	(23,435)	(7,893)	(16,454)	(5,577)
	Total	(685,532)	(120,875)	(83,810)	(90,213)	(21,130)	(63,477)	(14,800)
		(100 %)	(17.0 %)	(12.2 %)	(100 %)	(23.4 %)	(100 %)	(23.3 %)

Note : 1. Population by District is sourced from population statistics, 1988 Number of general or farm household are based on NSO, village survey.

2. Figures in Project area are estimated by use of the following data
   - Ⅰ. Irrigable area by Amphoe with the Project
   - Ⅱ. Ratio of crop area for paddy, upland, orchard proposed by Amphoe to total area by Amphoe
   - Ⅲ. Number of rice, orchard, upland crop farmer, NSO, Village survey.
   - Ⅳ. Population per household by Amphoe, NSO.
   - Ⅴ. Ratio of farm-household by Amphoe, NSO.

TABLE G-29 DISTRIBUTIONNOF LAND PRICE

(Unit : Number of sample responded)

Land price per rai (1,000 baht)	Paddy field (Lowland + Plain)			Upland field (High/Upland)		Orchard
	Tha Lat Irr. Area	Left Bank	Extension Area	Tha Lat Irr. Area	Extension Area	Left Bank
Less 10		-	8		1	
11 to 30		-	17		2	
31 to 50	18 *	-	3	3 *	-	1 *
51 to 100	38	-	4	16	-	7
110 to 150	14	4	-	4	-	2
160 to 200	4	2	-	4	-	-
210 to 250	1	-	-	1	-	-
260 to 300	2	1	-	-	-	-
310 to 350	2	1	-	-	-	-
360 to 400	1	1	-	-	-	-
Over 410	-	1 **	-	-	-	-

Note : * ---less than 50,000 Baht/rai, * * --Million Baht

Source : Socio - agro economic survey, Dec. 1989 , PDD, RID

G. 30 Analysis of farm Economy

The Agro-and Socio-economic survey was conducted November to December, 1989, for 180 farm households selected from 18 villages existing within the Study Area. the Project Area was divided into the following five sub-areas, from each of which sample farmers were selected at random.

Diversion of Area	No.of Vill Surveys	No. of Samples
Tha Lat Irrig. area (TLIA)	8	80
Left Bank of Bang Pakhon Irrig.(LBBP)	1	21
Newly Proposed Area (NPA)	3	40
Proposed Reservoir Area (PRA)	5	50
Orchard Area in the Down stream of Bang Pakhon River (OABP)	1	10
Total	18	180

Note :Capital language shown in the parenthesis is used in the following table as abbreviation of each area.

The data collected through the above 180 farm household survey have been analyzed so as to prepare the basic data/information for Project justification to be made in the Phase II Study. The location of the villages surveyed is illustrated in the following Figure G30-1.

1) Cropping Acreage and Harvested Acreage

The harvested acreages of paddy, cassava, etc. become less than the cropped acreages due to drought, flood, pests, insects.

The following table shows that the decreasing extent from cropped acreage to harvested acreage is largest in the paddy cropping in wet broadcasted paddy.

Cropped Acreage and Harvested Acreage

Crops	Sample	Cropped Acreage ha (rai)(A)	Harvested Acreage ha (rai)(B)	Decreased rata B/A %
paddy transplanted	128	128 (3,488)	518 (3.237)	93
Dry Broadcasted Paddy	36	200 (1,250)	174 (1.087)	87
Wet Broadcasted Paddy	8	23 (145)	14 (89)	61
Cassava	53	250 (1.563)	224 (1,402)	90

Those farmers who wewe damaged by drought are 8.3 percent with 15 households, and by flood are 20 percent with 36 households. (Raf.to Fig. G30-2 to G30-4)

2) Local Difference in Yield per Unit Acreage

The local difference in the yields of paddy and cassava is shown in the following table. The yield of the left bank of the Bang Pakhon is lower than that of the Tha Lat Irrigation Area, even in considering the small number of the samples taken at Bang Pakhon.

This indicates the characteristic features of the paddy cropping in the water conservation area. And the yield of cassava of the proposed submerging upland area is higher than that of the other paddy cropping areas.,

Yield by Crops

(unit : t/ha (kg/rai)

Area	Paddy Transplanted	Dry Broadcasted Paddy	Wet Broadcasted Paddy	Cassava
TLIA	2.9 (460)	2.5 (397)	2.8 (440)	1.5 (240)
LBBP	1.8 (294)	-	-	-
NPA	1.6 (255)	1.3 (208)	-	1.4 (224)
PRA	1.8 (285)	-	-	2.1 (336)

3) Average Land Holding Per Household

The average farm land holding per household of the sample farmers is as large as about 6.0 ha. (Ref. to Fig.G-5)

Average Land Holding per Household by Villages

(unit : ha)

Area	Average Acreage of Land Hold per Household	No. of Sample Village
TLIA	2.4 ~ 9.6	8
LBBP	3.6	1
NPA	4.0 ~ 7.7	3
PRA	7.1 ~ 12.1	5
OABP	3.2 ha	1

Note : Distribution of Average Values by Villages

4) Land Use

Tha land use rates by items can be shown as follows. (Ref. to Appendix Fig. I. 2-5).

Land Use rated by Items

(unit : %)

Area	Paddy Field	Upland Fields	Orchards	No. of Sample Village
TLIA	91 ~ 100	-	0 ~ 9	8
LBBP			100	1
NPA	100 ~ 87	0 ~ 13		3
PRA	24 ~ 58	38 ~ 74	2 ~ 5	5
OABP		-	100	1

Note : Distribution of Average Values by Villages

5) Gross Income per Hectare in Crop production

The most important income source in farm economy is crop production. Income level fluctuates by sample village. The gross income per hectare in crop as much as two or three times of that from paddy cropping areas. The newly developed areas generate the least gross income of all. (Ref. to Fig.G-7)

Gross Income per Hectare in Crop Production by sample Village (unit : '000 Baht)

Area	Gross Crop Income per ha	No. of Sample Village
TLIA	7.5 ~ 11.8	8
LBBP	21.4	1
NPA	4.4 ~ 9.3	3
PRA	7.0 ~ 8.8	5
OABP	31.4	1

Note : Distribution of Average Values by Village

6) Summery of Farm - household Economy

Economy of Farm-household

(unit : Bhat/farm)

Item	TLEA	LBEA	TLPA
Cultivated land (rai)	31.84	22.53	36.13
Household size (person)	4.76	5.27	5.00
Income :			
Farm income			
Crop	49,989	48,040	37,428
Livestock	7,434	2,296	4,752
Sub - Total	57,332	50,336	42,180
Off farm income			
Employment	12,660	11,992	9,628
Non-agriculture	20,800	47,012	10,777
Sub - Total	33,460	59,004	20,405
Gross family income	90,792	109,340	62,584
Espenses :			
Farm espenses			
Crop	20,933	22,445	15,290
Livestock	4,875	1,092	873
Sub - Total	25,808	23,537	16,163
Hosehold expenses	39,735	42,662	32,139
Gross family expenses	65,543	66,199	48,302
(Excluding family labor)			
Net farm income	31,524	26,799	26,016
Not family income	25,250	43,142	14,281
(Including family labor)			
Net farm income	24,320	13,414	18,772
Net family income	18,045	29,757	7,938

Note : Non-agriculture income is estimated as net value.

Source : Socio-agro economic survey, Dec. 1989.

APPENDIX-H. FACILITY DESIGN AND COST ESTIMATE

APPENDIX-H FACILITY DESIGN AND COST ESTIMATE

LIST OF CONTENTS

H.1.1. Location Comparison of Proposed Damsite

The relationship between locations of the proposed damsites and the previous damsites is shown as follows.

No.1; Same as that of JICA (Aug. '83)

No.2; About 8.2 km upstream of No.1 damsite

No.3; About 3.1 km upstream of ECI (Sep. '71)

No.4; Same as the Site 2 of RID Sit Yat

No.5; Same as the Sit e 3 of RID Si Yat

No.6 About 5.3 km upstream of ECI (Sep. '71)

No.7; Same as the site of ECI (Sep '71)

No.8; New Site

No.9; New Site

No.10; About 1.4 km downstream of ECI (Sep. '71)

No.11; Same as that of RID

No.12; About 3.2 km upstream of ECI (Sep. '71)

No.13; New Site

No.14; New site

No.15; Same as that of ECI (Sep. '71)

No.16;. New site

No.17; New site

No.18; Same as that of ECI (Sep. '71)

No.19; New site

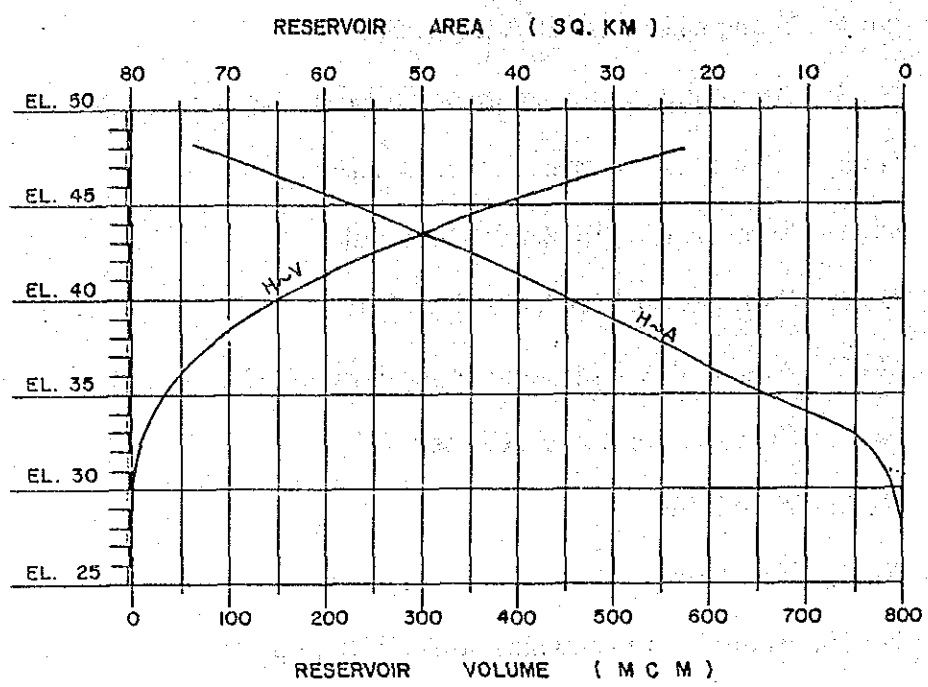
No.20; New site

No.21; Same as that of ECI (Sep. '71)

No.22; About 7.5 km upstream of ECI (Sep. '71)

H.1-2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (1/11)

NO. 1 DAM HEIGHT—AREA AND HEIGHT—VOLUME



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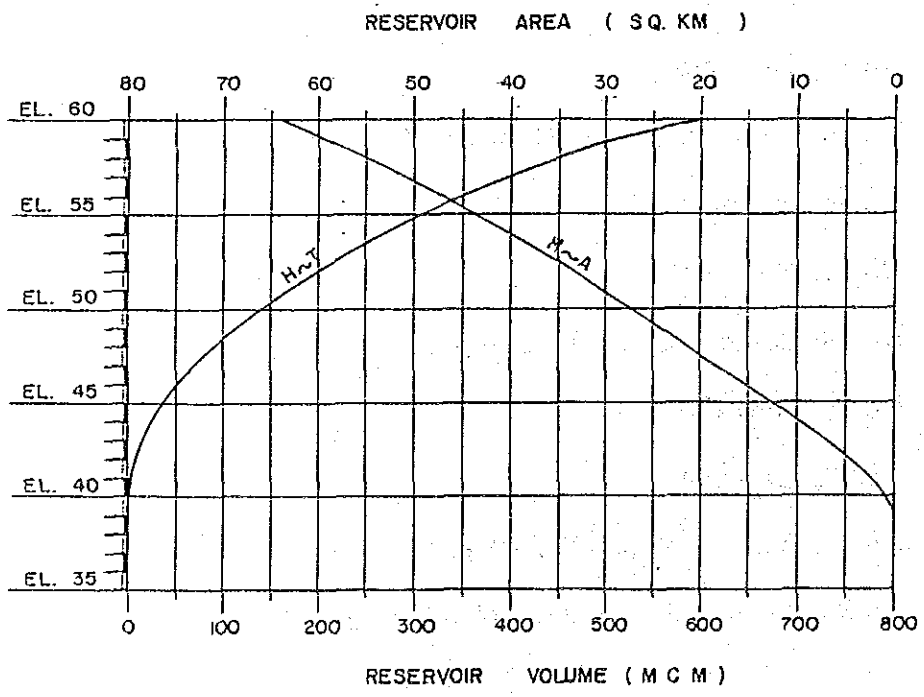
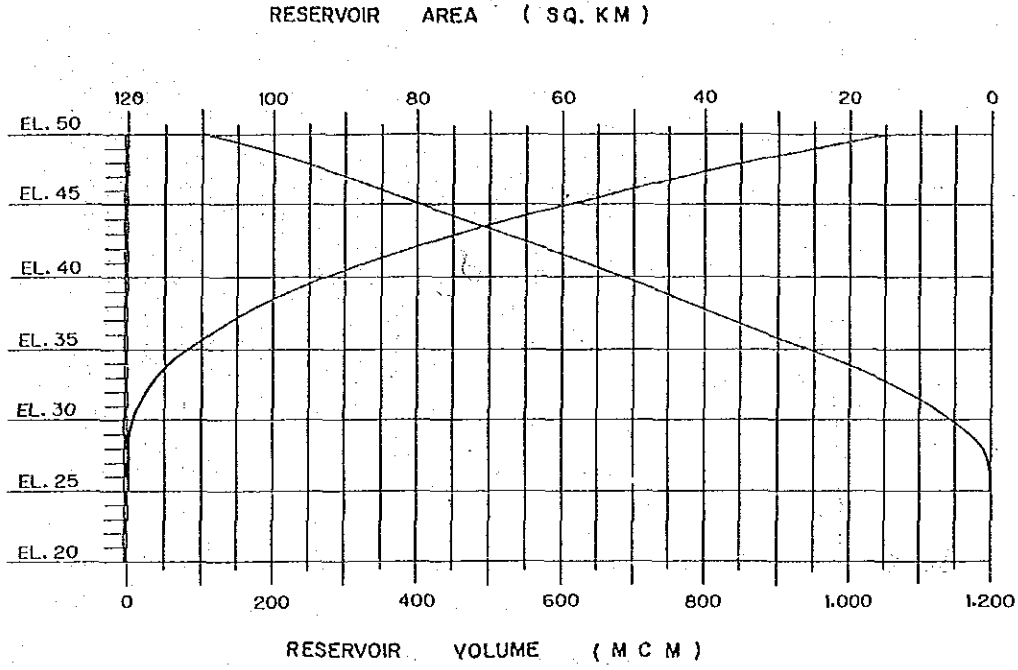


H. 1 - 2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (2/11)

NO. 3 DAM HEIGHT— AREA AND HEIGHT—VOLUME



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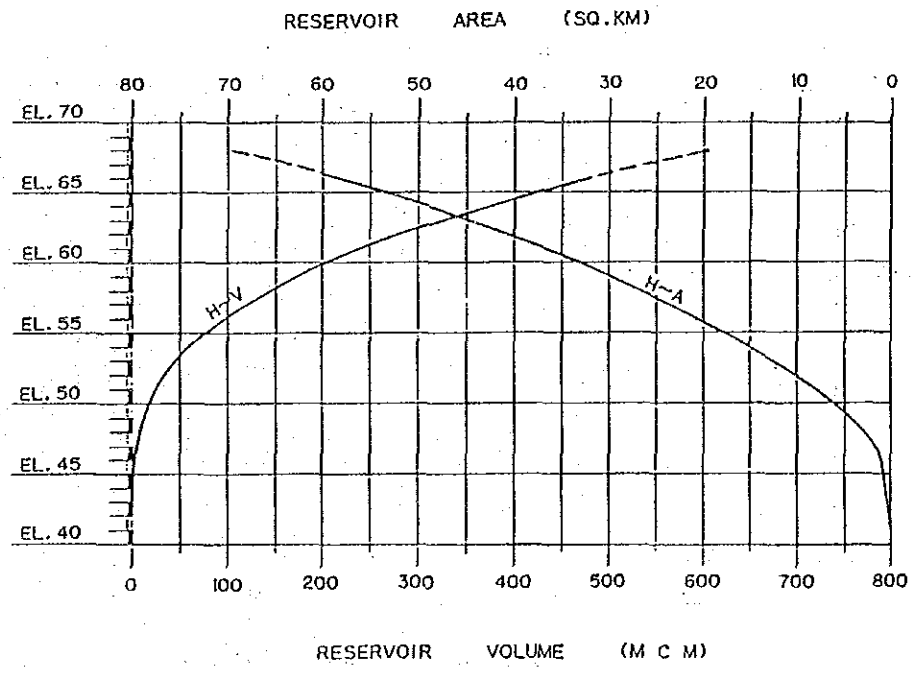
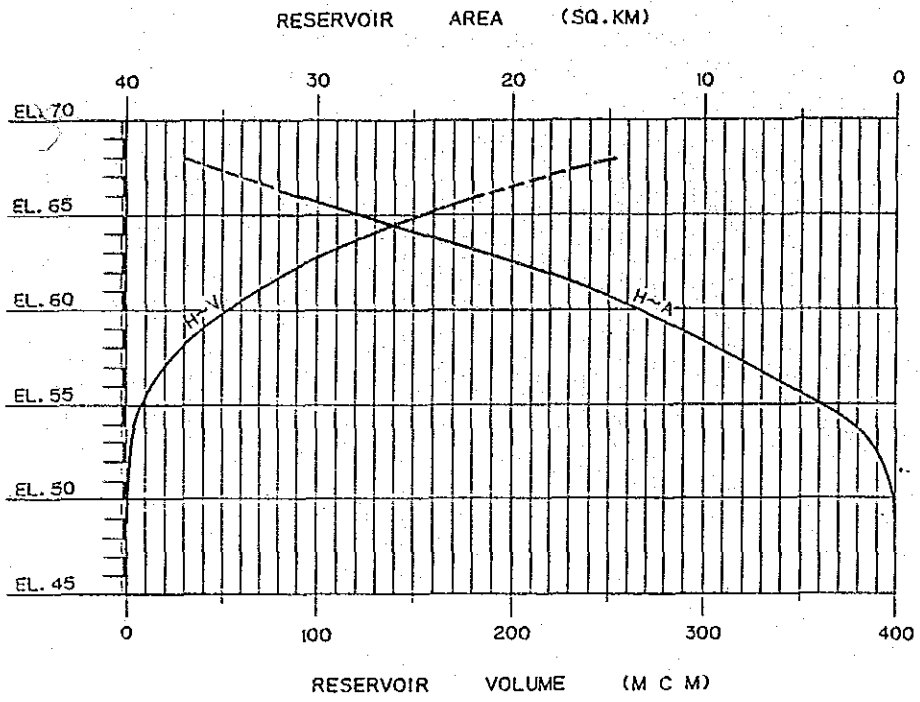


H.1-2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (3/11)

No.5 DAM HEIGHT – AREA AND HEIGHT – VOLUME



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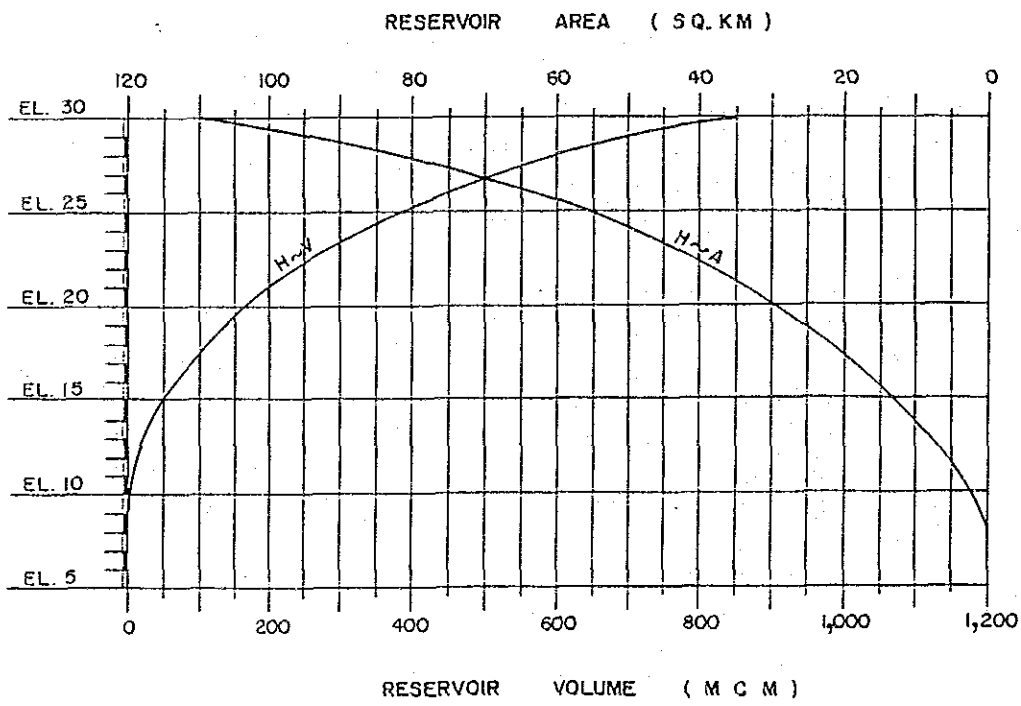
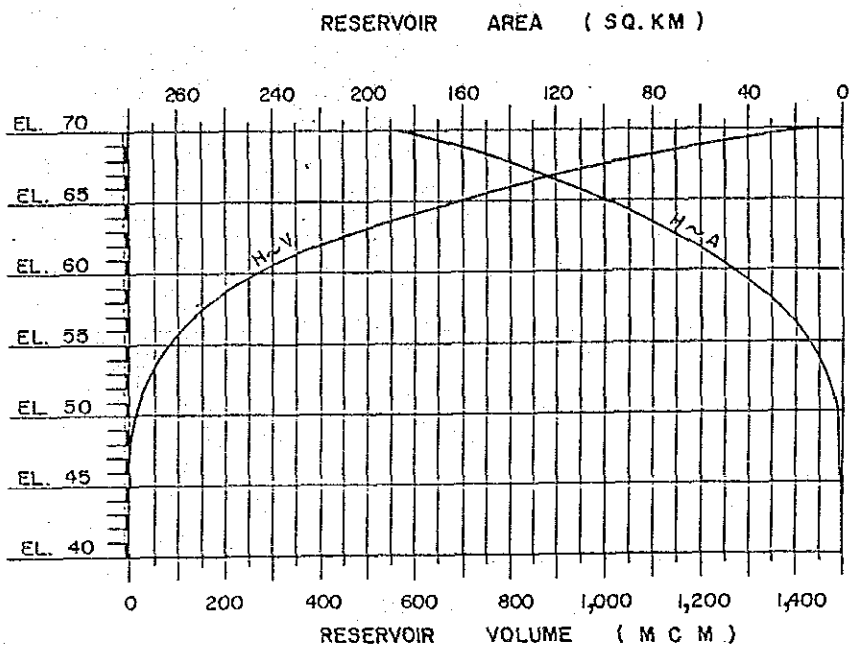


H. 1 - 2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (4/11)

NO. 7 DAM HEIGHT— AREA AND HEIGHT — VOLUME



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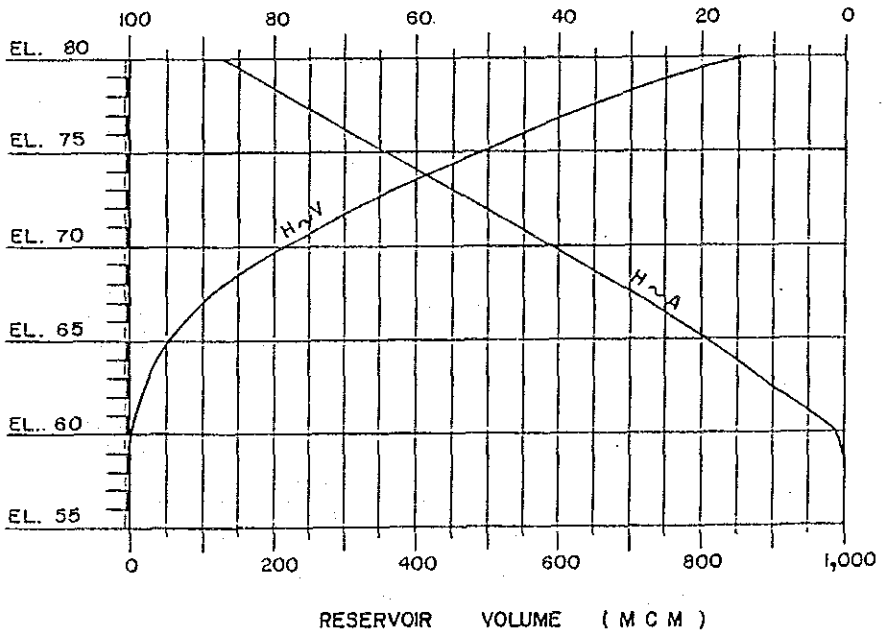

H.1-2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (5/11)

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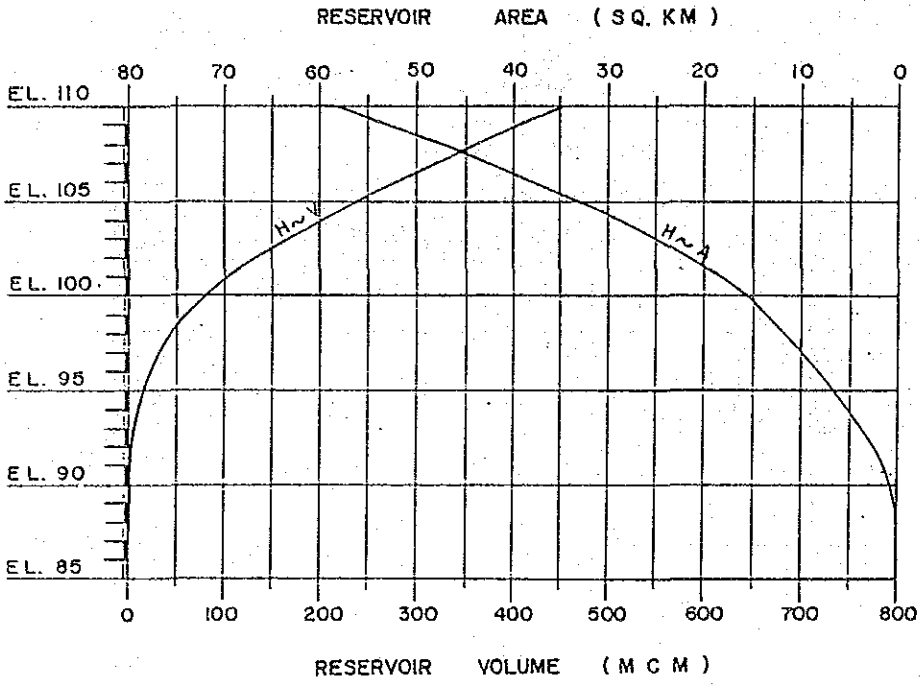

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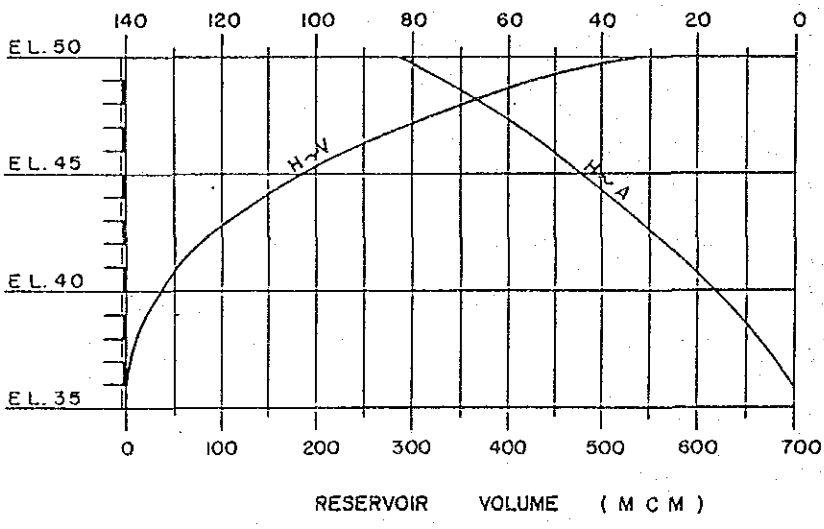
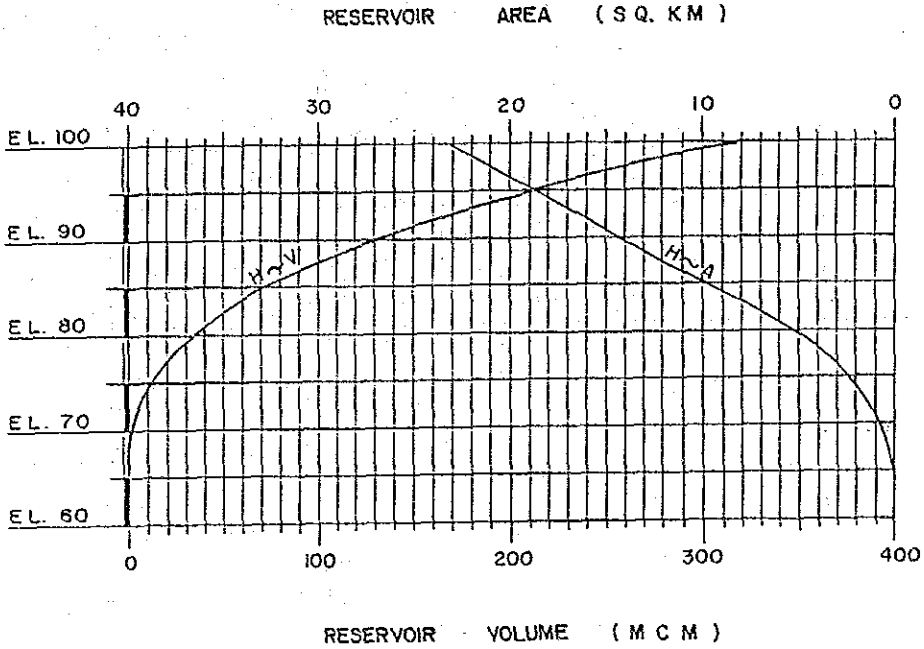


H.1-2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (6/11)

NO. 11 DAM HEIGHT — AREA AND HEIGHT — VOLUME



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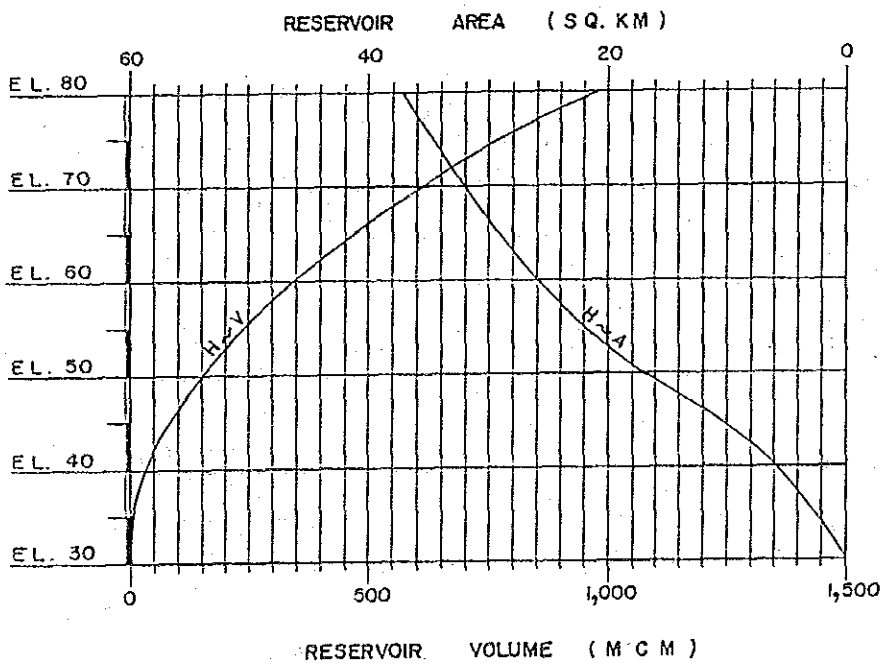
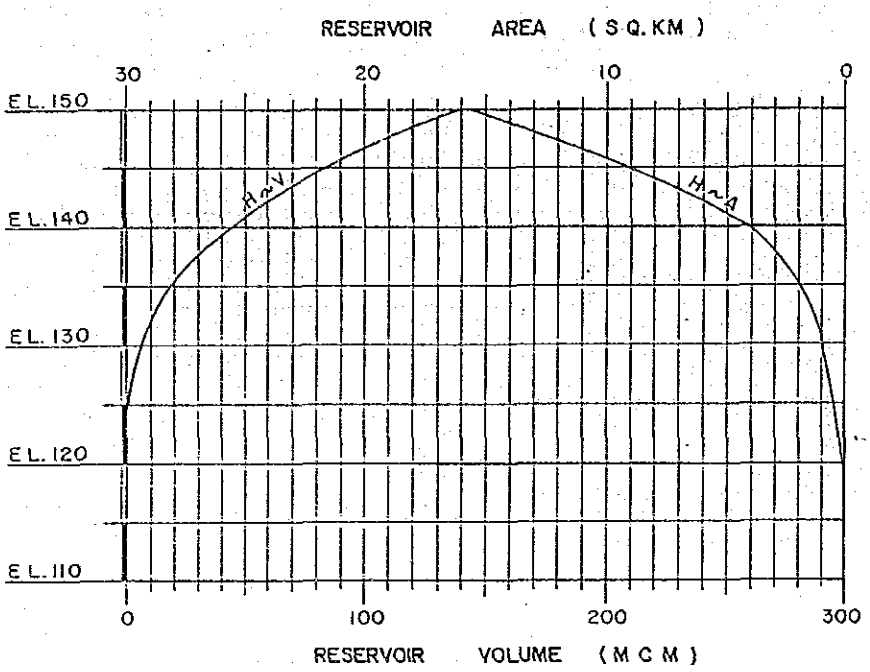
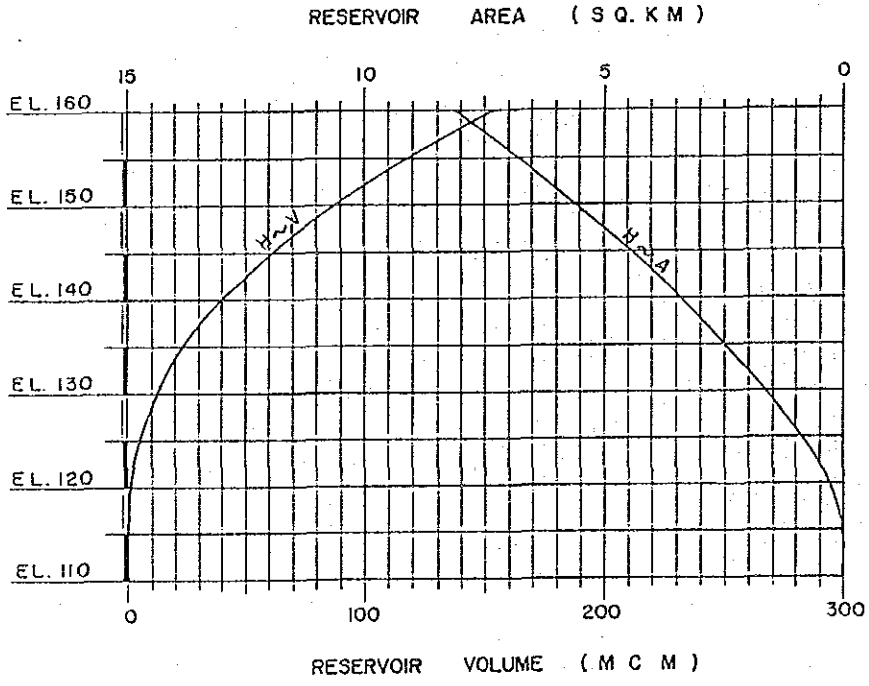


H. 1 - 2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (7/11)

NO. 13 DAM HEIGHT — AREA AND HEIGHT — VOLUMB

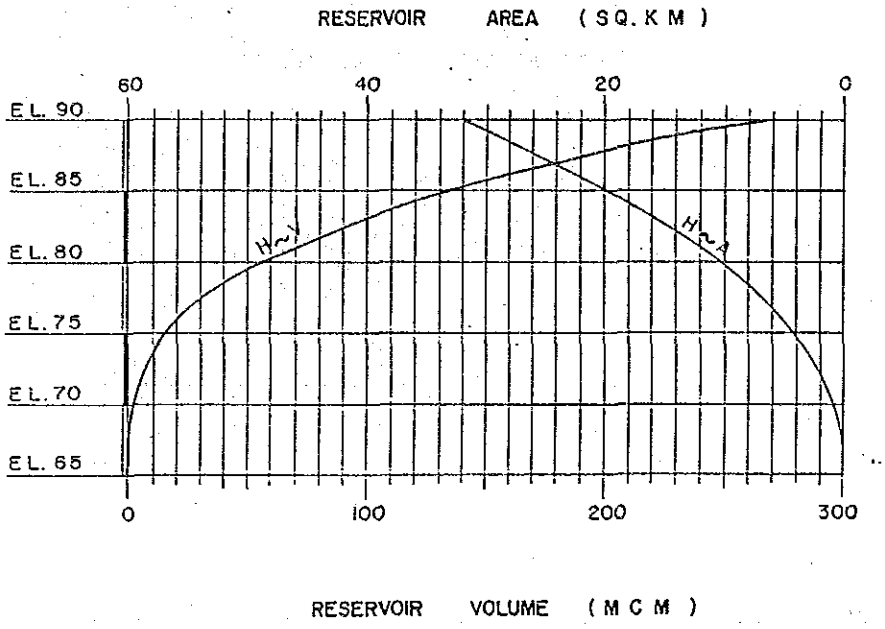


NO. 14 DAM HEIGHT — AREA AND HEIGHT — VOLUME



H.1-2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (8/11)

NO. 15 DAM HEIGHT — AREA AND . HEIGHT — VOLUME



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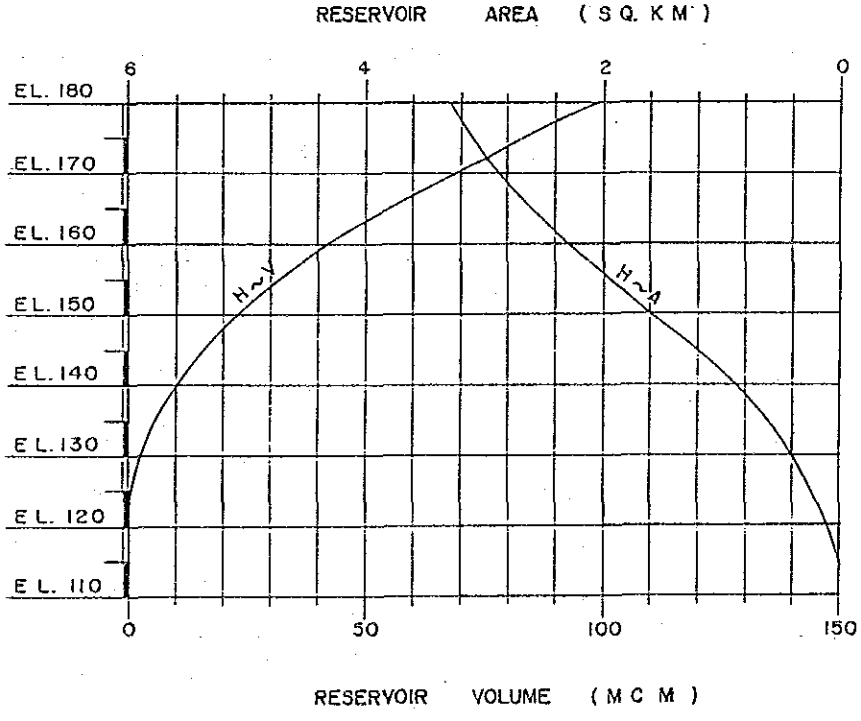
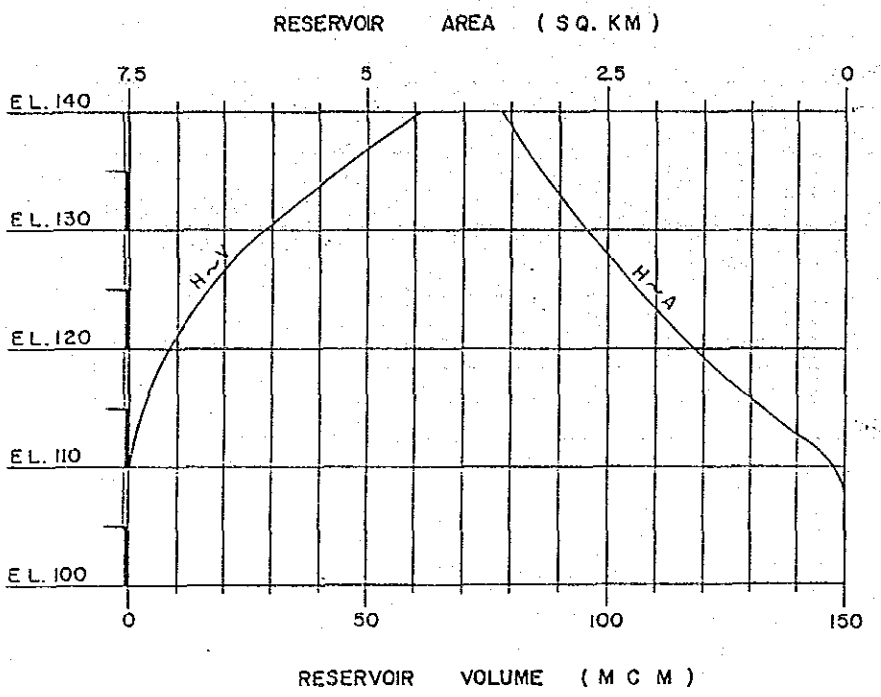


H.1-2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (9/11)

NO. 17 DAM HEIGHT — AREA AND HEIGHT — VOLUME



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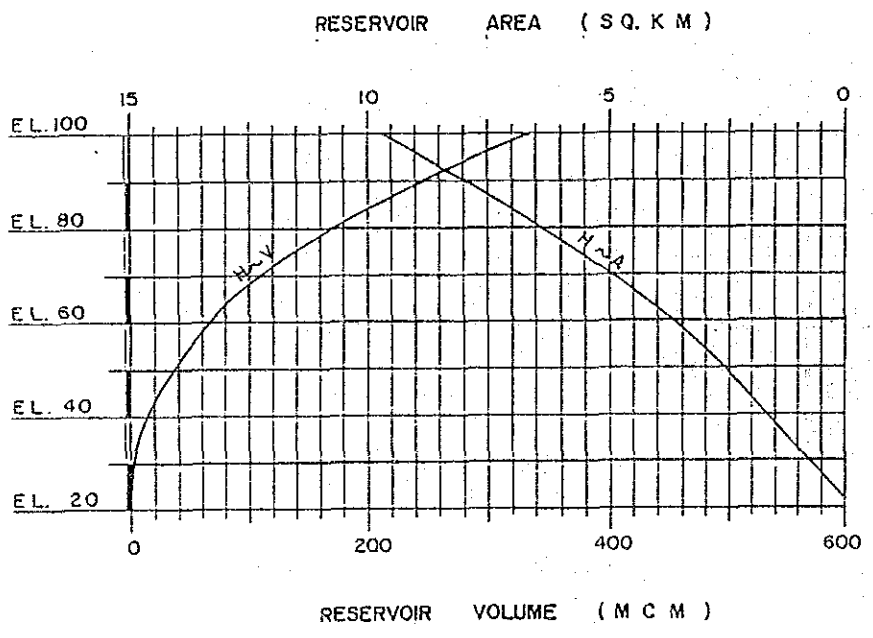

H. 1 - 2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (10/11)

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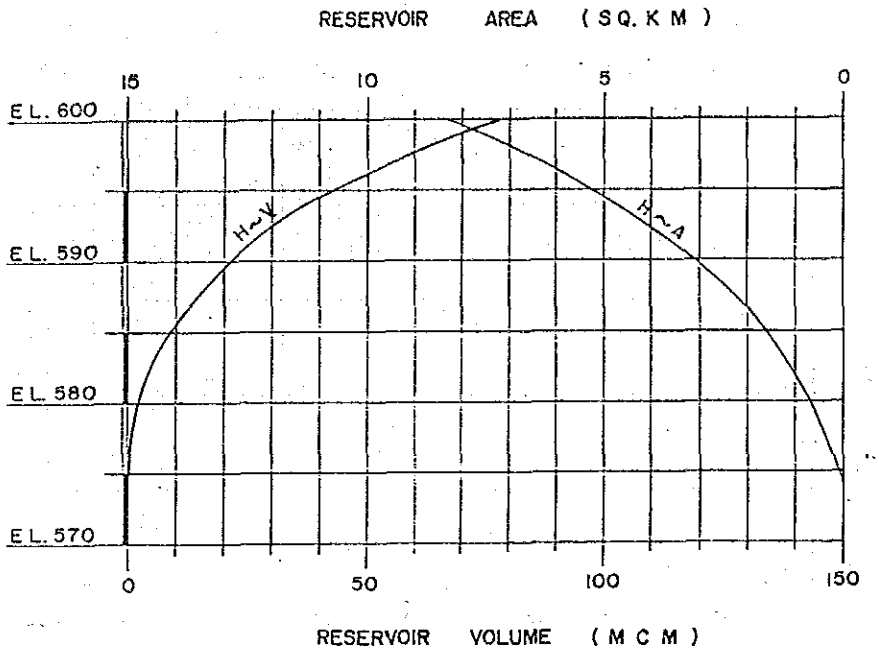
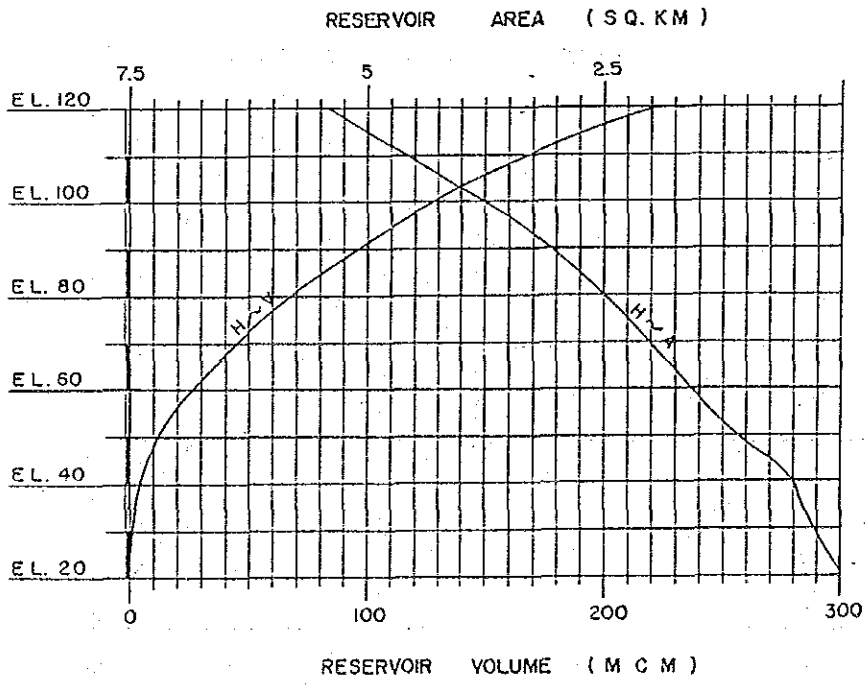
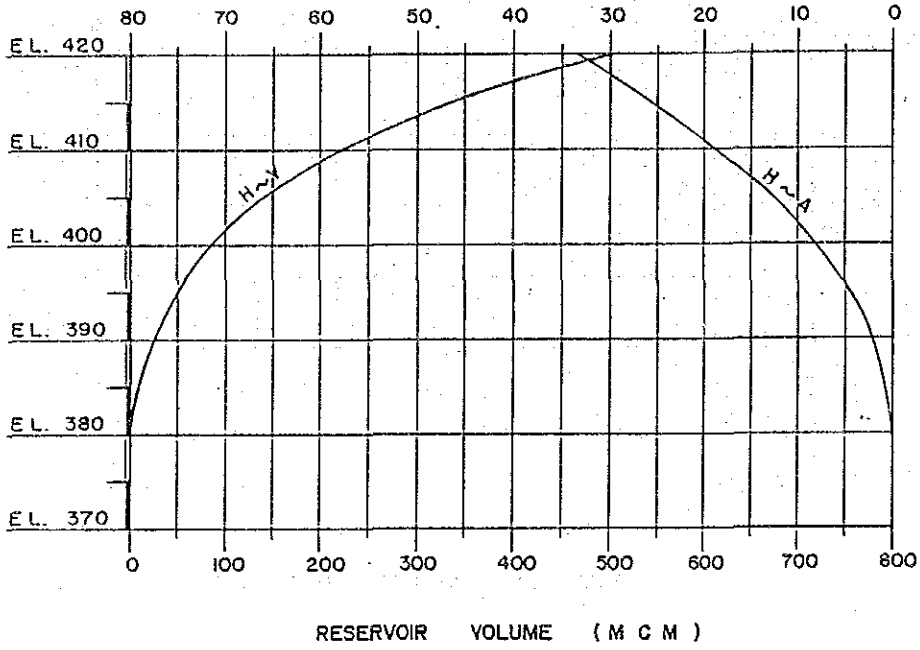


NO. 20 DAM HEIGHT — AREA AND HEIGHT — VOLUME

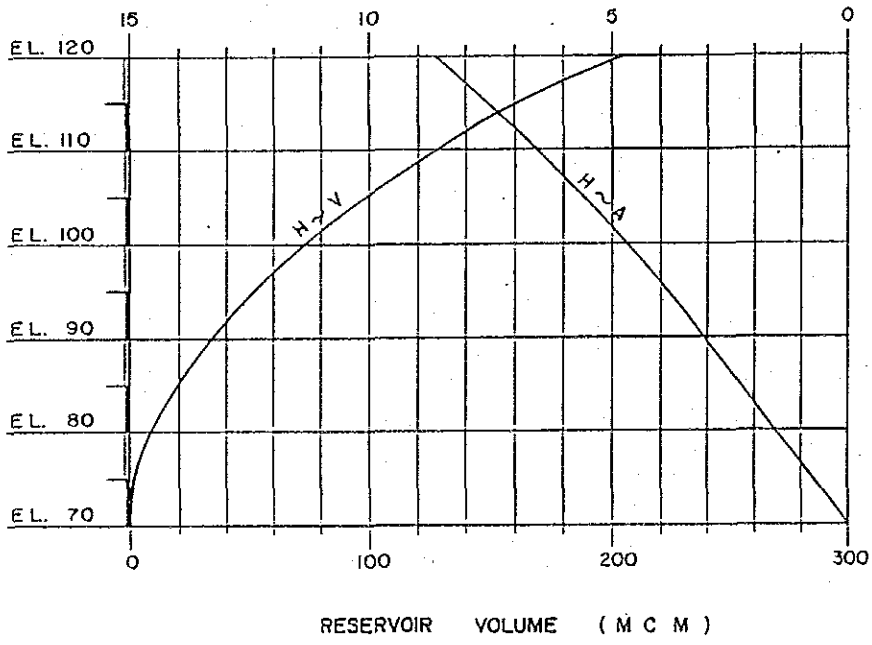


H. 1 - 2 HEIGHT ~ AREA AND HEIGHT ~ VOLUME CURVE (11/11)

NO. 21 DAM HEIGHT – AREA AND HEIGHT – VOLUME



NO. 22 DAM HEIGHT – AREA AND HEIGHT VOLUME



H.1.3 HEIGHT - AREA AND HEIGHT - VOLUME (1/8)

(Calculation Sheet)

No. 1 Dam (Khlong Luang Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
25.4	-	0	-	-	-
30	4.6	0.92	0.46	2.12	2.12
32	2	2.87	1.895	3.79	5.91
34	2	9.35	6.11	12.22	18.13
36	2	18.37	13.86	27.72	45.85
38	2	26.05	22.21	44.42	90.27
40	2	34.36	30.205	60.41	150.68
42	2	43.14	38.75	77.5	228.18
44	2	52.46	47.80	95.6	323.78
46	2	62.53	57.495	114.99	438.77
48	2	72.48	67.505	135.01	573.78

Source: The East Coast Water Resources Development Project (Phase II) August, 1983, JICA

No. 2 Dam (Upper Khlong Luang Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
39	-	0	-	-	-
40	1	1.0	0.5	0.5	0.5
50	10	27.2	14.1	141.0	141.5
60	10	63.6	45.4	454.0	595.5

Note: Prepared based on 1 : 50,000 topo. Map

II.1.3 HEIGHT - AREA AND HEIGHT - VOLUME (2/8)

(Calculation Sheet)

No. 3 Dam (Klong Si Yat Dam)

El. (m)	ΔH (m)	Area (sq.km)	Ave. Area (sq. km)	Volume (MCM)	Accum, Volume (MCM)
20	-	0.00	-	-	-
24	4	0.06	0.03	0.12	0.12
26	2	0.36	0.21	0.42	0.54
28	2	1.16	0.76	1.52	2.06
30	2	5.87	3.515	7.03	9.09
32	2	12.64	9.255	18.51	27.60
34	2	20.32	16.48	32.96	60.56
36	2	31.61	25.965	51.93	112.49
38	2	40.93	36.27	72.54	185.03
40	2	51.91	46.42	92.84	277.87
42	2	62.48	57.195	114.39	392.26
44	2	73.16	67.82	135.64	527.90
46	2	84.23	78.695	157.39	685.29
48	2	96.24	90.235	180.47	865.76
50	2	109.71	102.975	205.95	1,071.71

Note : Prepared based on 1 : 10,000 Topo. Map.

No. 4 Dam (Middle Si Yat Dam)

EL. (m)	Δ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
40	6	0.00	-	-	-
46	2	0.88	0.44	2.64	2.64
48	2	3.01	1.945	3.89	6.53
50	2	6.15	4.58	9.16	15.69
52	2	10.31	8.23	16.46	32.15
54	2	15.10	12.705	25.41	57.56
56	2	21.49	18.295	36.59	94.15
58	2	27.01	24.25	48.50	142.65
60	2	33.11	30.06	60.12	202.77
62	2	41.31	37.21	74.42	277.49
64	2	49.39	45.35	90.70	368.19
66	2	58.66	54.025	108.05	476.24

Note: Prepared based on 1 : 10,000 Topo. Map. 1990

H.1.3 HEIGHT - AREA AND HEIGHT - VOLUME (3/8)

(Calculation Sheet)

No. 5 Dam (Upper Khlong Si Yat Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
48	-	0	-	-	-
50	2	0.17	0.085	0.17	0.17
52	2	0.81	0.49	0.98	1.15
54	2	2.38	1.595	3.19	4.34
56	2	6.08	4.23	8.46	12.80
58	2	9.63	7.855	15.71	28.51
60	2	13.66	11.645	23.29	51.80
62	2	19.29	16.475	32.95	84.75
64	2	24.81	22.05	44.10	128.85
66	2	31.09	27.95	55.90	184.75

Note: Prepared based on 1 : 10,000 Topo. Map 1990.

No. 6 Dam (Lower Khlong Luang Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
8	-	0	-	-	-
10	2	2.4	1.2	2.4	2.4
20	10	29.7	16.05	160.5	162.9
30	10	109.2	69.45	694.5	857.4

Note: Prepared based on 1 : 50,000 Topo. Map

H.1.3 HEIGHT - AREA AND HEIGHT - VOLUME (4/8)

(Calculation Sheet)

No. 7 Dam (Khlong Phra Sathung Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
40	-	0	-	-	-
50	10	2.5	1.25	12.5	12.5
60	10	45.9	24.2	242.0	254.5
70	10	186.2	116.05	1,160.5	1,415.0

No. 8 Dam (Middle Khlong Phra Sathung Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
56	-	0	-	-	-
60	4	1.1	0.55	2.2	2.2
70	10	41.5	21.3	213.0	215.2
80	10	87.3	64.4	644.0	859.2

No. 9 Dam (Upper Khlong Phra Sathung Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
86	-	0	-	-	-
90	4	0.3	0.15	0.6	0.6
100	10	15.5	7.9	79.0	79.6
110	10	58.4	36.95	369.5	449.1

H.1.3 HEIGHT - AREA AND HEIGHT - VOLUME (5/8)

(Calculation Sheet)

No. 10 Dam (Khlong Phra Prong Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
36	-	0	-	-	-
40	4	17.2	8.6	34.4	34.4
50	10	82.3	49.75	497.5	531.9

No. 11 Dam (Khlong Phra Prong Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
65	-	0	-	-	-
70	5	0.8	0.4	2.0	2.0
80	10	5.2	3.0	30.0	32.0
90	10	14.5	9.85	98.5	130.5
100	10	23.1	18.8	188.0	318.5

No. 12 Dam (Huai Samong Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
30	-	0	-	-	-
40	10	5.9	2.95	29.5	29.5
60	20	25.9	15.9	318.0	347.5
80	20	37.4	31.65	633.0	980.5

H.1.3 HEIGHT - AREA AND HEIGHT - VOLUME (6/8)

(Calculation Sheet)

No. 13 Dam (Upper Huai Samong Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
110	-	0	-	-	-
120	10	0.08	0.04	0.4	0.4
140	20	4.1	2.09	41.8	42.2
150	10	15.6	9.85	98.5	140.7

No. 14 Dam (Huai Kham Pku Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
110	-	0	-	-	-
120	10	0.4	0.2	2.0	2.0
140	20	3.4	1.9	38.0	40.0
160	20	8.1	5.75	115.0	155.0

No. 15 Dam (Lam Phraya Than Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
66	-	0	-	-	-
70	4	0.9	0.45	1.8	1.8
80	10	10.1	5.5	55.0	56.8
90	10	31.9	21.0	210.0	266.8

H.1.3 HEIGHT - AREA AND HEIGHT - VOLUME 7/8)

(Calculation Sheet)

No. 16 Dam (Huai Wang Mut Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
114	-	0	-	-	-
120	6	0.1	0.05	0.3	0.3
140	20	0.9	0.5	10.0	10.3
160	20	2.3	1.6	32.0	42.3
180	20	3.3	2.8	56.0	98.3

No. 17 Dam (Upper Lam Phraya Than Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
108	-	0	-	-	-
110	2	0.1	0.05	0.1	0.1
120	10	1.6	0.85	8.5	8.6
140	20	3.6	2.6	52.0	60.6
160	20	6.0	4.8	96.0	156.6

No. 18 Dam (Huai Sai Noi Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
22	-	0	-	-	-
40	18	1.7	0.85	15.3	15.3
60	20	3.6	2.65	53.0	68.3
80	20	6.5	5.05	101.0	169.3
100	20	9.6	8.05	161.0	330.3
120	20	13.0	11.3	226.0	556.3

H.1.3 HEIGHT - AREA AND HEIGHT - VOLUME (8/8)

(Calculation Sheet)

No. 19 Dam (Huai Sai Yai Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
574	-	0	-	-	-
580	6	0.7	0.35	2.1	2.1
590	10	3.1	1.9	19.0	21.1
600	10	8.3	5.7	57.0	78.1

No. 20 Dam (Khlong Nong Kaeo Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
20	-	0	-	-	-
40	20	0.5	0.25	5.0	5.0
60	20	1.6	1.05	21.0	26.0
80	20	2.5	2.05	41.0	67.0
100	20	3.8	3.15	63.0	130.0
120	20	5.4	4.6	92.0	222.0

No. 21 Dam (Khlong Tha Dan Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
370	-	0	-	-	-
380	10	0.2	0.1	1.0	1.0
400	20	8.0	4.1	82.0	83.0
420	20	33.1	20.55	411.0	494.0

No. 22 Dam (Khlong Ban Na Dam)

EL. (m)	△ H (m)	Area (sq.km)	Ave. Area (sq.km)	Volume (MCM)	Accum. Volume (MCM)
70	-	0	-	-	-
80	10	1.6	0.8	8.0	8.0
100	20	4.7	3.15	63.0	71.0
120	20	8.6	6.65	133.0	204.0

H.1.4. Design Discharge of Spillway

Design discharge of spillway is estimated taking into account effect of storage above normal water surface in case of large water surface area of reservoir compared with drainage area.

a) Inflow Hydrograph

The hydrographs prepared on the flood discharges with 1,000 year and 500-year probability which are analyzed in paragraphy 2-4-4 in Chapter 2.

b) Flood Routing

The accumulation of storage in the reservoir above normal water surface depends on difference between the rates of inflow and outflow. For an interval of time T, this relationship can be expressed by the following equation;

$$Vtn = Vtn\text{-}1 + \left\{ \frac{Qtn + Qtn\text{-}1}{2} - Qdtn \right\} \times \Delta T$$

where;

Vtn ; storage accumulated at tn time

Vtn-1 ; storage accumulated at tn-1 time

Qtn ; inflow at tn time (cu.m/s)

Qdtn Average outflow during T (tn - tn-1) (cu.m/s)

T ; interval of time from tn to tn-1

Based on the method mentioned above, the inflow and outflow of each dams are as shown in Table H.1- .

The inflow and outflow of No.4 dam (Si Yat No.2 dam) are as shown in Figure H- .

Max inflow = 2,037 cu.m/s

Max outflow = 1,030 cu.m/s

Therefore, about 1,000 cu.m/s of discharge can be reduced by reservoir storage and actual design of spillway shall be made with the maximum outflow.

c) Design Discharge for each Dam

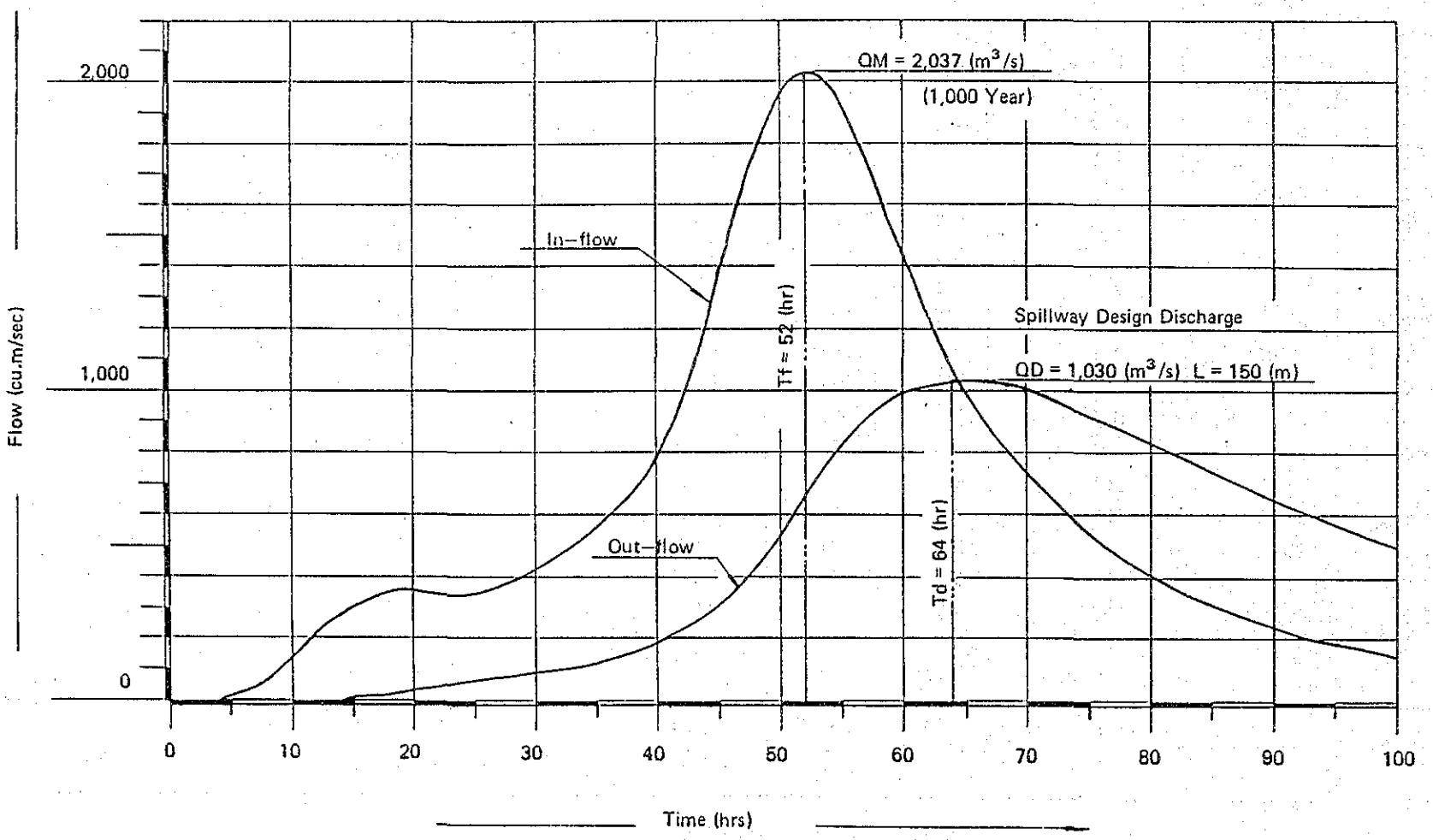
Design discharge of spillway for all dams are decided in Table H.1-

TABLE H-1-4 DESIGN DISCHARGE OF SPILLWAY

No. of Dam	Drainage Area	Return Period	(Q.M) Design Flood	N.W.L	Reservoir Area	Weir of Spillway		(Q.D) Design Discharge	H.W.L	Rate of QD/QM
						Length	Hd			
	(sq.km)	(year)	(cu.m/s)	(m)	(sq.km)	(m)	(m)	(cu.m/s)	(m)	
1	528	1,000	1,073	39.5	32.5	70	2.0	391	41.48	0.36
2	344	1.000	756	48.5	24.0	80	1.7	361	50.22	0.48
3	1,371	1,000	2,492	42.6	60.4	150	2.4	1,045	44.95	0.42
4	976	1,000	2,037	63.1	45.5	150	2.3	1,030	65.38	0.41
5	585	1,000	1,221	66.1	31.1	50	2.6	405	68.65	0.33
6	798	1,000	1,647	23.0	43.7	150	1.9	786	24.90	0.48
7	2,254	1,000	4,666	65.8	110.0	250	2.6	2,009	68.33	0.43
8	1,453	1,000	3,190	75.3	66.0	180	2.8	1,694	78.11	0.53
9	614	1,000	1,514	104.5	31.0	100	2.4	730	106.87	0.48
10	1,041	1,000	2,313	44.9	43.5	140	2.6	1,170	47.50	0.51
11	266	500	582	87.0	12.2	50	2.2	332	89.23	0.57
12	443	1,000	1,417	57.8	22.1	150	2.3	1,085	60.15	0.77
13	147	500	471	145.0	9.1	20	2.8	187	147.79	0.40
14	64	500	214	138.0	3.0	40	1.7	184	139.72	0.86
15	338	1,000	837	83.5	16.8	40	2.6	343	86.14	0.41
16	96	500	252	157.7	2.1	50	1.8	232	159.46	0.92
17	68	500	174	128.0	2.5	50	1.3	153	129.32	0.88
18	432	1,000	1,296	99.5	9.5	140	2.6	1,183	102.11	0.91
19	273	1,000	694	585.0	1.6	30	4.9	637	589.84	0.92
20	107	1,000	393	101.0	3.8	100	1.5	378	102.53	0.96
21	151	1,000	498	408.5	17.0	20	2.1	126	410.64	0.25
22	114	1,000	380	105.7	5.8	100	1.4	337	107.12	0.89

FIGURE H-1-3 INFLOW - OUTFLOW HYDROGRAPH

(SI YAT NO.2 DAM)



H.1.5 TECHNICAL MATTERS ON EMBANKMENT WORKS

A: Reliability on Dams Foundation (5 points)
B: Quality and Quantity of Embankment Materials (3 points)
C: Easiness in Construction Works (2 points)

Block No.	Damsite	Dam Height (m)	Emb. Vol. ('000 m³)	A	B	C	Total	General Evaluation
LBP	①	23.5	3,340	3	3	2	8	B
	2	18.3	2,960	3	3	2	8	B
KTL	3	34.1	8,200	2	3	2	7	C
	④	33.5	3,740	3	3	2	8	B
	5	28.7	580	4	3	2	9	A
	6	25.9	5,100	2	3	1.5	6.5	D
KPS	7	35.5	11,500	1	2	1.5	4.5	E
	⑧	30.3	4,270	3	2	2	7	C
	9	26.9	4,260	3	2	2	7	C
UPP	⑩	23.5	2,750	1	3	2	6	E
	⑪	28.3	1,060	4	3	2	9	A
MHM	⑫	35.2	3,450	3	2	1.5	6.5	D
	13	41.8	450	5	3	1.5	9.5	A
	14	33.8	500	5	1	1.5	7.5	C
	⑮	24.2	260	5	1	2	8	B
	16	50.5	2,450	4	2	1.5	7.5	C
	17	26.4	1,280	4	2	1.5	7.5	C
	⑱	85.6	10,800	4	1	1.5	6.5	D
UBP	⑲	23.0	480	4	2	1	7	C
MNN	⑳	86.6	11,150	5	2	1.5	8.5	B
	21	47.7	920	1	3	1.5	5.5	E
	22	43.2	6,600	4	2	1	7	C

Point ... 5 A Favourable: No trouble at all

Point ... 1 E Unfavourable: With troubles

TABLE H-1-6 DIMENSION AND SPECIFICATIONS OF PROPOSED DAMSITES(1)

DAM NAME (NO.) / Description	Unit	No.1 Khlong Luang	No.2 Upper Khlong Luang	No.3 Khlong Si Yat (No.1)	No.4 Middle Khlong Si Yat (No.2)	No.5 Upper Klong Si Yat (No.3)
1. Location : Map No.		5235 I	5235 I	5336 III	5335 IV	5335 IV
: Coordinates		54.8 - 80.9	61 - 75.5	76 - 99.1	87.6 - 87.1	91.7 - 85.6
2. Drainage Area	sq.km	528	344	1,371	976	585
3. Basin Rainfall: Annual Average	mm	1,266	1,268	1,332	1,334	1,334
4. Runoff : Maximum Annual	MCM	175	117	666	487	291
: Minimum Annual	MCM	100	67	259	182	109
: Average Annual	MCM	136	91	396	286	171
5. Topography : River Bed Elevation	m	25.4	39	18.6	40	48
: Highest Mountain EL.	m	525	525	777	777	660
: Left Bank Abutment Slope	DEG	3	1	0.5	1	8
: River Bed Width	m	25	20	25	20	15
: Right Bank Abutment Slope	DEG	0.4	0.7	0.7	6	15
: Span-Height Ratio	-	236	249	171	79	26
6. Reservoir : Active Storage Capacity	MCM	119	91	396	300	171
: Dead Storage Capacity	MCM	16	9	35	25	15
: Gross Storage Capacity	MCM	135	100	431	325	186
: Normal Water Surface Area	sq.km	32.5	24	60.4	45.5	31.1
: Low Water Level (L.W.L)	m	33.8	41.8	32.5	51.5	56.5
: Normal Water Level (N.W.L)	m	39.5	48.5	42.6	63.1	66.1
: Maximum Water Level (H.W.L)	m	41.5	50.3	45.0	65.4	68.7
7. Dam Body : Crest Elevation	m	43.5	52.3	47.1	67.5	70.7
: Foundation Elevation	m	20	34	13	34	42
: Dam Height	m	23.5	18.3	34.1	33.5	28.7
: Crest Length	m	5,550	4,550	6,200	2,640	760
: Dam Volume	1000 cu.m	3,340	2,960	8,200	3,740	580
8. Spillway : Design Flood	CMS	1,073	756	2,492	2,037	1,221
: Design Discharge	CMS	391	361	1,045	1,030	405
: Crest Length	m	70	80	150	150	50
: Crest Elevation	m	39.5	48.5	42.6	63.1	66.1
9. Active Storage Capacity/Dam Volume	-	35.6	30.7	48.3	80.2	295

TABLE H-1-6 DIMENSION AND SPECIFICATIONS OF PROPOSED DAMSITES(2)

DAM NAME (NO.)			No.6 Lower Khlong Rabom	No.7 Khlong Phra Sathung	No.8 Middle Khlong Phra Sathung	No.9 Upper Khlong Phra Sathung	No.10 Khlong Phra Prong
Description		Unit					
1. Location	: Map No.		5336 III	5436 III	5436 III	5435 IV	5436 IV
	: Coordinates		76 - 11.4	84.1 - 11.5	80.4 - 0.7	84.1 - 87.5	90.6 - 33.4
2. Drainage Area		sq.km	798	2,254	1,453	614	1,041
3. Basin Rainfall:	Annual Average	mm	1,369	1,514	1,538	1,566	1,547
4. Runoff	: Maximum Annual	MCM	364	830	565	242	478
	: Minimum Annual	MCM	165	536	326	142	325
	: Average Annual	MCM	232	715	470	203	387
5. Topography	: River Bed Elevation	m	8	40	56	86	36
	: Highest Mountain EL.	m	325	1,608	1,608	802	840
	: Left Bank Abutment Slope	DEG	0.4	0.5	6	0.4	3
	: River Bed Width	m	20	30	25	25	20
	: Right Bank Abutment Slope	DEG	0.5	0.4	1.2	1	3
	: Span-Height Ratio	-	239	324	153	234	336
6. Reservoir	: Active Storage Capacity	MCM	252	715	470	203	160
	: Dead Storage Capacity	MCM	20	57	37	16	21
	: Gross Storage Capacity	MCM	272	772	507	219	181
	: Normal Water Surface Area	sq.km	43.7	110	66	31	43.5
	: Low Water Level (L.W.L)	m	12.7	53.8	63.9	95.0	39.0
	: Normal Water Level (N.W.L)	m	23.0	65.8	75.3	104.5	44.9
	: Maximum Water Level (H.W.L)	m	24.9	68.4	78.2	106.9	47.5
7. Dam Body	: Crest Elevation	m	26.9	70.5	80.3	108.9	49.5
	: Foundation Elevation	m	1	35	50	82	26
	: Dam Height	m	25.9	35.5	30.3	26.9	23.5
	: Crest Length	m	6,200	11,500	4,650	6,300	7,900
	: Dam Volume	1000 cu.m	5,100	11,500	4,270	4,260	2,750
8. Spillway	: Design Flood	CMS	1,647	4,666	3,190	1,514	2,313
	: Design Discharge	CMS	786	2,009	1,694	730	1,170
	: Crest Length	m	150	250	180	100	140
	: Crest Elevation	m	23.0	65.8	75.3	104.5	44.9
9. Active Storage Capacity/Dam Volume		-	49.4	62.2	110	47.6	58.2

TABLE H-1-6 DIMENSION AND SPECIFICATIONS OF PROPOSED DAMSITES(3)

DAM NAME (NO.)		Unit	No.11 Upper Khlong Phra Prong	No.12 Huai Samong	No.13 Upper Huai Samong	No.14 Huai Kham Pku	No.15 Lam Phraya Than
Description							
1. Location	: Map No.		5437 II	5437 III	5437 III	5437 III	5337 II
	: Coordinates		22.2 - 49.1	79.4 - 58.3	90.5 - 60.3	80.3 - 64.5	12.6 - 70.7
2. Drainage Area		sq.km	266	443	147	64	338
3. Basin Rainfall:	Annual Average	mm	1,339	2,030	1,836	1,748	1,417
4. Runoff	: Maximum Annual	MCM	106	376	103	39	134
	: Minimum Annual	MCM	70	204	57	22	85
	: Average Annual	MCM	86	289	80	31	124
5. Topography	: River Bed Elevation	m	65	30	110	110	66
	: Highest Mountain EL.	m	840	975	804	975	992
	: Left Bank Abutment Slope	DEG	2	0.8	30	20	14
	: River Bed Width	m	15	15	20	10	15
	: Right Bank Abutment Slope	DEG	5	4	9	25	26
	: Span-Height Ratio	-	39	97	4.3	6.2	11
6. Reservoir	: Active Storage Capacity	MCM	86	290	80	31	98
	: Dead Storage Capacity	MCM	6	9	3	2	7
	: Gross Storage Capacity	MCM	92	299	83	33	105
	: Normal Water Surface Area	sq.km	12.2	22.1	9.1	3.0	16.8
	: Low Water Level (L.W.L)	m	72.8	41.7	128.2	120.0	73.0
	: Normal Water Level (N.W.L)	m	87.0	57.8	145.0	138.0	83.5
	: Maximum Water Level (H.W.L)	m	89.3	60.2	147.8	139.8	86.2
7. Dam Body	: Crest Elevation	m	91.3	62.2	149.8	141.8	88.2
	: Foundation Elevation	m	63	27	108	108	64
	: Dam Height	m	28.3	35.2	41.8	33.8	24.2
	: Crest Length	m	1,100	3,400	180	210	260
	: Dam Volume	1000 cu.m	1,060	3,450	450	500	260
8. Spillway	: Design Flood	CMS	582	1,417	471	214	837
	: Design Discharge	CMS	332	1,085	187	184	343
	: Crest Length	m	50	150	20	40	40
	: Crest Elevation	m	870	57.8	145.0	138.0	83.5
9. Active Storage Capacity/Dam Volume		-	81.1	84.0	178	62.0	377

TABLE H-1-6 DIMENSION AND SPECIFICATIONS OF PROPOSED DAMSITES(4)

DAM NAME (NO.)			Unit	No.16 Huai Wang Mut	No.17 Upper Lam Phraya Than	No.18 Huai Sai Noi	No.19 Huai Sai Yai	No.20 Khlong Nong Kaeo
1. Location	:	Map No.		5337 I	5337 I	5337 III	5337 IV	5337 III
	:	Coordinates		11.6 - 84	6.4 - 81.2	91.7 - 67.8	87.7 - 83.3	81.1 - 69.5
2. Drainage Area			sq.km	96	68	159	273	107
3. Basin Rainfall:		Annual Average	mm	1,342	1,342	2,109	1,571	1,855
4. Runoff	:	Maximum Annual	MCM	44	34	202	209	171
	:	Minimum Annual	MCM	20	17	109	128	106
	:	Average Annual	MCM	32	23	150	172	133
5. Topography	:	River Bed Elevation	m	114	108	22	574	20
	:	Highest Mountain EL.	m	824	875	967	1,326	960
	:	Left Bank Abutment Slope	DEG	17	4	11	10	11
	:	River Bed Width	m	10	10	-	-	35
	:	Right Bank Abutment Slope	DEG	5	6	23	3	15
	:	Span-Height Ratio	-	15	66	11	48	14
6. Reservoir	:	Active Storage Capacity	MCM	35	23	322	-	133
	:	Dead Storage Capacity	MCM	2	2	4	8.5	3
	:	Gross Storage Capacity	MCM	37	25	326	8.5	136
	:	Normal Water Surface Area	sq.km	2.1	2.5	9.5	1.6	3.8
	:	Low Water Level (L.W.L)	m	128.0	113.0	30.0	585.0	34.0
	:	Normal Water Level (N.W.L)	m	157.5	128.0	99.5	-	101.0
	:	Maximum Water Level (H.W.L)	m	159.5	129.4	102.2	590.0	102.6
7. Dam Body	:	Crest Elevation	m	161.5	131.4	104.2	592.0	104.6
	:	Foundation Elevation	m	111	105	19	569	18
	:	Dam Height	m	50.5	26.4	85.6	23	86.6
	:	Crest Length	m	780	1,750	970	1,100	1,200
	:	Dam Volume	1000 cu.m	2,450	1,280	10,800	480	11,150
8. Spillway	:	Design Flood	CMS	252	174	1,296	694	393
	:	Design Discharge	CMS	232	153	1,183	637	378
	:	Crest Length	m	50	50	140	30	20
	:	Crest Elevation	m	157.5	128.0	99.5	590.0	101.0
9. Active Storage Capacity/Dam Volume			-	14.3	18.0	29.8	-	11.9

TABLE H-1-6 DIMENSION AND SPECIFICATIONS OF PROPOSED DAMSITES(5)

DAM NAME (NO.)				No.21 Khlong Tha Dan	No.22 Khlong Ban Na			
Description			Unit					
1. Location	:	Map No.		5237 I	5237 IV			
	:	Coordinates		58.2 - 80.6	32.2 - 95.2			
2. Drainage Area			sq.km	151	114			
3. Basin Rainfall:		Annual Average	mm	1,851	1,602			
4. Runoff	:	Maximum Annual	MCM	231	126			
	:	Minimum Annual	MCM	145	73			
	:	Average Annual	MCM	188	98			
5. Topography	:	River Bed Elevation	m	370	70			
	:	Highest Mountain EL.	m	1,351	1,052			
	:	Left Bank Abutment Slope	DEG	11	4.5			
	:	River Bed Width	m	20	15			
	:	Right Bank Abutment Slope	DEG	21	7			
	:	Span-Height Ratio	-	5.7	32			
6. Reservoir	:	Active Storage Capacity	MCM	188	98			
	:	Dead Storage Capacity	MCM	3	3			
	:	Gross Storage Capacity	MCM	191	101			
	:	Normal Water Surface Area	sq.km	17.0	5.8			
	:	Low Water Level (L.W.L)	m	382.0	76.0			
	:	Normal Water Level (N.W.L)	m	408.5	105.7			
	:	Maximum Water Level (H.W.L)	m	410.7	107.2			
7. Dam Body	:	Crest Elevation	m	412.7	109.2			
	:	Foundation Elevation	m	365	66			
	:	Dam Height	m	47.7	43.2			
	:	Crest Length	m	270	1,400			
	:	Dam Volume	1000 cu.m	920	6,600			
8. Spillway	:	Design Flood	CMS	498	380			
	:	Design Discharge	CMS	126	337			
	:	Crest Length	m	20	100			
	:	Crest Elevation	m	408.5	105.7			
9. Active Storage Capacity/Dam Volume			-	204	14.8			

H.2 COST ESTIMATE

TABLE H-2-1 CONSTRUCTION COST FOR STAGED DEVELOPMENT (IRRIGATION COMPONENT)

1) FIRST STAGE DEVELOPMENT

Name of Sub-River Basin	Service Area
LBP(Lower Bang Pakong)	36,800 ha
KTL(Khlong Tha Lat)	6,900 ha
Total (2)	43,700 ha

(Unit:Million Baht)

Common Facility		Main Irrigation Facility				On-farm Facility
Name of Dam	Amount	Name of Project	Area(ha)	New Const.	Rehabili.	Total	
-Khlong Si Yat	754*	Tha Lat(Ex.)	21,200	-	636	636	212
-Rabon	-	Bang Pakong L.B.	14,700	-	294	294	147
-Diversion dam	595**	Tha Lat(New)	8,500	444	-	444	85
		Bang Pakong(New)	2,000	60	-	60	20
Total	1,349		46,400	504	930	1,434	464

Note: * Cost allocations between "irrigation sector" and "drinking/industrial sector" are based on the annual water consumption ratio 3,609:345 = 92:8.

** The cost of Bang Pakong diversion dam shall be allocated into the following three sectors based on the cost allocation method.

1) Cost allocation between "irrigation sector" and "drinking/industrial sector" by the "separable cost alternative justifiable expenditure method" is sa follows;

Sector	Cost	Allocation Ratio
Irrigation	B 750,000,000	50%
Drinking/industry	B 750,000,000	50%
Total	B1,500,000,000	100%

2) Cost allocation between "subject study area"and "Bang Pakong Right Bank area" by the raito of annual water consumption is as follows;

Name of Area	Annual Water Consumption	Cost
Subject Study area	384.6MCM(79.36%)	B 595,000,000
Bang Pakong Right Bank area	100.0MCM(20.64%)	B 155,000,000
Total	484.6MCM(100%)	B 750,000,000

TABLE H-2-1 CONSTRUCTION COST FOR STAGED DEVELOPMENT (IRRIGATION COMPONENT)(2)

2) SECOND STAGE DEVELOPMENT

Name of Sub-River Basin	Service Area
LBP(Lower Bang Pakong)	30,300 ha
KPS(Khlong Phra Sathung)	29,700 ha
MPP(Middle Phra Prong)	16,600 ha
Total (3)	76,600 ha

(Unit:Million Baht)

Common Facility		Main irrigation facility				On-farm Facility
Name of Dam	Amount	Name of Project	Area(ha)	New Const.	Rehabili.	Total	
-No.1(Luang)	583	Luang(New)	6,600	418	-	418	66
-No.8(Phra Sathung)	972	Phan Thong	3,500	-	105	105	35
		Phan Thong East	5,800	-	174	174	58
		Bang Pakong(Exp.)	13,500	-	270	270	135
		Phra Sathung	37,000	1,741	-	1,741	370
Total	1,510		66,400	2,159	549	2,708	664

3) THIRD STAGE DEVELOPMENT

Name of Sub-River Basin	Service Area
-UBP(Upper Bang Pakong)	136,900 ha
-UPP(upper Phra Prong)	43,300 ha
-MHM(Maenum Hanuman)	28,100 ha
-MNN(Maenum Nakhon Nayok)	76,400 ha
Total (4)	284,700 ha

Common Facility		Main Irrigation Facility				On-farm Facility
Name of Dam	Amount	Name of Project	Area(ha)	New Const.	Rehabili.	Total	
-No.20(Nong Kaeo)	1,424	Nong kaeo	27,280	1,099	-	1,099	273
-No.10(Phra Prong)	679	Takhian Thong	1,700	-	34	34	17
-No.11(U.P.Prong)	205	Tha Hae	12,100	-	242	242	121
-No.12(Huai Samong)	694	Prachantakham	3,000	-	-	-	-
-No.15(Lam Phraya)	138	Khok Kacha	4,900	-	98	98	49
-No.18(H.Sai Noi)	1,575	Khlong Saraphi	6,300	-	126	126	63
-No.19(H.sai Yai)	209	Bang Phluang	82,400	-	1,648	1,648	824
-No.21(Tha)	140	Phra Prong	40,700	499	-	499	407
-No.22(Ban Na)	770	U.Phra Prong	10,940	266	-	266	109
		Huai Samong	14,300	1,238	-	1,238	143
		Lam Phraya Than	7,500	687	-	687	75
		Huai Sai Noi	4,200	337	-	337	42
		Huai Sai Yai	3,100	-	62	62	31
		Tha	6,940	414	-	414	69
		Ban Na(New)	11,040	258	-	258	110
		Nakhon Nayok	50,000	-	1,000	1,000	500
		Ban Na(Ex.)	7,600	-	152	152	76
Total	5,835		294,000	4,798	3,362	8,160	2,909
Grand Total	8,693		406,800	7,461	4,841	12,302	3,433

TABLE H-2-2 PROJECT COST FOR STAGED DEVELOPMEMT PLAN (OVERALL AREA)

Designation	First Stage	Second Stage	Third Stage	Total
A. Irrigation Component				
1)Irrigable Area(ha)				
-LBP	36,800	30,300	-	67,100
-KTL	6,900	-	-	6,900
-KPS	-	29,700	-	29,700
-MPP	-	16,600	-	16,600
-UBP	-	-	136,900	136,900
-UPP	-	-	43,300	43,300
-MHM	-	-	28,100	28,100
-MNN	-	-	76,400	76,400
(Total)	43,700	76,600	284,700	406,800
2)Direct Project Cost (Million Baht)				
(1)Construction Cost				
-Storage dam	754	1,510	5,834	8,098
-Diversion dam	595	-	-	595
-Main irri.facility	1,434	2,708	8,160	12,302
(New construction)	(444)	(2,159)	(4,798)	(7,401)
(Rehabilitation)	(990)	(549)	(3,362)	(4,901)
Sub-Total	2,783	4,218	13,994	20,995
(2)Land Compensation	364	727	1,262	2,353
(3)Engineering Cost	315	494	1,526	2,335
(4)Administ. Cost	108	164	510	782
Sub-Total	787	1,385	3,298	5,470
(5)Contingencies	360	567	1,728	2,655
Total(1) - (5)	3,930	6,170	19,020	29,120
3)Indirect Project Cost(Million Baht)				
On-farm development	464	664	2,909	4,037
Other cost items	136	186	871	1,193
Total	600	850	3,780	5,230
Grand Total	4,530	7,020	22,800	34,350
B. Drinking and Industrial Water Component				
1)Construction Cost(Common facility only)				
-Storage dam	83	168	543	794
-Diversion dam	750	-	-	750
-Conveyance pipe	1,000	-	-	1,000
Sub-Total	1,833	168	543	2,544
2)Engineering Cost	183	17	54	254
3)Administ. Cost	54	5	13	72
Sub-Total	237	22	67	326
4)Contingencies	210	20	60	290
Total	2,280	210	670	3,160
Grand Total(A+B)	6,810	7,230	23,470	37,510

TABLE H-2-3 SUMMARY OF CONSTRUCTION COST BY SUB-RIVER BASIN AND IRRIGATION BLOCK

(Unit:Million Baht)

Sub-river Basin	Irrigation Block	Irrigable Area (ha)	Main Facilities(Direct) Dams	New C.	Rehabi.C.	Total	On-farm (Indirect)
LBP	Khlong Luang	6,600	538	418	-	956	66
LBP	Tha Lat	21,200	-	-	636	636	212
LBP	Bang Pakong(L)	14,700	-	-	294	294	147
LBP	Phan Thong	3,500	-	-	105	105	35
LBP	Phan Thong(E)	5,800	-	-	174	174	58
LBP	Bang Pakong(D)	15,500	595*	-	330	925	155
	Sub-Total	67,300	1,133	418	1,539	3,090	673
KTL	Khlong Si Yat	8,500	754	444	-	1,198	85
	Sub-Total	8,500	754	444	-	1,198	85
KPS	Phra Sathung	29,700	972	1,398	-	2,370	297
	Sub-Toatl	29,700	972	1,398	-	2,370	297
MPP	M.Phra Prong	16,600	-	457	-	457	166
	Sub-Total	16,600	-	457	-	457	166
UPP	Phra Prong	31,400	679	385	-	1,064	314
UPP	U.Phra Prong	10,940	205	266	-	471	109
	Sub- Total	42,340	884	651	-	1,535	423
MHM	Huai Samong	14,300	694	1,238	-	1,932	143
MHM	Lam Phraya	7,500	138	687	-	825	75
MHM	Huai Sai Noi	4,200	1,575	337	-	1,912	42
MHM	Huai Sai Yai	3,100	209	-	62	271	31
	Sub-Total	29,100	2,616	2,262	62	4,940	291
UBP	Nong Kaeo	27,280	1,424	1,099	-	2,523	273
UBP	Takhian Thong	1,700	-	-	34	34	17
UBP	Tha Hae	12,100	-	-	242	242	121
UBP	Prachatakham	3,000	-	-	-	-	-
UBP	Khok Kacha	4,900	-	-	98	98	49
UBP	Khlong Saraphi	6,300	-	-	126	126	63
UBP	Bang Phluang	82,400	-	-	1,648	1,648	824
	Sub-Total	137,680	1,424	1,099	2,148	4,671	1,347
MNN	Tha	6,940	140	414	-	554	69
MNN	Ban Na(New)	11,040	770	258	-	1,028	110
MNN	Nakhon Nayok	50,000	-	-	1,000	1,000	500
MNN	Ban Na	7,600	-	-	152	152	76
	Sub-Total	75,580	910	672	1,152	2,734	755
	Total	406,800	8,693	7,401	4,901	20,995	4,037

TABLE H-2-4 SUMMARY OF PROJECT COST BY SUB-RIVER BASIN (IRRIGATION COMPONENT)

(UNIT:MILLION BAHT)

DESCRIPTION	LBP	KTL	KPS	UPP	MPP	MHM	UBP	MNN	TOTAL
A.DIRECT PROJECT COST									
1.Construction Cost									
-Storage Dam	538	754	972	884	-	2,616	1,424	910	8,098
-Diversion Dam	595	-	-	-	-	-	-	-	595
-Canal Construction	418	444	1,398	651	457	2,262	1,099	672	7,401
-Canal Rehabilitation	1,539	-	-	-	-	62	2,148	1,152	4,901
Sub-Total	3,090	1,198	2,370	1,535	457	4,940	4,671	2,734	20,995
2.Land Compensation	361	265	431	322	46	400	325	203	2,353
3.Engineering Service	345	146	280	186	50	534	500	294	2,335
4.Administration Cost	115	49	93	62	17	178	167	101	782
Sub-Total	821	460	804	570	113	1,112	992	598	5,470
5.Contingency	389	162	316	205	60	608	567	348	2,655
Total(1 - 5)	4,300	1,820	3,490	2,310	630	6,660	6,230	3,680	29,120
B.INDIRECT PROLECT COST									
1.Construction Cost									
-On-farm Development	673	85	297	423	166	291	1,347	755	4,037
Sub-Total	673	85	297	423	166	291	1,347	755	4,037
2.Engineering/Admini.	197	25	83	127	44	89	403	225	1,193
Total(1 - 2)	870	110	380	550	210	380	1,750	980	5,230
Grand Total(A)+(B)	5,170	1,930	3,870	2,860	840	7,040	7,980	4,660	34,350

TABLE H-3-1 PREPARATORY WORK (OFFICE AND QUATER)

Description of Works	Unit	Q'ty	Unit Rate (฿) F/C	Unit Rate (฿) L/C	Unit Rate (฿) Total	Amount (฿'000) F/C	Amount (฿'000) L/C	Amount (฿'000) Total
A. Phase I Project								
1. Bang Pakong Diversion Dam								
- Office and Quater	sq.m	2,000	1,100	3,400	4,500	2,200	6,800	9,000
- Garage and Warehouse	sq.m	1,000	220	680	900	220	680	900
- Miscellaneous	L.S	1				800	2,300	3,100
Sub - Total						3,220	9,780	13,000
2. Pumping Station and Bang Pkong System								
- Office and Quater	sq.m	1,000	1,100	3,400	4,500	1,100	3,400	4,500
- Garage and Warehouse	sq.m	500	220	680	900	110	340	450
- Miscellaneous	L.S	1				615	1,435	2,050
Sub - Total						1,825	5,175	7,000
Total						5,045	14,955	20,000
A. Phase II Project								
1. Klong Si Yat Dam								
- Office and Quater	sq.m	2,000	1,100	3,400	4,500	2,200	6,800	9,000
- Garage and Warehouse	sq.m	1,000	220	680	900	220	680	900
- Miscellaneous	L.S	1				800	2,300	3,100
Sub - Total						3,220	9,780	13,000
2. Tha Lat Existing and Expansion System								
- Office and Quater	sq.m	2,000	1,100	3,400	4,500	2,200	6,800	9,000
- Garage and Warehouse	sq.m	1,000	220	680	900	220	680	900
- Miscellaneous	L.S	1				800	2,300	3,100
Sub - Total						3,220	9,780	13,000
Total						6,440	19,560	26,000

TABLE H-3-2 CONSTRUCTION COST (Phase I Project)

Description of Works	Unit	Quantity	Unit Rate (฿) F/C	Unit Rate (฿) L/C	Unit Rate (฿) Total	Amount (฿'000) F/C	Amount (฿'000) L/C	Amount (฿'000) Total
A. Bang Pakong Diversion Dam								
1. Temporary Work	L.S	1				99,185	38,478	137,663
2. *Diversion Dam*								
- Stripping	cu.m	30,000	6	3	9	180	90	270
- Excavation	cu.m	500,000	36	14	50	18,000	7,000	25,000
- Laterite	cu.m	25,000	29	102	131	725	2,550	3,275
- P.C Pile ø300 ℓ=15m	pcs	126	26,100	17,400	43,500	3,289	2,192	5,481
- P.C Pile ø400 ℓ=15m	〃	1,428	30,200	20,200	50,400	43,126	28,846	71,972
- P.C Pile ø300 ℓ=10m	〃	310	19,200	12,800	32,000	5,952	3,968	9,920
- Sheet Pile T-II ℓ=3m	〃	840	17,280	4,320	21,600	14,515	3,629	18,144
- Sheet Pile T-II ℓ=8m	〃	420	31,040	7,760	38,800	13,037	3,259	16,296
- Reinforced Concrete	cu.m	36,770	2,488	3,042	5,530	91,484	111,854	203,338
- Second Stage Concrete	〃	460	1,200	1,800	3,000	552	828	1,380
- Other Material	ton	29.7	16,000	4,000	20,000	475	119	594
Sub-Total						191,335	164,335	355,670
3. River Bed Protection								
- Concrete Block (3ton)	pcs	2,940	7,425	9,075	16,500	21,830	26,680	48,510
- Rip-rap	〃	4,610	177	413	590	816	1,904	2,720
Sub-Total						22,646	28,584	51,230
4. Dike Protection								
- Concrete Pile ø200 ℓ=4m	pcs	1,000	5,120	7,680	12,800	5,120	7,680	12,800
- Reinforced Concrete	cu.m	500	2,488	3,042	5,530	1,244	1,521	2,765
- Wetted Stone Pitching	cu.m	4,370	342	798	1,140	1,495	3,487	4,982
Sub-Total						7,859	12,688	20,547
5. Gate								
- Regulating Gate (2 pcs)	ton	1,210	180,000	20,000	200,000	217,800	24,200	242,000
- Flood Gate (3 pcs)	〃	1,305	180,000	20,000	200,000	234,900	26,100	261,000
Sub-Total						452,700	50,300	503,000
6. Connecting Bridge and Road								
- Steel	ton	300	72,000	8,000	80,000	21,600	2,400	24,000
- Concrete	cu.m	475	2,488	3,042	5,530	1,182	1,445	2,627
- Guird Rail	m	340	1,600	400	2,000	544	136	680
- Lighting Pole	pcs	10	8,000	2,000	10,000	80	20	100
- Road	m	10,000	3,450	2,400	5,850	34,500	24,000	58,500
Sub-Total						57,906	28,001	85,907
7. Closure Dam								
- Stripping	cu.m	25,700	12	6	18	308	154	462
- Rip-rap	cu.m	33,040	177	413	590	5,848	13,646	19,494
- Back fill	cu.m	111,600	30	20	50	3,348	2,232	5,580
- Laterite	cu.m	2,520	29	102	131	73	257	330
- Base course	cu.m	600	177	413	590	106	248	354
- Asphalt Pavement	sq.m	3,000	80	80	160	240	240	480
Sub-Total						9,923	16,777	26,700
8. Diversion Channel								
- Stripping	cu.m	470,000	12	6	18	5,640	2,820	8,460
- Excavation	cu.m	4,064,000	60	20	80	243,840	81,280	325,120
Sub-Total						249,480	84,100	333,580
9. Miscellaneous Works	L.S	1				108,966	46,737	155,703
Total						1,200,000	470,000	1,670,000

Description of Works	Unit	Quantity	Unit Rate (฿) F/C	L/C	Total	Amount (฿'000) F/C	L/C	Total
B. Bang Pakong Pumping Station								
1. Temporary Work	L.S	1				9,112	3,539	12,651
2. Pump Station								
- Stripping	cu.m	600	6	3	9	3	2	5
- Excavation	cu.m	8,400	18	7	25	151	59	210
- Back fill	cu.m	2,800	31	12	43	87	33	120
- P. C Pile ø400 ℓ=18m	pcs	112	18,720	12,480	31,200	2,097	1,397	3,494
- Rainfoced Concrete	cu.m	2,850	2,488	3,042	5,530	7,091	8,670	15,761
- Pump ø1500m	pcs	4	20×10^6	5×10^6	25×10^6	80,000	20,000	100,000
- Pump House	sq.m	400	8,000	12,000	20,000	3,200	4,800	8,000
Sub - Total						92,629	34,961	127,590
3. Miscellaneous	L.S					1,263	1,496	2,759
Total						103,004	39,996	143,000
C. Intake Canal								
1. Temporary Work	L.S	1				737	945	1,682
2. Intake Canal								
- Stripping	cu.m	6,800	6	3	9	41	20	61
- Excavation	cu.m	15,100	18	7	25	272	106	378
- Compacted Fill	cu.m	37,100	29	11	40	1,076	408	1,484
- Sodding	sq.m	9,300	0	23	23	0	214	214
- Laterite	cu.m	700	19	68	87	13	48	61
- Concrete Lining	cu.m	1,100	928	1,392	2,320	1,021	1,531	2,552
- Miscellaneous	L.S	7				242	233	475
Sub - Total						2,665	2,560	5,225
3. Diversion Work								
- Stripping	cu.m	400	6	3	9	3	1	4
- Excavation	cu.m	1,800	18	7	25	32	13	45
- Compacted Fill	cu.m	2,700	29	11	40	78	30	108
- Reinforced Concrete	cu.m	700	2,488	3,042	5,530	1,742	2,129	3,871
- Gate 2,300×2,500	L.S	1				0	280	280
- Gate 2,000×2,500	L.S	3				0	720	720
- Other Work	L.S	1				185	217	402
- Miscellaneous	L.S	1				204	339	543
Sub - Total						2,244	3,729	5,973
4. Appurtenant Structure	L.S	1				491	629	1,120
Total						6,137	7,863	14,000
D. Left Main Canal								
1. Temporary Work	L.S	1				2,106	2,680	4,786
2. Left Main Canal								
- Stripping	cu.m	73,000	6	3	9	438	219	657
- Excavation	cu.m	51,700	18	7	25	931	362	1,293
- Compacted Fill	cu.m	165,900	29	11	40	4,811	1,825	6,636
- Sodding	sq.m	91,000	0	23	23	0	2,093	2,093
- Laterite	cu.m	12,000	19	68	87	228	816	1,044
- Concrete Lining	cu.m	8,100	928	1,392	2,320	7,517	11,275	18,792
- Miscellaneous	L.S	1				1,393	1,659	3,052
Sub - Total						15,318	18,249	33,567
3. Structures								
- Check	L.S	3	240,000	360,000	600,000	720	1,080	1,800
- Head Gate	L.S	7	120,000	180,000	300,000	840	1,260	2,100
- Related Structure	L.S	1				4,000	6,000	10,000
Sub - Total						5,560	8,340	13,900
4. Appurtenant Structures	L.S	1				2,088	2,659	4,747
Total						25,072	31,928	57,000

Description of Works	Unit	Quantity	Unit Rate (฿) F/C	Unit Rate (฿) L/C	Unit Rate (฿) Total	Amount (฿'000) F/C	Amount (฿'000) L/C	Amount (฿'000) Total
E. Right Main Canal								
1. Temporary Work	L.S	1				7,615	8,996	16,611
2. Right Main Canal								
- Stripping	cu.m	198,200	6	3	9	1,189	595	1,784
- Excavation	cu.m	314,600	18	7	25	5,663	2,202	7,865
- Compacted Fill	cu.m	646,100	29	11	40	18,737	7,107	25,844
- Sodding	sq.m	286,200	0	23	23	0	6,583	6,583
- Laterite	cu.m	24,000	19	68	87	456	1,632	2,088
- Concrete Lining	cu.m	27,800	928	1,392	2,320	25,798	38,698	64,496
- Miscellaneous	L.S	1				5,184	5,682	10,866
Sub - Total						57,027	62,499	119,526
3. Structures								
- Check	L.S	4	360,000	540,000	900,000	1,440	2,160	3,600
- Head Gate	L.S	10	180,000	270,000	450,000	1,800	2,700	4,500
- Related Structure	L.S	1				12,000	18,000	30,000
Sub - Total						15,240	22,860	38,100
4. Appurtenant Structures						7,227	8,536	15,763
Total						87,109	102,891	190,000
F. Drainage System								
1. Drainage Canal								
- Stripping	cu.m	94,500	6	3	9	567	284	851
- Excavation	cu.m	306,800	18	7	25	5,522	2,148	7,670
- Compacted Fill	cu.m	117,800	29	11	40	3,416	1,296	4,712
- Regulating Gate	L.S	4				1,920	2,880	4,800
- Miscellaneous	L.S	1				2,513	1,454	3,967
Sub - Total						13,938	8,062	22,000
2. Dike								
- Compacted Fill	cu.m	400,000	29	11	40	11,600	4,400	16,000
- Related Structures	L.S	1				19,200	28,800	48,000
Sub - Total						30,800	33,200	64,000
Total						44,738	41,262	86,000
Grand Total						1,466,060	693,940	2,160,000

TABLE H-3-3 CONSTRUCTION COST (Phase II Project)

Description of Works	Unit	Quantity	Unit Rate (฿) F/C	Unit Rate (฿) L/C	Unit Rate (฿) Total	Amount (฿'000) F/C	Amount (฿'000) L/C	Amount (฿'000) Total
A. Khlong Si Yat Dam								
1. Temporary Work	L.S	1				36,000	24,000	60,000
2. Dam								
- Stripping	cu.m	500,000	6	3	9	3,000	1,500	4,500
- Excavation, (Earth)	cu.m	600,000	18	7	25	10,800	4,200	15,000
- Excavation, (Rock)	cu.m	100,000	97	38	135	9,700	3,800	13,500
- Embankment, (Impervious)	cu.m	3,200,000	31	12	43	99,200	38,400	137,600
- Filter / Drain	cu.m	190,000	204	476	680	38,760	90,440	129,200
- Rip-rap	cu.m	200,000	123	287	410	24,600	57,400	82,000
- Bedding for riprap	cu.m	80,000	204	476	680	16,320	38,080	54,400
- Sodding	sq.m	130,000	0	23	23	0	2,990	2,990
- Instrumentation	L.S	1				1,600	400	2,000
Sub - Total						243,980	277,210	521,190
3. Spillway								
- Excavation, (Earth)	cu.m	1,300,000	18	7	25	23,400	9,100	32,500
- Excavation, (Rock)	cu.m	700,000	97	38	135	67,900	26,600	94,500
- Backfill	cu.m	30,000	40	40	80	1,200	1,200	2,400
- Reinforced Concrete	cu.m	31,000	2,295	2,805	5,100	71,145	86,955	158,100
- Rip-rap	cu.m	10,000	123	287	410	1,230	2,870	4,100
- Bedding for riprap	cu.m	2,000	204	476	680	408	952	1,360
- Bridge	L.S	1				1,050	450	1,500
Sub - Total						166,333	128,127	294,460
4. Outlet Works								
- Excavation, (Earth)	cu.m	240,000	18	7	25	4,320	1,680	6,000
- Excavation, (Rock)	cu.m	10,000	97	38	135	970	380	1,350
- Backfill	cu.m	2,000	40	40	80	80	80	160
- Grouting	L.S	1				210	90	300
- Reinforced Concrete	cu.m	10,000	2,295	2,805	5,100	22,950	28,050	51,000
- Rip-rap	cu.m	5,000	123	287	410	615	1,435	2,050
- Bedding for Rip-rap	cu.m	2,000	204	476	680	408	952	1,360
- Operating Gate, ø2.5m	set	1				9,600	2,400	12,000
- 〃 , ø1.5m	set	1				4,800	1,200	6,000
- Maintenance Gate, ø2.5m	set	1				8,000	2,000	10,000
- 〃 , ø1.5m	set	1				4,000	1,000	5,000
- Emergency Gate	set	1				10,400	2,600	13,000
- Closure Gate	set	1				105	45	150
- Trashrack	L.S	1				2,100	900	3,000
- Steel Pipe	L.S	1				28,000	12,000	40,000
Sub - Total						96,558	54,812	151,370
5. Road Works	m	23,000	420	280	700	9,660	6,440	16,100
6. Miscellaneous Works	L.S	1				9,469	7,411	16,880
Total						562,000	498,000	1,060,000
B. Tha Lat Weir								
1. Temporary Work	L.S	1				339	1,018	1,357
2. Tha Lat Weir								
- Demolition	cu.m	370	300	700	1,000	111	259	370
- Concrete Pile ø300 ℓ=8m	pcs	88	4,140	2,760	6,900	364	243	607
- Reinforced Concrete	cu.m	470	2,488	3,042	5,530	1,169	1,430	2,599
- Rubber Dam	L.S	1				600	5,400	6,000
- Control House	L.S	1				20	80	100
- Miscellaneous	L.S	1				226	741	967
Sub - Total						2,490	8,153	10,643
Total						2,829	9,171	12,000

Description of Works	Unit	Quantity	Unit Rate (฿) F/C	Unit Rate (฿) L/C	Unit Rate (฿) Total	Amount (฿'000) F/C	Amount (฿'000) L/C	Amount (฿'000) Total
C. Tha Lat Irrigation System								
1. Temporary Work	L.S	1				22,750	22,350	45,100
2. Tha Lat Main Canal								
- Stripping	cu.m	299,500	6	3	9	1,797	899	2,696
- Excavation	cu.m	309,600	18	7	25	5,573	2,167	7,740
- Compacted Fill	cu.m	1,206,400	29	11	40	34,986	13,270	48,256
- Sodding	sq.m	458,800	0	23	23	0	10,552	10,552
- Laterite	cu.m	123,400	19	68	87	2,345	8,391	10,736
- Concrete Lining	cu.m	43,700	928	1,392	2,320	40,554	60,830	101,384
- Miscellaneous	L.S	1				8,526	9,610	18,136
Sub - Total						93,781	105,719	199,500
3. Improvement of Structures								
- Regulating Gate	L.S	1				400	600	1,000
- Siphon	L.S	6				12,000	18,000	30,000
- Related Structures	L.S	1				8,600	12,900	21,500
Sub - Total						21,000	31,500	52,500
4. Newly Constructed Structure								
- Check	L.S	6				7,200	10,800	18,000
- Head Gate	pcs	16	4×10^5	6×10^5	1×10^6	6,400	9,600	16,000
Sub - Total						13,600	20,400	34,000
5. Lateral Canal								
- Excavation	cu.m	810,500	18	7	25	14,589	5,674	20,263
- Compacted Fill	cu.m	1,621,100	29	11	40	47,009	17,831	64,840
- Laterite	cu.m	162,100	19	68	87	3,080	11,023	14,103
- Miscellaneous	L.S	1				6,468	3,326	9,794
Sub - Total						71,146	37,854	109,000
6. Turn-Out								
- Turn-Out	pcs	442	15,000	35,000	50,000	6,630	15,470	22,100
- Miscellaneous	L.S	1				660	1,240	1,900
Sub - Total						7,290	16,710	24,000
7. Appurtenant Structures	L.S	1				20,680	21,220	41,900
Total						250,247	255,753	506,000
D. Si Yat Irrigation System								
1. Temporary Work	L.S	1				15,943	16,518	32,461
2. Si Yat Main Canal								
- Stripping	cu.m	343,800	6	3	9	2,063	1,031	3,094
- Excavation	cu.m	960,000	18	7	25	17,280	6,720	24,000
- Compacted Fill	cu.m	789,000	29	11	40	22,881	8,679	31,560
- Sodding	sq.m	400,000	0	23	23	0	9,200	9,200
- Laterite	cu.m	49,500	19	68	87	941	3,366	4,307
- Concrete Lining	cu.m	52,000	928	1,392	2,320	48,256	72,384	120,640
- Miscellaneous	L.S	1				9,142	10,138	19,280
Sub - Total						100,563	111,518	212,081
3. Structures								
- Tha Lat Siphon	L.S	1				1,600	2,400	4,000
- Siphon & Culvert	L.S	10				4,000	6,000	10,000
- Check	L.S	8				3,400	5,100	8,500
- Head Gate	pcs	15	4×10^5	6×10^5	1×10^6	6,000	9,000	15,000
Sub - Total						15,000	22,500	37,500
4. Lateral Cnal								
- Strupping	cu.m	427,300	6	3	9	2,564	1,282	3,846
- Excavation	cu.m	569,600	18	7	25	10,253	3,987	14,240
- Compacted Fill	cu.m	356,000	29	11	40	10,324	3,916	14,240
- Laterite	cu.m	71,200	19	68	87	1,353	4,841	6,194
- Miscellaneous	L.S	1				2,450	1,030	3,480
Sub - Total						29,944	15,056	42,000

Description of Works	Unit	Quantity	Unit Rate (฿)			Amount (฿'000)		
			F/C	L/C	Total	F/C	L/C	Total
5. Turn-Out								
- Turn-Out	pcs	142	15,000	35,000	50,000	2,130	4,970	7,100
- Miscellaneous	L.S	1				300	600	900
Sub - Total						2,430	5,570	8,000
6. Appurtenant Structures	L.S	1				14,494	15,464	29,958
Total						175,374	186,626	362,000
Grand Total						990,450	949,550	1,940,000

TABLEH-3-4 LAND ACQUISITION

Description of Works	Unit	Q'ty	Unit Rate (฿) F/C	Unit Rate (฿) L/C	Unit Rate (฿) Total	Amount (฿'000) F/C	Amount (฿'000) L/C	Amount (฿'000) Total
A. Phase I Project								
1. Bang Pakong Diversion Dam								
1.1 Land Acquisition	Rai	330	-	200,000	200,000	-	66,000	66,000
1.2 Structures	house	45	-	200,000	200,000	-	9,000	9,000
1.3 Land Compensation	Rai	660	-	90,000	90,000	-	59,400	59,400
1.4 Survey	L.S	1					15,600	15,600
Sub - Total							150,000	150,000
2. Pumping Station								
2.1 Land Acquisition	Rai	15	-	300,000	300,000	-	4,500	4,500
2.2 Structures	house	2	-	200,000	200,000	-	400	400
2.3 Survey	L.S	1				-	100	100
Sub - Total							5,000	5,000
3. Irrigation Canal								
2.1 Land Acquisition	Rai	6,900	-	30,000	30,000	-	207,000	207,000
2.3 Survey	L.S	1				-	13,000	13,000
Sub - Total						-	220,000	220,000
Total						-	375,000	375,000
B. Phase II Project								
1. Klong Si Yat Dam								
1.1 Land Acquisition	Rai	34,000	-	1,755	1,755	-	59,670	59,670
1.2 Tree Crop	Tree	68,000	-	195	195	-	13.260	13,260
1.3 Structures	house	675	-	100,000	100,000	-	67,500	67,500
1.4 Survey	L.S	1					9,570	9,570
Sub - Total							150,000	150,000
2. Irrigation Canal								
1.1 Land Acquisition	Rai	15,600	-	15,000	15,000	-	234,000	234,000
1.2 Survey	L.S	1				-	16,000	16,000
Sub - Total							250,000	250,000
3. Resettlement Cost	L.S	1				-	280,000	280,000
Total							680,000	680,000

TABLEH-3- 5 RESETTLEMENT COST

Unit : ₿ '000

Description	Unit	Q'ty	Unit Cost	Cost
A. Evacuation and Resettlement Preparation				
1. Site Survey	km^2	20	100	2,000
2. Land Cleaving and Demarcation	km^2	15.5	800	12,400
3. Evacuation Expenditure	house	560	3.5	1,960
Sub - total				16,360
B. Infrastructure and Supporting Facilities				
1. Road System				
- B=5.5~7.0 m	km	18.5	1,800	33,300
- B=4.0 m	km	74.2	200	14,800
2. Irrigation System				
- Pumping Station	L.S	1		81,000
- Irrigation Canal	km	27.0	1,200	32,400
3. Drinking Water Supply System	system	5	10,000	50,000
4. Electrical Distribution System	system	5	2,000	10,000
5. School				
5.1 Primary School				
- No of Classroom	unit	15	200	3,000
- Teachers Center	unit	11	200	2,200
5.2 Secondary School				
- No of Classroom	unit	5	300	1,500
- Teachers house	unit	5	200	1,000
6. Health Center				
- Office Building	unit	3	350	1,050
- Staff House	unit	3	200	600
7. Resettlement Administrative Office				
- Office Building	1.S	1		450
- Staff House	Unit	5	250	1,250
8. Local Administrative Office		-		-
9. Police Station Office		-		-
10. Agriculture Extension Office	Unit	2	450	900
11. Agriculture Cooperative Office	Unit	1	700	700
12. Public Hall	Unit	5	200	1,000
13. Market	Unit	5	150	750
Sub-total				235,600
C. Resettlement Operation Cost				
1. Loan for Agriculture Development and Cooperative	house	560	20	11,200
2. Resettlement Administration	L.S			1,300
Sub-total				12,500
D. Contingency	L.S			18,540
Total				280,000

TABLE H-3-6 O & M EQUIPMENT

Unit Bhat '000

Description	Unit	Q'ty	Unit Cost			Amount		
			F/C	L/C	Total	F/C	L/C	Total
A. Phase I Project								
1. Moter Grader, 125HP	Set	1	1,072	268	1,340	1,072	268	1,340
2. Loder/Backhoe	Set	1	632	158	790	632	158	790
3. Steak Truck, 4ton	Set	2	188	47	235	376	94	470
4. Pick up, 2ton	Set	5	176	44	220	880	220	1,100
5. Station Wagon	Set	2	400	100	500	800	200	1,000
6. Truck Crane, 15ton	Set	1	3,080	770	3,850	3,080	770	3,850
7. Moter Bicycle, 125cc	Set	30	20	5	25	600	150	750
8. Diesel Generating Set, 15KVA	Set	1	92	23	115	92	23	115
9. Diesel Generating Set, 5KVA	Set	2	56	14	70	112	28	140
10. 4"Centrifugal Pump	Set	3	76	19	95	228	57	285
11. Chain Hoist, 5ton	Set	1	40	10	50	40	10	50
12. Spare Ports	L.S	1				890	220	1,110
Total						8,802	2,198	11,000
B. Phase II Project								
1. Moter Grader, 125HP	Set	2	1,072	268	1,340	2,144	536	2,680
2. Loder/Backhoe	Set	2	632	158	790	1,264	316	1,580
3. Steak Truck, 4ton	Set	4	188	47	235	752	188	940
4. Pick up, 2ton	Set	6	176	44	220	1,056	264	1,320
5. Station Wagon	Set	3	400	100	500	1,200	300	1,500
6. Truck Crane, 15ton	Set	-	3,080	770	3,850	-	-	-
7. Moter Bicycle, 125cc	Set	58	20	5	25	1,160	290	1,450
8. Diesel Generating Set, 15KVA	Set	1	92	23	115	92	23	115
9. Diesel Generating Set, 5KVA	Set	3	56	14	70	168	42	210
10. 4"Centrifugal Pump	Set	4	76	19	95	304	76	380
11. Chain Hoist, 5ton	Set	2	40	10	50	80	20	100
12. Spare Ports	L.S	1				820	205	1,025
Total						9,040	2,260	11,300

TABLE H-3-7 COST OF SURVEY AND INVESTIGATION

Description of Works	Unit	Q'ty	Unit Rate (฿) F/C	Unit Rate (฿) L/C	Unit Rate (฿) Total	Amount (฿'000) F/C	Amount (฿'000) L/C	Amount (฿'000) Total
Phase I. Project								
A. Bang Pakong Diversion Dam								
- Plan map survey	ha	10	300	1,200	1,500	3	12	15
- Strip topography survey	km	10	2,800	11,200	14,000	28	112	140
- Core drilling	m	200	1,680	720	2,400	336	144	480
- Standard penetration test	L.S	-	-	-	-	2	6	8
- Dutch cone penetration test	m	100	1,400	600	2,000	140	60	200
- Field vane shear test	No.	60	3,220	1,380	4,600	193	83	276
- Sampling (undisturbed soil samples)	L.S					140	60	200
- Laboratory test								
Physical test	No.	50	1,300	5,200	6,500	65	260	325
Mechanical test	No.	20	8,250	19,250	27,500	165	385	550
Sub-total						1,072	1,122	2,194
Total						9,274	9,249	18,523
B. Canal Networks								
- Plan map survey	ha	30	300	1,200	1,500	9	36	45
- Strip topography survey	km	120	2,800	11,200	14,000	336	1,344	1,680
- Core drilling	m	400	1,680	720	2,400	672	288	960
- Standard penetration test	L.S	-	-	-	-	5	19	24
- Auger drilling	m	1,200	30	270	300	26	324	360
Sub-total						1,058	2,011	3,069
C. Contingency	L.S	1				1,030	1,178	2,208
Total						11,362	12,438	23,800
Phase II. Project								
A. Khlong Si Yat Dam								
- Plan map survey	ha	100	300	1,200	1,500	30	120	150
- Strip topography survey	km	25	2,800	11,200	14,000	70	280	350
- Seismic prospecting	km	9	240,000	60,000	300,000	2,160	540	2,700
- Core drilling	m	2,000	1,680	720	2,400	3,360	1,440	4,800
- Permeability test	No.	400	560	240	800	224	96	320
- Standard penetration test	L.S	-	-	-	-	16	64	80
- Test pit	No.	90	300	2,700	3,000	27	243	270
- Auger drilling	m	1,400	30	270	300	42	378	420
- Laboratory test								
Physical test	No.	100	1,300	5,200	6,500	130	520	650
Mechanical test	No.	60	8,250	19,250	27,500	495	1,155	1,650
Sub-total						6,554	4,836	11,390
B. Canal Networks								
- Plan map survey	No.	20	300	1,200	1,500	6	24	30
- Strip topogrpahy survey	km	80	2,800	11,200	14,000	224	896	1,120
- Core drilling	m	200	1,680	720	2,400	336	144	480
- Standard penetration test	L.S	-	-	-	-	4	16	20
- Auger drilling	m	800	30	270	300	24	216	240
Sub-total						594	1,296	1,890
C. Contingency	L.S	1				714	606	1,320
Total						7,862	6,738	14,600

TABLE H-3-8 ADMINISTRATION COST

Unit Bhat '000

Description of Works	Unit	Q'ty	Unit Cost F/C	Unit Cost L/C	Unit Cost Total	Amount F/C	Amount L/C	Amount Total
Phase I								
1. Salary and Wage	Year	6.5	-	4,621	4,621	-	30,037	30,037
2. Fuel and Repair	Year	6.5	-	1,517	1,517	-	9,861	9,861
3. Material Supplies and Repair	Year	6.5	-	2,000	2,000	-	13,000	13,000
4. Geneeral Expenditures	L.S	1.0				-	53,102	53,102
Total						-	106,000	106,000
Phase II								
1. Salary and Wage	Year	7.0	-	4,581	4,581	-	32,067	32,067
2. Fuel and Repair	Year	7.0	-	2,078	2,078	-	14,546	14,546
3. Material Supplies and Repair	Year	7.0	-	2,600	2,600	-	18,200	18,200
4. Geneeral Expenditures	L.S	1.0					65,187	65,187
Total							130,000	130,000

TABLE H-3-9 SALARY AND WAGE FOR PROJECT OFFICE IN ANNUM

Unit Bhat '000

Description	Salary Per Annum	Phase I Project Number	Phase I Project Amount	Phase II Project Number	Phase II Project Amount
1. Project Director	160	1	160	1	160
2. Division Chief	130	2	260	2	260
3. Section chief	120	8	960	8	960
4. Engineer	100	8	800	9	900
5. Technician	55	12	660	12	660
6. Mechanician	55	3	165	1	55
7. Electrician	55	3	165	1	55
8. Surveyor	40	11	440	13	520
9. Clerk	55	9	495	9	495
10. Secretary	40	3	120	3	120
11. Typist	36	6	216	6	216
12. Driver	36	5	180	5	180
Total		71	4,621	70	4,581

TABLE H-3-10 ON-FARM FACILITIES

Description of works	Unit	Q'ty	Unit Rate (Baht)			Amount (Baht '000)		
			F/C	L/C	Total	F/C	L/C	Total
Phase I Project								
A. Bang Pakong Right Bank Area								
- On-farm	ha	14,700	5,850	3,900	9,750	85,995	57,330	143,325
- Drainage Excavatin	cu·m	2,205,000	18	7	25	39,690	15,435	55,125
- Miscellaneous	L.S	1				12,600	8,950	21,550
Total						138,285	81,715	220,000
Phase II Project								
B. The Lat Existing Area								
- On-farm	ha	22,100	5,850	3,900	9,750	129,285	86,190	215,475
- Drainage Excavatin	cu·m	3,315,000	18	7	25	59,670	23,205	82,875
- Miscellaneous	L.S	1				18,900	10,750	29,650
Sub-Total						207,855	120,145	328,000
C. The Lat Expansion Area								
- On-farm	ha	7,100	7,200	4,800	12,000	51,120	34,080	85,200
- Drainage Excavatin	cu·m	1,065,000	18	7	25	19,170	7,455	26,625
- Miscellaneous	L.S	1				7,030	2,145	12,175
Sub-Total						77,320	46,680	124,000
Total						285,175	166,825	452,000

TABLE H-3-11 UNIT COST

(Unit : Baht)

Discription of Works	Unit	F/C	L/C	Total
A. Bang Pakong Diversion Dam				
- Stripping (In the Water)	cu.m	6	3	9
- Stripping (B.H. / Damp Truck)	cu.m	12	6	18
- Excavation (Back hoe)	cu.m	36	14	50
- Excavation (Dredger)	cu.m	60	20	80
- Laterite	cu.m	29	102	131
- Riprap	cu.m	177	413	590
- Reinforced Concrete	cu.m	2,488	3,042	5,530
- Stone Pitching	cu.m	342	798	1,140
B. Khlong Si Yat Dam				
- Stripping	cu.m	6	3	9
- Excavation (Earth)	cu.m	18	7	25
- Excavation (Weathered)	cu.m	51	19	70
- Excavation (Rock)	cu.m	97	38	135
- Embankment(Impervious Zone)	cu.m	31	12	43
- Riprap	cu.m	123	287	410
- Filter/Drain	cu.m	204	476	680
- Backfill	cu.m	40	40	80
- Stone Pitching	cu.m	342	798	1,140
- Sodding	sq.m	0	23	23
- Grouting	m	1,260	540	1,800
- Asphalt Surfacing	sq.m	80	80	160
- Reinforced Concrete	cu.m	2,295	2,805	5,100
C. Canal				
- Stripping	cu.m	6	3	9
- Excavation	cu.m	18	7	25
- Compacted Fill	cu.m	29	11	40
- Sodding	sq.m	0	23	23
- Laterite	cu.m	19	68	87
- Lining Concrete	cu.m	928	1,392	2,320

TABLE H-3-12 PRICE ESCALATION FACTOR

A. Foreign Currency

Project Year	Annual Rate	Escalation factor for Project Cost
	%	
1991	1.43	$1.0 + 0.0143 \times 0.5 = 1.007$
1992	2.68	$1.0143 \times 1.0134 = 1.028$
1993	7.45	$1.0143 \times 1.0268 \times 1.03725 = 1.08$
1994	5.05	$1.0143 \times 1.0268 \times 1.0745 \times 1.02525 = 1.147$
1995	5.18	$1.0143 \times 1.0268 \times 1.0745 \times 1.0505 \times 1.0259 = 1.206$
1996	4.41	$1.0143 \times \cdots \times 1.0518 \times 1.02205 = 1.264$
1997	4.32	$1.0143 \times \cdots \times 1.0441 \times 1.0216 = 1.319$
1998	4.37	$1.0143 \times \cdots \times 1.0432 \times 1.02185 = 1.376$

B. Local Currency

Project Year	Annual Rate	Escalation factor for Project Cost
	%	
1991	6.5	$1.0 + 0.0325 = 1.033$
1992	6.0	$1.065 \times 1.03 = 1.097$
1993	6.0	$1.065 \times 1.06 \times 1.03 = 1.163$
1994	5.5	$1.065 \times 1.06 \times 1.06 \times 1.0275 = 1.230$
1995	5.3	$1.065 \times 1.06 \times 1.06 \times 1.055 \times 1.0265 = 1.296$
1996	4.7	$1.065 \times \cdots \times 1.053 \times 1.0235 = 1.361$
1997	4.5	$1.065 \times \cdots \times 1.047 \times 1.0225 = 1.423$
1998	4.5	$1.065 \times \cdots \times 1.045 \times 1.0225 = 1.494$

Note : Annual rate for foreign Currency is based on the G-5 Manufactures Exported Goods Index, IBRD.
Annual rate for local currency are assumed as follows.
1991 ··· rate in the first quater in 1990
1992 to 1998 ··· Inflation would be falled through an economical efforts of the Government