

表

Tables

表 2.2.1 カンボジアの水稲（籾）生産

	Total				Wet season				Dry season			
	Cultivated area (ha)	Harvested area (ha)	Yield (ton/ha)	Production (ton)	Cultivated area (ha)	Harvested area (ha)	Yield (ton/ha)	Production (ton)	Cultivated area (ha)	Harvested area (ha)	Yield (ton/ha)	Production (ton)
1980/81	1,441,000	1,440,000	1.19	1,717,000	1,346,000	1,345,000	1.19	1,605,000	95,000	95,000	1.18	112,000
1981/82	1,493,000	1,317,000	1.13	1,490,000	1,343,000	1,171,000	1.05	1,234,000	150,000	146,000	1.75	256,000
1982/83	1,674,000	1,615,000	1.21	1,949,000	1,546,000	1,488,000	1.14	1,696,000	128,000	127,000	1.99	253,000
1983/84	1,740,000	1,610,890	1.27	2,039,000	1,624,000	1,505,890	1.22	1,831,000	116,000	105,000	1.98	208,000
1984/85	1,418,000	978,000	1.29	1,260,000	1,299,000	868,000	1.18	1,025,000	119,000	110,000	2.14	235,000
(1) Average of 1980/81-1984/85	1,553,200	1,392,178	1.22	1,691,000	1,431,600	1,275,578	1.16	1,478,200	121,600	116,600	1.81	212,800
1985/86	1,462,000	1,450,000	1.25	1,812,000	1,345,000	1,333,000	1.18	1,573,000	117,000	117,000	2.04	239,000
1986/87	1,535,000	1,520,000	1.38	2,093,000	1,413,000	1,402,000	1.29	1,813,000	122,000	118,000	2.37	280,000
1987/88	1,378,000	1,370,000	1.32	1,815,000	1,249,000	1,243,000	1.21	1,502,000	129,000	127,000	2.46	313,000
1988/89	1,879,000	1,825,000	1.37	2,500,000	1,735,000	1,695,000	1.32	2,240,000	144,000	130,000	2.00	260,000
1989/90	1,932,000	1,861,000	1.44	2,672,000	1,787,000	1,721,000	1.36	2,336,000	145,000	140,000	2.40	336,000
1990/91	1,890,000	1,855,000	1.35	2,500,000	1,740,000	1,710,000	1.25	2,138,000	150,000	145,000	2.50	362,000
1991/92	1,910,000	1,719,000	1.40	2,400,000	1,761,000	1,572,000	1.29	2,030,000	149,000	147,000	2.52	370,000
1992/93	1,844,100	1,685,380	1.32	2,221,000	1,701,100	1,545,380	1.21	1,871,000	143,000	140,000	2.50	350,000
1993/94	1,856,560	1,823,625	1.31	2,383,350	1,701,560	1,673,625	1.20	2,008,350	155,000	150,000	2.50	375,000
1994/95	1,924,000	1,494,600	1.49	2,223,480	1,753,900	1,329,600	1.30	1,728,480	170,100	165,000	3.00	495,000
1995/96	2,085,991	1,924,041	1.79	3,447,827	1,869,991	1,709,041	1.64	2,802,827	216,000	215,000	3.00	645,000
1996/97	2,170,900	1,879,000	1.84	3,458,000	1,936,900	1,649,000	1.67	2,759,000	234,000	230,000	3.04	699,000
1997/98	2,076,011	1,928,689	1.77	3,414,918	1,827,328	1,684,906	1.59	2,672,597	248,683	243,783	3.05	742,321
1998/99	2,104,013	1,962,566	1.79	3,509,871	1,873,093	1,745,396	1.65	2,873,906	230,920	217,170	2.93	635,965
1999/00	2,157,592	2,079,442	1.94	4,040,900	1,915,592	1,846,442	1.81	3,332,900	242,000	233,000	3.04	708,000
2000/01	2,318,495	1,903,159	2.12	4,026,092	2,058,648	1,647,812	1.95	3,212,269	259,847	255,347	3.19	813,823
2001/02	2,192,873	1,980,295	2.07	4,099,016	1,926,004	1,723,385	1.90	3,275,953	266,869	256,910	3.20	823,063
2002/03	2,113,215	1,994,645	1.92	3,822,509	1,821,225	1,709,652	1.71	2,915,900	291,990	284,993	3.18	906,609
(2) Average of 1998/99-2002/03	2,152,386	1,956,480	1.91	3,727,392	1,903,598	1,714,454	1.74	2,980,669	248,789	242,025	3.09	746,723
(2)/(1) (%)	139%	141%	157%	220%	133%	134%	150%	202%	205%	208%	171%	351%

Source: Agricultural Statistics, MAFF

表 2.2.2 カンボジアの食糧自給率

		1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	Average of 1998/99-2002/03
Cultivated area	ha	1,844,100	1,856,560	2,260,000	2,085,991	2,170,900	2,076,011	2,104,013	2,157,592	2,318,495	2,192,873	2,113,215	2,177,238
Destroyed area	ha	158,723	32,935	424,300	161,950	288,900	147,422	141,447	78,150	415,336	260,622	142,480	207,607
Replanted area	ha										48,044	23,910	
Yield	ton/ha	1.32	1.31	1.21	1.79	1.84	1.77	1.79	1.94	2.12	2.07	1.92	1.97
Harvested area	ha	1,685,377	1,823,625	1,835,700	1,924,041	1,882,000	1,928,589	1,962,566	2,079,442	1,903,159	1,980,295	1,994,645	1,984,021
Production	ton	2,221,000	2,383,350	2,223,480	3,447,827	3,458,000	3,414,918	3,509,871	4,040,900	4,026,092	4,099,016	3,822,509	3,899,678
Reduction for losses and seed use	%					17%	17%	17%	17%	17%	13%	13%	15%
	ton	333,000	375,000	356,000	517,174	587,860	580,536	596,678	686,953	684,436	532,872	496,926	599,573
Paddy for consumption	ton	1,888,000	2,008,350	1,867,480	2,930,653	2,870,140	2,834,382	2,913,193	3,353,947	3,341,656	3,566,144	3,325,583	3,300,105
Conversion ratio	%	62%	62%	62%	62%	62%	62%	62%	62%	62%	64%	64%	63%
Milled rice	ton	1,170,560	1,245,177	1,157,838	1,817,005	1,779,487	1,757,317	1,806,180	2,079,447	2,071,827	2,282,332	2,128,373	2,073,632
Population	person	9,430,000	9,500,000	9,700,000	10,500,000	10,700,000	10,934,334	11,746,760	12,028,680	13,099,485	13,413,872	13,792,778	12,816,315
Consumption	kg /psn	162.0	162.0	162.0	151.2	151.2	151.2	151.2	151.2	151.2	143.0	143.0	147.9
Food requirement	ton	1,527,660	1,539,000	1,571,400	1,587,600	1,617,840	1,653,271	1,776,110	1,818,736	1,980,642	1,918,184	1,972,367	1,893,208
Surplus / Deficit	ton	-357,100	-293,823	-413,562	229,405	161,647	104,046	30,070	260,711	91,185	364,148	156,006	180,424
	%	-23%	-19%	-26%	14%	10%	6%	2%	14%	5%	19%	8%	10%

Source: Agricultural Statistics, MAFF

表 2.2.3 カンボジアの畑作物生産 (1/4)

1 Maize		Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total								
Cultivated area	ha	44,915	59,835	71,462	80,215	80,468	67,379	
Harvested area	ha	39,857	59,739	57,404	67,213	71,594	59,161	
Yields	t/ha	1.22	1.59	2.73	2.76	2.08	2.08	
Production	ton	48,510	95,274	156,972	185,589	148,897	127,048	
Yellow maize								
Cultivated area	ha	16,459	32,185	44,347	55,147	54,657	40,559	
Harvested area	ha	14,086	32,011	34,671	46,235	50,265	35,454	
Yields	t/ha	1.38	1.71	3.51	3.41	2.33	2.47	
Production	ton	19,456	54,680	121,741	157,652	117,344	94,175	
White maize								
Cultivated area	ha	28,456	27,650	27,115	25,068	25,811	26,820	
Harvested area	ha	25,771	27,728	22,733	20,978	21,329	23,708	
Yields	t/ha	1.13	1.46	1.55	1.33	1.48	1.39	
Production	ton	29,054	40,594	35,231	27,937	31,553	32,874	
Wet season total								
Cultivated area	ha	41,486	56,455	67,872	75,299	75,124	63,247	
Harvested area	ha	36,453	56,385	54,041	62,370	66,277	55,105	
Yields	t/ha	1.19	1.60	2.81	2.87	2.14	2.12	
Production	ton	43,487	90,220	151,885	179,088	142,016	121,339	
Yellow maize								
Cultivated area	ha	16,098	31,396	43,894	54,962	54,142	40,098	
Harvested area	ha	13,725	31,230	34,218	46,050	49,750	34,995	
Yields	t/ha	1.38	1.72	3.54	3.42	2.34	2.48	
Production	ton	18,918	53,560	120,965	157,310	116,547	93,460	
White maize								
Cultivated area	ha	25,388	25,059	23,978	20,337	20,982	23,149	
Harvested area	ha	22,728	25,155	19,823	16,320	16,527	20,111	
Yields	t/ha	1.08	1.46	1.56	1.33	1.54	1.39	
Production	ton	24,569	36,660	30,920	21,778	25,469	27,879	
Dry season total								
Cultivated area	ha	3,429	3,380	3,590	4,916	5,344	4,132	
Harvested area	ha	3,404	3,354	3,363	4,843	5,317	4,056	
Yields	t/ha	1.48	1.51	1.51	1.34	1.29	1.43	
Production	ton	5,023	5,054	5,087	6,501	6,881	5,709	
Yellow maize								
Cultivated area	ha	361	789	453	185	515	460.6	
Harvested area	ha	361	781	453	185	515	459	
Yields	t/ha	1.49	1.43	1.71	1.85	1.55	1.61	
Production	ton	538	1,120	776	342	797	715	
White maize								
Cultivated area	ha	3,068	2,591	3,137	4,731	4,829	3,671	
Harvested area	ha	3,043	2,573	2,910	4,658	4,802	3,597	
Yields	t/ha	1.47	1.53	1.48	1.32	1.27	1.41	
Production	ton	4,485	3,934	4,311	6,159	6,084	4,995	
2 Cassava								
		Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total								
Cultivated area	ha	8,792	14,039	16,279	14,239	19,563	14,582	
Harvested area	ha	8,208	14,003	15,380	13,590	19,284	14,093	
Yields	t/ha	8.11	16.32	9.61	10.47	6.33	10.17	
Production	ton	66,534	228,512	147,763	142,262	122,014	141,417	
Wet season								
Cultivated area	ha	7,062	12,519	14,429	12,457	17,754	12,844	
Harvested area	ha	6,537	12,500	13,545	12,126	17,500	12,442	
Yields	t/ha	8.54	16.44	9.36	10.07	5.38	9.96	
Production	ton	55,812	205,530	126,815	122,139	94,089	120,877	
Dry season								
Cultivated area	ha	1,730	1,520	1,850	1,782	1,809	1,738	
Harvested area	ha	1,671	1,503	1,835	1,464	1,784	1,651	
Yields	t/ha	6.42	15.29	11.42	13.75	15.65		
Production	ton	10,722	22,982	20,948	20,123	27,925	20,540	

Source: Agricultural Statistics, MAFF

表 2.2.3 カンボジアの畑作物生産 (2/4)

3 Sweet Potato							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	9,339	9,341	7,435	7,225	8,136	8,295
Harvested area	ha	9,008	9,322	7,217	7,055	7,714	8,063
Yields	t/ha	3.38	3.49	3.90	3.72	4.09	3.72
Production	ton	30,476	32,516	28,178	26,252	31,530	29,790
Wet season							
Cultivated area	ha	6,302	6,572	4,796	4,180	5,285	5,427
Harvested area	ha	5,977	6,557	4,590	4,032	4,900	5,211
Yields	t/ha	3.26	3.32	3.69	3.88	4.34	3.70
Production	ton	19,461	21,738	16,943	15,652	21,254	19,010
Dry season							
Cultivated area	ha	3,037	2,769	2,639	3,045	2,851	2,868
Harvested area	ha	3,031	2,765	2,627	3,023	2,814	2,852
Yields	t/ha	3.63	3.90	4.28	3.51	3.65	3.79
Production	ton	11,015	10,778	11,235	10,600	10,276	10,781
4 Vegetables							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	37,747	31,450	33,755	35,311	34,433	34,539
Harvested area	ha	36,940	31,240	32,143	34,569	32,847	33,548
Yields	t/ha	5.88	5.82	6.09	5.34	4.36	5.50
Production	ton	217,258	181,851	195,894	184,640	143,175	184,564
Wet season							
Cultivated area	ha	23,406	22,845	19,400	21,616	20,599	21,573
Harvested area	ha	22,602	22,641	17,823	21,014	19,129	20,642
Yields	t/ha	5.65	5.68	6.30	4.97	3.23	5.17
Production	ton	127,646	128,596	112,276	104,347	61,864	106,946
Dry season							
Cultivated area	ha	14,341	8,605	14,355	13,695	13,834	12,966
Harvested area	ha	14,338	8,599	14,320	13,555	13,718	12,906
Yields	t/ha	6.25	6.19	5.84	5.92	5.93	6.03
Production	ton	89,612	53,255	83,618	80,293	81,311	77,618
5 Mung bean							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	25,163	26,812	24,991	29,431	39,802	29,240
Harvested area	ha	16,463	26,747	22,895	27,108	35,174	25,677
Yields	t/ha	0.56	0.59	0.66	0.63	0.68	0.62
Production	ton	9,160	15,913	15,100	17,153	23,925	16,250
Wet season							
Cultivated area	ha	17,097	22,623	18,400	21,491	34,302	22,783
Harvested area	ha	8,411	22,558	17,811	19,238	29,713	19,546
Yields	t/ha	0.59	0.60	0.68	0.60	0.67	0.63
Production	ton	4,962	13,575	12,072	11,460	19,864	12,387
Dry season							
Cultivated area	ha	8,066	4,189	6,591	7,940	5,500	6,457
Harvested area	ha	8,052	4,189	5,084	7,870	5,461	6,131
Yields	t/ha	0.52	0.56	0.60	0.72	0.74	0.63
Production	ton	4,198	2,338	3,028	5,693	4,061	3,864

Source: Agricultural Statistics, MAFF

表 2.2.3 カンボジアの畑作物生産 (3/4)

6 Peanut							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	9,695	10,587	10,370	11,913	13,840	11,281
Harvested area	ha	9,605	10,557	10,271	11,271	11,505	10,642
Yields	t/ha	0.69	0.88	0.73	0.79	0.85	0.79
Production	ton	6,612	9,244	7,490	8,913	9,738	8,399
Wet season							
Cultivated area	ha	6,714	8,766	7,611	9,437	11,028	8,711
Harvested area	ha	6,628	8,736	7,540	8,823	8,726	8,091
Yields	t/ha	0.59	0.90	0.74	0.84	0.92	0.80
Production	ton	3,942	7,830	5,557	7,400	8,030	6,552
Dry season							
Cultivated area	ha	2,981	1,821	2,759	2,476	2,812	2,570
Harvested area	ha	2,977	1,821	2,731	2,448	2,779	2,551
Yields	t/ha	0.90	0.78	0.71	0.62	0.61	0.72
Production	ton	2,670	1,414	1,933	1,513	1,708	1,848
7 Soya bean							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	30,981	35,085	33,256	31,997	33,613	32,986
Harvested area	ha	30,975	34,945	33,256	28,687	28,935	31,360
Yields	t/ha	0.89	1.00	0.85	0.86	1.34	0.99
Production	ton	27,709	35,063	28,111	24,658	38,801	30,868
Wet season							
Cultivated area	ha	30,749	34,860	33,256	31,997	33,438	32,860
Harvested area	ha	30,743	34,720	33,256	28,687	28,760	31,233
Yields	t/ha	0.89	1.00	0.85	0.86	1.34	0.99
Production	ton	27,504	34,840	28,111	24,658	38,661	30,755
Dry season							
Cultivated area	ha	232	225	0	0	175	126
Harvested area	ha	232	225	0	0	175	126
Yields	t/ha	0.88	0.99			0.80	0.89
Production	ton	205	223	0	0	140	114
8 Sugarcane							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	7,068	8,417	7,723	7,854	9,473	8,107
Harvested area	ha	6,933	8,374	7,480	7,727	9,395	7,982
Yields	t/ha	19.19	19.09	21.95	21.91	22.23	20.87
Production	ton	133,053	159,859	164,176	169,302	208,819	167,042
Wet season							
Cultivated area	ha	4,824	6,784	5,414	5,807	6,142	5,794
Harvested area	ha	4,689	6,745	5,229	5,692	6,089	5,689
Yields	t/ha	18.25	18.39	22.42	22.68	24.09	21.17
Production	ton	85,593	124,010	117,256	129,097	146,691	120,529
Dry season							
Cultivated area	ha	2,244	1,633	2,309	2,047	3,331	2,313
Harvested area	ha	2,244	1,629	2,251	2,035	3,306	2,293
Yields	t/ha	21.15	22.01	20.84	19.76	18.79	20.51
Production	ton	47,460	35,849	46,920	40,205	62,128	46,512

Source: Agricultural Statistics, MAFF

表 2.2.3 カンボジアの畑作物生産 (4/4)

9 Sesame							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	14,787	16,462	19,222	20,158	20,852	18,296
Harvested area	ha	9,435	16,410	18,130	17,444	18,021	15,888
Yields	t/ha	0.54	0.45	0.54	0.51	0.56	0.52
Production	ton	5,087	7,385	9,855	8,957	10,157	8,288
Wet season							
Cultivated area	ha	14,400	16,187	18,883	20,016	20,604	18,018
Harvested area	ha	9,048	16,135	17,791	17,302	17,773	15,610
Yields	t/ha	0.54	0.45	0.54	0.51	0.56	0.52
Production	ton	4,915	7,263	9,676	8,885	10,029	8,154
Dry season							
Cultivated area	ha	387	275	339	142	248	278
Harvested area	ha	387	275	339	142	248	278
Yields	t/ha	0.44	0.44	0.53	0.51	0.52	0.49
Production	ton	172	122	179	72	128	135
10 Tobacco							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	13,791	8,292	9,678	8,554	4,078	8,879
Harvested area	ha	13,761	8,292	9,669	8,540	4,058	8,864
Yields	t/ha	0.74	0.77	0.79	0.55	0.62	0.69
Production	ton	10,144	6,358	7,665	4,662	2,501	6,266
Wet season							
Cultivated area	ha	247	0	0	0	423	134
Harvested area	ha	217	0	0	0	422	128
Yields	t/ha	0.51				0.51	0.51
Production	ton	111	0	0	0	217	66
Dry season							
Cultivated area	ha	13,544	8,292	9,678	8,554	3,655	8,745
Harvested area	ha	13,544	8,292	9,669	8,540	3,636	8,736
Yields	t/ha	0.74	0.77	0.79	0.55	0.63	0.69
Production	ton	10,033	6,358	7,665	4,662	2,284	6,200
11 Jute							
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total							
Cultivated area	ha	1,251	273	208	203	485	484
Harvested area	ha	1,021	261	208	198	434	424
Yields	t/ha	1.08	1.01	0.87	1.23	1.47	1.13
Production	ton	1,104	264	180	243	636	485
Wet season							
Cultivated area	ha	1,231	259	208	142	399	448
Harvested area	ha	1,001	247	208	137	348	388
Yields	t/ha	1.08	1.01	0.87	1.09	1.64	1.14
Production	ton	1,084	250	180	150	570	447
Dry season							
Cultivated area	ha	20	14	0	61	86	36
Harvested area	ha	20	14	0	61	86	36
Yields	t/ha	1.00	1.00		1.52	0.77	1.07
Production	ton	20	14	0	93	66	39

Source: Agricultural Statistics, MAFF

表 2.2.4 カンボジアの家畜頭羽数

(Unit: 1,000)

	Total Cattle		Total Buffalo		Total of draft animals	Pig	Poultry
	Draft cattle		Draft buffalo				
1980	772.0	562.0	375.0	277.0	839.0	131.0	2,442.0
1981	917.0	635.0	404.0	294.0	929.0	223.0	2,883.0
1982	1,143.0	703.0	482.0	329.0	1,032.0	723.0	4,779.0
1983	1,271.0	811.0	540.0	380.0	1,191.0	824.0	4,595.0
1984	1,436.0	832.0	603.0	374.0	1,206.0	1,009.0	5,430.0
1985	1,560.0	780.0	613.0	425.0	1,205.0	1,203.0	6,398.0
1986	1,705.0	786.0	635.0	452.0	1,238.0	1,161.0	7,347.0
1987	1,852.0	893.0	659.0	453.0	1,346.0	1,251.0	7,164.0
1988	1,891.0	952.0	709.0	456.0	1,408.0	1,500.0	9,259.0
1989	2,095.0	942.0	739.0	449.0	1,391.0	1,737.0	8,717.0
1990	2,181.0	1,018.0	736.0	478.0	1,496.0	1,515.0	8,163.0
1991	2,257.0	1,042.0	755.0	502.0	1,544.0	1,550.0	8,816.0
1992	2,468.0	1,050.0	804.0	482.0	1,532.0	2,043.0	9,901.0
1993	2,527.0	1,097.2	840.0	514.8	1,612.0	1,991.5	9,464.6
1994	2,621.9	1,169.6	814.2	472.5	1,642.1	2,002.3	10,094.4
1995	2,778.0	1,320.1	764.7	444.4	1,764.5	2,038.9	10,066.7
1996	2,761.8	1,198.5	743.9	434.2	1,632.7	2,151.1	11,411.7
1997	2,872.2	1,246.4	766.3	447.2	1,693.6	2,237.0	11,981.7
1998	2,679.9	1,285.7	693.7	413.5	1,699.2	2,339.2	13,167.0
1999	2,826.4	1,303.3	653.9	398.3	1,701.5	2,189.3	13,417.3
2000	2,992.6	1,328.0	693.6	412.6	1,740.6	1,933.9	15,249.2
2001	2,868.8	1,309.8	626.0	356.8	1,666.6	2,114.5	15,248.4
2002	2,924.5	1,338.4	625.9	365.9	1,704.2	2,105.4	16,677.9

Source: Agricultural Statistics, MAFF

表 3.1.1 調査および計画対象地域の戸数と人口 (1/3)

Category	Province	District	Commune	House-holdes (no.)	Population			Average family size (psn/hh)	
					Total (person)	Female (person)	Male (person)		
A1	Study and Target Area (Inside area of main canal)								
A1	KSP	Chbar Mon		7,887	41,708	21,285	20,423	5.29	
A1		050201	Chbar Mon	1,416	7,619	3,889	3,730	5.38	
A1		050202	Kandaol Dom	1,374	6,877	3,493	3,384	5.01	
A1		050203	Roka Thum	2,580	13,459	6,805	6,654	5.22	
A1		050204	Sopoar Tep	1,154	6,064	3,143	2,921	5.25	
A1		050205	Svay Kravan	1,363	7,689	3,955	3,734	5.64	
A1		Total	5	7,887	41,708	21,285	20,423	5.29	
A1	KSP	Kong Pisei		20,767	109,187	56,812	52,375	5.26	
A1		050301	Angk Popel	955	5,300	2,758	2,542	5.55	
A1		050305	Preah Nipean	2,092	11,454	5,904	5,550	5.48	
A1		050308	Roka Kaoh	1,205	6,378	3,354	3,024	5.29	
A1		050313	Veal	1,537	8,010	4,191	3,819	5.21	
A1		Total	4	5,789	31,142	16,207	14,935	5.38	
A1	KSP	Samraong Tong		24,791	133,168	68,939	64,229	5.37	
A1		050701	Roleang Chak	1,479	7,409	3,924	3,485	5.01	
A1		050702	Kahaeng	1,312	6,691	3,468	3,223	5.10	
A1		050706	Roleang Kreul	1,998	11,676	5,772	5,904	5.84	
A1		050709	Saen Dei	1,976	10,895	5,740	5,155	5.51	
A1		050711	Tang Krouch	1,421	7,291	3,855	3,436	5.13	
A1		050713	Trapeang Kong	2,495	13,252	6,873	6,379	5.31	
A1		050715	Voa Sa	2,322	13,786	6,905	6,881	5.94	
A1		Total	7	13,003	71,000	36,537	34,463	5.46	
A1	KDL	Kandal Stueng		18,810	89,158	46,928	42,230	4.74	
A1		080106	Daeum Rues	1,627	7,472	3,909	3,563	4.59	
A1		080117	Roka	620	2,960	1,586	1,374	4.77	
A1		080118	Roleang Kaen	1,031	4,907	2,613	2,294	4.76	
A1		Total	3	3,278	15,339	8,108	7,231	4.68	
A1	KDL	Angk Snuol		18,366	100,520	52,049	48,471	5.47	
A1		080801	Baek Chan	1,793	8,943	4,529	4,414	4.99	
A1		080802	Boeng Thum	1,144	5,961	3,123	2,838	5.21	
A1		080803	Chhak Chheu Neang	597	3,067	1,597	1,470	5.14	
A1		080804	Damnak Ampil	857	4,726	2,396	2,330	5.51	
A1		080806	Kantaok	1,689	9,423	4,856	4,567	5.58	
A1		080807	Krang Mkak	780	4,169	2,222	1,947	5.34	
A1		080808	Lumhach	1,323	6,829	3,520	3,309	5.16	
A1		080811	Peuk	1,208	6,551	3,429	3,122	5.42	
A1		080813	Prey Puok	1,218	6,698	3,461	3,237	5.50	
A1		Total	9	10,609	56,367	29,133	27,234	5.31	
A1	Total		28	40,566	215,556	111,270	104,286	5.31	
A2	Study and Target Area (Outside area of main canal)								
A2	KSP	Kong Pisei		20,767	109,187	56,812	52,375	5.26	
		050302	Chongruk	2,286	11,583	5,911	5,672	5.07	
		050306	Prey Nheat	1,712	9,335	4,809	4,526	5.45	
		Total	2	3,998	20,918	10,720	10,198	5.23	
A2	KSP	Samraong Tong		24,791	133,168	68,939	64,229	5.37	
A2		050703	Khtum Krang	1,260	6,629	3,470	3,159	5.26	
A2		050704	Krang Ampil	1,399	7,398	3,794	3,604	5.29	
A2		050705	Pneay	1,946	10,610	5,639	4,971	5.45	
A2		050707	Samraong Tong	1,104	5,845	3,051	2,794	5.29	
A2		050708	Sambour	1,389	7,363	3,747	3,616	5.30	
A2		050710	Skuh	1,892	9,745	5,031	4,714	5.15	
A2		050712	Thommoda Ar	1,747	9,082	4,816	4,266	5.20	
		Total	7	10,737	56,672	29,548	27,124	5.28	
A2	Total		9	14,735	77,590	40,268	37,322	5.27	
Total of Study and Target Area (A1+A2)				37	55,301	293,146	151,538	141,608	5.30
Kampong Speu				25	41,414	221,440	114,297	107,143	5.35
Kandal				12	13,887	71,706	37,241	34,465	5.16
Total				37	55,301	293,146	151,538	141,608	5.30

Source: SEILA Database

表 3.1.1 調査および計画対象地域の戸数と人口 (2/3)

Category	Province	District	Commune	House-holdes (no.)	Population			Average family size (psn/hh)
					Total (person)	Female (person)	Male (person)	
B11	Study Area (Inundation area by original plan of Prek Thnot Dam)							
B11	KSP	Aoral		4,335	19,888	10,330	9,558	4.59
B11		050401	Haong Samnam	641	3,001	1,550	1,451	4.68
B11		050402	Reaksmei Sameakki	386	1,864	955	909	4.83
B11		Total	2	1,027	4,865	2,505	2,360	4.74
B11	KSP	Phnum Sruoch		16,776	82,485	42,038	40,447	4.92
B11		050601	Chambak	633	2,857	1,455	1,402	4.51
B11		050607	Ou	2,721	12,539	6,074	6,465	4.61
B11		050608	Prey Rumduol	843	4,244	2,153	2,091	5.03
B11		050611	Tang Sya	1,599	8,127	4,197	3,930	5.08
B11		Total	4	5,796	27,767	13,879	13,888	4.79
B11	KSP	Samraong Tong		24,791	133,168	68,939	64,229	5.37
B11		050714	Tumpoar Meas	1,051	5,496	2,854	2,642	5.23
B11		Total	1	1,051	5,496	2,854	2,642	5.23
B11	Total		7	7,874	38,128	19,238	18,890	4.84
B12	Study Area around Target Area (Upper-stream area Except B11)							
B12	KSP	Aoral		4,335	19,888	10,330	9,558	4.59
B12		050403	Trapeang Chour	1,432	6,309	3,299	3,010	4.41
B12		050404	Sangkae Satob	985	4,817	2,467	2,350	4.89
B12		050405	Ta Sal	891	3,897	2,059	1,838	4.37
B12		Total	3	3,308	15,023	7,825	7,198	4.54
B12	KSP	Phnum Sruoch		16,776	82,485	42,038	40,447	4.92
B12		050602	Choam Sangkae	829	4,380	2,273	2,107	5.28
B12		050603	Dambouk Rung	852	4,771	2,471	2,300	5.60
B12		050604	Kiri Voan	1,067	5,548	2,755	2,793	5.20
B12		050605	Krang Dei Vay	1,153	5,689	2,881	2,808	4.93
B12		050606	Moha Sang	2,091	10,765	5,505	5,260	5.15
B12		050609	Prey Kmeng	627	3,256	1,672	1,584	5.19
B12		050610	Tang Samraong	958	4,752	2,542	2,210	4.96
B12		050613	Traeng Trayueng	3,403	15,557	8,060	7,497	4.57
B12		Total	8	10,980	54,718	28,159	26,559	4.98
B12	Total		11	14,288	69,741	35,984	33,757	4.88
Total of Upper-stream Study area								
B11+B12			18	22,162	107,869	55,222	52,647	4.87

Source: SEILA Database

表 3.1.1 調査および計画対象地域の戸数と人口 (3/3)

Category	Province	District	Commune	House-holdes (no.)	Population			Average family size (psn/hh)
					Total (person)	Female (person)	Male (person)	
B2	Study Area (Downstream area where was studied by "Phnom Penh Suburbs Area, JICA")							
B2	KDL	Kandal Stueng		18,810	89,158	46,928	42,230	4.74
B2		080101	Ampov Prey	1,228	5,434	2,838	2,596	4.43
B2		080102	Anlong Romiet	728	3,369	1,765	1,604	4.63
B2		080103	Barku	922	5,055	2,777	2,278	5.48
B2		080104	Boeng Khyang	1,170	5,669	2,794	2,875	4.85
B2		080105	Cheung Kaeub	715	3,204	1,732	1,472	4.48
B2		080107	Kandaok	1,129	5,044	2,695	2,349	4.47
B2		080108	Thmei	405	1,891	1,019	872	4.67
B2		080109	Kouk Trab	855	4,044	2,100	1,944	4.73
B2		080110	Kong Noy	309	1,476	803	673	4.78
B2		080113	Preah Putth	388	1,955	1,051	904	5.04
B2		080114	Preaek Kamps	1,449	6,770	3,504	3,266	4.67
B2		080115	Preaek Roka	834	4,142	2,131	2,011	4.97
B2		080116	Preaek Slaeng	690	3,139	1,676	1,463	4.55
B2		080119	Roluos	518	2,321	1,207	1,114	4.48
B2		080122	Siem Reab	819	4,168	2,249	1,919	5.09
B2		080124	Spean Thma	524	2,534	1,323	1,211	4.84
B2		080125	Tbaeng	743	3,627	1,843	1,784	4.88
B2		080126	Tien	453	2,004	1,113	891	4.42
B2		080127	Trapeang Veang	643	2,939	1,521	1,418	4.57
B2		080128	Trea	1,010	5,034	2,679	2,355	4.98
B2		Total	20	15,532	73,819	38,820	34,999	4.75
B2	TAK	Bati		24,686	127,130	66,129	61,001	5.15
B2		210202	Champey	1,218	5,756	3,026	2,730	4.73
B2		210204	Kandoeng	1,444	6,466	3,304	3,162	4.48
B2		210207	Krang thnong	1,572	8,432	4,357	4,075	5.36
B2		210210	Pot Sar	1,918	10,288	5,307	4,981	5.36
B2		Total	4	6,152	30,942	15,994	14,948	5.03
B2	Total	24		21,684	104,761	54,814	49,947	4.83
Total of Down stream Study Area								
B1+B2		42		43,846	212,630	110,036	102,594	4.85
Total of Study Area								
A+B		79		99,147	505,776	261,574	244,202	5.10

- Note
- 1: Category of Study Area
 - A1 Study and Target Area (Inside area of main canal)
 - A2 Study and Target Area (Outside area of main canal)
 - B11 Study Area (Inundation area by original plan of Prek Thnot Dam)
 - B12 Study Area (Upper-stream area other than B11)
 - B2 Study Area of Downstream area where was studied by "Phnom Penh Suburbs Area, JICA"
 - C Excluded area from Study (Rural area in Southern Phnom Penh)
 - 2: Name of Province
 - KSP Kampong Speu
 - TDL Kandal
 - TAK Takeo
 - 3: Area of paddy field in Chbar Mon District is reported area from the District

Data Source: SEILA Data-base 2002

表 3.4.1 調査・計画対象地域の水田面積および家畜飼養状況 (1/3)

Category	Province	District	Commune	Households (no.)	Population Total (person)	Paddy field		Families with cattle		Families with pig	
						Area (ha)	Average (ha/hh)	Household (no.)	Ratio (%)	Household (no.)	Ratio (%)
A1	Study and Target Area (Inside area of main canal)										
A1	KSP	Chbar Mon		7,887	41,708						
A1		050201	Chbar Mon	1,416	7,619						
A1		050202	Kandaol Dom	1,374	6,877						
A1		050203	Roka Thum	2,580	13,459						
A1		050204	Sopoar Tep	1,154	6,064						
A1		050205	Svay Kravan	1,363	7,689						
A1		Total	5	7,887	41,708	2,620	0.33	3,000	38%	2,500	32%
A1	KSP	Kong Pisei		20,767	109,187	14,106	0.68	16,926	82%	13,402	65%
A1		050301	Angk Popel	955	5,300	956	1.00	831	87%	769	81%
A1		050305	Preah Nipean	2,092	11,454	1,436	0.69	1,465	70%	1,181	56%
A1		050308	Roka Kaoh	1,205	6,378	980	0.81	1,054	87%	792	66%
A1		050313	Veal	1,537	8,010	1,029	0.67	1,320	86%	933	61%
A1		Total	4	5,789	31,142	4,401	0.76	4,670	81%	3,675	63%
A1	KSP	Samraong Tong		24,791	133,168	15,331	0.62	19,588	79%	13,223	53%
A1		050701	Roleang Chak	1,479	7,409	740	0.50	1,087	73%	855	58%
A1		050702	Kahaeng	1,312	6,691	703	0.54	999	76%	1,030	79%
A1		050706	Roleang Kreul	1,998	11,676	1,033	0.52	1,452	73%	1,138	57%
A1		050709	Saen Dei	1,976	10,895	1,110	0.56	1,591	81%	1,204	61%
A1		050711	Tang Krouch	1,421	7,291	1,235	0.87	1,199	84%	702	49%
A1		050713	Trapeang Kong	2,495	13,252	1,241	0.50	1,453	58%	1,000	40%
A1		050715	Voa Sa	2,322	13,786	1,023	0.44	1,582	68%	618	27%
A1		Total	7	13,003	71,000	7,085	0.54	9,363	72%	6,547	50%
A1	KDL	Kandal Stueng		18,810	89,158	13,313	0.71	9,423	50%	7,566	40%
A1		080106	Daeum Rues	1,627	7,472	1,030	0.63	1,116	69%	727	45%
A1		080117	Roka	620	2,960	416	0.67	389	63%	261	42%
A1		080118	Roleang Kaen	1,031	4,907	512	0.50	813	79%	511	50%
A1		Total	3	3,278	15,339	1,958	0.60	2,318	71%	1,499	46%
A1	KDL	Angk Snuol		18,366	100,520	10,590	0.58	11,746	64%	2,856	16%
A1		080801	Baek Chan	1,793	8,943	543	0.30	524	29%	285	16%
A1		080802	Boeng Thum	1,144	5,961	720	0.63	895	78%	102	9%
A1		080803	Chhak Chheu Neang	597	3,067	465	0.78	352	59%	147	25%
A1		080804	Damnak Ampil	857	4,726	385	0.45	511	60%	72	8%
A1		080806	Kantaok	1,689	9,423	750	0.44	619	37%	323	19%
A1		080807	Krang Mkak	780	4,169	640	0.82	636	82%	78	10%
A1		080808	Lumhach	1,323	6,829	785	0.59	882	67%	180	14%
A1		080811	Peuk	1,208	6,551	577	0.48	556	46%	188	16%
A1		080813	Prey Puok	1,218	6,698	871	0.72	923	76%	105	9%
A1		Total	9	10,609	56,367	5,736	0.54	5,898	56%	1,480	14%
A1	Total		28	40,566	215,556	21,800	0.54	25,249	62%	15,701	39%
A2	Study and Target Area (Outside area of main canal)										
A2	KSP	Kong Pisei		20,767	109,187	14,106	0.68	16,926	82%	13,402	65%
		050302	Chongruk	2,286	11,583	1,745	0.71	1,366	60%	1,619	71%
		050306	Prey Nheat	1,712	9,335	1,385	0.72	992	58%	1,229	72%
		Total	2	3,998	20,918	3,130	0.71	2,358	59%	2,848	71%
A2	KSP	Samraong Tong		24,791	133,168	15,331	0.62	19,588	79%	13,223	53%
A2		050703	Khtum Krang	1,260	6,629	1,343	1.07	1,110	88%	605	48%
A2		050704	Krang Ampil	1,399	7,398	1,457	1.04	1,241	89%	1,034	74%
A2		050705	Pneay	1,946	10,610	154	0.08	1,644	84%	894	46%
A2		050707	Samraong Tong	1,104	5,845	833	0.75	926	84%	423	38%
A2		050708	Sambour	1,389	7,363	941	0.68	1,165	84%	511	37%
A2		050710	Skuh	1,892	9,745	1,289	0.68	1,655	87%	1,080	57%
A2		050712	Thommoda Ar	1,747	9,082	1,479	0.85	1,563	89%	1,427	82%
A2		Total	7	10,737	56,672	7,496	0.70	9,304	87%	5,974	56%
A2	Total		9	14,735	77,590	10,626	0.72	11,662	79%	8,822	60%
Total of Study and Target Area (A1+A2)											
			37	55,301	293,146	32,425	0.59	36,911	67%	24,523	44%
Kampong Speu			25	41,414	221,440	24,731.8	0.60	28,695.0	69%	21,544.4	52%
Kandal			12	13,887	71,706	7,693.5	0.55	8,216.0	59%	2,979.0	21%
Total			37	55,301	293,146	32,425.3	0.59	36,911.0	67%	24,523.4	44%

Source: SEILA Database (2002)

表 3.4.1 調査・計画対象地域の水田面積および家畜飼養状況 (2/3)

Category	Province	District	Commune	House- holdes (no.)	Population Total (person)	Paddy field		Families with cattle		Families with pig	
						Area (ha)	Average (ha/hh)	Household (no.)	Ratio (%)	Household (no.)	Ratio (%)
B11	Study Area (Inundation area by original plan of Prek Thnot Dam)										
B11	KSP	Aoral		4,335	19,888	6,166	1.42	3,509	81%	2,014	46%
B11		050401	Haong Samnam	641	3,001	255	0.40	562	88%	252	39%
B11		050402	Reaksmei Sameakki	386	1,864	109	0.28	321	83%	252	65%
B11		Total	2	1,027	4,865	364	0.35	883	86%	504	49%
B11	KSP	Phnum Sruoch		16,776	82,485	23,495	1.40	11,595	69%	9,421	56%
B11		050601	Chambak	633	2,857	400	0.63	625	99%	236	37%
B11		050607	Ou	2,721	12,539	4,611	1.69	1,667	61%	1,527	56%
B11		050608	Prey Rumduol	843	4,244	1,391	1.65	706	84%	575	68%
B11		050611	Tang Sya	1,599	8,127	6,887	4.31	1,248	78%	1,081	68%
B11		Total	4	5,796	27,767	13,289	2.29	4,246	73%	3,419	59%
B11	KSP	Samraong Tong		24,791	133,168	15,331	0.62	19,588	79%	13,223	53%
B11		050714	Tumpoar Meas	1,051	5,496	750	0.71	921	88%	702	67%
B11		Total	1	1,051	5,496	750	0.71	921	88%	702	67%
B11	Total		7	7,874	38,128	14,403	1.83	6,050	77%	4,625	59%
B12	Study Area around Target Area (Upper-stream area Except B11)										
B12	KSP	Aoral		4,335	19,888	6,166	1.42	3,509	81%	2,014	46%
B12		050403	Trapeang Chour	1,432	6,309	2,110	1.47	1,185	83%	624	44%
B12		050404	Sangkae Satob	985	4,817	992	1.01	744	76%	573	58%
B12		050405	Ta Sal	891	3,897	2,700	3.03	697	78%	313	35%
B12		Total	3	3,308	15,023	5,802	1.75	2,626	79%	1,510	46%
B12	KSP	Phnum Sruoch		16,776	82,485	23,495	1.40	11,595	69%	9,421	56%
B12		050602	Choam Sangkae	829	4,380	1,301	1.57	752	91%	578	70%
B12		050603	Dambouk Rung	852	4,771	1,660	1.95	692	81%	461	54%
B12		050604	Kiri Voan	1,067	5,548	550	0.52	732	69%	792	74%
B12		050605	Krang Dei Vay	1,153	5,689	2,176	1.89	1,068	93%	763	66%
B12		050606	Moha Sang	2,091	10,765	1,345	0.64	1,702	81%	1,698	81%
B12		050609	Prey Kmeng	627	3,256	1,018	1.62	575	92%	363	58%
B12		050610	Tang Samraong	958	4,752	1,640	1.71	814	85%	669	70%
B12		050613	Traeng Trayueng	3,403	15,557	516	0.15	1,014	30%	678	20%
B12		Total	8	10,980	54,718	10,206	0.93	7,349	67%	6,002	55%
B12	Total		11	14,288	69,741	16,008	1.12	9,975	70%	7,512	53%
Total of Upper-stream Study area											
B11+B12			18	22,162	107,869	30,411	1.37	16,025	72%	12,137	55%

Source: SEILA Database (2002)

表 3.4.1 調査・計画対象地域の水田面積および家畜飼養状況 (3/3)

Category	Province	District	Commune	House- holdes (no.)	Population Total (person)	Paddy field		Families with cattle		Families with pig		
						Area (ha)	Average (ha/hh)	Household (no.)	Ratio (%)	Household (no.)	Ratio (%)	
B2	Study Area (Downstream area where was studied by "Phnom Penh Suburbs Area, JICA")											
B2	KDL	Kandal Stueng		18,810	89,158	13,313	0.71	9,423	50%	7,566	40%	
B2		080101	Ampov Prey	1,228	5,434	678	0.55	559	46%	818	67%	
B2		080102	Anlong Romiet	728	3,369	262	0.36	183	25%	286	39%	
B2		080103	Barku	922	5,055	382	0.41	327	35%	197	21%	
B2		080104	Boeng Khyang	1,170	5,669	1,000	0.85	315	27%	636	54%	
B2		080105	Cheung Kaeub	715	3,204	954	1.33	438	61%	460	64%	
B2		080107	Kandaok	1,129	5,044	934	0.83	634	56%	628	56%	
B2		080108	Thmei	405	1,891	372	0.92	273	67%	128	32%	
B2		080109	Kouk Trab	855	4,044	538	0.63	400	47%	91	11%	
B2		080110	Kong Noy	309	1,476	224	0.72	139	45%	50	16%	
B2		080113	Preah Putth	388	1,955	410	1.06	209	54%	179	46%	
B2		080114	Preaek Kampis	1,449	6,770	716	0.49	447	31%	237	16%	
B2		080115	Preaek Roka	834	4,142	697	0.84	305	37%	183	22%	
B2		080116	Preaek Slaeng	690	3,139	504	0.73	150	22%	320	46%	
B2		080119	Roluos	518	2,321	360	0.69	151	29%	37	7%	
B2		080122	Siem Reab	819	4,168	388	0.47	272	33%	265	32%	
B2		080124	Spean Thma	524	2,534	497	0.95	233	44%	114	22%	
B2		080125	Tbaeng	743	3,627	743	1.00	666	90%	632	85%	
B2		080126	Tien	453	2,004	380	0.84	196	43%	115	25%	
B2		080127	Trapeang Veang	643	2,939	768	1.19	451	70%	405	63%	
B2		080128	Trea	1,010	5,034	548	0.54	757	75%	286	28%	
B2		Total	20	15,532	73,819	11,355	0.73	7,105	46%	6,067	39%	
B2	TAK	Bati		24,686	127,130	17,727	0.72	17,760	72%	15,642	63%	
B2		210202	Champey	1,218	5,756	1,725	1.42	823	68%	699	57%	
B2		210204	Kandoeng	1,444	6,466	906	0.63	964	67%	782	54%	
B2		210207	Krang thnong	1,572	8,432	1,069	0.68	1,112	71%	848	54%	
B2		210210	Pot Sar	1,918	10,288	3,430	1.79	1,527	80%	824	43%	
B2		Total	4	6,152	30,942	7,130	1.16	4,426	72%	3,153	51%	
B2	Total	24		21,684	104,761	18,485	0.85	11,531	53%	9,220	43%	
Total of Down stream Study Area												
B1+B2				42	43,846	212,630	48,896	1.12	27,556	63%	21,357	49%
Total of Study Area												
A+B				79	99,147	505,776	81,321	0.82	64,467	65%	45,880	46%

Note 1: Category of Study Area

- A1 Study and Target Area (Inside area of main canal)
- A2 Study and Target Area (Outside area of main canal)
- B11 Study Area (Inundation area by original plan of Prek Thnot Dam)
- B12 Study Area (Upper-stream area other than B11)
- B2 Study Area of Downstream area where was studied by "Phnom Penh Suburbs Area, JICA"
- C Excluded area from Study (Rural area in Southern Phnom Penh)

2: Name of Province

- KSP Kampong Speu
- TDL Kandal
- TAK Takeo

3: Area of paddy field in Chbar Mon District is reported area from the District

Data Source: SEILA Database 2002

表 3.5.1 計画・調査対象地域の作物生産の現況 (1/5)

1 Rice		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated area	ha	84,635	87,698	86,266	86,431	66,371	82,280	88,350	91,523	95,613	101,351	92,300	93,827	228,973	235,102	231,400	222,371	222,483	228,066
Destroyed area	ha	195	2,395	2,562	2,018	1,543	1,743	2,150	3,849	19,245	9,988	2,590	7,564	9,648	3,971	54,073	35,992	14,926	23,722
Harvested area	ha	84,440	85,303	83,704	84,413	64,828	80,538	86,200	87,674	76,368	91,363	89,710	86,263	219,325	231,131	177,327	186,379	207,557	204,344
Yield	t/ha	1.42	1.82	1.88	2.19	1.53	1.77	2.68	2.81	3.14	3.45	3.25	3.07	2.02	2.40	2.63	2.13	2.35	2.31
Production	ton	119,500	155,388	157,180	184,588	99,462	143,224	230,800	246,331	239,780	314,877	291,923	264,742	443,680	554,890	466,360	397,629	487,977	470,107
Wet season																			
Cultivated area	ha	83,645	86,598	85,451	85,431	65,340	81,293	44,150	45,143	48,113	45,341	40,253	44,600	170,648	176,102	182,288	166,998	153,912	169,990
Early	ha	22,050	24,167	24,380	24,118	21,730	23,289	9,510	12,556	10,533	8,043	8,388	9,806	66,359	74,095	80,714	66,413	55,690	68,654
IR	ha	15,120	1,180	1,074	848	2,962	4,237	8,085	10,454	10,533	5,799	8,388	8,652	58,840	16,435	27,191	31,673	47,602	36,348
Medium	ha	45,335	45,615	43,093	45,853	32,931	42,565	14,290	11,760	16,693	15,833	14,094	14,534	79,918	84,477	84,545	80,508	78,922	81,674
Upland	ha	1,725	1,154	503	370	740	898	700	441	1,955	1,405	799	1,060	0	0	0	0	0	0
Late	ha	14,535	15,662	17,475	15,090	9,939	14,540	15,800	16,661	14,600	15,489	13,043	15,119	21,585	15,021	15,299	15,966	15,485	16,671
Floating	ha	0	0				0	3,850	3,725	4,332	4,571	3,929	4,081	2,786	2,509	1,730	4,111	3,815	2,990
Destroyed area	ha	45	2,295	2,542	2,018	1,498	1,680	1,950	2,469	18,245	9,988	2,590	7,048	8,648	2,971	52,193	34,472	12,226	22,102
Flood	ha	0	1,756	2,319	1,876	0	1,190	950	1,869	18,245	9,888	2,362	6,663	0	1,147	51,015	33,180	7,030	18,474
Mouse	ha	0	0				0	0	165				83	0	660				330
Drought	ha	0	539	223	16	1,498	455	0	435	0	35	228	140	8,648	1,164	1,176	505	5,107	3,320
Insect	ha	45	0	0	126	0	34	1,000	0	0	65	0	213	0	0	2	787	89	176
Replanted area	ha			0	0	0	0			2,058	5,010	791	2,620			10,691	5,373	9,633	8,566
Harvested area	ha	83,600	84,303	82,909	83,413	63,842	79,613	42,200	42,674	29,868	40,363	38,454	38,712	162,000	173,131	130,095	137,899	151,319	150,889
Yield	t/ha	1.40	1.81	1.87	2.18	1.52	1.76	1.92	2.17	2.58	2.42	2.67	2.35	1.73	2.20	2.41	1.90	2.05	2.06
Production	ton	117,300	152,588	154,874	181,488	96,976	140,645	81,200	92,646	77,030	97,487	102,749	90,222	280,300	380,890	313,139	261,885	310,204	309,284
Dry season																			
Cultivated area	ha	990	1,100	815	1,000	1,031	987	44,200	46,380	47,500	51,000	51,256	48,067	58,325	59,000	49,112	50,000	58,938	55,075
Destroyed area	ha	150	100	20	0	45	63	200	1,380	1,000	0	0	516	1,000	1,000	1,880	1,520	2,700	1,620
Harvested area	ha	840	1,000	795	1,000	986	924	44,000	45,000	46,500	51,000	51,256	47,551	57,325	58,000	47,232	48,480	56,238	53,455
Yield	t/ha	2.62	2.80	2.90	3.10	2.52	2.79	3.40	3.42	3.50	4.26	3.69	3.65	2.85	3.00	3.24	2.80	3.16	3.01
Production	ton	2,200	2,800	2,306	3,100	2,486	2,578	149,600	153,685	162,750	217,390	189,174	174,520	163,380	174,000	153,221	135,744	177,773	160,824
2 Cassava																			
		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated area	ha	90	233	1,200	881	2,969	1,075	216	216	269	248	143	218	673	768	695	564	536	647
Harvested area	ha	90	233	1,200	870	2,969	1,072	216	215	191	164	123	182	613	760	695	560	501	626
Yields	t/ha	6.48	12.96	6.80	8.00	3.99	7.65	3.54	18.40	9.92	11.43	8.93	10.44	6.82	8.13	8.89	6.86	8.02	7.74
Production	ton	583	3,020	8,160	6,960	11,845	6,114	764	3,957	1,895	1,874	1,099	1,918	4,180	6,180	6,179	3,840	4,017	4,879
Wet season																			
Cultivated area	ha	88	193	1,200	881	2,969	1,066	53	120	161	160	64	112	540	688	505	400	319	490
Harvested area	ha	88	193	1,200	870	2,969	1,064	53	120	85	76	44	76	535	680	505	400	286	481
Yields	t/ha	6.51	12.95	6.80	8.00	3.99	7.65	5.26	18.33	7.35	12.50	5.23	9.74	7.01	8.09	9.00	6.00	6.90	7.40
Production	ton	573	2,500	8,160	6,960	11,845	6,008	279	2,200	625	950	230	857	3,750	5,500	4,545	2,400	1,974	3,634
Dry season																			
Cultivated area	ha	2	40	0	0	0	8	163	96	108	88	79	107	133	80	190	164	217	157
Harvested area	ha	2	40	0	0	0	8	163	95	106	88	79	106	78	80	190	160	215	145
Yields	t/ha	5.00	13.00				9.00	2.98	18.49	11.98	10.50	11.00	10.99	5.51	8.50	8.60	9.00	9.50	8.22
Production	ton	10	520	0	0	0	106	485	1,757	1,270	924	869	1,061	430	680	1,634	1,440	2,043	1,245

Source: Agricultural Statistics, MAFF

表 3.5.1 計画・調査対象地域の作物生産の現況 (2/5)

3 Maize		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated	ha	830	586	509	414	683	604	13,668	14,282	14,152	15,034	14,086	14,244	434	341	305	258	172	302
Harvested	ha	830	585	509	400	622	589	11,614	14,268	8,342	10,682	9,403	10,862	434	341	305	255	170	301
Yields	t/ha	1.18	1.20	1.23	1.25	1.86	1.34	1.15	1.87	1.54	1.35	1.58	1.50	1.10	1.11	0.95	0.99	1.11	1.05
Production	ton	979	700	626	500	1,157	792	13,375	26,676	12,837	14,390	14,854	16,426	476	377	290	253	189	317
Yellow maize																			
Cultivated	ha	0	0	0	0	5	1	8,411	8,567	8,989	8,988	6,425	8,276	0	0	0	0	0	0
Harvested	ha	0	0	0	0	5	1	7,852	8,511	4,069	5,323	3,862	5,923	0	0	0	0	0	0
Yields	t/ha	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	1.00	#DIV/0!	1.28	1.44	1.59	1.30	1.27	1.38						
Production	ton	0	0	0	0	5	1	10,031	12,225	6,474	6,929	4,901	8,112	0	0	0	0	0	0
White maize																			
Cultivated	ha	830	586	509	414	678	603	5,257	5,715	5,163	6,046	7,661	5,968	434	341	305	258	172	302
Harvested	ha	830	585	509	400	617	588	3,762	5,757	4,273	5,359	5,541	4,938	434	341	305	255	170	301
Yields	t/ha	1.18	1.20	1.23	1.25	1.87	1.34	0.89	2.51	1.49	1.39	1.80	1.62	1.10	1.11	0.95	0.99	1.11	1.05
Production	ton	979	700	626	500	1,152	791	3,344	14,451	6,363	7,461	9,953	8,314	476	377	290	253	189	317
Wet season total																			
Cultivated	ha	830	586	504	414	683	603	12,100	13,059	12,700	12,670	11,224	12,351	392	310	272	175	172	264
Harvested	ha	830	585	504	400	622	588	10,054	13,053	7,112	8,352	6,553	9,025	392	310	272	175	170	264
Yields	t/ha	1.18	1.20	1.23	1.25	1.86	1.34	1.06	1.88	1.50	1.37	1.71	1.50	1.10	1.10	0.92	0.90	1.11	
Production	ton	979	700	620	500	1,157	791	10,675	24,550	10,646	11,466	11,206	13,709	430	340	250	157	189	273
Yellow maize																			
Cultivated	ha	0	0	0	0	5	1	8,109	8,426	8,895	8,895	6,152	8,095	0	0	0	0	0	0
Harvested	ha	0	0	0	0	5	1	7,550	8,370	3,975	5,230	3,589	5,743	0	0	0	0	0	0
Yields	t/ha					1.00	1.00	1.27	1.43	1.58	1.29	1.27	1.37						
Production	ton	0	0	0	0	5	1	9,581	12,000	6,300	6,743	4,546	7,834	0	0	0	0	0	0
White maize																			
Cultivated	ha	830	586	504	414	678	602	3,991	4,633	3,805	3,775	5,072	4,255	392	310	272	175	172	264
Harvested	ha	830	585	504	400	617	587	2,504	4,683	3,137	3,122	2,964	3,282	392	310	272	175	170	264
Yields	t/ha	1.18	1.20	1.23	1.25	1.87	1.34	0.44	2.68	1.39	1.51	2.25	1.65	1.10	1.10	0.92	0.90	1.11	1.02
Production	ton	979	700	620	500	1,152	790	1,094	12,550	4,346	4,723	6,660	5,875	430	340	250	157	189	273
Dry season total																			
Cultivated	ha	0	0	5	0	0	1	1,568	1,223	1,452	2,364	2,862	1,894	42	31	33	83	0	38
Harvested	ha	0	0	5	0	0	1	1,560	1,215	1,230	2,330	2,850	1,837	42	31	33	80	0	37
Yields	t/ha			1.20			1.20	1.73	1.75	1.78	1.25	1.28	1.56	1.10	1.19	1.21	1.20		1.18
Production	ton	0	0	6	0	0	1	2,700	2,126	2,191	2,924	3,648	2,718	46	37	40	96	0	44
Yellow maize																			
Cultivated	ha	0	0	0	0	0	0	302	141	94	93	273	180.6	0	0	0	0	0	0
Harvested	ha	0	0	0	0	0	0	302	141	94	93	273	180.6	0	0	0	0	0	0
Yields	t/ha							1.49	1.60	1.85	2.00	1.30	1.65						
Production	ton	0	0	0	0	0	0	450	225	174	186	355	278	0	0	0	0	0	0
White maize																			
Cultivated	ha	0	0	5	0	0	1	1,266	1,082	1,358	2,271	2,589	1,713	42	31	33	83	0	38
Harvested	ha	0	0	5	0	0	1	1,258	1,074	1,136	2,237	2,577	1,656	42	31	33	80	0	37
Yields	t/ha			1.20			1.20	1.79	1.77	1.78	1.22	1.28	1.57	1.10	1.19	1.21	1.20		1.18
Production	ton	0	0	6	0	0	1	2,250	1,901	2,017	2,738	3,293	2,440	46	37	40	96	0	44

Source: Agricultural Statistics, MAFF

表 3.5.1 計画・調査対象地域の作物生産の現況 (3/5)

4 Sweet Potato		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	62	60	60	85	397	133	759	809	357	793	677	679	353	524	361	361	382	396
Harvested are:	ha	62	60	60	85	397	133	759	807	349	788	671	675	353	524	311	361	380	386
Yields	t/ha	3.95	3.33	2.87	2.75	3.49	3.28	3.54	3.64	3.26	4.22	4.35	3.80	3.00	3.00	4.63	4.48	3.65	3.75
Production	ton	245	200	172	234	1,386	447	2,685	2,941	1,136	3,325	2,919	2,601	1,060	1,570	1,441	1,618	1,387	1,415
Wet season																			
Cultivated are	ha	51	40	40	85	397	123	36	67	73	73	36	57	213	105	259	209	190	195
Harvested are:	ha	51	40	40	85	397	123	36	67	67	73	36	56	213	105	209	209	190	185
Yields	t/ha	4.06	3.25	2.50	2.75	3.49	3.21	3.00	4.03	5.00	5.00	7.86	4.98	3.00	3.05	5.33	5.40	4.00	4.16
Production	ton	207	130	100	234	1,386	411	108	270	335	365	283	272	640	320	1,115	1,129	760	793
Dry season																			
Cultivated are	ha	11	20	20	0	0	10	723	742	284	720	641	622	140	2,769	102	152	192	671
Harvested are:	ha	11	20	20	0	0	10	723	740	282	715	635	619	140	2,765	102	152	190	670
Yields	t/ha	3.45	3.50	3.60			3.52	3.56	3.61	2.84	4.14	4.15	3.66	3.00	3.90	3.20	3.22	3.30	3.32
Production	ton	38	70	72	0	0	36	2,577	2,671	801	2,960	2,636	2,329	420	10,778	326	489	627	2,528
5 Vegetables																			
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	872	1,595	1,716	1,064	1,943	1,438	4,298	3,910	4,802	5,198	4,677	4,577	2,110	2,460	1,841	1,756	1,744	1,982
Harvested are:	ha	872	1,590	1,716	1,048	1,900	1,425	4,260	3,870	4,333	5,095	4,542	4,420	2,110	2,430	1,840	1,741	1,739	1,972
Yields	t/ha	5.72	5.58	5.64	5.12	2.28	4.87	4.56	5.09	6.15	5.08	4.33	5.04	6.32	6.35	12.33	5.59	3.89	6.90
Production	ton	4,985	8,869	9,680	5,363	4,333	6,646	19,445	19,698	26,644	25,897	19,674	22,272	13,340	15,425	22,683	9,724	6,769	13,588
Wet season																			
Cultivated are	ha	600	1,415	1,523	886	1,546	1,194	1,308	2,286	2,082	2,398	2,472	2,109	1,390	1,800	1,220	1,011	999	1,284
Harvested are:	ha	600	1,410	1,523	870	1,503	1,181	1,270	2,250	1,618	2,345	2,362	1,969	1,390	1,770	1,220	1,001	999	1,276
Yields	t/ha	5.59	5.52	5.60	5.14	1.56	4.68	5.12	5.59	9.00	4.97	3.53	5.64	6.00	6.10	15.00	5.65	2.66	7.08
Production	ton	3,353	7,780	8,530	4,473	2,348	5,297	6,500	12,570	14,562	11,666	8,338	10,727	8,340	10,805	18,300	5,654	2,662	9,152
Dry season																			
Cultivated are	ha	272	180	193	178	397	244	2,990	1,624	2,720	2,800	2,205	2,468	720	660	621	745	745	698
Harvested are:	ha	272	180	193	178	397	244	2,990	1,620	2,715	2,750	2,180	2,451	720	660	620	740	740	696
Yields	t/ha	6.00	6.05	5.96	5.00	5.00	5.60	4.33	4.40	4.45	5.17	5.20	4.71	6.94	7.00	7.07	5.50	5.55	6.41
Production	ton	1,632	1,089	1,150	890	1,985	1,349	12,945	7,128	12,082	14,231	11,336	11,544	5,000	4,620	4,383	4,070	4,107	4,436
6 Mung bean																			
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	390	788	551	677	842	650	2,424	2,063	3,362	4,134	3,720	3,141	133	385	400	515	284	343
Harvested are:	ha	390	770	551	670	832	643	2,416	2,063	1,649	4,061	3,573	2,752	133	385	400	515	284	343
Yields	t/ha	0.50	0.60	0.60	0.60	1.12	0.68	0.55	0.60	0.65	0.79	0.85	0.69	0.45	0.61	0.70	0.66	0.62	0.61
Production	ton	195	460	330	402	932	464	1,340	1,238	1,068	3,211	3,039	1,979	60	235	280	342	175	218
Wet season																			
Cultivated are	ha	390	788	551	677	842	650	244	308	355	579	1,049	507	0	385	400	472	241	300
Harvested are:	ha	390	770	551	670	832	643	236	308	144	541	913	428	0	385	400	472	241	300
Yields	t/ha	0.50	0.60	0.60	0.60	1.12	0.68	0.29	0.60	0.63	0.60	0.91	0.60		0.61	0.70	0.67	0.62	0.65
Production	ton	195	460	330	402	932	464	68	185	90	325	831	300	0	235	280	316	149	196
Dry season																			
Cultivated are	ha	0	0	0	0	0	0	2,180	1,755	3,007	3,555	2,671	2,634	133	0	0	43	43	44
Harvested are:	ha	0	0	0	0	0	0	2,180	1,755	1,505	3,520	2,660	2,324	133	0	0	43	43	44
Yields	t/ha							0.58	0.60	0.65	0.82	0.83	0.70	0.45			0.60	0.60	0.55
Production	ton	0	0	0	0	0	0	1,272	1,053	978	2,886	2,208	1,679	60	0	0	26	26	22

Source: Agricultural Statistics, MAFF

表 3.5.1 計画・調査対象地域の作物生産の現況 (4/5)

7 Peanut		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	328	416	288	294	484	362	1,579	373	1,207	1,045	1,129	1,067	0	255	147	96	165	133
Harvested are:	ha	328	416	283	290	479	359	1,579	369	1,206	1,027	1,118	1,060	0	250	147	96	164	131
Yields	t/ha	0.75	0.49	0.72	0.59	0.54	0.62	1.15	1.10	0.72	0.65	0.60	0.84		0.53	0.69	0.50	0.87	0.65
Production	ton	246	205	203	170	259	217	1,820	405	865	664	673	885	0	132	101	48	142	85
Wet season																			
Cultivated are	ha	328	416	283	294	484	361	13	69	21	27	18	30	0	235	133	86	104	112
Harvested are:	ha	328	416	278	290	479	358	13	65	20	27	18	29	0	230	133	86	104	111
Yields	t/ha	0.75	0.49	0.72	0.59	0.54	0.62	0.62	0.62	0.60	0.74	0.72	0.66		0.52	0.69	0.50	1.06	0.69
Production	ton	246	205	200	170	259	216	8	40	12	20	13	19	0	120	92	43	110	73
Dry season																			
Cultivated are	ha	0	0	5	0	0	1	1,566	304	1,186	1,018	1,111	1,037	0	20	14	10	61	21
Harvested are:	ha	0	0	5	0	0	1	1,566	304	1,186	1,000	1,100	1,031	0	20	14	10	60	21
Yields	t/ha			0.60			0.60	1.16	1.20	0.72	0.64	0.60	0.86		0.60	0.64	0.50	0.53	0.57
Production	ton	0	0	3	0	0	1	1,812	365	853	644	660	867	0	12	9	5	32	12
8 Soya bean																			
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	0	0	0	0	0	0	216	215	0	30	175	127	0	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	216	215	0	30	175	127	0	0	0	0	0	0
Yields	t/ha							0.88	1.00		0.80	0.80	0.87						
Production	ton	0	0	0	0	0	0	190	215	0	24	140	114	0	0	0	0	0	0
Wet season																			
Cultivated are	ha	0	0	0	0	0	0	0	0	0	30	0	6	0	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	0	0	0	30	0	6	0	0	0	0	0	0
Yields	t/ha										0.80		0.80						
Production	ton	0	0	0	0	0	0	0	0	0	24	0	5	0	0	0	0	0	0
Dry season																			
Cultivated are	ha	0	0	0	0	0	0	216	215	0	0	175	121	0	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	216	215	0	0	175	121	0	0	0	0	0	0
Yields	t/ha							0.88	1.00			0.80	0.89						
Production	ton	0	0	0	0	0	0	190	215	0	0	140	109	0	0	0	0	0	0
9 Sugarcane																			
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	29	87	153	157	224	130	1,121	1,343	1,550	1,398	941	1,271	148	236	283	250	340	251
Harvested are:	ha	29	85	153	157	220	129	1,121	1,340	1,475	1,393	935	1,253	148	236	283	250	337	251
Yields	t/ha	33.83	17.65	22.03	20.00	19.50	22.60	26.17	23.65	25.76	22.85	21.99	15.00	15.08	19.38	19.56	18.72	17.55	17.55
Production	ton	981	1,500	3,370	3,140	4,290	2,656	29,337	31,695	38,000	31,825	20,563	30,284	2,220	3,558	5,484	4,890	6,310	4,492
Wet season																			
Cultivated are	ha	29	87	153	157	224	130	398	711	650	793	265	563	133	200	239	191	178	188
Harvested are:	ha	29	85	153	157	220	129	398	710	620	793	265	557	133	200	239	191	175	188
Yields	t/ha	33.83	17.65	22.03	20.00	19.50	22.60	26.50	21.13	25.00	25.00	24.50	24.43	15.00	15.00	20.00	20.50	20.50	18.88
Production	ton	981	1,500	3,370	3,140	4,290	2,656	10,547	15,000	15,500	19,825	6,493	13,473	1,995	3,000	4,780	3,916	3,588	3,456
Dry season																			
Cultivated are	ha	0	0	0	0	0	0	723	632	900	605	676	707	15	36	44	59	162	63
Harvested are:	ha	0	0	0	0	0	0	723	630	855	600	670	696	15	36	44	59	162	63
Yields	t/ha							25.99	26.50	26.32	20.00	21.00	23.96	15.00	15.50	16.00	16.51	16.80	15.96
Production	ton	0	0	0	0	0	0	18,790	16,695	22,500	12,000	14,070	16,811	225	558	704	974	2,722	1,037

Source: Agricultural Statistics, MAFF

表 3.5.1 計画・調査対象地域の作物生産の現況 (5/5)

10 Sesame		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	0	5	0	0	9	3	53	226	665	665	578	437	2	2	15	0	0	4
Harvested are:	ha	0	5	0	0	9	3	53	225	625	665	569	427	2	2	15	0	0	4
Yields	t/ha		0.40			0.67	0.53	0.28	0.44	0.50	0.56	0.57	0.47	0.50	0.50	0.53			0.51
Production	ton	0	2	0	0	6	2	15	100	310	374	326	225	1	1	8	0	0	2
Wet season																			
Cultivated are	ha	0	5	0	0	9	3	53	226	665	665	576	437	0	2	15	0	0	3
Harvested are:	ha	0	5	0	0	9	3	53	225	625	665	567	427	0	2	15	0	0	3
Yields	t/ha		0.40			0.67	0.53	0.28	0.44	0.50	0.56	0.57	0.47		0.50	0.53			0.52
Production	ton	0	2	0	0	6	2	15	100	310	374	325	225	0	1	8	0	0	2
Dry season																			
Cultivated are	ha	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0
Yields	t/ha											0.50	0.50	0.50					0.50
Production	ton	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
11 Tobacco																			
		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	0	0	0	0	0	0	369	102	131	19	26	129	50	0	0	0	0	10
Harvested are:	ha	0	0	0	0	0	0	369	102	130	19	26	129	50	0	0	0	0	10
Yields	t/ha							0.70	0.72	0.75	0.53	0.54	0.65	0.50					0.50
Production	ton	0	0	0	0	0	0	258	73	98	10	14	91	25	0	0	0	0	5
Wet season																			
Cultivated are	ha	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	10
Harvested are:	ha	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	10
Yields	t/ha													0.50					0.50
Production	ton	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	5
Dry season																			
Cultivated are	ha	0	0	0	0	0	0	369	102	131	19	26	129	0	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	369	102	130	19	26	129	0	0	0	0	0	0
Yields	t/ha							0.70	0.72	0.75	0.53	0.54	0.65						
Production	ton	0	0	0	0	0	0	258	73	98	10	14	91	0	0	0	0	0	0
12 Jute																			
		Campong Speu						Kandal						Takeo					
	Unit	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average	1998/99	1999/00	2000/01	2001/02	2002/03	Average
Total																			
Cultivated are	ha	0	0	0	0	0	0	0	28	58	58	135	56	0	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	0	25	58	58	130	54	0	0	0	0	0	0
Yields	t/ha								1.00	0.43	0.50	2.03	0.99						
Production	ton	0	0	0	0	0	0	0	25	25	29	264	69	0	0	0	0	0	0
Wet season																			
Cultivated are	ha	0	0	0	0	0	0	0	28	58	58	100	49	0	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	0	25	58	58	95	47	0	0	0	0	0	0
Yields	t/ha								1.00	0.43	0.50	2.48	1.10						
Production	ton	0	0	0	0	0	0	0	25	25	29	236	63	0	0	0	0	0	0
Dry season																			
Cultivated are	ha	0	0	0	0	0	0	0	0	0	0	35	7	0	0	0	0	0	0
Harvested are:	ha	0	0	0	0	0	0	0	0	0	0	35	7	0	0	0	0	0	0
Yields	t/ha											0.80	0.80						
Production	ton	0	0	0	0	0	0	0	0	0	0	28	6	0	0	0	0	0	0

Source: Agricultural Statistics, MAFF

表 3.5.2 調査対象地域の食糧自給率 (1/2)

Kampong Speu Province

		1998/99	1999/00	2000/01	2001/02	2002/03	Average
Cultivated area	ha	84,635	87,698	86,266	86,431	66,371	82,280
Destroyed area	ha	195	2,395	2,562	2,018	1,543	1,743
Yield	ton/ha	1.42	1.82	1.88	2.19	1.53	1.77
Harvested area	ha	84,440	85,303	83,704	84,413	64,828	80,538
Production	ton	119,500	155,388	157,180	184,588	99,462	143,224
Reduction for losses and seed	%	17%	17%	17%	13%	13%	15%
	ton	20,315	26,416	26,721	23,996	12,930	22,076
Paddy for consumption	ton	99,185	128,972	130,459	160,592	86,532	121,148
Conversion ratio	%	62%	62%	62%	64%	64%	63%
Milled rice	ton	61,495	79,963	80,885	102,779	55,380	76,100
Population	person	616,130	630,917	681,456	697,811	716,624	668,588
Consumption	kg /psn	151.2	151.2	151.2	143.0	143.0	147.9
Food requirement	ton	93,159	95,395	103,036	99,787	102,477	98,771
Surplus / Deficit	ton	-31,664	-15,432	-22,151	2,992	-47,097	-22,671
Ratio	%	-34%	-16%	-21%	3%	-46%	-23%

Kandal Province

		1998/99	1999/00	2000/01	2001/02	2002/03	Average
Cultivated area	ha	88,350	91,523	95,613	101,351	92,300	93,827
Destroyed area	ha	2,150	3,849	19,245	9,988	2,590	7,564
Yield	ton/ha	2.68	2.81	3.14	3.45	3.25	3.07
Harvested area	ha	86,200	87,674	76,368	91,363	89,710	86,263
Production	ton	230,800	246,331	239,780	314,877	291,923	264,742
Reduction for losses and seed	%	17%	17%	17%	13%	13%	15%
	ton	39,236	41,876	40,763	40,934	37,950	40,152
Paddy for consumption	ton	191,564	204,455	199,017	273,943	253,973	224,590
Conversion ratio	%	62%	62%	62%	64%	64%	63%
Milled rice	ton	118,770	126,762	123,391	175,324	162,543	141,358
Population	person	1,105,948	1,132,491	1,204,945	1,223,864	1,256,712	1,184,792
Consumption	kg /psn	151.2	151.2	151.2	143.0	143.0	147.9
Food requirement	ton	167,219	171,233	182,188	175,013	179,710	175,072
Surplus / Deficit	ton	-48,450	-44,471	-58,797	311	-17,167	-33,715
Consumption	%	-29%	-26%	-32%	0%	-10%	-19%

Source: Agricultural Statistics, MAFF

表 3.5.2 調査対象地域の食糧自給率 (2/2)

Phnom Penh Municipality

		1998/99	1999/00	2000/01	2001/02	2002/03	Average
Cultivated area	ha	9,053	8,730	8,451	8,205	8,164	8,521
Destroyed area	ha	1,680	2,134	2,162	1,450	96	1,504
Yield	ton/ha	2.07	1.84	2.00	1.79	1.95	1.93
Harvested area	ha	7,373	6,596	6,289	6,755	8,068	7,016
Production	ton	15,290	12,110	12,584	12,070	15,700	13,551
Reduction for losses and seed	%	17%	17%	17%	13%	13%	15%
	ton	2,599	2,059	2,139	1,569	2,041	2,081
Paddy for consumption	ton	12,691	10,051	10,445	10,501	13,659	11,469
Conversion ratio	%	62%	62%	62%	64%	64%	63%
Milled rice	ton	7,868	6,232	6,476	6,721	8,742	7,208
Population	person	1,028,069	1,052,743	1,184,945	1,192,900	1,283,355	1,148,402
	kg /psn	151.2	151.2	151.2	143.0	143.0	147.9
Food requirement	ton	155,444	159,175	179,164	170,585	183,520	169,577
Surplus / Deficit	ton	-147,576	-152,943	-172,688	-163,864	-174,778	-162,370
Consumption	%	-95%	-96%	-96%	-96%	-95%	-96%

Takeo Province

		1998/99	1999/00	2000/01	2001/02	2002/03	Average
Cultivated area	ha	228,973	235,102	231,400	222,371	222,483	228,066
Destroyed area	ha	10,648	3,971	54,073	35,992	14,926	23,922
Yield	ton/ha	2.03	2.40	2.63	2.13	2.35	2.31
Harvested area	ha	218,325	231,131	177,327	186,379	207,557	204,144
Production	ton	443,680	554,890	466,360	397,629	487,977	470,107
Reduction for losses and seed	%	17%	17%	17%	13%	13%	15%
	ton	75,426	94,331	79,281	51,692	63,437	72,833
Paddy for consumption	ton	368,254	460,559	387,079	345,937	424,540	397,274
Conversion ratio	%	62%	62%	62%	64%	64%	63%
Milled rice	ton	228,318	285,546	239,989	221,400	271,706	249,392
Population	person	813,515	833,039	880,096	901,218	912,376	868,049
Consumption	kg /psn	151.2	151.2	151.2	143.0	143.0	147.9
Food requirement	ton	123,003	125,955	133,071	128,874	130,470	128,275
Surplus / Deficit	ton	105,314	159,591	106,918	92,526	141,236	121,117
	%	86%	127%	80%	72%	108%	95%

Source: Agricultural Statistics, MAFF

表 3.5.3 調査対象県の食糧バランス (2002/03)

	Province	Kampong Spue					Kandal		Takeo	Phnom Penh
	District	Aoral	Phnum Sruoch	Samarong Tong	Chbar Mon	Kong Pisei	Kandal Stueng	Angk Snuol	Bati	Dangkao
Cultivated area	ha	2,285	10,695	8,802	2,509	11,122	13,638	10,305	25,857	6,960
Destroyed area	ha	62	549	206	63	196	115	486	237	96
Yield	ton/ha	1.05	1.60	1.53	2.06	1.20	2.36	3.00	2.61	1.79
Harvested area	ha	2,223	10,146	8,596	2,446	10,926	13,523	9,819	25,620	6,864
Production	ton	2,341	16,212	13,154	5,042	13,062	31,981	29,488	66,922	12,320
Reduction for losses and seed		13%	13%	13%	13%	13%	13%	13%	13%	13%
	ton	304	2,108	1,710	655	1,698	4,158	3,833	8,700	1,602
Paddy for consumption	ton	2,037	14,104	11,444	4,387	11,364	27,823	25,655	58,222	10,718
Conversion ratio	%	64%	64%	64%	64%	64%	64%	64%	64%	64%
Milled rice	ton	1,303	9,027	7,324	2,807	7,273	17,807	16,419	37,262	6,860
Population	person	23,205	85,975	135,145	47,281	115,343	98,437	112,552	133,488	161,383
Consumption	kg /psn	143.0	143.0	143.0	143.0	143.0	143.0	143.0	143.0	143.0
Food requirement	ton	3,318	12,294	19,326	6,761	16,494	14,076	16,095	19,089	23,078
Surplus / Deficit	ton	-2,015	-3,268	-12,002	-3,954	-9,221	3,731	324	18,173	-16,218
Ratio	%	-61%	-27%	-62%	-58%	-56%	27%	2%	95%	-70%

Source: Food Balance Sheet 2002/03, MAFF

表 3.5.4 調査・計画地域の家畜飼養頭数

Kampong Speu Province (Unit: 1,000)

	Cattle		Buffalo		Total of draft animals	Pig	Poultry
	Total	Draft cattle	Total	Draft buffalo			
1998	311.7	127.8	0.7	0.4	128.1	90.1	1,355.4
1999	312.0	138.7	0.4	0.2	138.8	76.7	1,194.6
2000	316.3	140.3	0.5	0.2	140.5	88.6	1,119.7
2001	321.9	140.1	0.6	0.4	140.4	105.1	833.9
2002	330.3	138.5	0.6	0.4	138.9	109.8	1,035.0
Average nos. per household	2.6	1.1	0.0	0.0	1.1	0.9	8.1

Kandal Province (Unit: 1,000)

	Cattle		Buffalo		Total of draft animals	Pig	Poultry
	Total	Draft cattle	Total	Draft buffalo			
1998	216.6	65.4	7.3	4.5	69.9	181.2	1,143.8
1999	191.1	65.5	5.7	3.9	69.5	147.9	1,179.8
2000	183.0	57.6	6.2	1.5	59.1	136.5	1,214.0
2001	180.1	62.7	6.8	4.2	67.0	145.5	1,200.2
2002	174.4	59.7	5.9	3.5	63.2	156.7	1,259.3
Average nos. per household	0.8	0.3	0.0	0.0	0.3	0.7	5.6

Takeo Province (Unit: 1,000)

	Cattle		Buffalo		Total of draft animals	Pig	Poultry
	Total	Draft cattle	Total	Draft buffalo			
1998	323.9	147.0	3.9	2.1	149.1	299.7	1,299.7
1999	330.3	149.9	4.0	2.1	152.0	311.7	1,338.7
2000	311.4	127.5	3.9	2.1	129.6	207.5	1,304.0
2001	313.7	134.0	3.2	1.2	135.1	197.3	1,385.1
2002	310.5	140.4	3.8	2.2	142.6	192.4	1,622.5
Average nos. per household	1.9	0.8	0.0	0.0	0.9	1.2	9.8

Phnom Penh (Unit: 1,000)

	Cattle		Buffalo		Total of draft animals	Pig	Poultry
	Total	Draft cattle	Total	Draft buffalo			
1998	21.7	7.1	0.1	0.1	7.2	21.4	322.9
1999	21.9	6.6	0.1	0.1	6.6	19.1	323.3
2000	20.3	7.1	0.2	0.1	7.3	20.2	344.7
2001	18.2	6.4	0.2	0.1	6.5	18.5	155.0
2002	17.1	6.2	0.2	0.1	6.3	17.7	223.1
Average nos. per household	0.1	0.0	0.0	0.0	0.0	0.1	1.2

Source

Nos. of animals: Agricultural Statistics, MAFF

Households: SEILA Database, 2002

Kampong Speu
127,953

Kandal
225,163

Takeo
165,878

Phnom Penh
182,464

表 3.5.5 カンボジアの改良水稻品種

Variety name	Year released	Ecology *1	Photo-period-sensitive	Growth period (days), Flowering	Yield (ton/ha)	Plant height (cm)	Resistance to BPH *2	Grain length (mm)	Grain width (mm)	Aroma (Scent)
Early rice										
IR 66	1990	IRR/RFL	none	105-115	4.0 - 6.5	80-118	m. susc.	7.2	2.0	None
IR 72	1990	IRR/RFL	none	110-120	3.5 - 6.0	110-120	susc.	7.2	2.1	None
Kru	1990	IRR/RFL	none	110-115	3.5 - 6.0	79-115	m. resist.	7.0	2.0	None
IR Kesar	1993	IRR/RFL	none	105-120	4.0 - 6.0	84-123	m. resist.	6.8	2.0	None
Baray	1999	IRR/RFL	none	100-115	4.0 - 6.0	100-115	m. susc.	6.8	2.0	None
Chul'sa	1999	IRR/RFL	none	95-110	4.0 - 6.0	95-110	m. resist.	6.8	1.9	None
Rohat	1999	IRR/RFL	none	105-120	4.0 - 6.0	105-120	m. susc.	6.7	2.0	None
Rumpe	1999	IRR/RFL	none	100-115	4.0 - 6.0	100-115	susc.	6.5	1.9	None
Medium rice										
Santeheap 1	1992	IRR/RFL	none	130-140	4.0 - 6.0	106-147	m. susc.	7.2	2.2	None
Santeheap 2	1992	IRR/RFL	none	130-140	4.0 - 6.0	108-150	m. susc.	7.6	2.2	None
Santeheap 3	1992	IRR/RFL	none	140-145	4.0 - 6.5	106-155	susc.	6.6	2.6	None
Popoul	1999	IRR/RFL	none	130-140	4.0 - 6.0	84-110	m. susc.	7.4	2.4	None
Sarika	1999	IRR/RFL	none	130-140	4.0 - 6.0	86-106	m. susc.	7.3	2.4	None
Riang Chey	1999	IRR/RFL	sensitive	Nov. 5 - 11	3.5 - 5.5	105-168	m. susc.	6.5	2.1	None
CAR 1	1995	IRR/RFL	sensitive	Nov. 2 - 9	2.5 - 4.0	127 - 177	susc.	6.4	2.2	None
CAR 2	1995	IRR/RFL	sensitive	Nov. 6 - 12	2.5 - 4.0	126-187	susc.	6.2	2.2	None
CAR 3	1995	IRR/RFL	sensitive	Oct.30-Nov.7	2.5 - 4.5	122-166	h. susc.	6.4	2.2	None
CAR 11	1997	IRR/RFL	sensitive	Nov. 5-11	2.5 - 4.5	137-173	susc.	7.6	2.1	None
Aromatic rice										
Pkha Rumchek	1999	IRR/RFL	sensitive	Oct. 25-Nov.1	3.0 - 5.0	112-165	m. susc	7.5	2.1	Aromatic
Phka Rumchang	1999	IRR/RFL	sensitive	Oct. 25-Nov.1	3.0 - 5.0	105-154	m. susc	7.5	2.2	Aromatic
Pkha Rumduoul	1999	IRR/RFL	sensitive	Oct. 30-Nov.7	3.5 - 5.5	107-171	susc.	7.5	2.1	Aromatic
Late rice										
CAR 4	1995	RFL	h. sensitive	Nov. 8-15	2.5 - 5.0	132-173	m. susc	6.4	2.2	None
CAR 5	1995	RFL	h. sensitive	Nov. 10-17	2.5 - 4.5	134-191	susc.	6.6	2.2	None
CAR 6	1995	RFL	h. sensitive	Nov. 9-16	2.5 - 5.0	129-177	susc.	6.6	2.2	None
CAR 7	1996	RFL	h. sensitive	Nov. 15-21	2.5 - 4.0	157-205	h. susc.	6.2	2.2	None
CAR 8	1996	RFL	h. sensitive	Nov. 19-26	2.5 - 4.5	146-199	susc.	5.8	2.4	None
CAR 9	1996	RFL	h. sensitive	Nov.10-17	2.5 - 4.5	140-182	susc.	6.4	2.2	None
CAR 12	1997	RFL	h. sensitive	Nov.17-24	2.5 - 4.5	149	m. susc	6.6	2.5	None
CAR 13	1997	RFL	h. sensitive	Nov.19-26	2.5 - 4.5	154	susc.	5.9	2.0	None
Upland rice										
Rimke	1991	UPL	none	90-95	2.5 - 4.0	105-121	-	6.0	2.0	None
Sita	1991	UPL	none	90-100	2.5 - 4.0	92-108	-	7.0	2.3	None
Floating rice										
Don	1991	DPW	h. sensitive	Nov.20-27	2.0 - 4.5	195-254	-	7.8	2.2	None
Khao Tah Petch	1991	DPW	h. sensitive	Nov.15-23	2.0 - 4.0	202-207	-	7.8	2.2	None
Tewada	1991	DPW	h. sensitive	Nov.12-19	2.0 - 4.0	201-205	-	7.6	2.2	None

Note: *1 IRR: Irrigated RFL: Rainfed lowland UPL: Upland

DPW: Deep water TDL: Tidal wetland

*2 susc.: Susceptible resist.: Resistance

m.: Moderately h.: Highly

Source: Rice Varieties Released by the Varietal Recommendation Committee of Cambodia, CARDI, 2001

表 3.8.1 SEILA データベースの項目(1/2)

Question ID	Short Name	Question Name	Province	Level	Rural/Urban
1	FAMILY	Total number of families	(National)	Village	Both
2	FEM_TOT	Total number of females	(National)	Village	Both
3	MAL_TOT	Total number of males	(National)	Village	Both
4	FEM_0_5	# Girls 0-5 years old (under 6's)	(National)	Village	Both
5	MAL_0_5	# Boys 0-5 years old (under 6's)	(National)	Village	Both
6	FEM_6_14	# Girls 6 to 14 years old	(National)	Village	Both
7	MAL_6_14	# Boys 6 to 14 years old	(National)	Village	Both
8	F6_14_go	# Girls 6 to 14 who go to school	(National)	Village	Both
9	M6_14_go	# Boys 6 to 14 who go to school	(National)	Village	Both
10	FEM15_17	# Women 15 to17 years old	(National)	Village	Both
11	MAL15_17	# Men 15 to17 years old	(National)	Village	Both
12	FEM18_64	# Women 18 to 64 years old	(National)	Village	Both
13	MAL18_64	# Men 18 to 64 years old	(National)	Village	Both
14	F_OVER65	# Women over 65 years of age	(National)	Village	Both
15	M_OVER65	# Men over 65 years of age	(National)	Village	Both
16	F_ILT_15	# Illiterate women over 15 years old	(National)	Village	Both
17	M_ILT_15	# Illiterate men over 15 years old	(National)	Village	Both
18	THATCH_R	# Houses with thatched roof	(National)	Village	Both
19	TILE_R	# Houses with tiled roof	(National)	Village	Both
20	FIBRO_R	# Houses with fibro roof	(National)	Village	Both
21	ZINC_R	# Houses with zinc roof	(National)	Village	Both
22	CONCR_R	# Houses with concrete roof	(National)	Village	Both
23	TOILET	# Latrines	(National)	Village	Rural
24	H2O_HOUSE	# Families with piped water, private pump well or private ring well, usable year round, at their house, less then 150m.	(National)	Village	Rural
25	H2O_150M	# Families with a communal tap, pump well or ring well, usable year round, within 150m of their house.	(National)	Village	Rural
26	H2O_OTHER	Most common source of water for other families: pond, river, rain water, other.	(National)	Village	Rural
27	COW_FAMI	# families with cattle and buffalo in village	(National)	Village	Rural
28	PIG_FAMI	# families with pigs in the village	(National)	Village	Rural
29	PAD_PRICE	Average farm gate price of paddy in Riel for this month, December	(National)	Village	Rural
30	MOTO_NUM	# Motorcycles	(National)	Village	Rural
31	CAR_NUM	# Tractors/koyons/cars	(National)	Village	Rural
32	OX_CART	# Horse carts and ox carts	(National)	Village	Rural
33	BICY_NUM	# Bicycles	(National)	Village	Rural
34	ROW_BOAT	# Row boats	(National)	Village	Rural
35	MOTOBOAT	# Boats with motor	(National)	Village	Rural
36	TV_MUM	# TVs	(National)	Village	Rural
37	TBA_USE	# families who used a traditional birth attendant in the past year	(National)	Village	Rural
38	MWIFE_USE	# families who used a trained midwife in the past year	(National)	Village	Rural
39	TBA_NUM	# traditional birth attendants in the village	(National)	Village	Rural
40	MWIFE_NUM	# government trained midwives in the village	(National)	Village	Rural
41	NUM_IRRI	# family who have some irrigated rice land	(National)	Village	Rural
42	NUM_FERT	# family using chemical fertilizer in the past year	(National)	Village	Rural
43	NUM_PEST	# family using pesticide in the past year	(National)	Village	Rural
44	INSECURITY	# murder, robbery, theft cases in the past year	(National)	Village	Both
45	NUM_LANDC	# land conflict case in the past year	(National)	Village	Both
46	F_HH_UD5	# female headed household/families, where the head is a mother with one or more children with under 5 yrs old	(National)	Village	Both
47	HH_VIOLEN	# families having problems with violence in home	(National)	Village	Both
48	MARK_LOC	Name of the nearest market villager frequently go to buy goods	(National)	Village	Rural
49	HRS_MARK	Time taken to get from village to this nearest market by motor or motorboat	(National)	Village	Rural
50	KM_ROAD	Distance in Km to nearest year-round road (4 wheel motor vehicles)	(National)	Village	Rural
51	HRS_ROAD	Time taken to get from village to nearest year-road by motor or motorboat	(National)	Village	Rural
52	GARBAGE	# Houses which have access to garbage collection by a garbage collector?	(National)	Village	Urban
53	PIPWATER	# Houses which have access to piped water	(National)	Village	Urban
54	ELECTRIT	# Houses with electricity	(National)	Village	Urban
55	TOIL_FAM	# Families with latrines	(National)	Village	Urban
56	MOTO_FAM	# families with motorcycles	(National)	Village	Urban
57	CAR_FAM	# families with tractors/koyons/cars	(National)	Village	Urban
58	BICY_FAM	# families with bicycles	(National)	Village	Urban
59	TV_FAM	# families with TVs	(National)	Village	Urban
60	TRAFFICKI	# trafficking cases reported in the past year	(National)	Village	Urban
61	CROOM_P	# primary school classrooms in the commune	(National)	Commune	Both
62	CROOM_S	# secondary school classrooms in the commune	(National)	Commune	Both
63	TEACH_P	# primary school teachers in the commune	(National)	Commune	Both
64	TEACH_S	# secondary school teachers in the commune	(National)	Commune	Both
65	WET-RAINFED	Area wet season rain fed rice land in Ha	(National)	Commune	Rural
66	WET_IRRI	Area wet season supplemental irrigated rice land in Ha	(National)	Commune	Rural
67	WET_PADDY	Rice production in wet season, MT	(National)	Commune	Rural
68	DRY_IRRI_FULLL	Area of full-irrigated dry season rice land in Ha	(National)	Commune	Rural
69	DRY_RECESS	Area of recession dry season rice land in Ha	(National)	Commune	Rural
70	DRY_PADDY	Rice production in dry season, MT	(National)	Commune	Rural
71	CROOM_K	# kindergarten classrooms	(National)	Commune	Urban
72	TEACH_K	# kindergarten teachers in the commune	(National)	Commune	Urban
73	F_HHH	# Female household headed	(National)	Village	Both
74	M_ILT15_17	# illiterate men from 15-17ys	(National)	Village	Both
75	M_ILT18_64	# illiterate men from 18-64ys	(National)	Village	Both

表 3.8.1 SEILA データベースの項目(2/2)

Question ID	Short Name	Question Name	Province	Level	Rural/Urban
79	F_ILT15_17	# illiterate women from 15-17ys	(National)	Village	Both
80	F_ILT18_64	# illiterate women from 18-64ys	(National)	Village	Both
81	F_ILT_Ov65	# Illiterate women over 65 years old	(National)	Village	Both
82	F15_14SCH	# girl 15 to 17ys who go to school	(National)	Village	Both
83	F6_17SCH	# girl 6 to 17ys who go to school	(National)	Village	Both
84	H_THATCH	# family living in thatched roof	(National)	Village	Rural
85	H_TILE	# family living in tiled roof	(National)	Village	Rural
86	H_FIBRO	# family living in fibro-cement roof	(National)	Village	Rural
87	H_ZINC	# family living in zinced roof	(National)	Village	Rural
88	H_CONCR	# family living in concrete roof	(National)	Village	Rural
89	Lat_that	# Latrine in total thatch house	(National)	Village	Rural
90	Lat_tile	# Latrine in total tiled house	(National)	Village	Rural
91	Lat_fibro	# Latrine in total fibro-cement house	(National)	Village	Rural
92	Lat_zinc	# Latrine in total zinc house	(National)	Village	Rural
93	Lat_conc	# Latrine in total concrete house	(National)	Village	Rural
94	TV_that	# TVs in total thatch house	(National)	Village	Rural
95	VT_tile	# TVs in total tiled house	(National)	Village	Rural
96	TV_fibro	# TVs in total fibro-cement house	(National)	Village	Rural
97	TV_zinc	# TVs in total zinc house	(National)	Village	Rural
98	VT_conc	# TVs in total concrete house	(National)	Village	Rural
99	Baby_born	# Women deliver baby in village	(National)	Village	Rural
100	Pri_class	# Primary classes in commune	(National)	Commune	Both
101	Sec_class	# Secondary classes in commune	(National)	Commune	Both
102	Kid_class	# Kindergarten classes in commune	(National)	Commune	Urban
103	Ric_area	Rice land area in commune	(National)	Commune	Rural
104	M0_5SCH	# boy 0 to 5ys who go to school	(National)	Village	Urban
105	F0_5SCH	# girl 0 to 5ys who go to school	(National)	Village	Urban

表 3.10.1 カンボジアの平均所得と消費水準

Zone	Unit	Cambodia	Phnom Penh	Other Urban	Rural
Average family size	person/family	5.3	5.5	5.4	5.3
Income					
Annual income	Riel/family	403,334	1,139,553	515,027	314,247
Annual income	US\$/family	1,269	3,584	1,620	988
Income source					
Self employment income	%	59.5	29.4	57.4	70.6
Income from wage employment	%	20.3	32.9	21.5	15.5
Others	%	20.2	37.7	21.1	13.8
Quintile groups					
Lowest 20%	US\$/family	497	1,229	528	479
Second 20%	US\$/family	783	1,950	915	747
Third 20%	US\$/family	1,003	2,597	1,304	939
Forth 20%	US\$/family	1,308	3,725	1,737	1,168
Highest 20%	US\$/family	3,023	9,496	3,884	1,889
Consumption					
Annual value	US\$/family	1,138	3,168	1,426	895
Food, beverage and tobacco					
Rice	US\$/family	-	207	194	191
Fish, meat and egg	US\$/family	207	-	-	-
Non-food					
Clothing and foot wear	US\$/family	31	68	36	27
Housing and utilities	US\$/family	195	1,042	291	96
Furnishing and household operation	US\$/family	8	20	12	7
Medical care	US\$/family	67	126	81	59
Transportation and communication	US\$/family	39	269	48	14
Recreation	US\$/family	3	25	3	1
Education	US\$/family	24	169	25	8
Personal care and effects	US\$/family	25	68	33	19
Miscellaneous	US\$/family	45	111	58	37

Source: Cambodia Socio-economic Survey 1999

Some figures were estimated based on the Report

Note: Figures in US\$ were converted by using of exchange rage of : US\$= 3,815 Riel

表 4.2.1 プレクトノット多目的ダムの IEE

Environmental Items	Catchment Area	Reservoir Area	Downstream River Channel		Irrigation Area	Resettlement Area
			I	II		
A.Problems due to Project Location						
1) Impacts on Minority Ethnic Group	--/C	X	*	*	*	--/C
2) Resettlement	*	--/A	*	*	*	--/A
3) Impacts on Land Use	*	--/C	*	*	++/C	--/C
4) Impairment of the Transportation System	*	--/C	X	X	*	*
5) Inundation of Mineral Resources	*	X	*	*	*	*
6) Inundation of Historical Assets	*	--/C	*	*	--/C	*
7) Encroachment into the Precious Ecosystem	--/A	X	X	X	X	X
8) Degradation of Forest Resources	--/A	--/C	*	*	X	--/C
9) Watershed Erosion and Sedimentation	--/B	X	*	*	*	--/C
10) Migrating Valuable Fish Species	X	X	X	X	*	*
B.Problems Associated with the Construction Stage						
1) Air Pollution, Noise and Vibration	*	--/C	--/C	*	--/C	--/C
2) Soil Erosion and Silt Runoff	*	--/C	--/C	--/C	*	--/C
3) Sanitation of Workers' Camp & Hazardous Wastes	*	--/C	*	*	*	--/C
4) Aesthetics and Landscape	*	X	X	X	X	X
C.Problems related to Project Operation						
1) Change of the River Flow Regime	*	*	--/A	--/A	*	*
2) Eutrophication of the Reservoir	*	--/A	*	*	*	*
3) Deterioration of Downstream Water Quality	*	*	--/A	--/A	--/A	--/C
4) Depreciation of Fisheries	*	++/B	X	X	X	*
5) Impacts on the Precious Ecology	--/A	X	X	X	X	X
6) Vector Borne Parasitic Disease	*	--/B	X	X	--/B	X
7) Change of Micro-climates	*	+-/C	*	*	*	*

Notes: Each area is marked with the following classifications.

++/A: Upper part stands for direction of impact and lower part shows the magnitude of impacts.

A: Relatively high magnitude of impact is expected.

B: Relatively medium magnitude of impact is expected.

C: Relatively low magnitude of impact is expected.

X: No effect is expected.

*: There is no relation.

++: Positive effect is expected.

--: Negative effect is expected.

+/: Neutral effect is expected.

Source: Prek Thnot Multipurpose Project Environment Study Report, August 1994, NIPPON KOEI Co., Ltd. in associated with SNOWY MOUNTAINS ENGINEERING CORPORATION

表 4.2.2 水質試驗結果

Item	unit	St.1 Dam Site		St.2 Roleng Chrey		St.3 Kp Tram		St.4 Tuk Thla		St.5 P.T. Bridge	
		5-May	4-Jun	26-Apr	27-May	26-Apr	27-May	26-Apr	27-May	26-Apr	27-May
1) Time	-	8:30	9:50	8:55	10:20	9:50	11:30	10:40	12:50	12:35	14:50
2) Weather	-	fair	cloudy	fair	fair	fair	fair	fair	fair	fair	cloudy
3) A. Temp.	°C	28.5	29.0	29.5	30.6	32.3	32.4	32.4	34.6	34.4	28.4
4) Discharge	m ³ /s	1.8	7.5	stagnant	slight	1.1	50.0	1.5	50	stagnant	25
5) Color	-	light	light	light	light	light	light	light	light	light	light
		brown	brown	brown	brown	brown	brown	brown	brown	brown	brown
6) W. Temp	°C	31.0	30.4	31.8	30.4	32.6	31.2	31.6	32.6	32.4	32.4
7) Transparency	m	0.5	0.5	0.5	0.5	0.2	0.1	0.1	0.1	0.1	0.1
8) PH	-	7.6	7.4	7.4	7.1	7.5	7.1	7.4	7.1	7.5	7.3
9) DO	mg/l	-	7.1	-	6.3	-	6.5	-	6.1	-	6.1
10) COD	mg/l	2.3	3.6	5.2	7.7	3.9	5.6	4.5	6.1	8.7	6.2
11) SS	mg/l	4	16	4	134	32	352	54	282	156	280
12) NH4-N	mg/l	0.175	0.067	0.287	0.127	0.190	0.079	0.183	0.043	0.444	0.099
13) NO2-N	mg/l	0.025	0.008	0.006	0.032	0.004	0.029	0.022	0.050	0.028	0.038
14) NO3-N	mg/l	0.031	0.011	0.015	0.323	0.010	0.099	0.182	0.151	0.582	0.476
15) T-N	mg/l	0.460	0.340	0.750	1.100	0.360	0.370	0.880	0.600	2.120	1.400
16) PO4-P	mg/l	0.001	0.026	0.015	0.060	0.019	0.052	0.045	0.075	0.159	0.134
17) T-P	mg/l	0.022	0.031	0.020	0.095	0.028	0.054	0.071	0.084	0.166	0.158

Item	unit	St.6 Chbar Ampor		St.7 Tonle Bati		St.8 Lower Tonle Bati	St.9 L.B. Irr'n Area	St.10 T.B. Irr'n Area
		26-Apr	27-May	26-Apr	27-May	27-May	27-May	27-May
1) Time	-	12:50	16:50	11:15	13:40	15:40	8:50	14:10
2) Weather	-	fair	cloudy	fair	cloudy	cloudy	fair	cloudy
3) A. Temp.	°C	34.4	28.0	33.8	30.7	27.6	30.9	29.6
4) Discharge	m ³ /s	stagnant	stagnant	0.2	0.5	stagnant	0.0	0.0
5) Color	-	light	light	light	light	brown	light gray	light gray
		brown	brown	brown	brown			
6) W. Temp	°C	33.2	31.2	32.8	35.0	31.0	30.9	35.4
7) Transparency	m	0.6	0.5	0.1	0.1	0.1	0.5	0.3
8) PH	-	8.1	7.8	6.7	6.7	7.1	7.0	7.0
9) DO	mg/l	-	6.7	-	6.5	5.6	6.7	8.5
10) COD	mg/l	2.9	2.8	8.3	9.5	9.5	4.3	9.3
11) SS	mg/l	11	18	42	98	590	32	172
12) NH4-N	mg/l	0.534	0.072	0.050	0.095	0.090	0.040	0.106
13) NO2-N	mg/l	0.006	0.102	0.010	0.016	0.034	0.014	0.015
14) NO3-N	mg/l	0.098	0.219	0.210	0.143	1.243	0.052	0.276
15) T-N	mg/l	1.400	0.910	0.660	0.600	2.800	1.300	1.800
16) PO4-P	mg/l	0.009	0.008	0.040	0.079	0.291	0.020	0.021
17) T-P	mg/l	0.015	0.015	0.190	0.268	0.606	0.033	0.094

Note: 1) All samples were analyzed by a laboratory in Dept. of Hydrology, M/AF&F

2) Values of T-N on April 26 are estimated by using the correlation between T-N and Summed values of NH₄-Nm NO₂ and NO₃ in May 27

Source Prek Thnot Multipurpose Project Environment Study Report, August 1994, NIPPON KOEI Co., Ltd. in associated with SNOWY MOUNTAINS ENGINEERING CORPORATION

表 4.2.3 プレクトノット多目的ダムによる湛水域の世帯数と人口

District	Commune	Village	Households				Population			
			1990	1994	2000	2002	1990	1994	2000	2002
Aoral	Haong Samnam	Champeï	134	141	69	68	641	557	316	319
		Prey Totueng			28	35			129	136
		Dei Chhnang	80	105	115	123	400	520	493	552
		Krang Kokir	49	57	57	78	238	234	284	496
		Krang Ta Va	70	67	64	58	292	259	369	240
		Tang Robang	37	123	106	63	170	542	476	301
	Total	6	370	493	439	425	1,741	2,112	2,067	2,044
	Reaksmei Sameakki	Ou Phdau	50	60	53	56	230	276	244	280
		Reaksmei	78	94	76	83	250	300	307	350
		Sameakki	55	66	38	45	271	325	167	195
Total	3	183	220	167	184	751	901	718	825	
Total of District		9	553	713	606	609	2,492	3,013	2,785	2,869
Phnum Sruoch	Krang Dei Vay	Banteay Roka	30	95	100	125	148	488	504	649
		Dak Por	42	53	141	158	163	318	807	751
		(50% will be submerged)	21	27	71	79	82	159	404	376
		Doung	78	84	108	126	376	438	487	665
		(10% will be submerged)	8	8	11	13	38	44	49	67
		Krang Kor	72	106	130	130	474	531	649	683
		Krang Krouch	70	95	80	86	374	426	468	414
		Krasang Khpos	30	78	86	89	166	465	428	474
		Prey Kahiech	51	81	112	116	271	456	602	550
		Prey Totueng	81	121	162	184	458	953	852	841
		(80% will be submerged)	65	97	130	147	366	762	682	673
		Trapeang Prei	71	93	109	139	342	433	272	662
		Total	9	525	806	1,028	1,153	2,772	4,508	5,069
	(Total submerged)		418	680	828	924	2,261	3,764	4,057	4,547
	Ou	Chek	70	93	231	288	366	457	1,086	1546
		Koun Trom	72	100	134	116	335	538	603	773
		Krang Ta Tan	34	92	101	113	162	451	602	671
		(50% will be submerged)	17	46	51	57	81	226	301	336
		Ta Lat Thmei	84	84	169	456	383	435	822	811
	Total	4	260	369	635	973	1,246	1,881	3,113	3,801
	(Total submerged)		243	323	585	917	1,165	1,656	2,812	3,466
	Prey Rumduol	Chonlong Mlu	111	142	154	168	477	775	744	822
		Kab Tuk	58	73	62	76	318	369	325	367
		Kiri Reaksmei Khang Tboung	34	108	124	125	172	513	805	732
		Ou Mukh Tuek	97	199	138	134	369	958	707	687
		Prey Romiet	66	125	148	175	309	529	770	825
		Prum Taos	55	99	84	97	268	457	456	459
		(50% will be submerged)	28	50	42	49	134	229	228	230
		Rumduol Thmei	77	92	75	68	248	454	365	352
Total	7	498	838	785	843	2,161	4,055	4,172	4,244	
(Total submerged)		471	789	743	795	2,027	3,827	3,944	4,015	
Tang Samraong	Kandal	58	101	117	141	241	430	495	564	
	Khnanng Krang	52	83	112	112	275	470	494	380	
	Krang Boeng	35	83	97	98	138	409	408	463	
	Krang thum	79	127	149	154	390	559	656	731	
	Sdok Chrey	68	121	157	164	368	642	766	958	
	Srae Chrov	50	78	92	96	235	337	393	504	
	Tang Samraong	60	58	63	66	312	255	304	339	
	Thmei	48	74	112	127	215	326	488	813	
Total	8	450	725	899	958	2,174	3,428	4,004	4,752	
Tang Sya	Chheu Neang Khpos	34	40	58	66	133	186	296	289	
	Dei Doh	22	42	45	47	106	205	267	280	
	Kiri Reaksmei Khang Cheung	19	97	102	107	81	435	518	485	
	Krang Ta Kan	26	79	79	80	102	385	431	429	
	Tnaot Preaek	83	82	92	92	336	384	456	449	
Total	5	184	340	376	392	758	1,595	1,968	1,932	
Total of District		33	1,917	3,078	3,723	4,319	9,111	15,467	18,326	20,418
(Total Submerged)			1,765	2,856	3,430	3,985	8,385	14,269	16,785	18,711
Samraong Tong	Tumpoar Meas	Prachiev bat	77	92	126	126	367	440	550	615
Total of District		1	77	92	126	126	367	440	550	615
Grand Total		43	2,547	3,883	4,455	5,054	11,970	18,920	21,661	23,902
(Grand total submerged)			2,395	3,661	4,162	4,720	11,244	17,722	20,120	22,195

Source: 1990 and 1994; Environmental Study Report, Aug. 1994, Prek Thnot Multipurpose Project 2002; SEILA Database 2002, SEILA Program, MRD

表 4.2.4 移転地の整備費用 (1/3)

Haong Samnam Resettlement Site	Unit	Number nos.	Acreage	Unit Price (US\$)	Cost (US\$)
I. Cost for Land Development					
A. Land Preparation					
1) Clearing	ha		6,000	400	2,400,000
2) Land Leveling	ha		6,000	850	5,100,000
B. Construction of Houses for Resettlers	m ²	3,700	177,600	63	11,188,800
C. Construction of Public Facilities					
1) Public Office	m ²	18	3,526	63	222,138
2) School					
Primary School	m ²	12	3,690	63	232,470
Secondary School	m ²	3	2,214	63	139,482
3) Health Center	m ²	2	900	63	56,700
4) Temple	m ²	9	2,029	63	127,827
5) Market	m ²	2	2,000	63	126,000
Sub-total					19,593,417
II. Cost for Infrastructure					
D. Road					
1) Gravel Road (4 m width, 20 cm gravel)	m ²		40,000	10	400,000
2) Feeder Road	m ²		30,000	5	150,000
E. Water Supply					
1) Well (1 m dia. 30 m depth)	nos.	60		10,000	600,000
2) Hand Pump	nos.	60		2,000	120,000
F. Drainage and Sanitary System					
1) Drainage Channel	m	10,000		8	80,000
2) Garbage Disposal	nos.	37		1,000	37,000
G. Electrification					
1) Distribution System	m	15,000		40	600,000
Sub-total					1,987,000
Grand Total					21,580,417

Source: Prek Thnot Multipurpose Project Environment Study Report, 1994, Nippon Koei Co., Ltd.

Note: Only data of houses which will be resettled is updated.

表 4.2.4 移転地の整備費用 (2/3)

Tang Samraong Resettlement Site	Unit	Number nos.	Acreage	Unit Price (US\$)	Cost (US\$)
I. Cost for Land Development					
A. Land Preparation					
1) Clearing	ha		1,500	450	675,000
2) Land Leveling	ha		1,500	900	1,350,000
B. Construction of Houses for Resettlers	m ²	600	28,800	63	1,814,400
C. Construction of Public Facilities					
1) Public Office	m ²	3	588	63	37,044
2) School					
Primary School	m ²	2	615	63	38,745
Secondary School	m ²	1	369	63	23,247
3) Health Center	m ²	1	450	63	28,350
4) Temple	m ²	2	338	63	21,294
5) Market	m ²	1	1,000	63	63,000
Sub-total					4,051,080
II. Cost for Infrastructure					
D. Road					
1) Gravel Road (4 m width, 20 cm gravel)	m ²		120,000	10	1,200,000
2) Feeder Road	m ²		90,000	5	450,000
E. Water Supply					
1) Well (1 m dia. 30 m depth)	nos.	10		10,000	100,000
2) Hand Pump	nos.	10		2,000	20,000
F. Drainage and Sanitary System					
1) Drainage Channel	m	3,000		8	24,000
2) Garbage Disposal	nos.	6		1,000	6,000
G. Electrification					
1) Distribution System	m	5,000		40	200,000
Sub-total					2,000,000
Grand Total					6,051,080

Source: Prek Thnot Multipurpose Project Environment Study Report, 1994, Nippon Koei Co., Ltd.

Note: Only data of houses which will be resettled is updated.

表 4.2.4 移転地の整備費用 (3/3)

Chambak Resettlement Site	Unit	Number nos.	Acreage	Unit Price (US\$)	Cost (US\$)
I. Cost for Land Development					
A. Land Preparation					
1) Clearing	ha		1,500	500	750,000
2) Land Leveling	ha		1,500	950	1,425,000
B. Construction of Houses for Resettlers	m ²	750	36,000	63	2,268,000
C. Construction of Public Facilities					
1) Public Office	m ²	3	588	63	37,044
2) School					
Primary School	m ²	2	615	63	38,247
Secondary School	m ²	1	369	63	23,247
3) Health Center	m ²	1	450	63	28,350
4) Temple	m ²	1	338	63	21,294
5) Market	m ²	1	1,000	63	63,000
Sub-total					4,654,182
II. Cost for Infrastructure					
D. Road					
1) Gravel Road (4 m width, 20 cm gravel)	m ²		20,000	10	200,000
2) Feeder Road	m ²		30,000	5	150,000
E. Water Supply					
1) Well (1 m dia. 30 m depth)	nos.	10		10,000	100,000
2) Hand Pump	nos.	10		2,000	20,000
F. Drainage and Sanitary System					
1) Drainage Channel	m	3,000		8	24,000
2) Garbage Disposal	nos.	8		1,000	8,000
G. Electrification					
1) Distribution System	m	10,000		40	400,000
Sub-total					902,000
Grand Total					5,556,182

Source: Prek Thnot Multipurpose Project Environment Study Report, 1994, Nippon Koei Co., Ltd.

Note: Only data of houses which will be resettled is updated.

表 4.3.5 環境管理計画 (E M P) の費用

	Unit (\$/m)	Months (m/m)	Cost (\$)
I. Resettlement-RP 1 (Evaluation of Living Standard)			
Specialist (Foreign)	11,000	2	22,000
Specialist (Local)	5,000	2	10,000
Others (20 % of personnel cost)			6,400
Sub-total			38,400
II. Resettlement-PR 2 (Socio-economic Survey)			
Specialist (Foreign)	11,000	5	55,000
Specialist (Local)	5,000	10	50,000
Others (50 % of personnel cost)			52,500
Sub-total			157,500
III. Resettlement-RP 3 (Social Development)			
Specialist (Foreign)	11,000	9	99,000
Specialist (Local)	5,000	18	90,000
Others (20 % of personnel cost)			37,800
Sub-total			2,26,800
IV. Resettlement-RP 4 (Farming Instruction)			
Specialist (Foreign A)	20,000	9	180,000
Specialist (Foreign B)	11,000	18	198,000
Specialist (Local)	5,000	18	90,000
Others (20 % of personnel cost)			93,600
Sub-total			561,600
Grand Total			984,300

Source: Prek Thnot Multipurpose Project Environment Study Report, 1994, Nippon Koei Co., Ltd.

表 4.4.1 プレクトノット多目的ダム計画の初期投資額

(Unit: US\$ million)

	Original Plan *1	Review by JICA (2001) *2	Review by JICA (2003) *3	Remarks	
Dam and Power Facility					
Dam civil works	55.7	55.7	55.7		
Irrigation gate block and dissipater	1.6	1.6	1.6		
Diversion weir and canal head regulator refurbishing	0.1	0.1	0.1		
Power station building	5.8	5.8	5.8		
Power station plant	14.7	14.7	14.7		
Transmission line	4.0	4.0	4.0		
North substation	0.8	0.8	0.8		
Subtotal	82.7	82.7	82.7		
Engineering service 10%	8.3	8.3	8.3		
Overseas training	1.0	1.0	1.0		
Government administration 3%	2.8	2.8	2.8		
Environmental study and resettlement	9.5	52.8	57.9	*2	*3
Production foregone cost of farmland submerged				0.36	0.36 paddy field 7,150 ha x US\$ 50/ha
Construction cost of resettlement area				30.43	for 4,456 families, gross area: 9,000ha
Land compensation of foregone				2.72	2.72 (10,360 - 9,000)ha x US\$ 2000/ha
Living compensation				18.81	22,000 psn x US\$ 285/yr x 3yr
Cost for environmental management plan				0.51	0.51 23,900 psn x US\$ 297/yr x 3yr
Subtotal				52.83	57.88 environmental flow, water quality, etc.
Physical contingency 10%	10.4	14.8	15.3		
Subtotal	114.7	162.4	168.0		
Irrigation Works					
Irrigation infrastructure	76.9	85.0	85.0	*1: 34,000 ha x US\$ 2,500/ha	*2* 34,000 ha x US\$ 2,300/ha
Irrigation plant and other cost	11.9	11.9	11.9		
Physical contingency 10%	8.9	9.7	9.7		
Subtotal	97.7	106.6	106.6		
Total Capital Cost	212.4	269.0	274.6	Original *	JICA *2
				Capital cost (US\$/ha) 6,247	7,912
					JICA *3 8,076

Source *1: Prek Thnot Multipurpose Project Reappraisal Report, 1992

*2: Project Formulation Study by JICA, 2001

*3: The Preparatory Study Team, 2003

表 4.4.2 プレクトノット多目的ダム計画の経済便益

	Unit	Original Plan *1	JICA *2	JICA *3	Remarks
1 Irrigation Benefit					
Paddy/Rice price					
International price of rice	US\$/ton	273 - 457	250 - 350	235	Bangkok, broken 5%
Paddy price at farm-gate	US\$/ton	167 - 302	HYV: 110	160	Export parities are 0% for *1,
Average	US\$/ton	188	Local v.: 130	160	100% for *2, and 50% for *3
Yield					
Without	ton/ha	1.1 - 1.6	1.1	1.6	Original plan depends on land capability
With	ton/ha/year	5.2 - 8.5	5.2	6.6	Original plan depends on land capability
Gross income					
Without	US\$/ha/year		143	256	
With	US\$/ha/year		572	1,056	
Production cost					
Without	US\$/ha/year		93	70	
With	US\$/ha/year		146	216	
Net profit					
Without	US\$/ha/year	82 - 166	50	186	Original plan depends on land capability
With	US\$/ha/year	815 - 1,583	426	840	Original plan depends on land capability
Incremental benefit	US\$/ha/year	730 - 1,417	376	654	Original plan depends on land capability
Average	US\$/ha/year	935	376	654	
Irrigation Benefit	US\$ million/year	31.79	12.78	22.24	
2 Energy Benefit	US\$ million/year	2.95	2.95	2.95	
3 Fishery Benefit	US\$ million/year	0.17	0.17	0.17	
4 Flood Control Benefit	US\$ million/year	0.00	0.23	0.23	
Total Benefit	US\$ million/year	34.91	16.13	25.59	

Source *1: Prek Thnot Multipurpose Project Reappraisal Report, 1992

*2: Project Formulation Study by JICA, 2001

*3: The Preparatory Study Team, 2003

表 4.4.3 プレクトノット多目的ダム計画の費用対効果 (EIRR)

(Unit: US\$ million)

Year	Area (ha)	Cost					Benefit					Balance
		Dam & power	Resettlement & production	Irrigation	O&M	Total	Fishery	Irrigation	Energy	Flood	Total	
1			20.00	1.85	0.13	21.98					0.00	-21.98
2	300		20.00	3.11	0.06	23.17					0.00	-23.17
3	500		20.00	3.22	0.11	23.33		0.14			0.14	-23.19
4	700	3.12	0.48	2.48	0.16	6.24		0.39			0.39	-5.85
5	700	14.52	0.48	1.99	0.18	17.17		0.78			0.78	-16.39
6	700	34.42	0.48	1.42	0.21	36.53		1.23			1.23	-35.31
7	700	35.22	0.48	1.29	0.23	37.22		1.71			1.71	-35.51
8	1,000	17.01	0.48	2.10	0.25	19.84		2.24	0.23		2.47	-17.37
9	1,300	1.25	0.48	3.68	0.27	5.68		3.01	2.95	0.23	6.19	0.51
10	1,600	1.25	0.48	4.58	0.36	6.67		3.86	2.95	0.23	7.04	0.37
11	2,000	1.25	0.48	5.73	0.48	7.94	-0.13	4.91	2.95	0.23	7.96	0.02
12	2,000	1.25	0.48	5.79	0.63	8.15	-0.62	6.22	2.95	0.23	8.78	0.63
13	2,000	1.25	0.48	5.81	0.77	8.31	0.01	7.53	2.95	0.23	10.72	2.41
14	2,000	1.25	0.48	5.83	0.92	8.48	0.19	8.84	2.95	0.23	12.21	3.73
15	2,000	1.25	0.48	5.83	1.07	8.63	0.18	10.14	2.95	0.23	13.50	4.87
16	2,000	1.25	0.48	5.85	1.22	8.80	0.22	11.45	2.95	0.23	14.85	6.05
17	2,000	1.25	0.48	5.87	1.36	8.96	-0.13	12.76	2.95	0.23	15.81	6.85
18	2,000	1.25	0.48	5.89	1.51	9.13	-0.12	14.07	2.95	0.23	17.13	8.00
19	2,000	1.25	0.48	5.91	1.66	9.30	0.16	15.38	2.95	0.23	18.72	9.42
20	2,000	1.25	0.48	5.91	1.81	9.45	0.14	16.69	2.95	0.23	20.01	10.56
21	2,000	1.25	0.48	3.17	1.95	6.85	0.17	18.00	2.95	0.23	21.35	14.50
22	2,000	1.25	0.48	6.11	2.10	9.94	0.17	19.31	2.95	0.23	22.66	12.72
23	2,000	1.25	0.48	6.15	2.25	10.13	-0.17	19.92	2.95	0.23	22.93	12.80
24	500	1.25	0.48	1.99	2.40	6.12	0.14	21.92	2.95	0.23	25.24	19.12
25		1.25	0.48	0.47	2.43	4.63	-0.09	22.25	2.95	0.23	25.34	20.71
26		1.25	0.48	0.43	2.43	4.59	0.17	22.25	2.95	0.23	25.60	21.01
27		1.25	0.48	0.44	2.43	4.60	0.17	22.25	2.95	0.23	25.60	21.00
28		1.25	0.48	0.52	2.43	4.68	0.17	22.25	2.95	0.23	25.60	20.92
29		1.25	0.48	0.68	2.43	4.84	0.17	22.25	2.95	0.23	25.60	20.76
30		1.25	0.48	0.76	2.43	4.92	0.17	22.25	2.95	0.23	25.60	20.68
31		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
32		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
33		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
34		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
35		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
36		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
37		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
38		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
39		1.25	0.48	0.87	2.43	5.03	0.13	22.25	2.95	0.23	25.56	20.53
40		1.25	0.48	0.87	2.43	5.03	0.17	22.25	2.95	0.23	25.60	20.57
Total	34,000	144.29	77.76	113.56	60.97	396.58	2.63	556.54	94.40	7.59	661.16	264.58
EIRR=											3.9%	

表 5.2.1 農家所得向上の概算

1. Paddy Cultivation

	Unit	Irrigated paddy (cropping intensity)				Rainfed paddy
		100%	125%	150%	200%	
Farm-gate price of paddy	US\$/ton	110	110	110	110	110
Yield						
Without Project	ton/ha/year	1.6	1.6	1.6	1.6	1.6
With Project	ton/ha/year	3.2	4.0	4.8	6.7	2.0
Cropping Intensity	%	100%	125%	150%	200%	100%
Gross income						
Without	US\$/ha/year	176	176	176	176	176
With	US\$/ha/year	352	440	528	737	220
Production cost						
Without	US\$/ha/year	50	50	50	50	50
With	US\$/ha/year	90	113	135	190	65
Net profit						
Without	US\$/ha/year	126	126	126	126	126
With	US\$/ha/year	262	328	393	547	155
Incremental benefit	US\$/ha/year	136	202	267	421	29
Typical farming size	ha/family	0.7	0.7	0.7	0.7	0.7
Income Increase	US\$/family	95	141	187	295	20

2. Diversified crops

	Unit area (ha/family)	Production (ton)	Unit price (US\$/family)	G. income (US\$/family)	Profit ratio (%)	Net profit (US\$/family)
Vegetable *1	0.05	0.4	180	72	75%	54
Upland crops *2	0.2	0.2	350	70	70%	49

Note: per ha

Vegetable	1	8	180	1,440	75%	1,080
Upland crops	1	1	350	350	70%	245

*1: Watermelon, cucumber, tomato, long bean, cabbage, chili, chinese leaves, sugarcane, etc

*2: Mungbean, soybean, groundnut, maize, sesame, etc

3. Livestock

	Unit nos. (nos./family)	Nos. sold (head/yr)	Unit price (US\$/family)	Gross income (US\$/head)	Profit ratio (%)	Net profit (US\$/family)
Pig	2	2.5	80	200	30%	60
Chicken	40	80	2	160	30%	48
Cattle	1	0.3	200	60	60%	36

4. Other

Collection of Natural Resources

Wild vegetables, bamboo, rattan, fuel wood, charcoal, etc

Marketing and Processing

Rice mill, local wine distillation, animal feed processing, grading of cash crop products, etc

Trading, transporting, handicraft, etc.

Fishery

Fish catching, Fish culture (paddy, reservoir)

表 5.2.2 経済的便益の概算

	Unit	Irrigated paddy				Rainfed paddy
		Single cropping		Double cropping		
		100%	125%	150%	200%	
Price						
International price of rice *1	US\$/ton	235	235	235	235	235
Paddy at farm-gate	US\$/ton	160	160	160	160	160
Yield						
Without Project	ton/ha/year	1.6	1.6	1.6	1.6	1.6
With Project	ton/ha/year	3.2	4.0	4.8	6.7	2.0
Cropping Intensity	%	100%	125%	150%	200%	100%
Gross income						
Without	US\$/ha/year	256	256	256	256	256
With	US\$/ha/year	512	640	768	1,072	320
Production cost						
Without	US\$/ha/year	60	60	60	60	60
With	US\$/ha/year	100	125	150	210	70
Net profit						
Without	US\$/ha/year	196	196	196	196	196
With	US\$/ha/year	412	515	618	862	250
Incremental benefit	US\$/ha/year	216	319	422	666	54

Note *: Current price in 2005 at Bangkok, Global Commodity Price Prospects, 2003, World Bank

表 5.3.1 水源開発アプローチの費用対効果 (EIRR)の概算

	Unit	Existing water resources	Tributary stream	Small scale reservoir	Pump irrigation	Rainfed	Dam development *2
Irrigation and water development cost							
Irrigation development	US\$/ha	2,000	1,300 - 1,600	1,000 - 1,500	1,000 - 1,400	250	2,000
Pump	US\$/ha				135	50	
Dam / Reservoir	US\$/ha			530 - 1,000			
Other facility	US\$/ha		200 - 500				
Environmental cost	million US\$						1.0
Total	US\$/ha	2,000	1,500 - 2,100	1,500 - 2,500	1,000 - 1,500	300	
Irrigable area / Area applied	ha	5,000	(400) *3	(600) *3		25,000	
Implementation period	year	6	6	3			9
Operation cost of pump	US\$/ha/year				70	14	
Cropping intensity	%	125%	150%	125%	125%	100%	200%
Economic benefit	US\$/ha/year	319	422	319	249 *4	40 *4	666
O&M *1	%	2.0%	2.0%	2.0%	2.0%	2.5%	2.5%
Replacement cost *1	%	15%	15%	10%	20%	15%	15%
Yield	ton/ha/year	4.0	4.8	4.0	4.0	2.0	6.7
Economic IRR	%	11%	13% - 19%	9% - 16%	12% - 19%	11%	7% - 10% *2

Note

*1: % of irrigation development cost

*2: Dam development costs per ha were estimated as shown below

Target EIRR	Possible cost of dam development (US\$/ha)
For EIRR 10%	2,200
For EIRR 8%	3,200
For EIRR 7%	3,900

*3: The area is included in irrigable area by existing available water

*4: The economic benefit was deducted operation cost of pump from Irrigation benefit shown in Table 5.2.1

付属資料1

要請書

APPLICATION FORM FOR JAPAN'S DEVELOPMENT STUDIES

Date of entry : month July year 2001

Applicant : the Government of Kingdom of Cambodia

1. Project digest

- (1) Project Title : The Study on Prek Thnot River Basin Comprehensive Agricultural Development Project
- (2) Location (province/ country name) : Kompong Speu, Kandal, Takeo province and Phnom Penh
(city /town/village name) : _____
from the metropolis : about Two(2) hours' ride

(1) Implementing Agency

Name of the Agency : Ministry of Water Resources and Meteorology

Number of Staff of the Agency : 749 persons

Budget allocated to the Agency: 7,440 million Riels

(2) Justification of the Project

-Present conditions of the sector:

The main economic infrastructure of Cambodia is agriculture, as mentioned in the Royal Government of Cambodia Platform on Second Term 1998-2003.

Agriculture provides about 40% of the Gross Domestic Product and about 85% of the population living in rural areas which depend on agriculture for subsistence. Nearly 3.9 million ha or 22% of the total area of the country are being used for agricultural purpose.

Rice is the major agricultural crop, which occupies about 2.6 million ha or about 67% of the cultivated area, and also is the most dominant food crop in Cambodia, occupying 90% of total food production and accounting for about 70% of daily calorie intake of the people. In this connection, increase of rice production is one of the immediate targets of the Government's development strategies.

Although significant efforts have been made and agricultural production has recovered gradually since the late 1980's, productivity is still low compared to that of the surrounding Asian countries. In terms of rice production, average yield in 1997/98 crop year was only 1.77 tons/ha, in spite that Cambodia is rich in water resources and vast fertile low lying area in the Mekong Delta and surrounding of the Great Lake-Tonle Sap, which provide suitable physical condition for rice cultivation.

One of the reasons of low productivity is inadequate and insufficient irrigation and drainage facilities as well as inadequate water management technology. So improvement of irrigation and drainage facilities and water management technology is urgent and necessary to improve the productivity of rice.

-Sectoral development policy of the national/local government:

The main objective of the Government's development strategies is to reduce poverty and improve welfare of the Cambodian people. The emphasis of development policy, therefore, is put on rural development than urban. In this connection, agricultural sector is recognized to be as important as other sectors, such as transportation and communication, health, education and training, in order to achieve the prime objective.

The Second Five Year Socio-economic Development Plan (2001-2005) is under preparation. Following issues will be addressed as basic goals of the agriculture sector in the Five Year Plan.

- To obtain self-sufficiency of staple food by increasing production of rice and other food crops,
- To contribute to economic growth and to foreign earnings through export of agricultural produce,
- To increase income earning opportunities for farm households by diversifying crop production, particularly for those households headed by women,
- To add value to crop and livestock products by developing agro-processing industries,
- To improve of irrigation facilities and water management technology that is necessary for increasing productivity of rice and other crops, and
- To prevent and reduce natural disasters in Cambodia by improving and strengthening the capacities of meteorological observation and forecasting on disastrous meteorological phenomena and to preserve people's life and property by providing more accurate forecast and warnings.

-Problems to be solved in the sector:

- 1) Inadequate irrigation, drainage, and flood protection works (lack of proper water control over water resources),
- 2) Shortage of agricultural technical staff with appropriate skill and knowledge,
- 3) Shortage of application of agricultural inputs (fertilizer, improved seeds, credit, market system), and
- 4) Inaccessibility and poor rural infrastructure (roads, domestic water, communication).

-Outline of the Project:

The Prek Thnot river, tributary of the Bassac river, had been studied and investigated by national and international agencies since the early 1960s. It was envisaged in the original project plan that a storage dam with hydro-power station, irrigation facilities and flood control facilities were constructed. In accordance with the original plan, construction works of the dam and power station started in 1969, however in 1973 the works were suspended due to civil war. In 1975-79, some irrigation facilities were constructed in the Prek Thnot river basin ignoring the previous comprehensive development plan.

In 1990-91 the Interim Mekong Committee conducted re-appraisal study of the Prek Thnot Multipurpose Project that comprised four packages, namely 1) power development study, 2) study coordination and reappraisal of the civil works, 3) reappraisal of plant and equipment for power station, and 4) irrigation reappraisal. The conclusions were affirmative and funding for further implementation was recommended.

Despite the past efforts of providing the irrigation and drainage facilities since 1960s, the agricultural productivity in the area envisaged with the Prek Thnot project has not been improved, rather got worse.

Government of Cambodia has requested further study to Government of Japan to cover all issues regarding hydro-power generation, flood mitigation and irrigation with being given high priority since 1996, however it has been stalled. Because it is reported that dam construction has some difficulties such as replacement of quite a few dwellers in the dam site to be inundated, serious impact to the environment and a huge cost allotment for dam construction.

From the point of above mentioned background Government of Cambodia eagerly requests a comprehensive agricultural development study without considering a storage dam in the main stream of the Prek Thnot River.

Further study required now is to include Master Plan and Feasibility Study as follows.

- 1) To conduct a master plan for the agricultural development in the middle to lower basin of the Prek Thnot River,

- 2) To analyze flood flow and low-water flow regime of the Prek Thnot River in master plan level,
- 3) To carry out feasibility level study(s) on the priority projects and formulate an agricultural development plan, and
- 4) To conduct a feasibility study on the flood control and forecasting/warning system.

-Purpose (short-term objective) of the Project:

The comprehensive Prek Thnot development project is proposed integrating whole components, particularly deciding irrigation schemes, rural development plans and flood control project so that further financing for implementation of each project becomes much possible.

-Goal (long-term objective) of the Project:

The proposed project is aiming at sustainable agricultural development from production point of view. It will contribute to the self-sufficiency of staple food and poverty alleviation in rural area.

-Prospective beneficiaries:

From the view point of flood control, total number of about one million residents will benefit. Approximately 70,000 households of farmers in Kompong Speu, Kandal, Takeo Provinces and Phnom Penh municipality will directly benefit from the project.

-the Project's priority in the National Development Plan / Public Investment Program:

low medium high

(3) Desirable or Scheduled time of the commencement of the Project:

month June year 2002

(4) Expected funding source and / or assistance (including external origin) for the Project:

Government of Cambodia has the plan to implement the proposed projects as soon as possible after the completion of the study. Grant-aid from external agencies, anticipated from the Government of Japan, is expected.

(5) Other relevant Projects, if any.

The Royal Government has requested a grant aid project "Rehabilitation of the Kandal Snung Irrigation System in Lower Prek Thnot Basin" located in Lower Prek Thnot where is out of the study area to the Japanese Government. This project was selected as the priority project by JICA Development Study "Master Plan Study on the Integrated Agricultural and Rural Development Project in the Suburbs of Phnom Penh" (1993-1995). If this development study and above proposed grant aid project are realized to be implemented, they maximize the

effectiveness of the projects each other.

Furthermore, the Project-type technical cooperation "Technical Service Center for Irrigation System Project" has been implemented since this January whose target is the capacity building of irrigation engineers by OJT method. The OJT model site is located in the proposed grant aid project area. Then the Comprehensive Agricultural Study will more effectively promote the activities of the Technical Service Center indirectly.

2. Terms of Reference of the proposed Study

(1) Necessity/Justification of the Study:

In 1990-91 re-appraisal study consisting of four components was conducted as mentioned in "outline of the project". The re-appraisal study mainly focused on the dam construction. Irrigation and drainage system was also studied under the condition of water stored in the dam.

The proposed new study will include the following components,

- 1) Irrigable area should be decided paying careful attention to the low-water flow during dry spell without storage dam in the Prek Thnot River,
- 2) Flood control including flood warning/forecasting system should be studied,
- 3) Appropriate water allocation to the Prek Thnot River basin from upstream to down stream should be carefully examined for the maximum water utilization,
- 4) Diversified agriculture should be considered in the area where the water distribution from the Prek Thnot River is not expected, in order to equally benefit the farmers in the study area, and
- 5) Rural development focusing on village roads, domestic water and so on should be taken into consideration for satisfaction of minimum social welfare in the study area.

(2) Necessity/Justification of the Japanese Technical Cooperation:

Japan has been successfully rendering to the Kingdom of Cambodia the technical and financial assistance in implementing several agricultural and rural development projects such as Agricultural Technical Center in Bartambang, Animal Production Center in Kompong Cham, Maize Production Center in Day Ech, Tripartite cooperation on the rural development & resettlement project in Kompong Speu and Takeo, Technical Service Center for Irrigation System Project and many other agricultural development studies since 1960s. Through these assistances to the Kingdom of Cambodia, Japan has accumulated experiences and know-hows on the agricultural developments in this country. These accumulated experiences and know-hows combined with Japan's advanced technologies in agricultural and rural development will surely lead the study to a success.

(3) Objectives of the Study:

The objectives of the study are,

- 1) To prepare a master plan for the rehabilitation of the existing agricultural infrastructures, the construction of irrigation and drainage facilities in potential irrigation areas and the rural development in the middle to lower basin of the Prek Thnot River,

- 2) To analyze flood flow and low-water flow regime of the Prek Thnot River in master plan level. The study would be considered not to include the big dam in the main stream of the Prek Thnot River, which was examined and partly constructed before Khmer Rouge chaos. The hydro-meteorological stations would be installed in accordance with the necessity for the study.
- 3) To carry out feasibility level study(s) on the priority projects and formulate an agricultural development plan, including the rehabilitation/improvement plan of existing irrigation system, organizing plan of beneficial farmers into water users' groups, diversified agriculture, rural development and institutional strengthening plan of the government agencies concerned,
- 4) To conduct a feasibility study for the flood control and forecasting/warning system among the priority project(s) selected in the master plan study on the flood flow regime,
- 5) To involve the beneficiaries into the planning stage of the projects through a participatory approach, and
- 6) To transfer technology to the counterpart personnel through on-the-job training during the course of the study.

(4) Area to be covered by the Study:

The study area covers approximately 110,000 ha in gross in Kompong Speu, Kandal, Takeo Provinces and Phnom Penh municipality.

From the view point of flood control, total number of about one million residents will benefit. Approximately 70,000 households of farmers in the study area will directly benefit from the project.

(5) Scope of the Study:

The study will consist of two (2) phases and the following items;

1, Phase I (master plan study)

1.1 Collection and review of the existing data and information on the following items, and conduct of field survey.

- topography, geographical features, agricultural production basic systems, rural infrastructure,
- meteorology, hydrology,
- geology, soil,
- land use
- socio-economy, social environment, rural organization system, farmers water users' organization—survey will be done by questionnaire and/or beneficiaries participatory approach
- farming practices situation, agricultural economy, agricultural marketing & processing—survey will be done by questionnaire and/or beneficiaries participatory approach,
- agricultural support system (governmental and private)

- environment

- 1.2 The assessment on the study area will be conducted focusing on the agricultural, rural and irrigation development potential and basic needs of beneficiaries.
- 1.3 River flow will be examined based on the meteorological and hydrological data obtained. Hydro-meteorological stations and any other necessary equipment will be installed and data will be collected to make the river flow analysis more accurate.
- 1.4 Runoff model will be established to examine the water resource potential for irrigation and flood control. For example application of tank model such as the model developed in Thailand by JICA Project-Type Technical Cooperation in cooperation with Royal Irrigation Department will be considered.
- 1.5 Draft master plan will be formulated on the basis of the result of field survey, data collection, and data analysis.
- 1.6 Draft master plan will be discussed with the officials concerned and be finalized to master plan.
- 1.7 Master Plan will include the following plans,
 - 1) Farming plan
 - 2) Land use plan
 - 3) Water allocation plan in the Prek Thnot River Basin
 - 4) Basic irrigation plan
 - 5) Facilities operation and maintenance plan
 - 6) Post harvest, processing and marketing plan
 - 7) Rural infrastructure development plan
 - 8) Basic plan on the flood control and warning/forecasting system of the Prek Thnot River
 - 9) Environmental conservation plan
 - 10) Project implementation plan, which includes selection of priority project(s) and project implementation organization plan

2, Phase 2 (feasibility study)

- 2.1 Collection of data and information for the priority projects through additional field survey.
- 2.2 Feasibility study for the priority projects will include the following plans
 - 1) Farming improvement plan, which includes diversified agriculture
 - 2) Irrigation facilities development plan
 - 3) Facilities operation and maintenance development plan
 - 4) Post harvest, processing and marketing development plan
 - 5) Rural infrastructure development plan
 - 6) Flood control and warning/forecasting system of the Prek Thnot River
 - 7) Environmental conservation plan, which includes environmental impact assessment

- (ELA) in accordance with the necessity
- 8) Project cost estimation and project evaluation
 - 9) Project implementation plan

(6) Study Schedule:

Anticipated study period is 22 months in total consisting of phase 1, phase 2, and explanation and finalization of draft final report. Tentative schedule is shown in the attached table.

(7) Expected Major Outputs of the Study:

JICA will prepare and submit the following reports in English to the Government of Cambodia.

1, Inception Report

Thirty (30) copies at the commencement of the Phase 1 field work.

2, Progress Report 1

Thirty (30) copies at the end of the Phase 1 field work.

3, Interim Report

Thirty (30) copies at the commencement of the Phase 2 field work.

4, Progress Report 2

Thirty (30) copies at the end of the Phase 2 field work.

5, Draft Final Report

Thirty (30) copies at the end of the home office work on Phase 2. Cambodian side will provide its comments on the Draft Final Report to JICA within one (1) month after explanation to Cambodian side.

6, Final Report

Fifty (50) copies within two (2) months after the receipt of comments on the Draft Final Report from Cambodian side.

(8) Possibility to be implemented / Expected funding resources:

Government of Cambodia has the plan to implement the proposed projects as soon as possible after the completion of the study. Grant-aid from external agencies, anticipated from the Government of Japan, is expected.

(9) Request of the Study to other donor agencies, if any:

None

(10) Other relevant information

None

3. Facilities and information for the Study

(1) Assignment of counterpart personnel of the implementing agency for the Study

Before the implementation of the study counterpart personnel will be assigned in each study field.

(2) Available data, information, documents, maps, etc. related to the Study:

Available references for the study are shown in the attached list.

(3) Information on the security condition in the Study Area:

The security situation in the project area is stable. The social environment exposes no live-threat to locals as well as foreigners.

4. Global Issues (Environment, Women in Development, Poverty, etc.)

(1) Environmental components (such as pollution control, water supply, sewage, environmental management, forestry, biodiversity) of the Project if any.

Environmental conservation plan, which includes EIA in accordance with the necessity, is one of the plans in M/S and F/S.

(2) Anticipated environmental impacts (both natural and social) by the Project, if any.

None

(3) Women as main beneficiaries or not.

The project will not focus on only women, however households headed by woman, which are reported to be about 26 % of the whole in general, will significantly benefit from the project.

(4) Project components which require special considerations for women (such as gender difference, women specific role, women's participation), if any.

It is envisaged that women will play an important role for rural development so that the study should be conducted paying careful attention to them.

(5) Anticipated impacts on women caused by the Project, if any.

None

(6) Poverty alleviation components of the Project, if any.

Irrigated farming, flood damage mitigation, diversified agriculture and so forth will contribute to the poverty alleviation.

(7) Any constraints against the low-income people caused by the Project.

None

5. Undertakings of the Government of Cambodia

In order to facilitate the smooth and efficient conduct of the Study, the Government of Cambodia shall take necessary measures:

- (1) to secure the safety of the Study Team,
- (2) to permit the members of the Study Team to enter, leave and sojourn in Cambodia in connection with their assignment therein, and exempt them from foreign registration requirements and consular fees,
- (3) to exempt the Study Team from taxes, duties and any other charges on equipment, machinery and other materials brought into and out of Cambodia for the conduct of the Study,
- (4) to exempt the Study Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the Study Team for its services in connection with the implementation of the Study,
- (5) to provide necessary facilities to the Study Team for remittance as well as utilization of the funds introduced in Cambodia from Japan in connection with the implementation of the Study,
- (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
- (7) to secure permission for the Study Team to take all data, documents and necessary materials related to the Study out of Cambodia to Japan, and
- (8) to provide medical services as needed. Its expenses will be chargeable to members of the Study Team.

6. The Government of Cambodia shall bear claims, if any arise against member(s) of the Japanese Study Team resulting from, occurring in the course of or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the member of the Study Team.

7. Cambodia National Mekong Committee shall act as counterpart agency to the Japanese Study Team and also as coordinating body in relation with other governmental and non-governmental organization concerned for the smooth implementation of the Study.

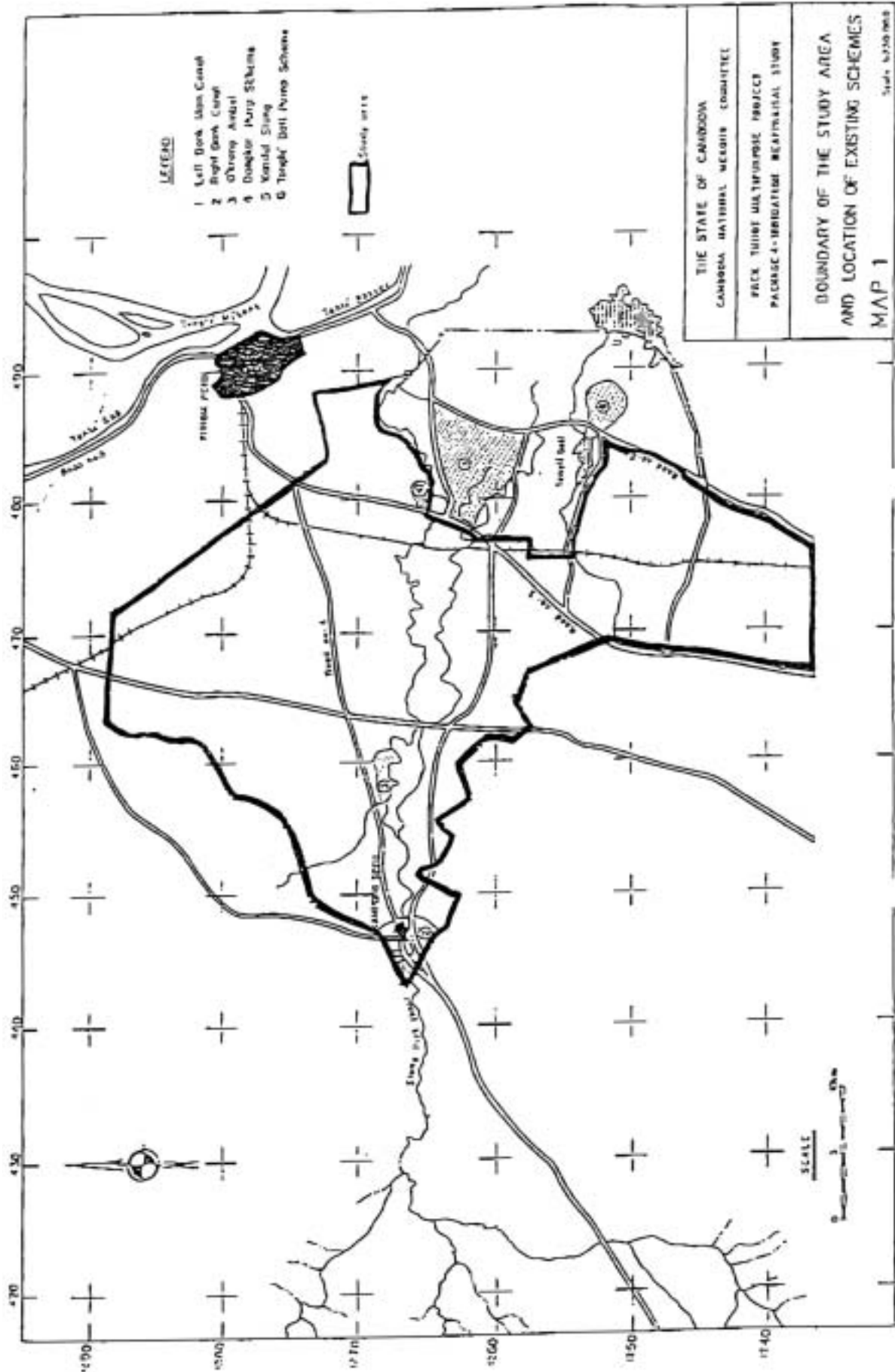
The Government of Cambodia assures that matters referred to in this form will be ensured for the smooth conduct of the Development Study by the Japanese Study Team.

Signed: _____

Title: _____

On behalf of the Government of Cambodia _____

Date: _____



Tentative Working Schedule

item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Planning	←			Phase 1						→					Phase 2				→			
Work in Cambodia																						
Work in Japan	□																					
Reports	Ic/R						P/R 1			I/R					P/R 2					D/R		F/R

- Ic/R : Inception Report
- P/R : Progress Report
- I/R : Interim Report
- D/R : Draft Final Report
- F/R : Final Report

References for the Study

Title, Name of document	Published Date	Remarks
Prek Thnot Pioneer Agricultural Project Khmer Republic (Project Preparation, Volume 1, Main Report) prepared by TAHAL CONSULTING ENGINEER LTD	Jan. 1975	in English
Prek Thnot Multipurpose Project Reappraisal Report, Volume 1 Summary prepared by Snowy Mountains Engineering Corporation Limited (SMEC)	Dec. 1991	in English
Prek Thnot Multipurpose Project Environment Study Report prepared by Nippon Kocci Co Ltd in association with Snowy Mountains Engineering Corporation Limited (SMEC)	Aug. 1994	in English
First Five Year Socioeconomic Development Plan 1996-2000	1997	in English
Second Five Year Socioeconomic Development Plan 2001-2005 (Draft)		in English
General Population Census of Cambodia 1998, Seven(7) Volumes are available	2000	in English

references are report, book, map, photo, law(decree, sub-decree), etc. for the study implementation

付屬資料2

英文要約

PREPARATORY STUDY
FOR
THE STUDY
ON
COMPREHENSIVE AGRICULTURAL DEVELOPMENT
OF PREK THNOT RIVER BASIN

EXECUTIVE SUMMARY



Japan International Cooperation Agency

January 2004



Photo-1: Oct.22, 2003. Prek Thnot River at Peam Khley (upstream view). Prek Thnot dam was proposed here with a catchment area of 3,650 km². Annual runoff is estimated at about 1,250 MCM.



Photo-2: Oct.28, 2003. Flood Relief Channel constructed by ADB emergency flood rehabilitation project in the downstream the Prek Thnot River. The capacity is estimated at 300 m³/s.



Photo-3: Oct.28, 2003. Prek Thnot River at Kong Noy, Kandal. Measured discharge was 750 m³/s. A village on the left bank is inundated. Flood dike on the left bank is located beyond the village.



Photo-4: Oct.28, 2003. Spillway of Ou Krang Ambel reservoir on the left bank of the Prek Thnot River. The irrigation system diverts water form a tributary of the Prek Thnot and Roleang Chrey North Main Canal.



Photo-5: The Lumbach main canal of Ou Krang Ambel irrigation system. The main canal was connected with the existing main canal in the downstream to command paddy field in Angk Snuol District of Kandal. The connecting canal was constructed by Western Phnom Penh Integrated Area Project in 2003.



Photo-6: Nov.19,2003. Roleang Chrey Regulator. Over flow depth was 0.12 m (WL=7.12 m). Generator, motor, cable for the gate, and others are considered to be upgraded or replaced.



Photo-7: Discussions were made at field level to identify existing problems and need. Rapid Rural Appraisal (RRA) was adopted to clarify general feature of rural life style in the study area.



Photo-8: Even suffering from water shortage, rice cultivation is practiced on commercial basis. There are several rice processing factories in the study area for exporting local rice.



Photo-9: Diesel engine pumps of MOWRAM (Dept. of Irrigated Agriculture). MOWRAM has its own workshop to assemble the pump set for irrigation system. Pump irrigation is widely used in gravity irrigation scheme for "intervention" during emergency dry period.



Photo-10: In upland areas where farmers do not have enough land for paddy rice cultivation, they should earn cash for their living. They often collect bamboo, firewood or make charcoal. Deforestation on the upstream basin is serious, which affects water retention in the watershed.

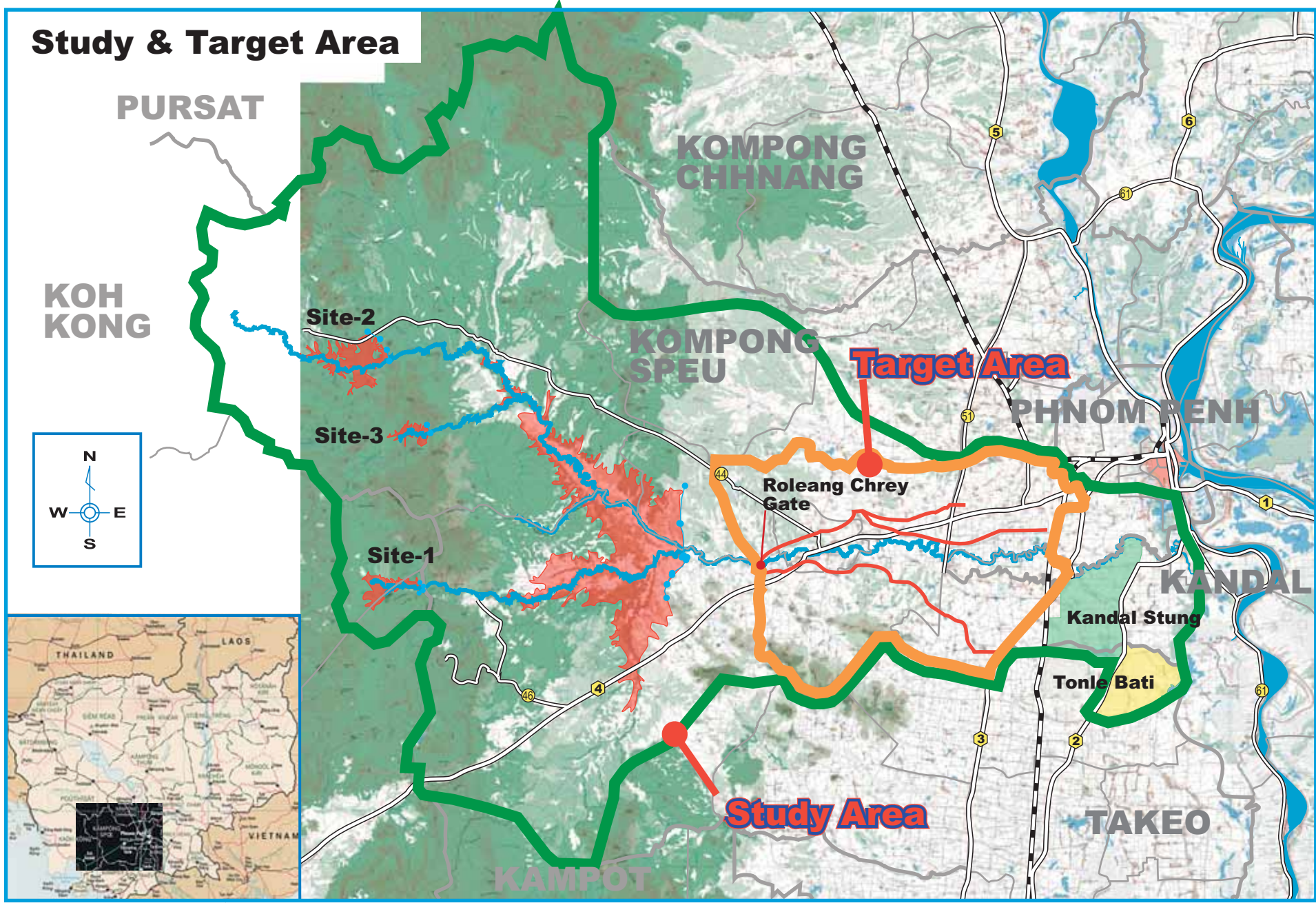


Photo-11: Dec.29, 2003. Public hearing workshop was held in Kandal Province inviting representatives of relevant communes and districts in the target area, and line ministries. Existing problems and development approaches were discussed and identified through the participatory approach.



Photo-12: Dec.30,2003. The public hearing workshop held in Kampong Spue. Representatives of 26 communes in 3 districts participated in the workshop. The participants themselves categorized their communes and proposed development idea in a written format.

Study & Target Area



List of Abbreviation and Acronyms

ADB	- Asian Development Bank
APIP	- Agriculture Productivity Improvement Project
AQIP	- Agriculture Quality Improvement Project
CAAEP	- Cambodia-Australia Agricultural Extension Project
CARDI	- Cambodia Agricultural Research and Development Institute
CARERE	- Cambodia Area Rehabilitation and Regeneration Project
CBO	- Community-based Organization
CD	- Community Development
CDC	- Commune Development Committee
CI	- Cropping Intensity
CNMC	- Cambodia National Mekong Committee
EIRR	- Economic Internal Rate of Return
FAO	- Food and Agriculture Organization
FC	- Foreign Currency
FFW	- Food for Work
FWUC	- Farmer Water User Community
FWUG	- Farmer Water User Group
GDP	- Gross Domestic Product
GIS	- Geographical Information System
GOJ	- Government of Japan
GPS	- Global Positioning System
GRDP	- Gross Regional Domestic Product
HYV	- High Yielding Variety
IFAD	- International Fund for Agricultural Development
IO	- International Organization
I/P	- Implementation Program
IPM	- Integrated Pest Management
IR	- International Rice
IRRI	- International Rice Research Institute
ISF	- Irrigation Service Fee
IWMI	- International Water Management Institute
JBIC	- Japan Bank for International Cooperation
JICA	- Japan International Cooperation Agency
LC	- Local Currency
MAFF	- Ministry of Agriculture, Forestry and Fisheries
MC	- Main Canal
MCM	- Million Cubic Meter (10 ⁶ m ³)
MOC	- Ministry of Commerce
MOE	- Ministry of Environment
MOWRAM	- Ministry of Water Resources and Meteorology
MRC	- Mekong River Commission
MRD	- Ministry of Rural Development
NBC	- National Bank of Cambodia
NGO	- Non government organization
O&M	- Operation and Maintenance
PCM	- Project Cycle Management
PDM	- Project Design Matrix
PDAFF	- Provincial Department of Agriculture, Forestry and Fisheries

PDOWRAM	-	Provincial Department of Water Resources and Meteorology
PMF	-	Probable Maximum Flood
PMP	-	Probable Maximum Precipitation
PIM	-	Participatory Irrigation Management
PIMD	-	Participatory Irrigation Management and Development
PRA	-	Participatory Rural Appraisal
PRASAC	-	Support Programme for the Agricultural Sector in Cambodia
PRDC	-	Provincial Rural Development Committee
RGC	-	Royal Government of Cambodia
RGOC	-	Royal Government of Cambodia
RRA	-	Rapid Rural Appraisal
SCF	-	Standard Conversion Factor
SEILA	-	Programme on Strengthening Decentralized Planning Capacities (literally: “foundation stone”)
S/W	-	Scope of Work
TA	-	Technical Assistance
TOR	-	Terms of Reference
TSCISP	-	Technical Service Center for Irrigation System Project (JICA)
UNDP	-	United Nations Development Program
VDC	-	Village Development Committee
WFP	-	World Food Programme

Conversion Factors

	Metric to Imperial		Imperial to Metric	
Length	1 cm	= 0.349 inch	1 inch	= 2.54 cm
	1 m	= 3.28 feet	1 foot	= 30.48 cm
	1 km	= 0.621 mile	1 mile	= 1.609 km
Area	1 m ²	= 10.76 sq. ft	1 sq. ft	= 0.0929 m ²
	1 ha	= 2.471 acres	1 acre	= 0.4047 ha
	1 km ²	= 0.386 sq. mile	1 sq. mile	= 2.59 km ²
Volume	1 lit	= 0.22 gal (imp)	1 gal (imp)	= 4.55 lit
	1 m ³	= 35.3 cu. ft	1 cu. ft	= 28.32 m ³
	1 MCM	= 1 x 10 ⁶ m ³		
Weight		= 811 acre-ft	1 acre-ft	= 1,233.5 m ³
	1 kg	= 2.20 lb	1 lb	= 0.4536 kg
	1 ton	= 0.984 long ton	1 long ton	= 1.1016 ton
Derived Measures	1 m ³ /sec	= 35.3 cusec	1 cusec	= 0.0283 m ³ /sec
		= 19.0 mgd	1 mgd	= 0.0526 m ³ /sec
Temperature	1 ton/ha	= 892 lb/acre	1 lb/acre	= 1.12 kg/ha
	°C	= (°F - 32) x 5/9	°F	= 1.8 x °C + 32

Exchange Rate (Internal Bank Rate): as of November 1, 2003

\$ 1.00 = Riel. 3,994

¥ 1.00 = Riel. 36.34

\$ 1.00 = ¥ 110.0

suspended due to chaos of the civil war.

6. **Reappraisal Study** : After the civil war, reappraisal of the multipurpose project was carried out by the National Mekong Committee and environmental study on the proposed reservoir area was conducted by during 1993 to 1994.
7. **Request for Development Study on the Multipurpose Dam** : Since 1994, the government of Cambodia (hereinafter referred to as “RGOC”) has been requesting for technical assistance for the development study on the development plan of the Prek Thnot River basin to the Japanese government (herein after referred to as “ GOJ”).
8. **Project Formulation Study by JICA (2001)** : In response to the request of RGOC, GOJ dispatched a project formulation study team in early 2001. The study concluded that the dam development is not considered the best approach and implementation of the development study focusing on the dam construction is not recommendable mainly due to; i) low economic viability (EIRR 2.67 %) with huge environmental cost, and ii) negative social environmental impact (relocation of over 20,000 people is required).

On the basis of such understanding on the development plan, the project formulation study team proposed the following development concept and approach paying due consideration on environmental issue and sustainable development.

- Rehabilitation and reconstruction of irrigation facilities such as existing intake weir and irrigation canals that accommodate middle to downstream area of the basin,
 - Agricultural development plan in the irrigation area, and
 - Improvement of hydrological observation network including flood information management system.
9. **Request for Development Study without Multipurpose Dam** : Getting the conclusion and recommendation of the project formulation study, RGOC has requested GOJ for implementation of the development study on the Prek Thnot River basin development focusing on the agricultural development itself without special intention on the large-scale dam development.
 10. **Other Irrigation-related Studies on the Prek Thnot River** : Beside the above-mentioned studies, the following project and study are closely related with the proposed study.
 - “ Master Plan Study on the Integrated Agricultural and Rural Development Project in the Suburbs of Phnom Penh ” , JICA、 1993-94. (Master Plan and Feasibility Study on improvement of irrigated agriculture and rural life over

Kandal Stueng and Tonle Bati located on the downstream basin of the Prek Thnot River),

- “Technical Service Center for Irrigation System Project”, JICA, 2000-04, (Project-type technical cooperation program which covers part of Kandal Stueng
- “Basic Design Study on Rehabilitation of the Kandal Stueng Irrigation System in the Lower Prek Thnot River Basin in the Royal Government of Cambodia”, JICA, 2003, (Basic design of improvement of irrigation facilities of Kandal Stueng. Grant aid project of GOJ)

III THE STUDY AREA

11. **Profile of the Study Area:** The Study Area (Prek Thnot River basin in Kampong Speu, Kandal and Takeo Provinces) is located in the western part of Phnom Penh as shown in the location map of this report. Profiles of the Study Area are summarized in the following table.

Profiles of the Study Area

	Kampong Speu	Kandal	Takeo	Total
District	Aoral, Chbar Mon, Kong Pisei, Phnom Sruoch, and Samraong Tong	Kandal Stueng, and Angk Snuol	Bati	8
Number of Commune	43	32	4	79
Population	329,309	145,525	30,942	505,776
Household	63,576	29,419	6,152	99,147
Rice field (ha)	55,143	19,048	7,130	81,321

12. **Climate:** The Study area has two prominent seasons in a year, namely, wet season and dry season affected by tropical monsoon winds. The wet season starts in April or May and ends in October or November.
13. **Rainfall:** Most of rainfall in a year is observed in the wet season. Annual rainfall in low land amounts to more or less 1,200 mm, while it rains at 1,800 ~ 3,000 mm or more in the upper catchment near the Elephant Mountains. Average monthly rainfall in Kampong Speu (Chbar Mon, 1966~1969, 1983~2003) and estimated monthly dependable rainfall are given in the following table.

Average and Dependable Rainfall

Unit: mm

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean	15.5	5.8	31.9	83.4	119.7	115.8	126.7	142.0	217.6	230.0	79.5	23.5	1197.6
80%	0.0	0.0	0.0	2.8	64.6	67.5	69.4	77.5	145.9	112.2	0.8	0.0	540.7

Remarks: Rainfall at Chbar Mon (1966~1969, 1983~2003, MOWRAM). 80%=probable rainfall in 4 years out of 5 years.

14. **Runoff:** The Prek Thnot River has catchment area of 5,000 km² at the confluence to the Bassac River. Annual runoff of the river is estimated at about 0.335 mm/km². The previous study on the Prek Thnot Multipurpose Project estimated “dependable flow” of the Prek Thnot River and its tributaries as follows:

Dependable Runoff of Prek Thnot River and Tributaries

Unit: MCM

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
PT	4.8	2.5	2.2	2.6	10.3	6.0	26.0	52.8	95.3	162.8	23.6	8.8	4.8
TB	0.00	0.00	0.00	0.00	0.10	0.15	0.73	0.65	3.97	4.50	0.25	0.00	0.00

Remarks: PT: Prek Thnot River at Roleang Chrey Regulator Gate (catchment area: 3,880 km²).

TB: Runoff of tributaries per 100 km².

15. **Water Resources:** According to preliminary analysis of water balance, irrigable area with a target cropping intensity of 150 % (paddy rice) by use of existing surface water resources (Prek Thnot River and tributaries) without any storage is estimated at about 5,000 ha, and additional 1,000 ha may possibly be irrigated with small reservoirs and other storage system such as drains, Pol Pot canals, pond, etc..
16. **Flood:** According to the previous studies, probable flood discharge of the Prek Thnot River is estimated as follows:

Probable Flood Discharge

Return Period	Discharge (m ³ /s)
5 years	800
10 years	1000
50 years	1300
100 years	1600

On the other hand, capacity of the Prek Thnot River is restrained by low capacity of the Bassac River that is 200 m³/s ~ 400 m³/s in the wet season. Even with flood dike and flood relief channel constructed by ADB project, it is considered difficult to drain the flood discharge of 1 in 5 year recurrence.

17. **Soils :** Compared with flood are of the Mekong and Bassac Rivers, soils in the Study Area is not that fertile. According to land classification, they are classified into Class-2 or Class-3. Suitability for agriculture becomes poorer or lower as it goes away from the Prek Thnot River or in the upstream basin.
18. **Land Use:** Paddy rice field is predominant in the Study Area, particularly in the middle to downstream reach of the basin. Paddy rice field in the Study Area is summarized in the following table.

Paddy Rice Field in the Study Area

Unit : ha

	Area of Paddy Rice Field	
	Whole District	Study Area *1
Kampong Speu		

Aoral	6,166	6,166
Chbar Mon	2,620 *2	2,620 *2
Kong Pisei	14,106	7,531
Phnom Srouch	23,495	23,495
Samraong Tong	15,331	15,331
Kandal		
Kandal Stueng	13,313	13,313
Angk Snuol	10,590	5,736
Takeo		
Bati	17,727	7,130
Total	103,348	81,321

Source : SEILA Database 2002

*1: All the paddy field in the relevant communes

*2: Collected at District office (Not available in SEILA Database)

19. **Land Holding:** After Pol Pot Regime, land was equally distributed to the people in accordance with number of family member. Land holding size of typical farm household ranges from 0.5 to 1.2 ha/household. The average land holding size is estimated at 0.7 ha/household.
20. **Rice Cultivation :** Rice is the most popular and predominant crop in Cambodia and in the Study Area as well. Early rice, medium rice, late rice, floating rice, dry season rice and upland rice are cultivated. In the Study Area, the medium rice and late rice are widely cultivated. Situated in the “rice deficit” area, Kampong Speu has a target of percentage of improved rice at 40 % of the total production. However, due to low market price and high input requirement, farmers are not eager to cultivate the improved rice. Area, yield and production of rice in relevant provinces are given below:

Area, Yield and Production of Rice (1998-2003)

Province	Season	Planted Area (ha)	Harvested Area (ha)	Yield (ton/ha)	Production (ton)
Kampong Speu	Total	82,280	80,538	1.77	143,224
	Wet	81,293	79,613	1.76	140,645
	Dry	987	924	2.79	2,578
Kandal	Total	93,827	86,263	3.07	264,742
	Wet	44,600	38,712	2.35	90,222
	Dry	48,067	47,551	3.65	174,520
Takeo	Total	228,066	204,344	2.31	470,107
	Wet	169,990	150,889	2.06	309,284
	Dry	55,075	53,455	3.01	160,824
Whole country	Total	2,191,628	1,984,021	1.97	3,899,678
	Wet	1,918,912	1,734,537	1.80	3,122,186
	Dry	258,325	249,484	3.11	777,492

Remarks: “Yield = Production / harvested area”

Source : Agricultural Statistics (1998/99 – 2002/03), MAFF

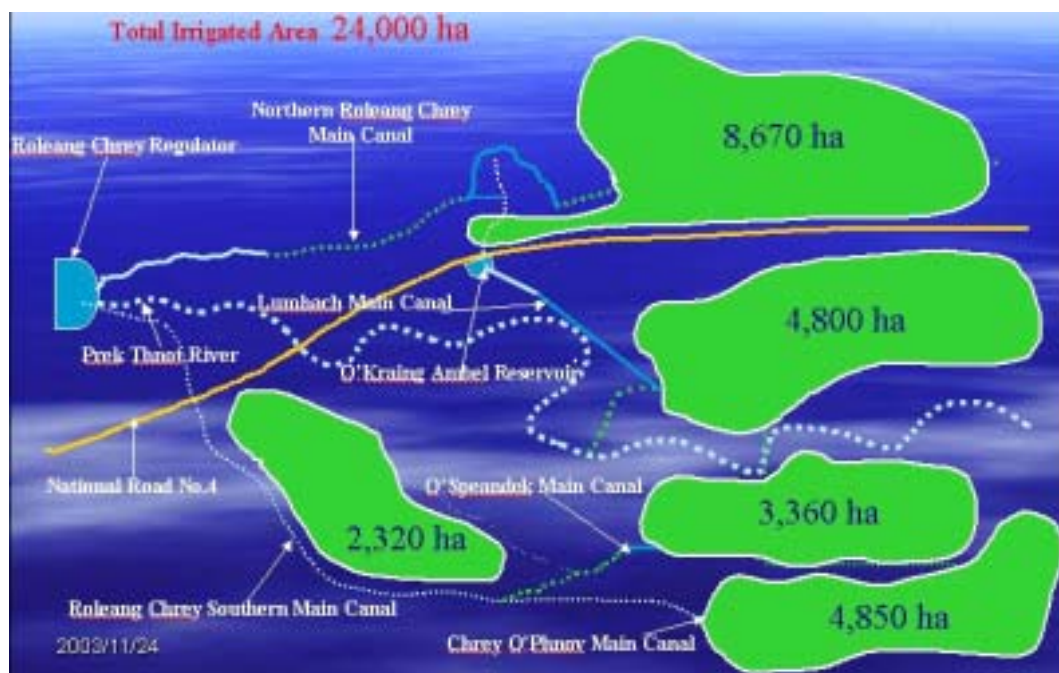
21. **Self Sufficiency:** According to the agricultural statistics of the latest five years, rice productions in Kampong Speu and Kandal Provinces do not meet their demand by 22 % and 19 % respectively, while in Takeo Province they produce twice (195 %) the demand. The self-sufficiency rate as the whole country was 110 %. In the Study Area, the self-sufficiency rate is estimated at 70~80 %, which results in shortage of rice during 2 to 3 months (September ~ November before harvesting).

22. **Animal Husbandry:** Cattle, pig and poultry are raised widely in the Study Area by the farmers. Cattle are raised mainly for draft power, while pig and poultry are raised to get cash income for living expenditure. About 70 % of farm households have two to three cattle and 5 to 30 chickens or ducks, while 50 to 55 % of households raise one to three pigs. Animal husbandry is one of the major sources to raise cash income of farm households particularly in water shortage area.
23. **Agricultural Extension Services:** Extension offices of Provincial department of agriculture takes responsibility for agricultural extension including crop cultivation, animal husbandry and inland fisheries. Cambodia Australia Agricultural Extension Project (CAAEP) is being carried out in Kandal and Kampong Speu Provinces for capacity building of extension officers and farmers, improvement of extension system and facilities.
24. **Agricultural Input :** Improved seeds are produced by CARDI and several private companies and distributed (sold) to farmers through project, NGO activities or retailers. Fertilizer and agro-chemical are handled by the private sector on the commercial basis.
25. **Credit :** Micro credit is available for purchase of fertilizer and agro-chemical but little for other inputs. There is no government-operated credit system, but NGOs are involved in credit and saving activities in rural community.
26. **Processing and Marketing :** Most of processing and marketing activities are for rice. In most cases, middlemen come to farm gate and buy the paddy rice, which is sent to rice millers. There are about 40 middle-size millers and 10 large millers. Some milling factories use Japanese milling machines and export processed rice to Singapore and other countries. Cambodian aromatic rice is popular as high-grade rice and traded at higher prices by 20~30 %. Other crops, vegetables and livestock are traded in the local market or at the farm gate with middlemen or farmers themselves.
27. **Farm Household Economy :** According to the Cambodia Socio-economic Survey, annual household income in the rural area is US\$ 988 including self-consumption. Annual household consumption is estimated at US\$ 900 ~950, which is equivalent to US\$ 0.5 per person per day.

The Study Team carried out interview survey on household economy to 200 farm household in the Study Area. The major results are given below:

- Annual household cash income is US\$ 133, out of which 70 % is non-agricultural income.
 - Rate of non-agricultural income is higher in the downstream area probably due to small land holding size, and more job opportunity.
28. **Major Irrigation Schemes in the Study Area** are;
 - West Phnom Penh Integrated Development Center Project (Roleang Chrey),

- Kandal Stueng (Kampong Tuol, Tuk Thla)
 - Tonle Bati (pump and gravity), and
 - Dangkao (pump)
29. **West Phnom Penh Integrated Development Center Project** covers irrigation area of 24,000 ha on the both bank of the Prek Thnot River in Kampong Speu, Kandal, Takeo Provinces and Phnom Penh Municipality. Water sources of the scheme are Prek Thnot River and Ou Krang Ambel (Ou Thum) Stream that is one of major tributaries of the Prek Thnot River. The project started in 2002 to rehabilitate and construct irrigation and drainage system with RGOC's own budget (US\$ 7.9 million).
30. **Small Irrigation Scheme:** There are over 30 small reservoirs for irrigation in the Study Area. Some temporary intake facilities are also utilized by farmers on small streams in the wet season, which are subject to damage by flooding every year. The irrigation area by these small irrigation schemes is small compared with the Roleang Chrey irrigation area.
31. **Pumping Irrigation:** Pumping irrigation is widely practiced in the Study Area. Two types of pumping irrigation are applied. One is diesel engine pump set that



Layout of West Phnom Penh Integrated Center Project

MOWRAM provides for intervention of gravity irrigation or emergency irrigation for rainfed paddy rice with fuel and operators. The other is small portable engine pumps that are generally applied by private sector including farmers. Both types of the pumping irrigation have big needs or are applied on demand bases due to serious water shortage.

32. **Groundwater:** No groundwater irrigation scheme exists in the Study Area handled by RGOC. Groundwater potential of the Study Area is not high. Shallow groundwater is one of the main sources for domestic water use in rural areas, and groundwater irrigation whose water requirement is far bigger than that of domestic water use, will probably affect domestic water. Therefore, it is not recommended to promote extensive groundwater irrigation in the Study Area.
33. **Surface Water Potential:** In order to estimate irrigable area with existing surface water resources, preliminary water balance was examined. Firstly, dependable runoff from the Prek Thnot River and tributaries (Ou Krang Ambel:480 km², and others 100 km²) was estimated.

Dependable Runoff of Prek Thnot River and Tributaries

Unit: m³/s

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PT	2.0	1.0	0.8	1.0	4.0	3.3	10.0	20.4	36.8	62.8	9.1	3.4
TB	0.0	0.0	0.0	0.0	0.2	0.3	1.6	1.5	8.9	10.1	0.6	0.0

Remarks: Estimated based on the study results of Prek Thnot Multipurpose Project ~ Reappraisal Report (1992)

PT: Prek Thnot River at Roleang Chrey Regulator Gate (catchment area: 3,880 km²).

TB: Runoff of tributaries (catchment area: 580 km²)

34. **Irrigation Water Requirement :** Then, irrigation water requirement for paddy rice (improved rice, harvested at 90 days after transplanting, double cropping) was estimated. Conditions of the estimation are assumed as follows:

- Irrigation method: water saving irrigation (same as the procedure of Slakou Study, JICA 2002)
- Evapotranspiration : (adopted from the study result of Phnom Penh Suburbs, JICA 1994. Penman Method with meteorological data of Pochentong)
- Cropping patten and crop coefficient:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.95					1.10	1.10	1.05	1.05	0.95			
									1.10	1.10	1.05	1.05

land preparation

- Land preparation and nursery : 130 mm (one month)
- Effective rainfall : 70 % of dependable rainfall of 80 % (4 in 5 years),
Rainfall data of Chbar Mon
- Percolation loss: 2 mm/day
- Irrigation efficiency: 0.65

Irrigation water requirement is as follows:

Irrigation Water Requirement (IWR)

Unit: l/s/ha

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IWR	0.79	-	-	-	0.47	0.59	0.86	0.71	-	0.30	0.88	1.21

Remarks: calculation was done on half-monthly basis.

35. **Water Balance** : According to the above available water resources and irrigation water requirement, irrigable area was estimated as follows:

Irrigable Area with Existing Surface Water

Unit: ha

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	dry				wet					dry		
All	2529				8899	5157	11424	23699	>30000	>30000	11000	2800
TB					475	485	1600	1579	2906			

Remarks: All: Irrigable area with all the available surface water. (Prek Thnot River at Roleang Chrey Regulator Gate (catchment area: 3,880 km²) and tributaries of 580 km²).
TB: Irrigable area by tributaries (catchment area: 580 km²). This area is included in “All”

From the above, it is estimated that the irrigable area of 4 in 5 years reliability with the existing surface water resources is 5,000 ha in the wet season, and 2,500 ha in the dry season.¹

36. **Protected Area** : There are two protected areas in/around the Study Area gazetted in 1993. They are; Aoral Wildlife Sanctuary (253,750 ha) and Kirirom National Park (52,783 ha).

IV REVIEW OF PREK THNOT MULTIPURPOSE PROJECT

37. **Previous Studies** : Following studies have been conducted on the Prek Thnot multipurpose dam:

- Feasibility study, “Prek Thnot Multipurpose Project” (1960) -- Japan, Australia, Israel)
- Environment study, “Environmental and Resettlement Evaluation, Prek Thnot Project, Reappraisal Study (SMEC, 1990)
- Reappraisal study, “Prek Thnot Multipurpose Project” (1992) – Australia
- Environmental study, “Prek Thnot Multipurpose Project – Environment Study Report” (1994), -- Nippon Koei (Japan), SMEC (Australia)
- “Project Formulation Study – Agriculture Development Support” (2001) – Japan (JICA)

The Prek Thnot Multipurpose Project was re-examined through review of the above studies and supplemental investigation during this preparatory study.

38. **Outline of Prek Thnot Multipurpose Project** is summarized below:

Prek Thnot Multipurpose Project

¹ It should be noted that the surface water from the residual catchment and return flow for the downstream irrigation area below Kampong Tuol and Tuk Thla Regulator are not accounted. The irrigable area will possibly be increased by 20~40 % taking into account the runoff from the residual catchment and return flow.

Item	Description
Dam	
Type of dam	Earth / rockfill
Dam height	28.3 m
Crest elevation	EL. 62.5 m AMSL
Dam length	10.3 km
Design flood	6,900 m ³ /s (PMF outflow)
Embankment volume	3,650,880 m ³
Reservoir	
Reservoir area	195 km ²
Total storage capacity	1,120 MCM
Effective storage capacity	980 MCM
High water level	EL 58.5 m AMSL
Minimum operation level	EL 54.0 m AMSL
Power generation	
Capacity	18 MW
Annual power generation	45.2 GWh
Irrigation area	
Without dam	4,200 ha (annual requirement 119 MCM)
With dam (irrigation priority)	34,000 ha (-do- 1,119 MCM)
With dam (power priority)	27,000 ha (-do- 805 MCM)

39. **Objectives of the Project:** The development purposes of the project consist of power generation, irrigation and flood control (even without specific flood control volume). However, power generation purpose was attained with two projects in Kirirom (one is rehabilitation of existing hydropower plan and the other is new construction on the Kamchay River) with total power generation capacity of 132 MW. As for irrigation, there is no possible alternative site to store the similar or more capacity than that of the original dam. However, three alternative sites were identified in the upstream in Aoral District and Kaoh Kong Province (north of Kirirom). The total storage capacity is estimated to be far below that of the original dam, but certain area will possibly be irrigated. The potential and possibility of these alternative dam sites are examined in “V. Alternative Development Approaches”. As mentioned in the hydrological report of “Prek Thnot Flood Relief Channel” (ADB 2001), ultimate approach of flood control for over 10 years recurrence period is the reservoir in the upstream. The original multipurpose dam has a catchment area of 3,650 km² and reservoir area of 195 km². The flood control effect of the original dam will not be realized with the alternative dam sites on the upstream.
40. **Evaluation from Technical Point of View :** The original dam is long but low in height with the maximum height of 28 m. There is little problem on geology and stability of the dam. Probable maximum flood (PMF) is adopted as the design flood, and the value is considered reasonable. It is considered necessary to review and re-estimate the flood discharge and to optimize the dam size according to the present condition of the irrigation target area.

41. ***Evaluation from Environmental Point of View*** : The following significant impacts are anticipated on the natural environment:

- Change in river discharge in both wet season and dry season,
- Watershed conservation and wildlife in the proposed inundation area, and
- Water quality

These impact and cost should be investigated in detail to estimate the value of the natural resources that might be affected and to estimate the cost to avoid the impact.

The biggest and vital negative factor for realization of the dam project is social impact of relocation of over 23,000 people in the proposed reservoir area. According to various guidelines on environmental impact assessment such as “Dams and Development” (World Commissions on Dams), the environmental guidelines of JICA and Japan Bank for International Cooperation (JBIC, executing agency of Yen Loan), the following items are common approaches and requirements for dam development related to resettlement:

- Living condition of the migrant shall not be degraded after relocation or resettlement,
- Discussions and meeting on relocation and the development plan shall be started with stakeholders at early stage of planning,
- Investigation and survey on socio-economic condition of the proposed resettlement area should be carried out prior to design and planning for resettlement,
- Livelihood after resettlement shall be secured,
- Not only infrastructures but also measures to improve migrant living standard should be planned and designed in the resettlement plan,
- Involvement and participation of the migrant to the resettlement plan,
- Involvement of NGO and local communities,
- Disclosure of information,
- Special consideration on the weak (widow, minority, aborigines),
- Budget allocation for resettlement,
- Strengthening of organizations that are responsible for resettlement, and
- Monitoring and evaluation of progress of resettlement.

All the above items shall be conducted in collaboration with the migrants and other stakeholders. In completion of the above process, the resettlement plan can be prepared to request for official assistance of donors. It is considered quite difficult or unrealistic to achieve the above process for the resettlement of over 23,000 people of 5,000 households.

42. ***Evaluation from Economical Point of View*** : According to the construction cost

estimated in the reappraisal report (1992), price escalation and other factors that might affect the cost, the construction cost of the multipurpose dam at present is estimated as follows:

Revised Cost of Multipurpose Dam as of 2003

Unit: million US\$

Item	Original	Revised
Dam and power plant construction including environmental cost for resettlement	114.7	168.0*
Irrigation Development (34,000 ha)	97.7	106.6
Total	214.4	274.6

Note: * Revised cost of the dam includes cost for resettlement of 23,000 migrants, environmental management cost and income support for three years.

The economic benefit and economic internal rate of return in the original plan (1992) and revised ones are summarized below:

Revised Economic Evaluation of Multipurpose Dam

Item	Unit	Original	Revised
Economic farm gate price of paddy	US\$/ton	190	160
Yield under without project condition	ton/ha/year	1.1~1.6	1.6
Yield under with project condition	ton/ha/year	5.2~8.5	6.4
Economic benefit per hectare by irrigation	US\$/ha/year	935	655
Economic benefit by irrigation	million US\$/year	31.79	25.25
Economic benefit by power generation	million US\$/year	2.95	2.95
Other economic benefit (flood control, etc.)	million US\$/year	0.17	0.40
Total economic benefit	million US\$/year	34.91	25.60
Internal rate of return	%	9.5	3.9

43. ***Evaluation of Capacity of Stakeholders*** : There are few dam specialists in Cambodia due to lack of large dam project in the country. It is necessary to foster engineers on dam development, including operation and maintenance. Budget for environment cost is estimated at US\$ 58 million. This shall be prepared by RGOC and that will be a bottleneck against promotion of the project.
44. ***Overall Evaluation of the Project*** : Due to decline of price of rice and increased project cost, the economic viability of the project fell into unacceptable range. Moreover, arrangement for promoting the project will require huge amount of local budget for environmental cost, which is conditional for financial support by international donors. Even if these difficulties were overcome or solved, resettlement of 23,000 people with their involvement and agreement on the resettlement process will be a big task. Judging objectively from these figures and requirements, possibility of realization of the project is considered quite low under present situation. Consensus of RGOC should be achieved on the project or alternative

approaches as the first step from now on.

V ALTERNATIVE DEVELOPMENT APPROACHES

45. ***Target Area and Year of the Study:*** The Study Team proposes the target area and study area of the forth coming development study as follows:

The target area shall be the agricultural land in the Prek Thnot River basin that is located in Districts of Chbar Mon, Samraong Tong, and Kong Pisei of Kampong Speu Province and part of Districts of Angk Snuol and Kandal Stueng of Kandal Province situated to the west of National Road No.3.

The study area shall include the basin in the upstream and downstream, which may be developed or affected for/by the priority and urgent development projects.

The target year of the development study is proposed to be short-to mid term of 10 years so that priority and urgent needs should be fulfilled by the proposed projects.

46. ***Approaches on Irrigation and Water Resources Development :*** Six development approaches were identified as irrigation and water resources development approaches. They are;
- Efficient use of existing water resources of the Prek Thnot River,
 - Development of tributaries of the Prek Thnot River,
 - Small reservoir development,
 - Pump irrigation,
 - Improvement of rainfed agriculture, and
 - Small dam development in the upstream basin of the Prek Thnot River.
47. ***Efficient Use of Existing Water Resources of the Prek Thnot River :*** Existing water resources of the Prek Thnot River and Ou Krang Ambel stream have potential to irrigate 4,000~5,000 ha of paddy rice with a cropping intensity of 150 %. This development approach is to improve irrigation system and water management by realizing high irrigation efficiency of the existing irrigation system. The project components will be; i) rehabilitation of Roleang Chrey regulator and other main control structures, ii) wide area water management including the downstream area, iii) strengthening of FWUC and PIMD approaches, and iv) capacity building of staffs for water management activities. Construction cost is assumed at US\$ 2,000 /ha, taking into account on-going rehabilitation in the West Phnom Penh Integrated Development Center Project.
48. ***Development of Tributaries of the Prek Thnot River :*** Beside Ou Krang Ambel stream, there are several tributaries flowing into the Prek Thnot River in the target

area. The irrigable area will be more or less 100 hectares. Small-scale irrigation development by use of these water resources will be the second alternative development approach. Construction of small irrigation facilities through participatory approach (PIMD) and strengthening of FWUC will be the main project activities. Construction cost is assumed at US\$ 200 /ha for temporary intake and field channels.

49. ***Small Reservoir Development*** is the third approach. There are more or less 30 small reservoirs in the target area. Their irrigation or irrigable area is over 500 ha. O' Treang Reservoir in Kong Pisei District of Kampong Speu is one of the most successful small reservoir irrigation schemes that were improved and supported by ADB agriculture sector loan programme on PIMD. This approach will be fully applied to the small reservoir development in the target area. Rehabilitation cost for small reservoirs and construction cost for irrigation system are assumed at US\$ 1,500~2,000 ha in total.
50. ***Pump Irrigation*** is widely practiced in the target area for intervention of gravity irrigation. Considering its high operation cost, which is now owed by MOWRAM, the pumping irrigation should be supplemental or emergency irrigation in the gravity irrigation scheme. Need of paddy rice farmers for the pumping station or portable pumps is quite high, and the pumping irrigation handled by FWUC would be a good approach in the existing irrigation schemes. The irrigation or irrigable area will be accounted in those of the gravity scheme. Cost for new pumping irrigation scheme will be about US\$1,500 /ha including irrigation system development, while diesel pump will cost US\$ 150 /ha.
51. ***Improvement of Rainfed Agriculture*** might be the most important taking into account large coverage of rainfed agriculture in the target area. Utilization of small water body such as drains, Pol Pot canals, ponds, etc. will be proposed. The farmers are actually utilizing these small water bodies and channels to collect and distribute rainwater for paddy rice cultivation. Systematic improvement of such native water use practices will be studied and proposed. Necessary cost for development will be about US\$300 /ha consisting of construction of field channels, paddy field consolidation with high field bund and cost for portable pumps.
52. ***Small Dam Development in the Upstream Basin of the Prek Thnot River*** : During the study period, the team identified three candidate dam sites in the upstream of the Prek Thnot River. Preliminary study was done with 1 in 100,000 scale map and through field reconnaissance at two sites.

(1) Site No.1 (See location map)

Location: North of Kirirom in Kaoh Kong Province. 40 km upstream of Peam Khley

Catchment area: 211 km²
 Possible storage: 100~150 MCM (on the basis of 1 in 100,000 scale map with 10 m contour)
 Height of dam: About 50 m
 Advantage:

- no village, resident area and farm land in the reservoir area
- No protected area
- Good accessibility (accessible by car)
- Hard foundation rock
- Good storage efficiency (good pocket for reservoir)
- Certain base flow is expected even in the dry season.
- Possibility for hydropower

 Disadvantage:

- The river runs in-between different geological formations. Some geological problems such as fault are anticipated.

(2) Site No.2 (See location map)

Location: West of Aoral in Kampong Speu Province. 50 km upstream of Peam Khley
 Catchment area: 473 km²
 Possible storage: 100~150 MCM (on the basis of 1 in 100,000 scale map with 10 m contour)
 Height of dam: About 20 m
 Advantage:

- no village, resident area and farm land in the reservoir area
- Good accessibility (4 km from a District road)
- Low dam height (technical soundness is high)
- Low cost

 Disadvantage:

- The proposed dam site and reservoir area are located in the wild life sanctuary.

(3) Site No.3 (See location map)

Location: West of Aoral in Kampong Speu Province. 45 km upstream of Peam Khley
 Catchment area: 110 km²
 Possible storage: 50 MCM (on the basis of 1 in 100,000 scale map with 10 m contour)
 Height of dam: About 50 m
 Advantage:

- no village, resident area and farm land in the reservoir area

 Disadvantage:

- Poor access
- Part of reservoir area is located in the wild life sanctuary.
- Possibility of geological fault (1 in 100,000 map)

Common problems or constraints on promotion of development of the above dam candidates are as follows:

- No hydrological data (rainfall, river discharge) in the catchment or on the river for flood estimation and dam size optimization.

- Located far from the irrigation area.
- Flood mitigation effect is not very high.

It is quite difficult to estimate construction cost for these dams. However, according to estimation of embankment volume (800,000~1,800,000 m³) of the dams on the basis of the 1 in 100,000 scale map and general construction cost of fill-type dams (about US\$25/m³), the construction cost is estimated at US\$20~45 million per dam.

In order to estimate possible reservoir capacity, it is necessary to get river discharge for at least 10 years and it can not be estimated under current situation without any hydrological data. In general, a dam whose effective capacity is 100 MCM can possibly irrigate double cropping of paddy rice 10,000 ha under annual rainfall condition of 1,500 mm~2,000 mm. However, taking into account relationship between the effective capacity and irrigable area of the Prek Thnot Multipurpose dam (effective capacity: 980 MCM, irrigable area 34,000 ha), proposed dam(s) should have high dam efficiency over 100².

53. ***Target of Agriculture Development*** : In the Study Area, average land holding size of farm household (5.3 family member on the average) is 0.7 ha. In order to produce self-sufficient rice for the household, required yield of paddy is 1.36 ton/ha, while the present yield is estimated at 1.12 ton/ha, 20 % lower than the self-sufficient yield level. Although national production of paddy rice has attained self-sufficiency, production in Kampong Speu and Kandal Provinces area still in deficit with self-sufficiency rate of 70 ~80 %. Therefore, the primary target of agriculture development in the target area should be production increase of rice for self-sufficiency at farm household level. For the small holders that do not have sufficient land to produce paddy for self-consumption should get cash income for purchasing food, and such income source should be acquired mainly from agricultural sector. Income increase is the secondary objective of the agriculture development. Approach to increase income will depend on the resources that beneficiaries possess. Agriculture development approaches to attain self-sufficiency at household level and to increase income are considered in accordance with such agricultural circumstances of the beneficiaries.
54. ***Approaches on Agriculture Development*** : Four development approaches were identified as agriculture development approaches. They are;
- Irrigated double cropping of paddy rice,
 - Irrigated single cropping of paddy rice,
 - Improved rainfed agriculture, and
 - Diversified agriculture for small holders,

² Dam efficiency here means “rate of effective storage volume against dam embankment volume. Prek Thnot multipurpose dam has a dam efficiency of over 300. In the area with annual rainfall of 1,000 mm to 1,500 mm, the efficiency of feasible dams ranges from 15 to 50 for small dams (5,000 ha), and 50 to 100 for medium to large scale dams (over 10,000 ha).

55. ***Irrigated Double Cropping of Paddy Rice*** : Under irrigated condition with sufficient water sources, double cropping³ of paddy rice is targeted. The target yield will be 6.7 ton/ha in a year. Income of farmers of average holding size (0.7 ha) will be increased by US\$ 187~295. Incremental economic benefit per hectare is expected to be US\$ 422~US\$ 666.
56. ***Irrigated Single Cropping of Paddy Rice*** : Under irrigated condition for supplemental irrigation, single cropping of paddy rice and some diversified crops before or after paddy cultivation are targeted⁴. The target yield will be 3.0~3.5 ton/ha in a year. Income of farmers of average holding size (0.7 ha) will be increased by US\$ 95 by paddy rice and US\$ 50 by diversified crops. The incremental economic benefit per hectare is expected to be US\$ 216~US\$ 319.
57. ***Improved Rainfed Agriculture***: Most of the paddy field in the target area belongs to rainfed condition. Even under such condition, certain improvement can be introduced with small water bodies such as pond, drains, and crop management with improved seeds, pest control, technical guidance and other agricultural support services. A target yield of 2.0 ton/ha can be set for such improved rainfed paddy cultivation. Income increase is expected by US\$ 20 by paddy rice and US\$ 50 by animal husbandry and diversified crops per average household. The incremental economic benefit is expected at US\$ 54 per hectare.
58. ***Diversified Agriculture for Smallholders*** : Many farm households in the target area are suffering from water shortage and land shortage. Such smallholders will not be able to produce sufficient paddy for their own consumption even with improved rainfed agriculture due to their small holding size. These farm households will have to seek for cash income to purchase food and living commodities. Following approaches are considered as possible livelihood for the small holders.
- Livestock cultivation (piggery, poultry, cattle, raising and sales)
 - Small scale cash crop and nursery cultivation (flower, seedling, etc)
 - Small scale tree crop
 - Mushroom cultivation with rice straw
 - Inland fisheries in pond and paddy rice field
 - Collection of non-timber forest products
59. ***Combination of Development Approaches*** : In accordance with six(6) development approaches on irrigation and water resources development and four(4) approaches on agriculture development, combination of alternative development approaches is considered as shown in the following matrix.

Combination Matrix of Development Approaches to be Considered

³ Cropping intensity is assumed at 150 %~200 %.

⁴ Cropping intensity is assumed at 100 %~125 %.

Agriculture Water/ Irrigation	Paddy Double	Paddy Single	Improved Rainfed	Small Holder
Existing Irrigation System			X	
Small-scale Irrigation with tributaries	X		X	
Small Reservoir	X		X	
Pump			X	
Rainfed with small water bodies	X	X		
Small Dam			X	

60. **Evaluation Criteria** : Following six(6) evaluation criteria were used for evaluation of the above combination of development approaches.

Agriculture Water/ Irrigation	Very good ()	Good ()	Marginal ()	Bad (x)
Economic viability	High economic viability	Economically justified	Economic viability is low	Economically not acceptable
Income Increase	Large increase is expected	High effect to increase income	Some effect is expected.	Little effect is expected
Environmental impact	None or little impact	Some but no significant impact	Possibility of significant impact	Significant impact
Number of beneficiaries	Quite a lot	many	Not many	small
Quick yielding	Possibility of implementation and benefit in short term	Possibility of implementation and benefit in middle term	Implementation in middle term and benefit in long term	Long term before implementation
Intention of stakeholders	Very strong need	Strong need	Some need	Little need

61. **Evaluation by Criterion** :

(1) Economic viability

Economic viability was examined on the basis of international rice market price at Bangkok. Farm gate price of paddy is estimated at US\$ 160/ton. Possible investment in terms of “cost and benefit balance” was estimated according to the anticipated benefit by the four agricultural development approaches. Consequently, double and single paddy rice cropping with existing irrigation system and water resources shows high and good economic viability, while small dam development is evaluated as “marginal” even with benefit of double cropping of paddy rice due to high investment cost.

(2) Income increase

Increased income of average farm household (0.7 ha) is examined. Double cropping of paddy rice will bring more income increase than other approaches. Pump irrigation is evaluated as marginal due to high operation cost.

(3) Environmental impact

Small dam development is evaluated as “marginal” even without any residents and farm land in the reservoir area. Two of three candidate sites are located in the wild life sanctuary and possibility of impact on the specific fauna and flora is anticipated. No significant impact is anticipated for the remaining approaches.

(4) Number of beneficiaries

On selection of development approaches, number of beneficiaries should be an important criterion in terms of “equity in development opportunity”. The number of beneficiaries of irrigation development will depend on the irrigation area or quantity of available water resources, while improved rainfed agriculture development will have large coverage in the number of the beneficiaries. As for the irrigation development, the small dam development will benefit most, while the irrigation with small reservoirs and small tributaries has quite small coverage in the target area.

(5) Quick yielding

It is also important on selection of combination of the development approaches if the approaches have quick impact with earlier implementation and small investment. Improved rainfed agriculture can realize quick yielding, while small dam development will require long-term investigation and studies. Pump irrigation is also a quick yielding approach for existing gravity irrigation scheme.

(6) Intension of stakeholders

According to the interview survey, public hearing meeting and other participatory study approaches, it is very clear that the highest need in the target area is water resources development, particularly dam development. The stakeholders of beneficiaries and government officials are all longing for the water resources development of either Prek Thnot multipurpose dam or other dams in the upstream catchments. However, it should also be noted that most residents in the reservoir

areas of the Prek Thnot multipurpose dam do not want to move out from the area.
The evaluation results by criterion are given in the following page.

1 . Economic Viability

	Paddy Double	Paddy Single	Improved Rainfed	Small holders
Existing			X	
Small Tributaries	X		X	
Small Reservoir	X		X	
Pump			X	
Rainfed	X	X		
Small Dam		X	X	X

2 . Income Increase

	Paddy Double	Paddy Single	Improved Rainfed	Small holders
Existing			X	
Small Tributaries	X		X	
Small Reservoir	X		X	
Pump			X	
Rainfed	X	X		
Small Dam			X	

3 . Number of Beneficiaries

	Paddy Double	Paddy Single	Improved Rainfed	Small holders
Existing			X	
Small Tributaries	X		X	
Small Reservoir	X		X	
Pump	X		X	
Rainfed	X	X		
Small Dam			X	

4 . Environmental Impact

	Paddy Double	Paddy Single	Improved Rainfed	Small holders
Existing			X	
Small Tributaries	X		X	
Small Reservoir	X		X	
Pump			X	
Rainfed	X	X		
Small Dam			X	

5 . Quick Yielding

	Paddy Double	Paddy Single	Improved Rainfed	Small holders
Existing			X	
Small Tributaries	X		X	
Small Reservoir	X		X	
Pump			X	
Rainfed	X	X		
Small Dam	X	X	X	X

6 . Intention of Stakeholders

	Paddy Double	Paddy Single	Improved Rainfed	Small holders
Existing			X	
Small Tributaries	X		X	
Small Reservoir	X		X	
Pump			X	
Rainfed	X	X		
Small Dam			X	

Results of Evaluation by Criterion

62. **Overall Evaluation with Incorporated Numeric Index :**

In order to evaluate the above six (6) criteria comprehensively, numeric index was incorporated according to the following manner.

<u>Incorporation of Numeric Index</u>	
1.	Covert evaluation into score: → "3", →"2", →"1", x →"0"
2.	Sum up scores of 6 criteria. Maximum score will be 18.
3.	Full score (18) is regarded as 100 (%), and the above total scores are converted into percentage score (0 – 100)
4.	The percentage score is converted into 0 – 10 (divide by 10)

The incorporated numeric index is givenbelow.

Incorporated Numeric Index for Overall Evaluation				
Agriculture Water/ Irrigation	Paddy Double	Paddy Single	Improved Rainfed	Small Holder
Existing Irrigation System	8	7	X	5
Small-scale Irrigation with tributaries	X	6	X	5
Small Reservoir	X	6	X	6
Pump	5	7	X	6
Rainfed with small water bodies	X	X	7	7
Small Dam	6	4	X	2

Judging from the above results, development approaches that utilize existing facilities and system for paddy rice cropping are given higher scores.

Small scale irrigation development with tributaries and small reservoirs can be

realized with low cost and quick yielding is expected. However, the coverage area is quite small and the system can be used only for supplemental irrigation in the wet season. Accordingly, the numeric index shows middle scores.

Pumping scheme is given high score with high need of farmers and quick yielding. The pumping for intervention is widely adopted at present which shows high need of farmers, and eradicates risks of drought damage during the wet season. Thus the pumping irrigation is considered a good approach as supplemental or emergency use in the gravity scheme.

Utilization of small water bodies such as pond, drains and Pol Pot canals is a good development approach to enhance water use efficiency or to eradicate risks of short drought. The anticipated benefit by this development approach is low, but the coverage area is quite large. This is the main reason of the high score for this approach.

Small dam development was evaluated with low numeric index because of the following reasons:

- Investment cost is high and economic viability is low.
- The project benefit will be achieved in long term.
- Natural environmental impact is anticipated in the wild life sanctuary

However, it should be noted that the above development approaches can not be compared simply with the incorporated numeric index, because some of the above approaches will not be substitute each other. For instance, the best approach, namely, “double cropping with existing irrigation system and water resources” is applicable for only 10 to 20 % of the target area, i.e., at the upstream reach of the existing Roleang Chrey irrigation system.

63. ***Flood Mitigation Approach*** : As mentioned above, the capacity of the Prek Thnot River is determined by that of the Bassac River during the wet season, and ultimate measure to solve the flood problem is big storage in the upstream, namely dam. However, there is little possibility to realize the dam construction in the near future, and some other measures to mitigate the flood damage must be considered. Preparation of a “flood hazard map” will be the first step to be taken to identify protective measures against the flood damage.
64. ***Flood Protection Dike*** : It is not recommended to construct new flood protection dike because it might cause flooding or prolong the flood period at other stretches of the river. In some locations, the flood dike is eroded and damaged by the river flow even at normal water level due to structural defect. Such portion of the flood dike shall be reconstructed or rehabilitated. Moreover, adequate design guidelines for the flood dike are necessary.

65. ***Flood Retarding Basin*** : There are several control points along the Prek Thnot River, such as Peam Khley, road bridge of the National Road 4, and others. At these control points, water level increases by 5 to 10 m in the flood season, and the upstream areas are often inundated. Such control points and upstream areas are considered as “flood retarding basin”. The flood retarding function of the existing control points should be utilized. A hazard map will give important information on the flood prone areas that can be utilized as “flood basin” with a sort of government policy as “flood protective land use strategy”.
66. ***Flood Alert System*** : The Prek Thnot is a “flush type” river with rapid increase of water level and discharge at flood time. Real time monitoring and operation of river structure is being done at Roleang Chrey and Tuk Thla regulators gates, but the real time flood alert to the public has not been practiced. By installing additional raingauges and river gauges in the upstream with radio communication system, the flood alert and basic hydrological analysis on the flood regime in the Prek Thnot River basin can be realized.
67. ***Drainage Improvement*** : Depression areas in the hinder land of natural levee are subject to inundation in the wet season. Even after the river capacity is recovered, the flooding water can not be drained due to the natural levee. In such areas, construction of drainage network would eradicate flood damage to the crops.

VI DEVELOPMENT STRATEGY

68. ***Concept of Development Strategy*** : The most important factor on agriculture development of the Prek Thnot River basin is water, namely, water resources, irrigation and flood. It is necessary to formulate development strategy that consists of water resources, irrigation development and agriculture development on the basis of target period (short, middle, long) and combination of development approaches according to the water availability and flood conditions.
69. ***Categorization of the Target Area*** : The target area is categorized into four(4) types according to the water availability.
- Type A: Irrigation system of Prek Thnot River with sufficient water⁵
 - Type B: Irrigation system of Prek Thnot River without sufficient water
 - Type C: Small scale irrigation without Prek Thnot river water
 - Type D: No water source beside rainfall and no irrigation facilities
70. ***Type A*** : On the basis of the water balance study, Type A area is estimated at about 5,000 ha in the upstream of Roleang Chrey irrigation system or Ou Krang Ambel irrigation system that has another water sources beside the Prek Thnot River.

⁵ “Sufficient” means that irrigation water requirement is satisfied in 4 years out of 5 years, i.e., 80 % reliability.

71. **Type B** : In the target area, the command area of Roleang Chrey irrigation system is estimated at 20,000 ha. Thus the area categorized into Type B is estimated at 15,000 ha. These areas meet frequent water shortage even in the wet season.
72. **Type C** : This area depends on tributaries of the Prek Thnot river or small reservoirs that collect surface runoff from its small catchment. According to the results of water balance study conducted in Slakou Development Study (2002, JICA), possible irrigation area by this type is estimated at no more than 1,000 ha in total.
73. **Type D** : The total agricultural land in the target area is estimated at 30,000 ha in which 10,000 ha is located outside the Roleang Chrey command area. Only 1,000 ha can be covered by Type C, small irrigation system, and the remaining area of 9,000 ha is considered to be categorized into this type.
74. **Development Target** : In accordance with the above categories, development strategy should be considered. However, taking into consideration the present condition of the target area, namely, “rice deficit area” and “favorable situation near the market”, the development target is set as follows for the whole categories.
- Primary or urgent target: Self-sufficiency of rice at household level
 - Target in the long run: Income increase with agriculture-oriented manner
75. **Double Cropping of Paddy Rice** : Benefited with sufficient water and irrigation system, the development strategy to attain the target for Type A is; i) improvement of irrigation efficiency to increase the irrigation area, ii) sustainable paddy rice cultivation in order to realize production and income increase of paddy rice cultivation. “TWO CROPPING OF PADDY RICE (High Yield Variety)” is the strategy for Type A.
76. **Crop-oriented Income Increase** : Short and middle term target for Type B that is subject to frequent water shortage even in the wet season is to secure sufficient rice production for self-consumption. The development strategy is to introduce improved seed and intensified agriculture along with pump irrigation for emergency use. In the long run, water resources development will be the solution or measure to upgrade this type to Type A. “ONE CROPPING OF PADDY RICE (Local or High Yield Variety)” for self-sufficiency and diversified crop cultivation for income increase will be the strategic approach of Type B for the time being. The small scale irrigation (Type C) would also follow this development strategy, and income increase by high-value crops can be achieved taking advantage of easier water management of the small scale irrigation system.
77. **Self-sufficient Agriculture and Non-crop-oriented Income Increase** : Under rainfed condition, the farmers should try field water management to utilize rainwater in the field with improved crop management with better agriculture inputs. However, they

should seek for source of income increase outside the farm land. “RAINFED CULTIVATION OF PADDY RICE (Local)” for self-consumption and income increase with non-crop products is the strategy to attain the target.

78. ***Non-farm-oriented Income Increase*** : Due to shortage of land and water, some household cannot get sufficient food for self-consumption. In this situation, they have to earn cash income and purchase food. They should find income source beside their land, such as cottage industry, processing of agro-products, trading, retail of living commodities and others. Since this type is independent from water sources or irrigation system, the development approach would be that of “community development” with vocational training or introduction of agriculture-oriented income generation activities focusing on the labor force of women. “NON-FARM-ORIENTED INCOME INCREASE” will be the strategy.

VII CONSIDERATION ON FRAMEWORK OF THE DEVELOPMENT STUDY

79. ***Scope of Work*** of the forth coming development study, namely, “The Study on Comprehensive Agricultural Development of the Prek Thnot River Basin” will be determined through due discussion between RGOC and the Japanese official mission that will be dispatched after completion of the preparatory study. In this chapter, framework of the development study is discussed from the technical point of view of the preparatory study team.
80. ***The Study*** will consist of two or three phases of; i) master plan study for long term, ii) feasibility study with short and middle term target year of 10 years, and iii) pilot study or implementation and monitoring if necessary. Taking into consideration that the Prek Thnot River basin development has been decelerated due to the Civil War and changes of the circumstances of the project, The development study should focus on urgent and priority development of quick yielding. The “master plan” will possibly be replaced with “development vision” of the target area. The third phase was not included in the official request of RGOC. However, taking into consideration importance of initial support of some development approaches such as establishment of hydrological monitoring system and analysis, institutional build-up, on-the-job training at the implementation stage, participatory irrigation management and development and others, the phase three for pilot implementation would have a significant role in the development study.
81. ***The Target Area and Study Area*** are proposed in the Item 45 of this summary. Upstream and downstream areas should duly be considered on allocation of limited water resource and influence of flood.
82. ***Concept of the Study*** : The development study will be carried out with the following concept:

- The feasibility study will focus on short-to-mid term (10 years) development plan of urgent and priority development as “quick-yielding” project.
- Accumulation of basic and fundamental data such as hydrological data, agro-economical data on the sustainable basis will be commenced in the course of the study.
- Existing data/information system such as digital topographic map, GIS database shall fully be utilized for efficient and transparent planning process and capacity building of RGOC counterparts.
- Intensive capacity building of the government staff will be conducted through on-the-job training.
- Involvement and participation of the stakeholders in the study process.
- The study itself would bring certain incentive to the stakeholders.
- Field survey or experimental implementation will be conducted in the course of the study in accordance with the above concept.

83. ***Framework of the Study*** : Considering the target year of the feasibility study, water resources development that requires long-term hydrological investigation will not be included in the feasibility study. However, establishment of hydrological network will be an important component of the study for the future development. The following concept will be the main framework of the development study.

- Establishment of hydrological observation network, preliminary analysis, and support for sustainable operation for collection of essential data for water resources assessment and flood alerting.
- Efficient use of existing water resources through improvement of irrigation system and strengthening of water management institutions.
- Provision of agricultural development plan to attain self-sufficiency of food at household level.
- Provision of concrete idea, method, and action plans to increase household income in environment-friendly and sustainable manner in according with available resources (water, land, human, livelihood) by the target household.
- Provision of environment conservation and watershed management master plan so that water retention capacity of the watershed should be recovered or improved.

84. ***Public Hearing Workshop in Kandal*** was held on December 29, 2003 aiming to confirm understanding and intention of the stakeholders on present condition and problems, development constraints and favorable development approaches for them. In Kandal, the following stakeholders participated in the workshop.

- Representatives of 12 communes of Angk Snuol and Kandal Stueng Districts in the target area. (Chief of commune and representative of farmers)

- District representatives
- District staff of PDAFF and PDOWRAM
- Representatives of PDAFF and PDOWRAM

The public hearing workshop consisted of; i) explanation of the study, ii) free discussion on the study, iii) identification of problems, development constraints, development approaches and expectation to RGOC and GOJ with questionnaire.

(1) Present water resources and irrigation condition

Present water resources and irrigation condition of the communes are as follows:

- Water sources of the area are Prek Thnot River (27.4 %), small reservoirs (11.6 %), small stream (9.4 %) and rainfall (53.1 %)
- Only 10~15 % of the users of the above water sources are satisfied with the water source quantity. 33 % replied that rainfall for cultivation (in the wet season) is sufficient for paddy rice cultivation.
- 72 % have canals, 83 % have pumps and 56 % have small reservoirs. Ponds are also utilized for irrigation.

(2) Categorization of the Area (Refer to No.69)

The area is categorized as follows:

- Type A: Irrigation system of Prek Thnot River with sufficient water 21.1 %
- Type B: Irrigation system of Prek Thnot River without sufficient water 9.7 %
- Type C: Small scale irrigation without Prek Thnot river water 11.0 %
- Type D: No water source beside rainfall and no irrigation facilities 57.6 %

(3) Problems Identified

Problems identified by the participants are; i) shortage of water resources, ii) poor function of irrigation facilities (lack of check gate, regulator, sedimentation in the small reservoir and canals), iii) poor O&M, iv) poor farming technique, v) shortage of qualified seeds, vi) shortage of draft animal, vii) damage by insects, viii) lack of rural infrastructures, and ix) flood.

(4) Development Approaches Identified

Development approaches or project component identified by the participants are; i) rehabilitation and improvement of irrigation facilities, ii) water resources development (dam and small reservoir construction), iii) pump, iv) increase of draft animal, v) agricultural extension, vi) improved seed supply and vii) construction of pond for fisheries.

The priority or favored development approaches are;

- 1st (1.3)⁶: Double cropping of paddy rice (high yield variety) under irrigated condition (income increase by rice cultivation)
- 2nd (2.6): Single cropping of paddy rice (high yield variety or local variety) under irrigated condition in the wet season and some diversified crops before or after the wet season rice for income increase.
- 3rd (2.9): Non-farm oriented income increase (purchase rice by cash income)
- 4th (3.1): Rainfed paddy rice cultivation for self consumption and increase of non-agricultural income

(5) Development Constraints

Development constraints identified were; i) labor shortage for construction works and ii) shortage of budget (food for work) for the construction works.

(6) Project Component

Priority of project components is as follows:

- 1st (1.2): Irrigation and water resource development
- 2nd (2.1): Agricultural extension
- 3rd (2.9): Rural infrastructure development (road, water supply, sanitation, etc)
- 4th (3.4): Health
- 5th (3.6): Education
- 6th (4.6): Non crop oriented income generation (vocational training, livestock, increase of employment opportunity, cottage industry, small business, etc.)

85. ***Public Hearing Workshop in Kampong Speu*** was held on December 30, 2003 at PDAFF at Kampong Speu. In Kampong Speu, the following stakeholders participated in the workshop.

- Representatives of 25 communes of Chbar Mon, Samraong Tong and Kong Pisei Districts in the target area. (Chief of commune and representative of farmers)
- District representatives
- District staff of PDAFF
- Representatives of PDAFF and PDOWRAM

(1) Present water resources and irrigation condition

Present water resources and irrigation condition of the communes are as follows:

⁶ Figure in the parentheses shows average ranking of priority given by the participants. The 3rd and 4th development approaches are given similar priority of 2.9 and 3.1.

- Water sources of the area are Prek Thnot River (12.8 %), small reservoirs (5.7 %), small stream (5.4 %) and rainfall (75.5 %)
- Respondents that replied their water sources are sufficient were 19 % of the user of the Prek Thnot River, 13 % of those of small streams, 26 % of those of small reservoirs and 45 % of those of rainwater.
- Canals are utilized by 61 %, while pump and small reservoirs are utilized by 87 % and 65 %, respectively.

(2) Categorization of the Area (Refer to No.69)

The area is categorized as follows:

- Type A: Irrigation system of Prek Thnot River with sufficient water 13.3 %
- Type B: Irrigation system of Prek Thnot River without sufficient water 9.6 %
- Type C: Small scale irrigation without Prek Thnot river water 6.8 %
- Type D: No water source beside rainfall and no irrigation facilities 74.6 %

(3) Problems Identified

Problems identified by the participants are; i) shortage of water resources, ii) poor function of irrigation facilities (lack of check gate, regulator, sedimentation in the small reservoir and canals), iii) poor soil fertility , iv) low yield, v) shortage of qualified seeds, vi) shortage of electricity, viii) food shortage, ix) lack of rural infrastructures, x) lack of credit system, and xi) flood.

(4) Development Approaches Identified

Development approaches or project component identified by the participants are; i) rehabilitation and improvement of irrigation facilities, ii) water resources development (particularly Prek Thnot Dam), iii) pump, iv) agriculture extension, v) drinking water, vi) improved seed supply, vii) credit , viii) rural infrastructure development, and ix) flood dike construction.

The priority or favored development approaches are;

- 1st (1.9): Double cropping of paddy rice (high yield variety) under irrigated condition (income increase by rice cultivation)
- 1st (1.9): Single cropping of paddy rice (high yield variety or local variety) under irrigated condition in the wet season and some diversified crops before or after the wet season rice for income increase.
- 3rd (2.5): Rainfed paddy rice cultivation for self consumption and increase of non-agricultural income
- 4th (3.6): Non-farm oriented income increase (purchase rice by cash income)

(5) Development Need

Most of the respondent proposes irrigation improvement and water resources development. Then, agriculture extension and rural infrastructure development follow.

(6) Project Component

Priority of project components is as follows:

- 1st (1.4): Irrigation and water resource development
- 2nd (2.1): Agricultural extension
- 3rd (3.0): Rural infrastructure development (road, water supply, sanitation, etc)
- 4th (4.2): Non crop oriented income generation (vocational training, livestock, increase of employment opportunity, cottage industry, small business, etc.)
- 5th (4.4): Education
- 6th (4.5): Health

VIII CONCLUSION AND RECOMMENDATION

86. *Conclusion:*

- The Prek Thnot multipurpose project has difficulties to be promoted under present condition having serious and significant social environmental impact. In order to overcome the situation, long time, big budget and continuous effort by RGOC are required.
- There are candidate sites of alternative dam development in the upstream of the Prek Thnot River. However, it is necessary to accumulate essential data for the development. Therefore, for the short-to-mid term development, efficient utilization of the existing water resources and the accumulation of basic and essential data would be the urgent and priority approaches.
- The development study shall focus on the above focal points.
- Ultimate flood control with storage in the upstream is not expected for the coming decade. Measures to mitigate the flood damage such as flood forecast and alert procedures shall be proposed on the basis of present flood condition shown in a “flood hazard map”.

87. *Recommendation:*

- Urgent implementation of the development study.
- In accordance with the above mentioned study concept, RGOC counterparts that will work with the study team should be on the full-time basis.
- Activities of the study should be performed by full use of the resources of the counterparts. For instance, selection and installation of hydrological

equipment, irrigation pumps, agricultural extension, operation and observation should be taken charge of with the counterparts.