6.4.3.2 Water Requirement Plan for Muruthawela Reservoir Scheme

(1) LB sub-scheme

1) Design irrigated area

Design irrigated area for Tract I, II and III is approx. 1,700 ha as follows.

Tract	Tract I	Tract II	Tract III	Total
Area	425	583	692	1,700

2) Design water source discharge

To be based on the 11 year (1984~95) discharge records for Muruthawela Reservoir.

3) Design crops

Paddy, OFCs, and banana are to be the design crops given soil conditions in the area.

4) Design irrigation period

Based on data obtained in the field, design irrigation period is to be as follows.

Crop	Maha season	Yala season	Remarks
Paddy	135 days from September 15 (including 30 days of land preparation)	135 days from April 15 (including 30 days of land preparation)	3 step stagger (30%, 40% 30%)
OFC	same as above	same as above	same as above
banana	throughout the year		to start in October

5) Design irrigation requirement.

Water requirement calculations for paddy (3.5 month variety), OFCs (ground nuts applied as the case for water requirement calculation), and banana (values for Uda Walawe area adopted) are given in Table 6.4.3.2-1 ~ 6.4.3.2-3.

6) Design cropping ratios

The results of present water balance calculations indicate a water shortage for the sub-scheme area. Design cropping ratios are determined as follows based on the cropping pattern under the farm management plan.

- Priority is to be given to introduction of 20% perennial OFCs and 5% percent perennial banana for the overall area.

- The present paddy rotation system will be maintained. Accordingly, paddy cropping in Tract II in the Yala season will be 70%, and in Tract III the same for the Maha season will be over 70%.

- The present paddy cropping intensity of over 65% in the Maha season in Tract I will be preserved.

On the basis of the above, design cropping ratios are tabulated below.

Unit: %

Tract	Tract I A=425ha			Tract I A=583ha			Tract I A=692ha		
Design crop	Paddy	OFC	Banana	Paddy	OFC	Banana	Paddy	OFC	Banana
Maha	85	10	5	30	20	5	95	0	5
Yala	50	10	5	95	0	5	30	20	5

7) Irrigation efficiency

Irrigation efficiency (Ec, Ea) taking into consideration canal rehabilitation are determined as follows.

Irrigation efficiency	Present	Design	Remarks
Canal conveyance efficiency (Ec)	50%	65%	Ec = 65% from ID design criteria
Field loss (Ea)	50%	50%	adopts value for upland paddy (in discussions with ID)

8) Results of design water balance calculation (refer to Table 6.4.3.2-4)

Unit: %

Calculation Period	1984/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	Average
Maha	100	92	66	97	97	100	--	93	--	100	100	94
Yala	98	67	67	99	92	100	--	95	--	100	100	91

9) Design irrigable area

Design irrigable area is as follows based on results of water balance calculation.

Unit: ha

Season	Maha				Yala			
Design crop	Paddy	OFC	Banana	Total	Paddy	OFC	Banana	Total
Tract I	85%	10%	5%	100%	50%	10%	5%	65%
A=425 ha	361	43	21	425	213	43	21	277
Tract II	30%	20%	5%	55%	95%	0%	5%	100%
A=583 ha	175	117	29	321	554	0	29	583
Tract III	95%	0%	5%	100%	30%	20%	5%	55%
A=692 ha	657	0	35	692	208	138	35	381
Total ΣA=1,700ha	1,193	160	85	1,438	975	181	85	1,241

On the basis of the above, cropped area in the Maha season is 1,438 ha (85%), and that in the Yala season is 1,241 ha (73%) for a total annual cropping intensity of 158%.

Present and design values are compared below.

Design irrigated area : 1,700 ha

		Present		Design (irrigated area)	
Maha	Paddy	984 ha	(58%)	1,193 ha	(70%)
	OFC	214 ha	(13%)	160 ha	(9%)
	Banana			85 ha	(5%)
Yala	Paddy	915 ha	(54%)	975 ha	(57%)
	OFC	101 ha	(6%)	181 ha	(11%)
	Banana			85 ha	(5%)
Total		2,214 ha	(131%)	2,679 ha	(158%)

Table 6.4.3.2-1 Design Water Requirement for Muruthawela LB Sub-scheme (Paddy 3.5 month Variaty)

					Maha						Yala					
KC:			Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage	1st Stagger	Tract I	30%	30%		1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90	
and Crop Factors	2nd Stagger	Tract II	40%	40%		1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90	
	3rd Stagger	Tract III	30%	30%		1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90	
ETo (Evapotranspiration of Reterence Crop)					5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
1. LP	Ls	(4.0inch/5days)			1.20	1.60					1.20	1.60				
(Land Preparation)						1.20						1.20				
	Lt	(7.5inch/25days)			0.90	1.35					0.90	1.35				
						3.00						3.00				
						0.90	1.35					0.90	1.35			
	Total LP				2.10	8.05	1.35				2.10	8.05	1.35			
2. E					0.77	0.72					0.73	0.65				
(Evapo. during LP)						1.92						1.73				
(E=ETo)						0.72	0.57					0.65	0.78			
	Total Evapo				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Sd (Standing Water)		(3.0inch)				2.10	0.90					2.10	0.90			
4. ETc	ETc (S_1)					1.08	0.29	0.23	0.25			0.97	0.39	0.29	0.31	
Crop Water							1.10	1.19	1.12				1.49	1.52	1.39	
Requirement	ETc (S_2)						1.53	1.21	1.32				2.07	1.55	1.64	
							0.59	0.63	1.49				0.79	0.81	1.85	
(ETc=ETo x KC)	ETc (S_3)						0.86	0.30	0.24	0.25			1.17	0.38	0.30	0.36
								1.14	1.24	1.14				1.45	1.54	1.61
	Total ETc				0.00	1.08	4.36	4.70	5.65	1.39		0.97	5.91	6.00	7.03	1.96
5. Farm Loss at ETc																
(Farm Loss + ETc)		Total ETc/50%			0.00	2.16	8.72	9.40	11.30	2.78	0.00	1.94	11.82	12.01	14.06	3.93
6. FWR (1+2+3+5)	Average	(inch/month)			2.10	12.31	10.97	9.40	11.30	2.78	2.10	12.09	14.07	12.01	14.06	3.93
Field Water		(mm/month)			53	313	279	239	287	71	53	307	357	305	357	100
Requirement		(mm/day)			1.78	10.43	9.28	7.96	9.56	2.35	1.78	10.24	11.91	10.17	11.90	3.32
	Peak	(mm/day)				15.10							15.15			

Total FWR = 2.721 mm

Table 6.4.3.2-2 Design Water Requirement for Muruthawela LB Sub-scheme (OFC)

				Maha						Yala					
KC:		Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage	1st Stagger	30%	30%		0.65	0.80	1.00	0.80			0.65	0.80	1.00	0.80	
and Crop Factors	2nd Stagger	40%	40%		0.65	0.80	1.00	0.80			0.65	0.80	1.00	0.80	
	3rd Stagger	30%	30%		0.65	0.80	1.00	0.80			0.65	0.80	1.00	0.80	
ETo (Evapotranspiration of Reference Crop)				5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
1. LP (Land Preparation)	(1.5inch/15days)			0.45	0.60 0.45					0.45	0.60 0.45				
	Total LP			0.45	1.05	0.00	0.00			0.45	1.05	0.00			
2. ETc Crop Water Requirement	ETc (S_1)				0.94 0.38	0.61 0.29	0.89	0.99			0.84 0.35	0.83 0.39	1.14	1.23	
	ETc (S_2)				0.94	0.25 1.02	0.21 0.99	0.62 0.99	0.34		0.84	0.34 1.38	0.27 1.27	0.77 1.23	0.48
(ETc=ETo x KC)	ETc (S_3)					0.74 0.31	0.63 0.30	0.93	1.01			1.01 0.41	0.81 0.38	1.16	1.43
	Total ETc			0.00	2.26	3.22	3.02	3.53	1.35	0.00	2.03	4.36	3.86	4.39	1.90
3. Farm Loss at ETc (Farm Loss + ETc)	Total ETc/60%			0.00	3.77	5.36	5.04	5.89	2.25	0.00	3.38	7.27	6.44	7.32	3.17
4. FWR (1+2+3)	Average	(inch/month)		0.45	4.82	5.36	5.04	5.89	2.25	0.45	4.43	7.27	6.44	7.32	3.17
Field Water Requirement		(mm/month)		11	122	136	128	149	57	11	113	185	164	186	81
		(mm/day)		0.38	4.08	4.54	4.27	4.98	1.90	0.38	3.75	6.15	5.45	6.20	2.69
	Peak	(mm/day)													

Total FWR = 1,343 mm

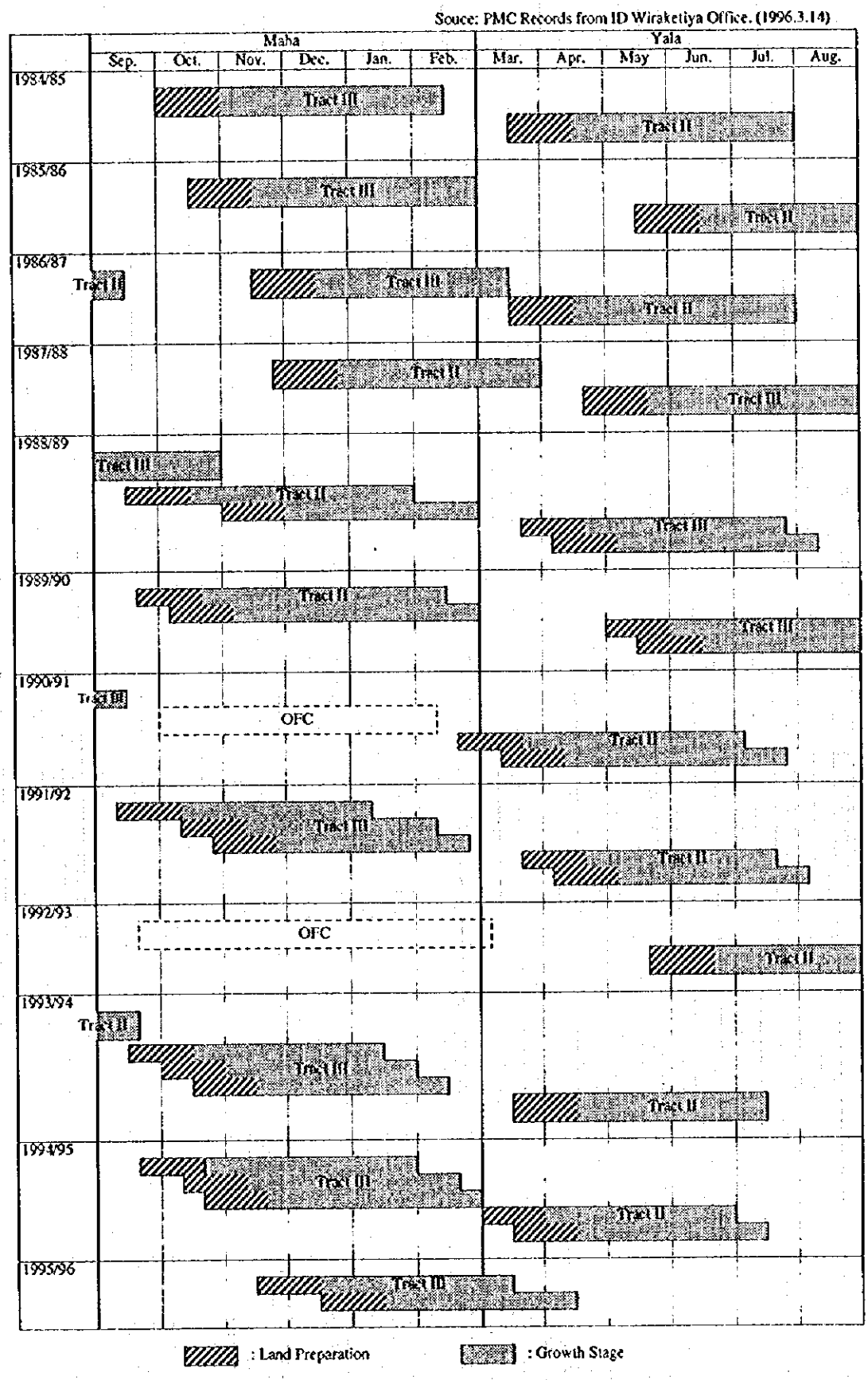


Figure 6.4.3.2-1 Irrigation Period for Muruthawela LB Sub-scheme (1984/85 ~ 1995/96)

Table 6.4.3.2-3 Design Water Requirement for Muruthawela LB Sub-scheme (Banana)

				Maha						Yala					
KC:				SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage	1st Stagger		30%	1.00	0.80	0.75	0.70	0.70	0.75	0.90	1.05	1.05	1.05	1.00	1.00
and Crop Factors	2nd Stagger		40%	1.00	1.00	0.80	0.75	0.70	0.70	0.75	0.90	1.05	1.05	1.05	1.00
	3rd Stagger		30%	1.00	1.00	1.00	0.80	0.75	0.70	0.70	0.75	0.90	1.05	1.05	1.05
ETo (Evapotranspiration of Reference Crop)				5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
1. ETc	ETc (S_1)			1.54	1.15	0.86	0.83	0.87	0.95	1.32	1.36	1.63	1.59	1.54	1.79
Crop Water Requirement	ETc (S_2)			2.06	1.92	1.22	1.19	1.16	1.18	1.46	1.56	2.18	2.13	2.16	2.38
	ETc (S_3)			1.54	1.44	1.15	0.95	0.93	0.88	1.02	0.97	1.40	1.59	1.62	1.87
(ETc=ETo x KC)	Total ETc			5.14	4.52	3.23	2.97	2.95	3.01	3.81	3.89	5.21	5.31	5.32	6.04
2. Farm Loss at ETc															
(Farm Loss + ETc)	Total ETc/60%			8.57	7.54	5.38	4.95	4.92	5.02	6.34	6.48	8.68	8.86	8.87	10.07
3. FWR	Average	(inch/month)		8.57	7.54	5.38	4.95	4.92	5.02	6.34	6.48	8.68	8.86	8.87	10.07
Field Water		(mm/month)		218	191	137	126	125	127	161	165	220	225	225	256
Requirement		(mm/day)		7.25	6.38	4.55	4.19	4.17	4.25	5.37	5.49	7.35	7.50	7.51	8.52
	Peak	(mm/day)													

Total FWR = 2,176 mm

(1 / 3)

Table 6.4.3.2-4 Proposed Water Balance Study for Muruthawela LB Sub-scheme (1985/86 ~ 1994/95)

Maha: 94%
Yala: 91%

	Muruthawela Tank Issue Records				Rainfall		Unit FWR			Unit FIR			Field Irrigation Requirement										Water Balance		
	LB Main Sluice	LB Main Canal				ER	Paddy	OFC	Banana	Paddy	OFC	Banana	Tract I A=425ha Maha / Yala	Paddy (85%) (50%) (j) (g x A) (000m3)	OFC (10%) (10%) (k) (h x A)	Banana (5%) (5%) (l) (i x A)	Tract II A=583ha Maha / Yala	Paddy (30%) (95%) (m) (g x A) (000m3)	OFC (20%) (0%) (n) (h x A)	Banana (5%) (5%) (o) (i x A)	Tract III A=692ha Maha / Yala	Paddy (95%) (30%) (p) (g x A) (000m3)	OFC (0%) (20%) (q) (h x A)	Banana (5%) (5%) (r) (i x A)	Total FIR (s) (000m3)	Volume (t) (b-s) (000m3)	Area (u) (t / d) (ha)	Success Rate (%)
	(Ac.ft)	(Ac.ft)	(a) (000m3)	(b) (ax65%) (000m3)	(mm)	(c) (mm)	(d) (mm)	(e)	(f)	(g) (d-c) (mm)	(h) (e-c)	(i) (f-c)																
1984/85 Sep	1,450	972	1,199	780	84	40	53	11	218	14	0	178	1	50	0	38	1	24	0	52	1	91	0	62	316	463		
Oct	2,367	1,586	1,957	1,272	119	63	313	122	191	250	60	129		903	25	27		438	70	38		1,644	0	45	3,189	-1,917		
Nov	4,522	3,030	3,739	2,431	272	165	279	136	137	113	0	0		409	0	0		198	0	0		743	0	0	1,350	1,081		
Dec	5,391	3,613	4,459	2,898	368	229	239	128	126	9	0	0		34	0	0		16	0	0		61	0	0	111	2,787		
Jan	4,677	3,134	3,868	2,514	142	78	287	149	125	209	71	47		754	30	10		365	83	14		1,372	0	16	2,645	-131		
Feb	5,108	3,423	4,224	2,746	95	46	71	57	127	24	11	81		87	4	17		42	12	24		158	0	28	373	2,373		
Maha total	23,514	15,759	19,447	12,640	1,080	622	1,241	604	924	619	142	435		2,236	60	92		1,083	165	127		4,070	0	150	7,984	4,656	375	100%
Mar	4,585	3,073	3,792	2,465	155	87	53	11	161	0	0	75	1	0	0	16	1	0	0	22	1	0	0	26	63	2,402		
Apr	4,232	2,836	3,500	2,275	59	0	307	113	165	307	113	165		653	48	35		1,702	0	48		638	156	57	3,336	-1,061		
May	4,224	2,831	3,494	2,271	183	105	357	185	220	252	79	115		535	34	24		1,397	0	34		523	110	40	2,696	-425		
Jun	3,019	2,023	2,497	1,623	489	229	305	164	225	76	0	0		162	0	0		424	0	0		159	0	0	745	878		
Jul	3,200	2,145	2,647	1,720	28	0	357	186	225	357	186	225		759	79	48		1,979	0	66		741	257	78	4,006	-2,286		
Aug	2,555	1,713	2,113	1,374	8	0	100	81	256	100	81	256		212	34	54		553	0	75		207	112	88	1,335	39		
Yala total	21,816	14,621	18,042	11,727	921	421	1,480	739	1,252	1,092	459	835		2,321	195	177		6,054	0	244		2,268	634	289	12,181	-454	-31	98%
Total	45,330	30,380	37,489	24,368	2,001	1,042	2,721	1,343	2,176	1,712	600	1,270		4,557	255	270		7,137	165	370		6,337	634	439	20,166			
1985/86 Sep	0	0	0	0	12	0	53	11	218	53	11	218	1	193	5	46	1	93	13	63	1	351	0	75	840	-840		
Oct	711	477	588	382	212	125	313	122	191	188	0	66		678	0	14		329	0	19		1,234	0	23	2,297	-1,915		
Nov	2,787	1,868	2,305	1,498	122	65	279	136	137	214	72	72		773	30	15		374	83	21		1,406	0	25	2,728	-1,230		
Dec	3,969	2,660	3,282	2,134	338	209	239	128	126	30	0	0		107	0	0		52	0	0		194	0	0	353	1,781		
Jan	3,951	2,648	3,267	2,124	174	99	287	149	125	188	50	26		678	21	5		328	59	7		1,233	0	9	2,341	-217		
Feb	3,730	2,500	3,085	2,005	60	0	71	57	127	71	57	127		255	24	27		124	67	37		464	0	44	1,041	964		
Maha total	15,149	10,153	12,528	8,143	917	498	1,241	604	924	743	190	509		2,683	81	108		1,300	222	149		4,882	0	176	9,600	-1,457	-117	92%
Mar	3,722	2,495	3,078	2,001	158	89	53	11	161	0	0	72	1	0	0	15	1	0	0	21	1	0	0	25	61	1,940		
Apr	918	615	759	493	238	143	307	113	165	165	0	22		350	0	5		912	0	6		342	0	8	1,622	-1,128		
May	1,928	1,292	1,594	1,036	0	0	357	185	220	357	185	220		759	78	47		1,980	0	64		742	255	76	4,002	-2,966		
Jun	2,593	1,738	2,145	1,394	24	0	305	164	225	305	164	225		648	69	48		1,690	0	66		633	226	78	3,458	-2,064		
Jul	2,332	1,563	1,929	1,254	48	0	357	186	225	357	186	225		759	79	48		1,979	0	66		741	257	78	4,006	-2,753		
Aug	2,215	1,485	1,832	1,191	145	80	100	81	256	19	0	175		41	0	37		108	0	51		40	0	61	339	852		
Yala total	13,708	9,187	11,337	7,369	614	312	1,480	739	1,252	1,203	534	940		2,557	227	200		6,669	0	274		2,498	739	325	13,489	-6,120	-414	67%
Total	28,857	19,340	23,865	15,512	1,531	810	2,721	1,343	2,176	1,946	725	1,449		5,239	308	308		7,968	222	423		7,380	739	501	23,089			
1986/87 Sep	2,315	1,552	1,915	1,244	552	229	53	11	218	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1,244		
Oct	969	649	801	521	114	60	313	122	191	253	63	132		914	27	28		443	73	38		1,664	0	46	3,233	-2,712		
Nov	1,474	988	1,219	793	167	95	279	136	137	184	42	42		665	18	9		322	48	12		1,209	0	15	2,298	-1,505		
Dec	3,376	2,263	2,792	1,815	50	0	239	128	126	239	128	126		862	54	27		418	149	37		1,569	0	43	3,160	-1,344		
Jan	2,704	1,812	2,236	1,453	48	0	287	149	125	287	149	125		1,036	64	27		502	174	36		1,886	0	43	3,768	-2,315		
Feb	2,115	1,418	1,750	1,137	81	37	71	57	127	33	20	90		120	8	19		58	23	26		218	0	31	503	634		
Maha total	12,954	8,682	10,713	6,964	1,012	420	1,241	604	924	996	401	515		3,597	171	109		1,743	468	150		6,546	0	178	12,962	-5,998	-483	66%
Mar	2,585	1,732	2,137	1,389	89	43	53	11	161	11	0	119	1	23	0	25	1	60	0	35	1	22	0	41	206	1,183		
Apr	1,619	1,085	1,339	870	53	0	307	113	165	307	113	165		653	48	35		1,702	0	48		638	156	57	3,336	-2,466		
May	1,134	760	938	610	39	0	357	185	220	357	185	220		759	78	47		1,980	0	64		742	255	76	4,002	-3,393		
Jun	2,338	1,567	1,934	1,257	0	0	305	164	225	305	164	225		648	69	48		1,690	0	66		633	226	78	3,458	-2,202		
Jul	3,110	2,084	2,572	1,672	501	229	357	186	225	128	0	0		273	0	0		712	0	0		267	0	0	1,252	420		
Aug	858	575	710	461	173	99	100	81	256	1	0	157		2	0	33		5	0	46		2	0	54	143	318		
Yala total	11,644	7,804	9,630	6,259	854	370	1,480	739	1,252	1,110	461	885		2,358	196	188		6,150	0	258		2,304	638	306	12,397	-6,138	-415	67%
Total	24,598	16,485	20,343	13,223	1,866	790	2,721	1,343	2,176	2,106	862	1,400		5,955	366	297		7,893	468	408		8,850	638	484	25,359			
1987/88 Sep	350	235	290	188	613	229	53	11	218	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	188		
Oct	831	557	687	447	374	229	313	122	191	84	0	0		304	0	0		147	0	0		553	0	0	1,005	-558		
Nov	3,509	2,352	2,902	1,887	224	133	279	136	137	146	3	4		526	1	1		255	4	1		957	0	1	1,745	141		
Dec	3,733	2,502	3,087	2,007	125	66	239	128	126	172	62	59		622	26	13		302	72	17		1,133	0	21	2,205	-198		
Jan	4,973	3,333	4,113	2,673	12	0	287	149	125	287	149	125		1,036	64	27		502	174	36		1,886	0	43	3,768	-1,095		
Feb	3,191	2,139	2,639	1,715	67	28	71	57	127	43	29	100		155	13	21		75	34	29		282	0	35	645	1,071		
Maha total	16,588	11,117	13,718	8,917	1,414	684	1,241	604	924	732	244	288		2,643	104	61		1,281	284	84		4,811	0	100	9,368	-451	-36	97%
Mar	3,568	2,391	2,951	1,918	110	57	53	11	161	0	0	105	1	0	0	22	1	0	0	30	1	0	0	36	89	1,829		
Apr	4,564	3,059	3,775	2,454	173	99	307	113	165	208	14	66		443	6	14		1,154	0	19		432	19	23	2,110	344		
May	4,303	2,884	3,558	2,313	119	63	357	185	220	295	122	158		626	52	33		1,632	0	46		611	169	55	3,224	-911		
Jun	3,448	2,311	2,852	1,853	67	28	305	164	225	277	136	197		589	58	42		1,537	0	58		576	188	68	3,116	-1,263		
Jul	3,540	2,372	2,927	1,903	85	40	357	186	225	317	146	185		673	62	39		1,756	0	54		658	202	64	3,509	-1,606		
Aug	2,888	1,935	2,388	1,552	163	92	100	81	256	8	0	164		16	0	35		43	0	48		16	0	57	215	1,338		
Yala total	22,310	14,952	18,451	11,993	717	378	1,480	739	1,252	1,105	417	874		2,348	177	186		6,123	0	255		2,294	578	302	12,262	-269	-18	99%
Total	38,898	26,069	32,169	20,910	2,130	1,062	2,721	1,343	2,176	1,837	661	1,162		4,991	281	247		7,404	284	339		7,105	578	402	21,630			

Table 6.4.3.2-4 Proposed Water Balance Study for Muruthawela LB Sub-scheme (1985/86 ~ 1994/95)

Maha: 94%
Yala: 91%

	Muruthawela Tank Issue Records				Rainfall		Unit FWR			Unit FIR			Field Irrigation Requirement										Water Balance		
	LB Main Sluice	LB Main Canal				ER	Paddy	OFC	Banana	Paddy	OFC	Banana	Tract I A=425ha Maha / Yala	Paddy (85%) (50%)	OFC (10%) (10%)	Banana (5%) (5%)	Tract II A=583ha Maha / Yala	Paddy (30%) (95%)	OFC (20%) (0%)	Banana (5%) (5%)	Tract III A=692ha Maha / Yala	Paddy (95%) (30%)	OFC (0%) (20%)	Banana (5%) (5%)	Total FIR	Volume	Area	Success Rate
			(a)	(b) (ax65%)		(c)	(d)	(e)	(f)	(g) (d-c)	(h) (e-c)	(i) (f-c)		(j) (g x A)	(k) (h x A)	(l) (i x A)		(m) (g x A)	(n) (h x A)	(o) (i x A)		(p) (g x A)	(q) (h x A)	(r) (i x A)	(s)	(t) (b-s)	(u) (t / d)	
	(Ac.ft)	(Ac.ft)	(000m3)	(000m3)	(mm)	(mm)	(mm)			(mm)				(000m3)				(000m3)				(000m3)			(000m3)	(000m3)	(ha)	(%)
1984/85 Sep	1,450	972	1,199	780	84	40	53	11	218	14	0	178		50	0	38		24	0	52		91	0	62	316	463		
1988/89 Sep	1,302	872	1,076	700	199	116	53	11	218	0	0	101		0	0	21		0	0	29		0	0	35	86	614		
Oct	5,772	3,869	4,774	3,103	148	82	313	122	191	230	40	109		832	17	23		403	47	32		1,515	0	38	2,907	196		
Nov	1,513	1,014	1,251	813	250	130	279	136	137	128	0	0		462	0	0		224	0	0		842	0	0	1,528	-715		
Dec	3,503	2,348	2,897	1,883	43	0	239	128	126	239	128	126		862	54	27		418	149	37		1,569	0	43	3,160	-1,276		
Jan	4,466	2,993	3,694	2,401	87	41	287	149	125	246	108	84		888	46	18		430	127	24		1,616	0	29	3,179	-778		
Feb	4,514	3,025	3,733	2,427	0	0	71	57	127	71	57	127		255	24	27		124	67	37		464	0	44	1,041	1,385		
Maha total	21,070	14,121	17,426	11,327	727	390	1,241	604	924	914	334	547		3,300	142	116		1,599	389	160		6,006	0	189	11,901	-574	-46	97%
Mar	2,111	1,415	1,746	1,135	116	61	53	11	161	0	0	100		0	0	21		0	0	29		0	0	35	85	1,050		
Apr	3,803	2,549	3,145	2,045	0	0	307	113	165	307	113	165		653	48	35		1,702	0	48		638	156	57	3,336	-1,292		
May	4,715	3,160	3,899	2,535	116	60	357	185	220	297	124	160		631	53	34		1,646	0	47		616	172	55	3,254	-719		
Jun	3,173	2,127	2,624	1,706	52	0	305	164	225	305	164	225		648	69	48		1,690	0	66		633	226	78	3,458	-1,753		
Jul	3,813	2,555	3,153	2,050	171	98	357	186	225	259	88	128		551	38	27		1,437	0	37		538	122	44	2,795	-746		
Aug	3,825	2,562	3,163	2,056	259	157	100	81	256	0	0	99		0	0	21		0	0	29		0	0	34	84	1,972		
Yala total	21,440	14,369	17,731	11,525	714	376	1,480	739	1,252	1,169	489	876		2,483	208	186		6,476	0	256		2,426	676	303	13,013	-1,487	-101	92%
Total	42,510	28,490	35,157	22,852	1,442	766	2,721	1,343	2,176	2,082	822	1,424		5,783	349	302		8,074	389	415		8,431	676	493	24,913			
1989/90 Sep	2,657	1,781	2,197	1,428	308	189	53	11	218	0	0	29		0	0	6		0	0	8		0	0	10	24	1,404		
Oct	4,044	2,710	3,345	2,174	268	162	313	122	191	151	0	29		544	0	6		264	0	9		990	0	10	1,822	352		
Nov	4,628	3,101	3,827	2,488	966	229	279	136	137	50	0	0		180	0	0		87	0	0		328	0	0	596	1,892		
Dec	4,987	3,342	4,124	2,681	0	0	239	128	126	239	128	126		862	54	27		418	149	37		1,569	0	43	3,160	-479		
Jan	5,514	3,695	4,560	2,964	0	0	287	149	125	287	149	125		1,036	64	27		502	174	36		1,886	0	43	3,768	-804		
Feb	6,012	2,688	3,318	2,156	288	176	71	57	127	0	0	0		0	0	0		0	0	0		0	0	0	0	2,156		
Maha total	25,841	17,318	21,371	13,891	1,829	756	1,241	604	924	726	277	308		2,623	118	66		1,271	324	90		4,773	0	107	9,370	4,521	364	100%
Mar	1,646	1,103	1,361	885	124	66	53	11	161	0	0	95		0	0	20		0	0	28		0	0	33	81	804		
Apr	367	246	304	197	107	54	307	113	165	253	58	110		537	25	23		1,400	0	32		525	80	38	2,661	-2,463		
May	3,149	2,111	2,604	1,693	382	229	357	185	220	129	0	0		274	0	0		713	0	0		267	0	0	1,254	439		
Jun	3,932	2,635	3,252	2,114	100	50	305	164	225	255	114	175		542	48	37		1,413	0	51		529	157	61	2,839	-725		
Jul	3,971	2,661	3,284	2,135	500	229	357	186	225	128	0	0		273	0	0		712	0	0		267	0	0	1,252	883		
Aug	3,497	2,344	2,892	1,880	102	51	100	81	256	49	30	205		103	13	43		270	0	60		101	41	71	702	1,178		
Yala total	16,563	11,101	13,698	8,904	1,315	679	1,480	739	1,252	814	201	584		1,729	86	124		4,509	0	170		1,689	278	202	8,787	116	8	100%
Total	42,404	28,419	35,069	22,795	3,144	1,435	2,721	1,343	2,176	1,540	479	893		4,351	203	190		5,780	324	260		6,462	278	309	18,157			
1990/91 Sep	1,049	702	868	564	56	0	53	11	218	53	11	218		193	5	46		93	13	63		351	0	75	840	-276		
Oct	352	236	291	189	116	61	313	122	191	252	62	131		911	26	28		441	72	38		1,657	0	45	3,219	-3,030		
Nov	0	0	0	0	182	105	279	136	137	174	31	32		627	13	7		304	36	9		1,142	0	11	2,150	-2,150		
Dec	1,101	738	911	592	76	34	239	128	126	205	94	92		739	40	19		358	110	27		1,345	0	32	2,670	-2,078		
Jan	2,066	1,384	1,708	1,110	53	0	287	149	125	287	149	125		1,036	64	27		502	174	36		1,886	0	43	3,768	-2,658		
Feb	2,722	1,824	2,251	1,463	44	0	71	57	127	71	57	127		255	24	27		124	67	37		464	0	44	1,041	422		
Maha total	7,290	4,886	6,029	3,919	527	200	1,241	604	924	1,041	405	724		3,761	172	154		1,822	472	211		6,845	0	251	13,688	-9,769	-787	45%
Mar	5,157	3,497	4,316	2,805	19	0	53	11	161	53	11	161		113	5	34		296	0	47		111	16	56	677	2,128		
Apr	3,534	2,629	3,244	2,109	35	0	307	113	165	307	113	165		653	48	35		1,702	0	48		638	156	57	3,336	-1,227		
May	3,885	2,700	3,332	2,166	32	0	357	185	220	357	185	220		759	78	47		1,980	0	64		742	255	76	4,002	-1,837		
Jun	2,807	1,883	2,324	1,511	111	57	305	164	225	248	106	168		527	45	36		1,374	0	49		515	147	58	2,751	-1,241		
Jul	2,369	1,206	1,488	967	79	36	357	186	225	321	150	190		683	64	40		1,782	0	55		667	208	66	3,565	-2,598		
Aug	325	104	129	84	98	48	100	81	256	51	32	207		109	14	44		284	0	60		106	45	72	734	-650		
Yala total	18,075	12,020	14,832	9,641	372	141	1,480	739	1,252	1,339	598	1,111		2,844	254	236		7,418	0	324		2,779	827	384	15,066	-5,425	-367	70%
Total	25,365	16,905	20,861	13,560	900	341	2,721	1,343	2,176	2,380	1,003	1,835		6,605	426	390		9,240	472	535		9,624	827	635	28,754			
1991/92 Sep	4,581	1,858	2,293	1,490	53	0	53	11	218	53	11	218		193	5	46		93	13	63		351	0	75	840	650		
Oct	3,504	2,361	2,914	1,894	308	190	313	122	191	123	0	2		445	0	0		216	0	1		810	0	1	1,472	422		
Nov	3,658	3,373	4,162	2,705	147	81	279	136	137	197	55	55		712	23	12		345	64	16		1,296	0	19	2,488	218		
Dec	3,023	2,643	3,261	2,120	37	0	239	128	126	239	128	126		862	54	27		418	149	37		1,569	0	43	3,160	-1,040		
Jan	4,682	2,440	3,011	1,957	0	0	287	149	125	287	149	125		1,036	64	27		502	174	36		1,886	0	43	3,768	-1,811		
Feb	1,967	1,729	2,134	1,387	0	0	71	57	127	71	57	127		255	24	27		124	67	37		464	0	44	1,041	346		
Maha total	21,416	14,404	17,775	11,554	545	271	1,241	604	924	970	401	653		3,503	170	139		1,697	467	190		6,375	0	226	12,768	-1,215	-98	93%
Mar	845	299	369	240	0	0	53	11	161	53	11	161		113	5	34		93	13	47		111	16	56	488	-248		
Apr	3,727	2,348	2,897	1,883	469	229	307	113	165	79	0	0		167	0	0		138	0	0		163	0	0	468	1,415		
May	3,475	2,468	3,046	1,980	57	0	357	185	220	357	185	220		759	78	47		625	215	64		742	255	76	2,863	-883		
Jun	2,657	1,690	2,085	1,355	103	52	305	164	225	253	111	173		537	47	37		443	130	50		525	154	60	1,983	-628		
Jul	3,012	1,810	2,234	1,452	147	81	357	186	225	276	105	144		586	45	31		483	122	42		572	145	50	2,075	-623		
Aug	3,285	1,364	1,683	1,094	36	0	100	81	256	100	81	256		212	34	54		175	94	75		207	112	88	1,051	43		
Yala total	17,001	9,979	12,314	8,004	812	362	1,480	739	1,252	1,118	493	954		2,375	209	203		1,956	575	278		2,320	682	330	8,928	-924	-62	95%
Total	38,417	24,383	30,089	19,558	1,357	633	2,721	1,343	2,176	2,088	893	1,607		5,878	380	341		3,653	1,042	469		8,695	682	556	21,696			

Table 6.4.3.2-4 Proposed Water Balance Study for Muruthawela LB Sub-scheme (1985/86 ~ 1994/95)

Maha: 94%
Yala: 91%

	Muruthawela Tank Issue Records				Rainfall		Unit FWR			Unit FIR			Field Irrigation Requirement												Water Balance		
	LB Main Sluice	LB Main Canal			ER		Paddy	OFC	Banana	Paddy	OFC	Banana	Tract I A=425ha	Paddy	OFC	Banana	Tract II A=583ha	Paddy	OFC	Banana	Tract III A=692ha	Paddy	OFC	Banana	Total FIR	Volume	Area	Success Rate
			(a)	(b) (ax65%)		(c)	(d)	(e)	(f)	(g) (d-c)	(h) (e-c)	(i) (f-c)	Maha Yala	(85%) (50%) (j) (g x A)	(10%) (10%) (k) (h x A)	(5%) (5%) (l) (i x A)	Maha Yala	(30%) (95%) (m) (g x A)	(20%) (0%) (n) (h x A)	(5%) (5%) (o) (i x A)	Maha Yala	(95%) (30%) (p) (g x A)	(0%) (20%) (q) (h x A)	(5%) (5%) (r) (i x A)	(s)	(t) (b-s)	(u) (t / d)	
	(Ac.ft)	(Ac.ft)	(000m3)	(000m3)	(mm)	(mm)	(mm)			(mm)				(000m3)				(000m3)				(000m3)			(000m3)	(000m3)	(ha)	(%)
1984/85 Sep	1,450	972	1,199	780	84	40	53	11	218	14	0	178	1	50	0	38	1	24	0	52	1	91	0	62	316	-463		
1992/93 Sep	0	0	0	0	103	52	53	11	218	1	0	165	1	4	0	35	1	2	0	48	1	8	0	57	154	-154		
Oct	2,948	192	237	154	172	98	313	122	191	214	24	93		774	10	20		375	28	27		1,409	0	32	2,675	-2,521		
Nov	0	0	0	0	163	92	279	136	137	187	44	45		674	19	10		327	52	13		1,227	0	15	2,336	-2,336		
Dec	3,903	2,058	2,540	1,651	26	0	239	128	126	239	128	126		862	54	27		418	149	37		1,569	0	43	3,160	-1,509		
Jan	6,026	1,984	2,448	1,591	0	0	287	149	125	287	149	125		1,036	64	27		502	174	36		1,886	0	43	3,768	-2,177		
Feb	4,167	3,689	4,552	2,959	50	0	71	57	127	71	57	127		255	24	27		124	67	37		464	0	44	1,041	1,917		
Maha total	17,044	7,923	9,777	6,355	515	243	1,241	604	924	998	403	681		3,606	171	145		1,747	470	199		6,562	0	236	13,135	-6,780	-546	62%
Mar	3,597	3,377	4,168	2,709	0	0	53	11	161	53	11	161	1	113	5	34	1	93	13	47	1	111	16	56	488	2,221		
Apr	2,497	2,306	2,846	1,850	150	83	307	113	165	224	29	81		475	12	17		391	34	24		464	40	28	1,487	363		
May	1,379	839	1,036	673	100	50	357	185	220	307	135	170		653	57	36		538	157	50		638	186	59	2,374	-1,701		
Jun	3,571	2,632	3,248	2,111	130	70	305	164	225	235	94	155		500	40	33		412	109	45		488	130	54	1,811	300		
Jul	3,518	2,992	3,692	2,400	82	38	357	186	225	319	148	187		678	63	40		558	173	55		662	205	65	2,499	-99		
Aug	4,276	3,441	4,246	2,760	0	0	100	81	256	100	81	256		212	34	54		175	94	75		207	112	88	1,051	1,709		
Yala total	18,838	15,587	19,235	12,502	462	241	1,480	739	1,252	1,239	498	1,011		2,631	211	215		2,167	581	295		2,571	689	350	9,710	2,793	189	100%
Total	35,882	23,510	29,011	18,857	976	484	2,721	1,343	2,176	2,237	900	1,692		6,237	383	359		3,914	1,050	493		9,133	689	585	22,844			
1993/94 Sep	3,597	3,085	3,806	2,474	4	0	53	11	218	53	11	218	1	193	5	46	1	93	13	63	1	351	0	75	840	1,634		
Oct	3,453	2,320	2,863	1,861	468	229	313	122	191	84	0	0		304	0	0		147	0	0		553	0	0	1,005	856		
Nov	3,209	2,100	2,591	1,684	301	185	279	136	137	94	0	0		339	0	0		164	0	0		617	0	0	1,120	564		
Dec	3,346	2,459	3,035	1,973	339	210	239	128	126	29	0	0		103	0	0		50	0	0		188	0	0	341	1,631		
Jan	5,425	3,819	4,712	3,063	0	0	287	149	125	287	149	125		1,036	64	27		502	174	36		1,886	0	43	3,768	-705		
Feb	4,060	3,590	4,430	2,880	0	0	71	57	127	71	57	127		255	24	27		124	67	37		464	0	44	1,041	1,838		
Maha total	23,090	17,373	21,439	13,935	1,111	623	1,241	604	924	618	218	470		2,230	93	100		1,081	254	137		4,059	0	163	8,116	5,819	469	100%
Mar	5,044	3,496	4,314	2,804	0	0	53	11	161	53	11	161	1	113	5	34	1	93	13	47	1	111	16	56	488	2,316		
Apr	6,001	4,040	4,986	3,241	107	55	307	113	165	253	58	110		536	25	23		442	68	32		524	80	38	1,768	1,472		
May	5,597	3,569	4,404	2,863	21	0	357	185	220	357	185	220		759	78	47		625	215	64		742	255	76	2,863	0		
Jun	5,389	3,003	3,705	2,408	100	50	305	164	225	255	114	175		542	48	37		446	132	51		529	157	61	2,004	404		
Jul	5,306	3,263	4,026	2,617	158	89	357	186	225	268	97	136		570	41	29		469	113	40		557	135	47	2,001	616		
Aug	1,869	1,225	1,511	982	99	49	100	81	256	50	31	206		107	13	44		88	37	60		105	43	71	569	414		
Yala total	29,207	18,596	22,948	14,916	485	243	1,480	739	1,252	1,237	496	1,009		2,628	211	214		2,164	579	294		2,567	686	349	9,693	5,223	353	100%
Total	52,296	35,969	44,386	28,851	1,596	866	2,721	1,343	2,176	1,854	714	1,479		4,858	303	314		3,245	833	431		6,626	686	512	17,809			
1994/95 Sep	1,243	802	990	644	164	93	53	11	218	0	0	125	1	0	0	26	1	0	0	36	1	0	0	43	106	538		
Oct	4,925	3,367	4,155	2,701	232	138	313	122	191	175	0	53		630	0	11		305	0	15		1,147	0	18	2,128	573		
Nov	4,007	3,139	3,873	2,518	380	229	279	136	137	50	0	0		180	0	0		87	0	0		328	0	0	596	1,922		
Dec	5,029	3,753	4,632	3,011	202	119	239	128	126	120	9	7		434	4	2		210	11	2		790	0	2	1,456	1,555		
Jan	5,175	3,720	4,591	2,984	242	145	287	149	125	142	4	0		512	2	0		248	5	0		932	0	0	1,699	1,285		
Feb	2,700	2,065	2,549	1,657	103	52	71	57	127	18	5	75		66	2	16		32	6	22		121	0	26	291	1,365		
Maha total	23,079	16,847	20,790	13,515	1,323	776	1,241	604	924	505	19	260		1,823	8	55		883	22	76		3,318	0	90	6,276	7,238	583	100%
Mar	4,815	2,651	3,271	2,126	56	0	53	11	161	53	11	161	1	113	5	34	1	93	13	47	1	111	16	56	488	1,638		
Apr	4,294	3,233	3,990	2,593	366	228	307	113	165	79	0	0		168	0	0		138	0	0		164	0	0	470	2,123		
May	4,332	2,861	3,530	2,294	125	67	357	185	220	291	118	154		617	50	33		509	137	45		603	163	53	2,210	84		
Jun	5,531	3,692	4,556	2,962	230	137	305	164	225	168	26	88		357	11	19		294	31	26		348	36	30	1,152	1,810		
Jul	5,716	3,805	4,696	3,052	52	0	357	186	225	357	186	225		759	79	48		625	217	66		741	257	78	2,870	183		
Aug	565	378	466	303	123	65	100	81	256	35	16	191		74	7	40		61	18	56		72	22	66	415	-112		
Yala total	25,254	16,620	20,509	13,331	951	497	1,480	739	1,252	983	357	818		2,088	152	174		1,719	417	239		2,040	494	283	7,605	5,726	387	100%
Total	48,332	33,467	41,299	26,844	2,274	1,273	2,721	1,343	2,176	1,487	376	1,079		3,911	160	229		2,603	438	315		5,358	494	373	13,880			

(2) Urubokka Sub-scheme

1) Design irrigated area

The sub-scheme is divided into 3 units based on the irrigation system. Total area is 2,262 ha.

unit: ha

Irrigation unit	Urubokka U/S	Urubokka D/S	High level	Total
Area	442	1,304	516	2,262

2) Design water source discharge

The design water source discharge for the Urubokka U/S (upstream) and D/S (downstream) is adopted from the 11 year discharge records (1984~1995) at Muruthawela Reservoir.

Topographically, the catchment of Udukiriwila tank (CA = 26 km²) and that of the Muruthawela Reservoir are adjacent, and both are within the larger Urubokka oya basin. Accordingly, discharge out of Udukiri oya tank was extrapolated from the value for Muruthawela Reservoir (Chapter 5) on the basis of proportionate size of catchment areas.

3) Design crops

Paddy is the design crop on the basis of soil conditions (3.5 month variety).

4) Design irrigation period

Irrigation period based on data obtained in the field is computed as follows for the 3 units (see attached sheet).

Crop	Maha season	Yala season	Remarks
Paddy (3.5 month variety)	135 days from September 15 (including 30 days of land preparation)	135 days from early March (including 30 days of land preparation)	3 step stagger (30%, 40% 30%)

5) Design irrigation requirement

Irrigation requirement calculations for paddy (3.5 month variety) are indicated in Table 6.4.3.2-5.

6) Design water balance calculation criteria

Design water balance was calculated according to the following criteria.

Item	Present	Design	Remarks
Conveyance efficiency (Ec)	40%	65%	Ec = 65%, from ID design criteria
Farm loss (Ea)	60%	60%	Ea = 60%
Repeating use of water	15% of field requirement	same as left	applied to Urubokka U/S and High Level units
Return flow	15% of LB Main consumption	same as left	applied to Urubokka D/S unit seepage volume from LB Main to Urubokka oya is applied as return flow

note: Rates for repeating use of water and return flow adopted for neighboring areas are around 27%. Trial calculation for the subject area yielded a value of approx. 25%; however this was adjusted to 15% under the Study applying a safety factor of 60%.

7) Design irrigated area

Design irrigated area is as follows.

Design irrigated area : 2,262 ha

Season	Maha	Yala
Area	2,149 ha \(95%\)	2,036 ha \(90%\)

8) Design water balance calculation

Results of design water balance calculation are summarized below. (refer to Table 6.4.3.2-6)

Unit: %

Calculation Period	1984/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	Average
Maha	100	100	79	100	100	100	--	99	--	100	100	97
Yala	100	77	80	100	93	100	--	99	--	100	100	94

Table 6.4.3.2-5 Design Water Requirement for Urubokka Oya Sub-scheme (Paddy 3.5 month Variaty)

					Maha						Yala					
KC:			Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage	1st Stagger	Uru-up	30%	30%		1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90	
and Crop Factors	2nd Stagger	High Level	40%	40%			1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
	3rd Stagger	Uru-down	30%	30%				1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
ETo (Evapotranspiration of Reterence Crop)					5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
1. LP	Ls	(4.0inch/5days)			1.20	1.60					1.20					
(Land Preparation)						1.20					1.60	1.20				
	Lr	(7.5inch/25days)			0.90	1.35					2.25					
						3.00					0.60	2.40				
						0.90	1.35					1.35	0.90			
	Total LP				2.10	8.05	1.35				5.65	4.95	0.90			
2. E					0.77	0.72					1.46					
(Evapo. during LP)						1.92					0.65	1.15				
(E=ETo)						0.72	0.57					0.86	0.52			
	Total Evapo				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Sd (Standing Water)		(3.0inch)				2.10	0.90				0.90	1.20	0.90			
4. ETc	ETc (S_1)					1.08	0.29	0.23	0.25			1.30	1.19	1.21		
Crop Water							1.10	1.19	1.12			0.50	0.62	1.37		
Requirement	ETc (S_2)						1.53	1.21	1.32			0.86	1.04	0.78	0.82	
							0.59	0.63	1.49				1.59	1.62	1.85	
(ETc=ETo x KC)	ETc (S_3)						0.86	0.30	0.24	0.25			1.55	1.75	1.85	1.61
								1.14	1.24	1.14						
	Total ETc				0.00	1.08	4.36	4.70	5.65	1.39		2.66	5.99	6.72	4.52	1.61
5. Farm Loss at ETc																
(Farm Loss + ETc)		Total ETc/60%			0.00	1.80	7.26	7.83	9.41	2.32	0.00	4.43	9.99	11.20	7.54	2.68
6. FWR (1+2+3+5)	Average	(inch/month)			2.10	11.95	9.51	7.83	9.41	2.32	6.55	10.58	11.79	11.20	7.54	2.68
Field Water		(mm/month)			53	304	242	199	239	59	166	269	299	285	191	68
Requirement		(mm/day)			1.78	10.12	8.05	6.63	7.97	1.96	5.55	8.96	9.98	9.48	6.38	2.27
	Peak	(mm/day)				14.48						14.17				

Total FWR = 2,374 mm

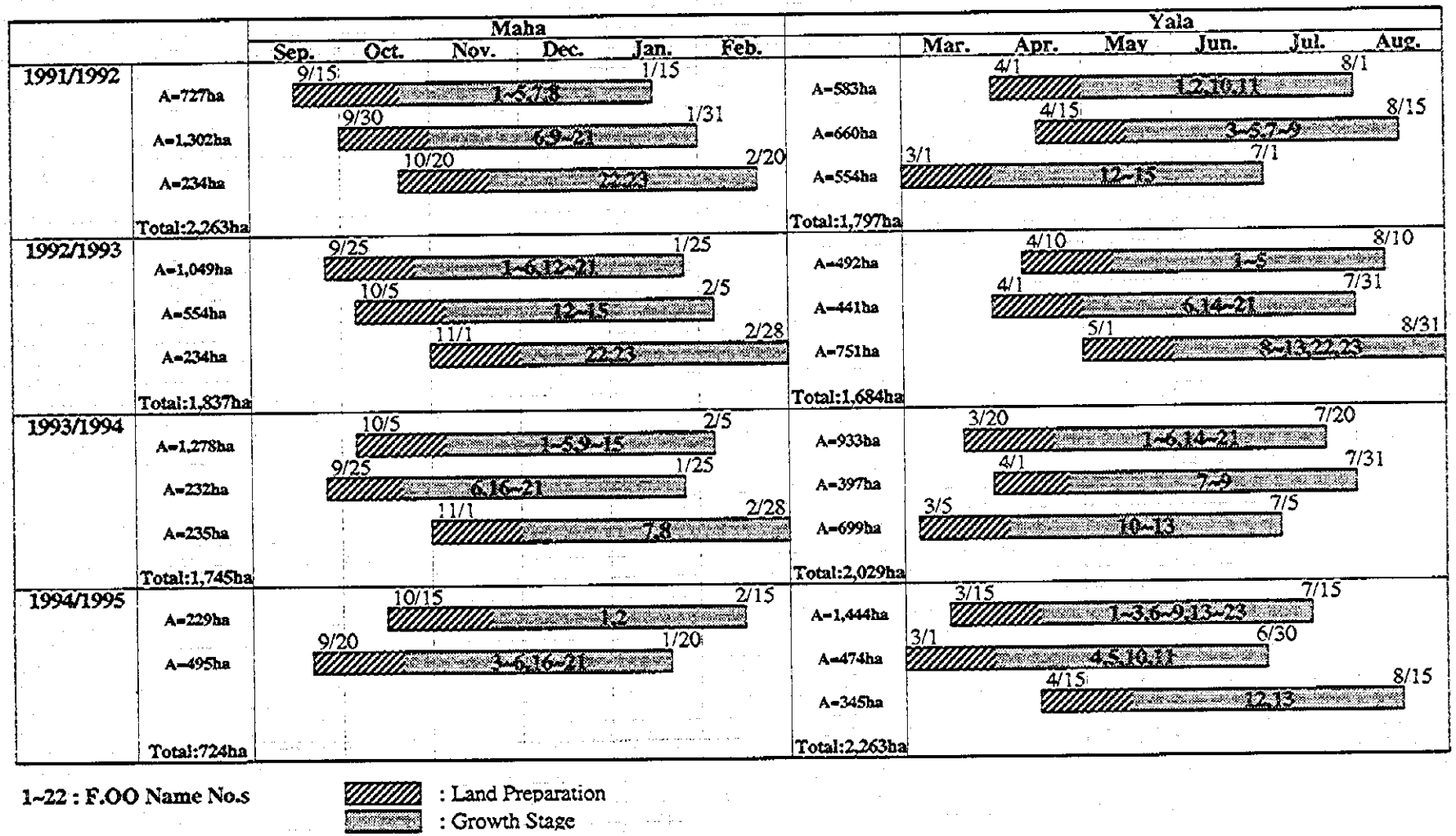


Figure 6.4.3.2-2 Irrigation Period for Muruthawela Reservoir Scheme Urruboka Oya Sub-scheme (1991/92 ~ 1994/95)

Table 6.4.3.2-6 Proposed Water Balance Study for Muruthawela Reservoir Scheme Urubokka Oya Sub-scheme (1984/85~1994/95)

Command Area = 2,262 ha

Proposed Cropping Area
A=2,149 ha (Maha:95%)
A=2,036 ha (Yala :90%)

Success Rate
Maha: (95%)
Yala : (93%)

	LB Main Flow	Urubokka Flow		Rainfall		Field Water Requirement	Unit FIR	Field Irrigation Requirement (FIR)												Water Balance			
			Effective Flow		ER	(PWR)		Urubokka-Upstream (A=442ha)			Urubokka-Downstream (A=1,904ha)				High Level Canal (A=516ha)					Total FIR	Volume	Area	Success Area	Rate
								FIR Paddy (Maha:95%) (Yala :90%)	Re-used Water	Actual Required	FIR Paddy (Maha:95%) (Yala :90%)	Re-used Urubokka	Re-used LB Main	Actual Required	FIR Paddy (Maha:95%) (Yala :90%)	Oluwakiliwewa Runoff (CA=26 km2)		Re-used Water	Actual Required				
	(a)	(b)	(c) (ba65%)		(d)	(f)	(h) (f-d)	(i) (haA)	(e) (fxAx15%)	(j) (i-e)	(k) (haA)	(l) (fxAx15%)	(m) (e x 15%)	(n) (k+l+m)	(o) (haA)	(p)	(q) (p x CA)	(r) (fxAx15%)	(s) (o-q-r)	(t) (j+n+s)	(u) (c-t)	(v) (u / f)	(w)	(x)
	(000m3)	(000m3)	(000m3)	(mm)	(mm)	(mm)	(mm)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(m3/s/km2)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(ha)	(ha)	(%)
1984/85 Sep	1,199	823	535	84	40	53	14	58	34	24	171	99	180	0	68	0.0123	827	39	0	24	510			
Oct	1,957	1,343	873	119	63	304	241	1,012	191	820	2,984	564	294	2,127	1,181	0.0136	916	223	41	2,988	-2,116			
Nov	3,739	2,565	1,667	272	165	242	76	320	152	168	944	449	561	0	374	0.0551	3,712	178	0	168	1,499			
Dec	4,459	3,059	1,988	368	229	199	0	0	125	0	0	370	669	0	0	0.0347	2,340	146	0	0	1,988			
Jan	3,868	2,653	1,725	142	78	239	161	676	151	525	1,994	444	580	970	789	0.0323	2,174	176	0	1,495	230			
Feb	4,224	2,898	1,883	95	46	59	12	52	37	15	133	109	634	0	60	0.0239	1,608	43	0	15	1,869			
Maha total	19,447	13,340	8,671	1,080	622	1,095	504	2,117	690	1,553	6,246	2,036	2,917	3,096	2,472		11,578	805	41	4,690	3,981	363	2,512	100%
Mar	3,792	2,601	1,691	155	87	166	80	317	99	218	936	293	569	74	370	0.0371	2,499	116	0	292	1,399			
Apr	3,500	2,401	1,561	59	0	269	269	1,069	160	908	3,153	473	525	2,155	1,248	0.0243	1,635	187	0	3,064	-1,503			
May	3,494	2,397	1,558	183	105	299	194	772	179	593	2,277	527	524	1,226	901	0.0197	1,326	209	0	1,819	-262			
Jun	2,497	1,713	1,113	489	229	285	56	223	170	53	656	501	374	0	260	0.0631	4,251	198	0	53	1,060			
Jul	2,647	1,815	1,180	28	0	191	191	762	114	647	2,247	337	397	1,513	889	0.0107	719	133	37	2,198	-1,018			
Aug	2,113	1,450	942	8	0	68	68	271	41	230	799	120	317	361	316	0.0071	479	47	0	591	351			
Yala total	18,042	12,376	8,045	921	421	1,278	858	3,413	763	2,650	10,068	2,251	2,706	5,330	3,984		10,909	891	37	8,017	26	2	2,038	100%
Total	37,489	25,716	16,716	2,001	1,042	2,374	1,362	5,530	1,453	4,202	16,314	4,286	5,623	8,426	6,456		22,487	1,696	79	12,707	4,008	294		
1985/86 Sep	0	0	0	12	0	53	53	224	34	190	661	99	0	562	261	0.0010	67	39	155	907	-907			
Oct	588	404	262	212	125	304	179	750	191	559	2,213	564	88	1,560	876	0.0273	1,842	223	0	2,119	-1,856			
Nov	2,305	1,581	1,028	122	65	242	177	743	152	591	2,193	449	346	1,399	868	0.0301	2,026	178	0	1,990	-962			
Dec	3,282	2,252	1,464	338	209	199	0	0	125	0	0	370	492	0	0	0.0391	2,632	146	0	0	1,464			
Jan	3,267	2,241	1,457	174	99	239	140	587	151	436	1,732	444	490	797	685	0.0212	1,430	176	0	1,234	223			
Feb	3,085	2,116	1,376	60	0	59	59	247	37	210	729	109	463	157	208	0.0143	963	43	0	366	1,009			
Maha total	12,528	8,594	5,586	917	498	1,095	608	2,551	690	1,987	7,527	2,036	1,879	4,474	2,978		8,959	805	155	6,616	-1,030	-94	2,768	100%
Mar	3,078	2,112	1,373	158	89	166	77	308	99	209	908	293	462	154	359	0.0157	1,057	116	0	362	1,010			
Apr	759	521	338	238	143	269	126	501	160	341	1,479	473	114	892	585	0.0183	1,235	187	0	1,233	-895			
May	1,594	1,094	711	0	0	299	299	1,191	179	1,012	3,513	527	239	2,747	1,390	0.0010	67	209	1,114	4,874	-4,163			
Jun	2,145	1,471	956	24	0	285	285	1,132	170	962	3,339	501	322	2,517	1,321	0.0010	67	198	1,056	4,535	-3,578			
Jul	1,929	1,323	860	48	0	191	191	762	114	647	2,247	337	289	1,621	889	0.0010	67	133	689	2,957	-2,097			
Aug	1,832	1,257	817	145	80	68	0	0	41	0	0	120	275	0	0	0.0056	375	47	0	0	817			
Yala total	11,337	7,777	5,055	614	312	1,278	979	3,894	763	3,171	11,487	2,251	1,701	7,931	4,546		2,869	891	2,859	13,961	-8,906	-697	1,565	77%
Total	23,865	16,371	10,641	1,531	810	2,374	1,586	6,445	1,453	5,158	19,014	4,286	3,580	12,405	7,524		11,828	1,696	3,014	20,577	-9,936	-626		
1986/87 Sep	1,915	1,313	854	552	229	53	0	0	34	0	0	99	287	0	0	0.0047	314	39	0	0	854			
Oct	801	550	357	114	60	304	244	1,025	191	833	3,023	564	120	2,338	1,196	0.0085	574	223	399	3,571	-3,213			
Nov	1,219	836	544	167	95	242	147	618	152	465	1,822	449	183	1,190	721	0.0181	1,218	178	0	1,656	-1,112			
Dec	2,792	1,916	1,245	30	0	199	199	835	125	710	2,464	370	419	1,676	975	0.0111	751	146	78	2,464	-1,219			
Jan	2,236	1,534	997	48	0	239	239	1,004	151	853	2,962	444	335	2,182	1,172	0.0124	836	176	160	3,195	-2,198			
Feb	1,750	1,200	780	81	37	59	21	90	37	53	265	109	262	0	105	0.0063	425	43	0	53	727			
Maha total	10,713	7,349	4,777	1,012	420	1,095	850	3,571	690	2,915	10,536	2,036	1,607	7,387	4,169		4,118	805	637	10,939	-6,162	-563	1,699	79%
Mar	2,137	1,466	953	89	43	166	124	493	99	393	1,453	293	321	840	575	0.0181	1,222	116	0	1,233	-280			
Apr	1,339	919	597	53	0	269	269	1,069	160	908	3,153	473	201	2,479	1,248	0.0383	2,580	187	0	3,388	-2,791			
May	938	643	418	39	0	299	299	1,191	179	1,012	3,513	527	141	2,846	1,390	0.0228	1,536	209	0	3,858	-3,440			
Jun	1,934	1,326	862	0	0	285	285	1,132	170	962	3,339	501	290	2,548	1,321	0.0099	670	198	453	3,963	-3,101			
Jul	2,572	1,764	1,147	501	229	191	0	0	114	0	0	337	386	0	0	0.0051	345	133	0	0	1,147			
Aug	710	487	316	173	99	68	0	0	41	0	0	120	106	0	0	0.0240	1,620	47	0	0	316			
Yala total	9,630	6,606	4,294	854	370	1,278	976	3,884	763	3,276	11,459	2,251	1,444	8,713	4,534		7,973	891	453	12,442	-8,148	-637	1,625	80%
Total	20,343	13,955	9,071	1,866	790	2,374	1,827	7,455	1,453	6,191	21,995	4,286	3,051	16,100	8,703		12,091	1,696	1,090	23,381	-14,310	-783		
1987/88 Sep	290	199	129	613	229	53	0	0	34	0	0	99	43	0	0	0.0155	1,042	39	0	0	129			
Oct	687	471	306	374	229	304	75	315	191	124	929	564	103	262	368	0.0568	3,828	223	0	386	-79			
Nov	2,902	1,991	1,294	224	133	242	109	456	152	304	1,346	449	435	462	533	0.0415	2,799	178	0	766	529			
Dec	3,067	2,118	1,377	125	66	199	133	557	125	431	1,642	370	463	809	650	0.0511	3,444	146	0	1,240	136			
Jan	4,113	2,821	1,834	12	0	239	239	1,004	151	853	2,962	444	617	1,901	1,172	0.0095	640	176	356	3,110	-1,276			
Feb	2,639	1,810	1,177	67	28	59	31	131	37	94	387	109	396	0	153	0.0133	897	43	0	94	1,083			
Maha total	13,718	9,410	6,117	1,414	684	1,095	587	2,463	690	1,806	7,266	2,036	2,058	3,433	2,875		12,651	805	356	5,596	521	48	2,310	100%
Mar	2,951	2,024	1,316	110	57	166	110	437	99	337	1,268	293	443	553	510	0.0337	2,268	116	0	890	426			
Apr	3,775	2,589	1,683	173	99	269	170	675	160	515	1,993	473	566	953	749	0.0425	2,867	187	0	1,469	214			
May	3,558	2,441	1,587	119	63	299	237	941	179	762	2,777	527	534	1,716	1,099	0.0160	1,081	209	0	2,478	-892			
Jun	2,852	1,956	1,271	67	28	285	257	1,022	170	852	3,015	501	428	2,087	1,193	0.0183	1,232	198	0	2,939	-1,668			
Jul	2,927	2,008	1,305	85	40	191	151	602	114	488	1,776	337	439	1,000	703	0.0075	507	133	63	1,551	-245			
Aug	2,388	1,638	1,065	162	92	68	0	0	41	0	0	120	358	0	0	0.0042	264	47	0	0	1,065			
Yala total	18,451	12,657	8,227	717	378	1,278	924	3,677	763	2,955	10,849	2,251	2,768	6,309	4,293		8,239	891	63	9,327	-1,100	-86	2,176	100%
Total	32,169	22,067	14,344	2,130	1,062	2,374	1,511	6,140	1,453	4,761	18,114	4,286	4,825	9,742	7,168		20,890	1,696	419	14,922	-579	-38		

Table 6.4.3.2-6 Proposed Water Balance Study for Muruthawela Reservoir Scheme Urubokka Oya Sub-scheme (1984/85~1994/95)

Command Area = 2,262 ha

Proposed Cropping Area
A=2,149 ha (Maha:95%)
A=2,036 ha (Yala :90%)

Success Rate
Maha: (95%)
Yala : (93%)

		LB Main Flow	Urubokka Flow		Rainfall		Field Water Requirement (FWR)	Unit FIR	Field Irrigation Requirement (FIR)														Water Balance			
			Effective Flow		ER				Urubokka-Upstream (A=442ha)			Urubokka-Downstream (A=1,304ha)			High Level Canal (A=516ha)						Total FIR	Volume	Area	Success	
									FIR Paddy (Maha:95%) (Yala :90%)	Re-used Water	Actual Required	FIR Paddy (Maha:95%) (Yala :90%)	Re-used Urubokka	Water LB Main	Actual Required	FIR Paddy (Maha:95%) (Yala :90%)	Uduukiliwewa Runoff (CA=26 km2)		Re-used Water	Actual Required				Area	Rate
		(a)	(b)	(c) (bx65%)		(d)	(f)	(h) (f-d)	(i) (hxA)	(e) (IxAx15%)	(j) (i-e)	(k) (hxA)	(l) (kxAx15%)	(m) (a x 15%)	(n) (k-l-m)	(o) (hxA)	(p)	(q) (p x CA)	(r) (IxAx15%)	(s) (o-q-r)	(t) (j+n+s)	(u) (c-t)	(v) (u / f)	(w)	(x)
		(000m3)	(000m3)	(000m3)	(mm)	(mm)	(mm)	(mm)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(m3/sec/m2)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(ha)	(ha)	(%)
1988/89	Sep	1,076	738	480	199	116	53	0	0	34	0	0	99	161	0	0	0.0190	1,214	39	0	0	480			
	Oct	4,774	3,275	2,129	148	82	304	221	929	191	738	2,741	564	716	1,461	1,085	0.0052	353	223	509	2,707	-579			
	Nov	1,251	858	558	250	150	242	91	383	152	231	1,129	449	188	493	447	0.0679	4,579	178	0	723	-165			
	Dec	2,897	1,988	1,292	43	0	199	199	835	125	710	2,464	370	435	1,660	975	0.0207	1,397	146	0	2,370	-1,078			
	Jan	3,694	2,534	1,647	87	41	239	198	832	151	681	2,454	444	554	1,456	971	0.0031	212	176	584	2,720	-1,073			
	Feb	3,733	2,561	1,665	0	0	59	59	247	37	210	729	109	560	59	288	0.0010	67	43	178	447	1,218			
Maha total		17,426	11,953	7,770	727	390	1,095	768	3,226	690	2,570	9,517	2,096	2,614	5,129	3,766		7,821	805	1,270	8,968	-1,198	-109	2,153	100%
	Mar	1,746	1,198	778	116	61	166	106	420	99	321	1,239	293	262	685	490	0.0243	1,638	116	0	1,005	-227			
	Apr	3,145	2,158	1,403	0	0	269	269	1,069	160	908	3,153	473	472	2,208	1,248	0.0040	267	187	793	3,910	+2,508			
	May	3,899	2,675	1,739	116	60	299	239	951	179	772	2,805	527	585	1,693	1,110	0.0010	67	209	834	3,299	-1,560			
	Jun	2,624	1,800	1,170	52	0	285	285	1,132	170	962	3,339	501	394	2,445	1,321	0.0116	779	198	344	3,751	-2,581			
	Jul	3,153	2,163	1,406	171	98	191	94	373	114	259	1,101	337	473	291	436	0.0235	1,584	133	0	550	856			
	Aug	2,162	2,170	1,410	259	157	68	0	0	41	0	0	120	474	0	0	0.0108	729	47	0	0	1,410			
Yala total		17,731	12,163	7,906	714	376	1,278	992	3,945	763	3,222	11,638	2,251	2,660	7,321	4,605		5,064	891	1,972	12,515	-4,609	-361	1,901	93%
Total		35,157	24,117	15,676	1,442	766	2,374	1,760	7,171	1,453	5,792	21,155	4,246	5,274	12,450	8,371		12,886	1,696	3,242	21,484	-5,808	-330		
1989/90	Sep	2,197	1,507	980	308	189	53	0	0	34	0	0	99	330	0	0	0.0036	242	39	0	0	980			
	Oct	3,345	2,294	1,491	208	162	304	141	594	191	403	1,752	564	502	686	693	0.0135	907	223	0	1,089	403			
	Nov	3,827	2,625	1,706	966	229	242	13	55	152	0	162	449	574	0	64	0.0446	3,007	178	0	0	1,706			
	Dec	4,124	2,829	1,839	0	0	199	199	835	125	710	2,464	370	619	1,476	975	0.0135	908	146	0	2,186	+347			
	Jan	4,560	3,128	2,033	0	0	239	239	1,004	151	853	2,962	444	684	1,834	1,172	0.0091	611	176	385	3,072	-1,039			
	Feb	3,318	2,276	1,479	288	176	59	0	0	37	0	0	109	498	0	0	0.0162	1,089	43	0	0	1,479			
Maha total		21,371	14,660	9,529	1,809	756	1,095	592	2,488	690	1,966	7,340	2,036	3,206	3,996	2,904		6,764	805	385	6,346	3,183	291	2,553	100%
	Mar	1,361	934	607	124	66	166	100	396	99	299	1,174	293	204	677	465	0.0330	2,227	116	0	976	-369			
	Apr	304	208	135	107	54	269	214	852	160	692	2,514	473	46	1,995	995	0.0152	1,026	187	0	2,687	-2,552			
	May	2,604	1,787	1,161	382	229	299	71	281	179	103	830	527	391	0	329	0.0272	1,836	209	0	103	1,058			
	Jun	3,252	2,231	1,450	100	50	285	235	933	170	763	2,753	501	488	1,764	1,089	0.0104	701	198	190	2,718	-1,268			
	Jul	3,284	2,253	1,464	500	229	191	0	0	114	0	0	337	493	0	0	0.0056	375	133	0	0	1,464			
	Aug	2,892	1,984	1,290	102	51	68	17	67	41	27	199	120	434	0	79	0.0073	489	47	0	27	1,263			
Yala total		17,698	9,397	6,108	1,315	679	1,278	637	2,532	763	1,885	7,470	2,251	2,055	4,436	2,956		6,654	891	190	6,510	-403	-31	2,231	100%
Total		35,069	24,056	15,637	3,144	1,435	2,374	1,229	5,020	1,453	3,849	14,810	4,286	5,260	8,432	5,860		13,418	1,696	575	12,857	2,780	226		
1990/91	Sep	866	595	387	56	0	53	53	224	34	190	661	99	130	431	261	0.0078	525	39	0	622	-235			
	Oct	291	200	130	116	61	304	243	1,020	191	829	3,010	564	44	2,402	1,191	0.0299	2,012	223	0	3,231	-3,102			
	Nov	0	0	0	182	105	242	137	574	152	422	1,694	449	0	1,245	671	0.1074	7,237	178	0	1,668	-1,668			
	Dec	911	625	406	76	34	199	165	692	125	567	2,043	370	137	1,536	808	0.0384	2,590	146	0	2,104	-1,697			
	Jan	1,708	1,172	762	53	0	239	239	1,004	151	853	2,962	444	256	2,261	1,172	0.0116	783	176	214	3,328	+2,566			
	Feb	2,251	1,544	1,004	44	0	59	59	247	37	210	729	109	338	282	288	0.0090	604	43	0	492	512			
Maha total		6,029	4,136	2,688	527	200	1,095	896	3,762	690	3,072	11,099	2,036	904	8,159	4,392		13,752	805	214	11,444	-8,756	-799	1,463	68%
	Mar	4,316	2,575	1,674	19	0	166	166	662	99	563	1,953	293	647	1,012	773	0.0052	348	116	309	1,004	-210			
	Apr	3,244	1,627	1,058	35	0	269	269	1,069	160	908	3,153	473	487	2,194	1,248	0.0268	1,804	187	0	3,102	-2,045			
	May	3,332	1,836	1,194	32	0	299	299	1,191	179	1,012	3,513	527	500	2,487	1,390	0.0105	707	209	474	3,973	-2,780			
	Jun	2,324	1,718	1,116	111	57	285	228	905	170	735	2,670	501	349	1,821	1,057	0.0335	2,261	198	0	2,556	-1,439			
	Jul	1,488	1,878	1,221	79	36	191	156	620	114	506	1,830	337	223	1,269	724	0.0110	742	133	0	1,775	-554			
	Aug	129	1,174	763	98	48	68	20	78	41	37	230	120	19	91	91	0.0097	653	47	0	128	635			
Yala total		14,832	10,808	7,025	372	141	1,278	1,137	4,525	763	3,762	13,349	2,251	2,225	8,873	5,282		6,515	891	785	13,418	-6,393	-500	1,762	87%
Total					900	341	2,374	2,033	8,287	1,453	6,834	24,447	4,286	3,129	17,032	9,674		20,267	1,696	997	24,862	-15,149	-745		
1991/92	Sep	2,293	3,905	2,538	53	0	53	53	224	34	190	661	99	344	218	261	0.0010	67	39	155	563	1,975			
	Oct	2,914	1,938	1,260	308	190	304	114	479	191	288	1,412	564	437	411	359	0.0213	1,435	223	0	699	561			
	Nov	4,162	862	560	147	81	242	160	673	152	521	1,986	449	624	912	786	0.0388	2,616	178	0	1,433	-873			
	Dec	3,261	1,134	737	37	0	199	199	835	125	710	2,464	370	449	1,606	975	0.0094	635	146	194	2,509	-1,772			
	Jan	2,011	3,294	2,141	0	0	239	239	1,004	151	853	2,962	444	452	2,066	1,172	0.0047	319	176	678	3,597	-1,456			
	Feb	2,134	787	512	0	0	59	59	247	37	210	729	109	320	299	288	0.0026	244	43	2	511	1			
Maha total		17,775	11,920	7,748	545	271	1,095	824	3,462	690	2,772	10,216	2,036	2,666	5,512	4,042		5,315	805	1,028	9,312	-1,564	-143	2,119	99%
	Mar	369	1,507	980	0	0	166	166	662	99	563	1,953	293	55	1,604	773	0.0010	67	116	589	2,756	-1,777			
	Apr	2,897	2,212	1,438	469	229	269	40	159	160	0	470	473	435	0	186	0.0034	226	187	0	0	1,438			
	May	3,046	1,771	1,151	57	0	299	299	1,191	179	1,012	3,513	527	457	2,529	1,390	0.0168	1,134	209	47	3,549	-2,438			
	Jun	2,085	1,824	1,185	103	52	285	232	925	170	755	2,728	501	313	1,914	1,079	0.0083	559	198	322	2,990	-1,805			
	Jul	2,234	2,079	1,351	147	81	191	110	438	114	324	1,293	337	335	621	512	0.0061	411	133	0	945	406			
	Aug	1,693	2,864	1,862	36	0	68	68	271	41	230	798	120	252	426	316	0.0018	124	47	145	801	1,061			
Yala total		12,314	12,256	7,966	812	362	1,278	916	3,646	763	2,884	10,755	2,251	1,847	7,095	4,256		2,521	891	1,103	11,082	-3,116	-244	2,018	99%
Total		30,089	24,176	15,714	1,357	633	2,374	1,741	7,108	1,453	5,656	20,969	4,286	4,513	12,607	8,298		7,837	1,696	2,131	20,394	-4,640	-269		

Table 6.4.3.2-6 Proposed Water Balance Study for Muruthawela Reservoir Scheme Urubokka Oya Sub-scheme (1984/85~1994/95)

Command Area = 2,262 ha

Proposed Cropping Area
A=2,149 ha (Maha:95%)
A=2,036 ha (Yala :90%)

Success Rate
Maha: (95%)
Yala : (93%)

		D/S Main Flow	Urubokka Flow		Rainfall		Field Water Requirement (FWR)	Unit FIR	Field Irrigation Requirement (FIR)													Water Balance				
				Effective Flow		ER			Urubokka-Upstream (A=1,228ha)			Urubokka-Downstream (A=1,304ha)				High Level Canal (A=516ha)					Total FIR	Volume	Area	Success	
									FIR Paddy (Maha:95%) (Yala :90%)	Re-used Water	Actual Required	FIR Paddy (Maha:95%) (Yala :90%)	Re-used Urubokka	Water L/B Main	Actual Required	FIR Paddy (Maha:95%) (Yala :90%)	Udawalawewa (CA=26 km2)		Runoff	Re-used Water	Actual Required				Area	Rate
		(a)	(b)	(c) (bx65%)	(d)		(f)	(h) (f-d)	(i) (hxA)	(e) (fxAx15%)	(j) (i-e)	(k) (hxA)	(l) (fxAx15%)	(m) (a x 15%)	(n) (k-l-m)	(o) (hxA)	(p)	(q) (p x CA)	(r) (fxAx15%)	(s) (o-q-r)	(t) (j+n+s)	(u) (c-t)	(v) (u / f)	(w)	(x)
		(000m3)	(000m3)	(000m3)	(mm)	(mm)	(mm)	(mm)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(m/sec/km2)	(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(ha)	(ha)	(%)
1992/93	Sep	0	1,021	664	103	52	53	1	5	341	0	14	99	0	0	6	0.0130	874	39	0	0	664				
	Oct	237	4,014	2,609	172	98	304	205	861	191	670	2,541	564	36	1,941	1,006	0.0131	884	223	0	2,612	-2				
	Nov	0	1,021	664	163	92	242	150	629	152	477	1,955	449	0	1,406	734	0.0539	3,630	178	0	1,893	-1,220				
	Dec	2,540	2,838	1,845	26	0	199	199	835	125	710	2,464	370	381	1,714	975	0.0199	1,342	146	0	2,424	-579				
	Jan	2,448	5,532	3,596	0	0	239	239	1,004	151	853	2,962	444	367	2,150	1,172	0.0010	67	176	929	3,933	-337				
	Feb	4,552	1,100	715	50	0	59	59	247	37	210	729	109	683	0	288	0.0113	762	43	0	210	595				
Maha total		9,777	15,527	10,092	515	243	1,095	853	3,581	690	2,920	10,566	2,036	1,467	7,212	4,181		7,560	805	929	11,061	-969	-88	2,174	100%
	Mar	4,168	886	575	0	0	166	166	662	99	563	1,953	293	625	1,034	773	0.0171	1,156	116	0	1,597	-1,022				
	Apr	2,846	883	574	150	83	269	185	737	160	576	2,173	473	427	1,274	860	0.0102	685	187	0	1,850	-1,276				
	May	1,036	1,466	953	100	50	299	249	992	179	813	2,927	527	155	2,244	1,158	0.0614	4,137	209	0	3,058	-2,105				
	Jun	3,248	1,704	1,108	130	70	285	215	854	170	685	2,521	501	487	1,533	997	0.0416	2,804	198	0	2,217	-1,110				
	Jul	3,692	1,211	787	82	38	191	154	611	114	497	1,802	337	554	911	713	0.0344	2,319	133	0	1,408	-621				
	Aug	4,246	1,626	1,057	0	0	68	68	271	41	230	798	120	637	42	316	0.0059	395	47	0	272	785				
Yala total (average)		22,235	7,773	5,052	462	241	1,278	1,037	4,126	763	3,364	12,174	2,251	2,885	7,038	4,817		11,495	891	0	10,402	-5,349	-418	1,844	91%
Total		29,011	23,299	15,145	976	484	2,374	1,890	7,708	1,453	6,284	22,740	4,286	4,352	14,250	8,998		19,055	1,696	929	21,463	-6,318	-334		
1993/94	Sep	3,806	1,194	776	4	0	53	53	224	34	190	661	99	571	0	261	0.0050	338	39	0	190	586				
	Oct	2,863	2,044	1,329	468	229	304	75	315	191	124	929	564	430	0	368	0.0416	2,805	223	0	124	1,205				
	Nov	2,591	1,896	1,232	301	185	242	57	239	152	87	706	449	389	0	279	0.0753	5,072	178	0	87	1,145				
	Dec	3,035	1,673	1,088	339	210	199	0	0	125	0	0	370	455	0	0	0.0132	887	146	0	0	1,088				
	Jan	4,712	2,509	1,631	0	0	239	239	1,004	151	853	2,962	444	707	1,811	1,172	0.0275	1,854	176	0	2,664	-1,033				
	Feb	4,430	1,056	686	0	0	59	59	247	37	210	729	109	665	0	288	0.0199	1,342	43	0	210	477				
Maha total		21,439	10,372	6,742	1,111	623	1,095	483	2,029	690	1,465	5,987	2,036	3,216	1,811	2,369		12,299	805	0	3,275	3,467	316	2,578	100%
	Mar	4,314	2,472	1,607	0	0	166	166	662	99	563	1,953	293	647	1,012	773	0.0102	691	116	0	1,575	32				
	Apr	4,986	2,930	1,904	107	55	269	214	851	160	691	2,512	473	748	1,291	994	0.0113	761	187	46	2,027	-123				
	May	4,404	3,030	1,969	21	0	299	299	1,191	179	1,012	3,513	527	661	2,326	1,390	0.0098	660	209	522	3,860	-1,890				
	Jun	3,705	3,320	2,158	100	50	285	235	933	170	763	2,753	501	556	1,696	1,089	0.0023	153	198	738	3,197	-1,039				
	Jul	4,026	2,981	1,938	158	89	191	103	408	114	294	1,205	337	604	264	477	0.0061	414	133	0	558	1,380				
	Aug	1,511	1,510	981	99	49	68	19	74	41	34	219	120	227	0	87	0.0088	592	47	0	34	947				
Yala total		22,948	16,242	10,557	485	243	1,278	1,036	4,120	763	3,357	12,154	2,251	3,442	6,589	4,809		3,271	891	1,305	11,250	-693	-54	2,208	100%
Total		44,386	26,614	17,299	1,596	866	2,374	1,519	6,149	1,453	4,821	18,141	4,286	6,658	8,399	7,178		15,569	1,696	1,305	14,526	2,773	183		
1994/95	Sep	990	1,411	917	164	93	53	0	0	34	0	0	99	149	0	0	0.0147	991	39	0	0	917				
	Oct	4,155	2,449	1,592	232	138	304	165	694	191	503	2,048	564	623	861	810	0.0273	1,838	223	0	1,364	228				
	Nov	3,873	1,599	1,039	380	229	242	13	55	152	0	162	449	581	0	64	0.0779	5,253	178	0	0	1,039				
	Dec	4,632	2,102	1,366	202	119	199	80	338	125	212	996	370	695	0	394	0.0473	3,187	146	0	212	1,154				
	Jan	4,591	2,323	1,510	242	145	239	94	395	151	244	1,164	444	689	31	461	0.0250	1,686	176	0	275	1,235				
	Feb	2,549	1,328	863	103	52	59	7	29	37	0	82	109	382	0	32	0.0119	804	43	0	0	863				
Maha total		20,790	11,212	7,288	1,323	776	1,095	359	1,509	690	959	4,452	2,036	3,118	892	1,762		13,758	805	0	1,851	5,436	496	2,758	100%
	Mar	3,271	3,300	2,145	56	0	166	166	662	991	563	1,953	293	491	1,169	773	0.0082	552	116	105	1,836	308				
	Apr	3,990	1,820	1,183	366	228	269	40	161	160	1	475	473	598	0	188	0.0357	2,408	187	0	1	1,182				
	May	3,530	2,343	1,523	125	67	299	233	925	179	747	2,730	527	529	1,674	1,080	0.0562	3,788	209	0	2,420	-897				
	Jun	4,556	2,712	1,763	230	137	285	147	586	170	417	1,730	501	685	545	684	0.0292	1,969	198	0	962	801				
	Jul	4,696	2,886	1,876	52	0	191	191	762	114	647	2,247	337	704	1,206	889	0.0069	466	133	290	2,143	-267				
	Aug	466	324	211	123	65	68	3	12	41	0	35	120	70	0	14	0.0086	582	47	0	0	211				
Yala total		20,509	13,384	8,700	951	497	1,278	781	3,109	763	2,374	9,169	2,251	3,076	4,594	3,628		9,765	891	395	7,363	1,337	105	2,367	100%
Total		41,299	24,596	15,987	2,274	1,273	2,374	1,141	4,617	1,453	3,333	13,621	4,286	6,195	5,486	5,390		23,523	1,696	395	9,214	6,774	594		

(3) Kirama Oya Sub-scheme

1) Design irrigation area

Design irrigation area is 1,511 ha.

2) Design water source discharge

As in the case of the Urubokka sub-scheme, design water source discharge is calculated applying the catchment discharge for Muruthawela Reservoir, and adjusting the same by proportion of catchment area for the sub-scheme (1984~95, 11 years).

3) Design crops

Paddy (3.5 month variety) is the design crop given the soil conditions of the area.

4) Design irrigation period

Based on data obtained in the field, design irrigation period is to be as follows (see attached sheet).

Crop	Maha season	Yala season	Remarks
Paddy	135 days from September 15 (including 30 days of land preparation)	135 days from early March (including 30 days of land preparation)	3 step stagger (30%, 40% 30%)

5) Design irrigation requirement

Irrigation requirement for paddy (3.5 month variety) is shown in Table 6.4.3.2-7.

6) Design water balance calculation criteria

Design water balance was calculated according to the following criteria.

Item	Present	Design	Remarks
Conveyance efficiency (Ec)	40%	65%	Ec = 65%, from ID design criteria
Farm loss (Ea)	60%	60%	Ea = 60%, "
Repeating use of water	15% of field requirement	same as left	
Return flow	not considered	same as left	

7) Design water balance calculation

Results of design water balance calculation are summarized below. (refer to Table 6.4.3.2-8)

Unit: %

Calculation Period	1984/ 85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	Average
Maha	100	100	--	100	100	100	100	82	--	100	100	98
Yala	100	79	--	100	100	100	100	75	--	74	100	92

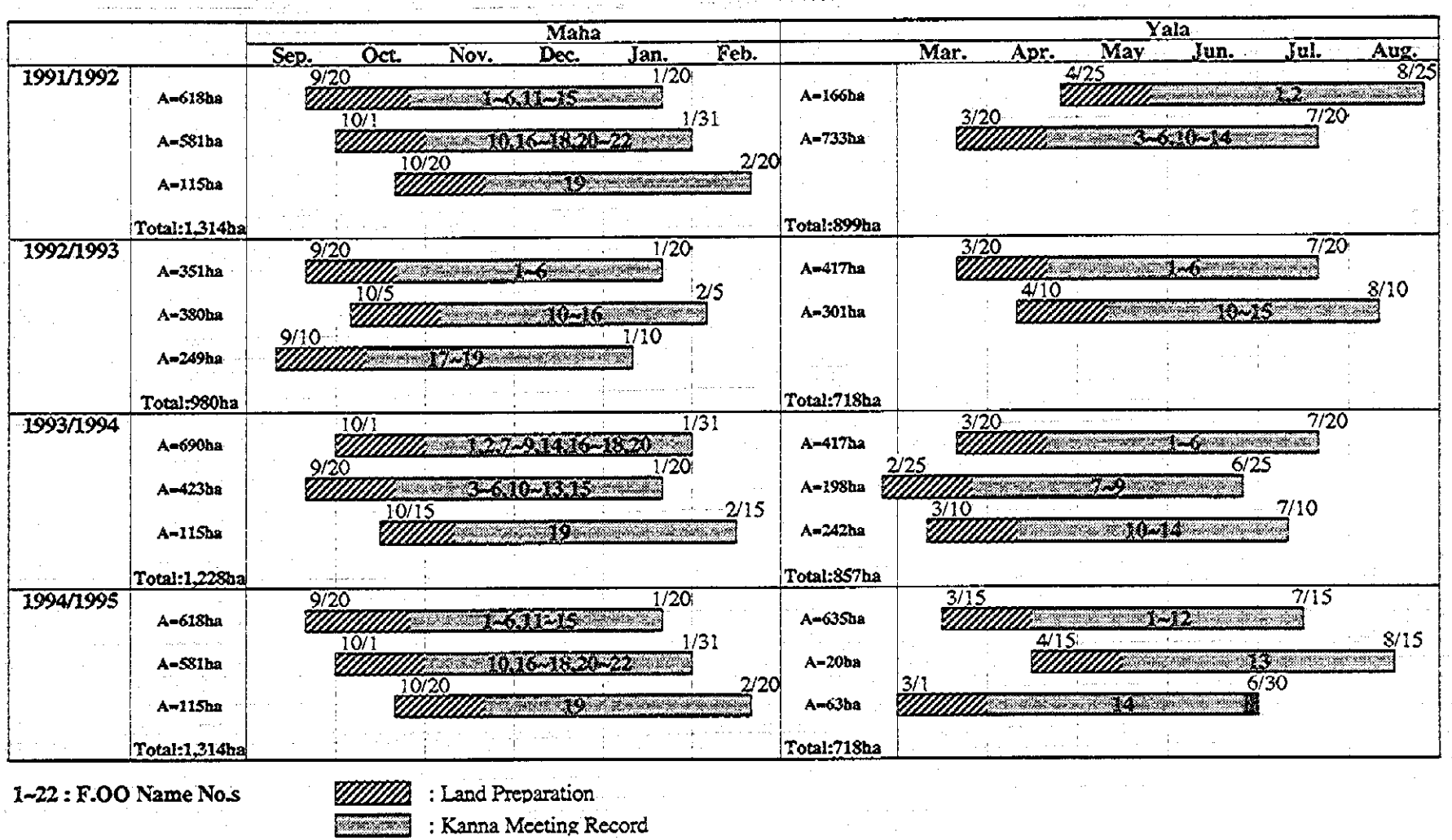
Comparison of the above with the present situation is shown below. Accordingly, the design area is irrigable.

	Present	Design irrigable area
Maha	1,239 ha (82%)	1,453 ha (95%)
Yala	982 ha (65%)	1,209 ha (80%)

Table 6.4.3.2-7 Design Water Requirement for Kirama Oya Sub-scheme (Paddy 3.5 month Variaty)

					Maha						Yala					
KC:			Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage and Crop Factors	1st Stagger	Uru-up	30%	30%		1.00	1.15	1.20	0.90		1.00	1.15	1.20	0.90		
	2nd Stagger	High Level	40%	40%		1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90	
	3rd Stagger	Uru-down	30%	30%			1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
ETo (Evapotranspiration of Reterence Crop)					5.14	4.81	3.82	3.96	4.13	4.21	4.88	4.32	5.18	5.06	5.14	5.95
1. LP	Ls				1.20						1.20					
		(4.0inch/5days)				1.60					1.60					
(Land Preparation)						1.20						1.20				
	Lt				0.90	1.35					2.25					
		(7.5inch/25days)				3.00					0.60	2.40				
						0.90	1.35					1.35	0.90			
	Total LP				2.10	8.05	1.35				5.65	4.95	0.90			
2. E					0.77	0.72					1.46					
(Evapo. during LP)						1.92					0.65	1.15				
(E=ETo)						0.72	0.57					0.86	0.52			
	Total Evapo				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Sd (Standing Water)		(3.0inch)				2.10	0.90				0.90	1.20	0.90			
4. ETc	ETc (S_1)					1.68	0.29	0.23	0.25			1.30	1.19	1.21		
Crop Water							1.10	1.19	1.12			0.50	0.62	1.37		
Requirement	ETc (S_2)						1.53	1.21	1.32			0.86	1.04	0.78	0.82	
							0.59	0.63	1.49				1.59	1.62	1.85	
(ETc=ETo x KC)	ETc (S_3)						0.86	0.30	0.24	0.25			1.55	1.75	1.85	1.61
								1.14	1.24	1.14						
	Total ETc				0.00	1.08	4.36	4.70	5.65	1.39		2.66	5.99	6.72	4.52	1.61
5. Farm Loss at ETc (Farm Loss + ETc)		Total ETc/60%			0.00	1.80	7.26	7.83	9.41	2.32	0.00	4.43	9.99	11.20	7.54	2.68
6. FWR (1+2+3+5)	Average	(inch/month)			2.10	11.95	9.51	7.83	9.41	2.32	6.55	10.58	11.79	11.20	7.54	2.68
Field Water		(mm/month)			53	304	242	199	239	59	166	269	299	285	191	68
Requirement		(mm/day)			1.78	10.12	8.05	6.63	7.97	1.96	5.55	8.96	9.98	9.48	6.38	2.27
	Peak	(mm/day)				14.48						14.17				

Total FWR = 2,374 mm



1~22 : F.OO Name No.s

: Land Preparation

: Kanna Meeting Record

Figure 6.4.3.2-3 Irrigation Period for Muruthawela Reservoir Scheme Kirama Oya Sub-scheme (1991/92 ~ 1994/95)

Table 6.4.3.2-8 Proposed Water Balance Study Kirama Oya Scheme(1984/85~1994/95)

Command Area = 1,511 ha | Proposed Cropping Area (Maha: 95%) A=1,435 ha (Yala : 80%) A=1,208 ha | Success Rate (Maha: 95%) (Yala : 93%)

	Calculation for Kirama Oya Flow			Rainfall		Field Water Requirement (FWR)	Field Irrigation Requirement (FIR)				Water Balance			
	Maruthawela Runoff	Kirama Inflow	Effective Flow		ER		FIR Paddy (Maha: 95%) (Yala : 80%)		Re-used Water	Actual Required FIR	Volume	Area	Success Area	Rate
	CA=45km2													
	(a)	(b)	(c)		(d)	(f)	(h)	(i)	(j)	(l)	(m)	(n)	(o)	(p)
	(m3/s/km2)	(ax45 km2, 000'm3)	(bx65%) (000'm3)	(mm)	(mm)	(mm)	(f-d) (mm)	(h x A) (000'm3)	(g x 15%) (000'm3)	(i-j) (000'm3)	(c-l) (000'm3)	(m / f) (ha)	(n+A) (ha)	(%)
1984/85 Sep	0.0123	1,432	931	84	40	53	14	188	115	73	857			
Oct	0.0136	1,586	1,031	119	63	304	241	3,284	654	2,631	-1,600			
Nov	0.0551	6,425	4,176	272	165	242	76	1,039	520	519	3,657			
Dec	0.0347	4,051	2,633	368	229	199	0	0	428	0	2,633			
Jan	0.0323	3,763	2,446	142	78	239	161	2,194	515	1,680	766			
Feb	0.0239	2,782	1,809	95	46	59	12	168	127	41	1,767			
Maha total		20,039	13,025	1,080	622	1,095	504	6,874	2,358	4,944	8,081	738	2,173	100%
Mar	0.0371	4,325	2,811	155	87	166	80	771	302	469	2,342			
Apr	0.0243	2,830	1,839	59	229	269	40	387	487	0	1,839			
May	0.0197	2,295	1,492	183	105	299	194	1,876	543	1,333	159			
Jun	0.0631	7,357	4,782	489	310	285	0	0	516	0	4,782			
Jul	0.0107	1,244	809	28	0	191	191	1,851	347	1,504	-695			
Aug	0.0071	829	539	8	0	68	68	657	123	534	5			
Yala total		18,880	12,272	921	731	1,278	573	5,543	2,317	3,841	8,432	660	1,868	100%
Total		38,919	25,298	2,001	1,353	2,374	1,078	12,416	4,675	8,785	16,513	1,532		
1985/86 Sep	0.0010	116	76	12	0	53	53	727	115	612	-537			
Oct	0.0273	3,187	2,072	212	125	304	179	2,435	654	1,781	290			
Nov	0.0301	3,506	2,279	122	65	242	177	2,414	520	1,893	385			
Dec	0.0391	4,555	2,961	338	209	199	0	0	428	0	2,961			
Jan	0.0212	2,475	1,609	174	99	239	140	1,906	515	1,391	218			
Feb	0.0143	1,666	1,083	60	0	59	59	802	127	675	408			
Maha total		15,507	10,079	917	498	1,095	608	8,283	2,358	6,353	3,726	340	1,775	100%
Mar	0.0157	1,829	1,189	158	89	166	77	748	302	447	743			
Apr	0.0183	2,138	1,389	238	229	269	40	387	487	0	1,389			
May	0.0010	116	76	0	0	299	299	2,894	543	2,351	-2,276			
Jun	0.0010	116	76	24	0	285	285	2,751	516	2,235	-2,159			
Jul	0.0010	116	76	48	0	191	191	1,851	347	1,504	-1,428			
Aug	0.0056	649	422	145	80	68	0	0	123	0	422			
Yala total		4,965	3,228	614	398	1,278	893	8,631	2,317	6,537	-3,309	-259	950	79%
Total		20,472	13,307	1,531	896	2,374	1,500	16,914	4,675	12,890	417	28		
1986/87 Sep	0.0047	543	353	552	353	53	0	0	115	0	353			
Oct	0.0085	993	645	114	60	304	244	3,326	654	2,673	-2,027			
Nov	0.0181	2,109	1,371	167	95	242	147	2,005	520	1,485	-115			
Dec	0.0111	1,299	844	50	0	199	199	2,712	428	2,284	-1,439			
Jan	0.0124	1,448	941	48	0	239	239	3,259	515	2,745	-1,804			
Feb	0.0063	736	479	81	37	59	21	291	127	165	314			
Maha total		7,127	4,632	1,012	545	1,095	850	11,594	2,358	9,351	-4,718	-431	1,004	70%
Mar	0.0181	2,115	1,375	89	43	166	124	1,197	302	895	479			
Apr	0.0383	4,465	2,902	53	229	269	40	387	487	0	2,902			
May	0.0228	2,659	1,728	39	0	299	299	2,894	543	2,351	-623			
Jun	0.0099	1,160	754	0	0	285	285	2,751	516	2,235	-1,481			
Jul	0.0051	597	388	501	319	191	0	0	347	0	388			
Aug	0.0240	2,803	1,822	173	99	68	0	0	123	0	1,822			
Yala total		13,799	8,970	854	688	1,278	748	7,229	2,317	5,482	3,488	273	1,481	100%
Total		20,926	13,602	1,866	1,233	2,374	1,598	18,823	4,675	14,833	-1,231	-77		
1987/88 Sep	0.0155	1,803	1,172	613	393	53	0	0	115	0	1,172			
Oct	0.0568	6,625	4,307	374	234	304	70	954	654	301	4,006			
Nov	0.0415	4,845	3,149	224	133	242	109	1,481	520	961	2,188			
Dec	0.0511	5,961	3,875	125	66	199	133	1,807	428	1,379	2,496			
Jan	0.0095	1,108	720	12	0	239	239	3,259	515	2,745	-2,025			
Feb	0.0133	1,553	1,009	67	28	59	31	425	127	299	710			
Maha total		21,896	14,233	1,414	854	1,095	581	7,927	2,358	5,684	8,549	780	2,215	100%
Mar	0.0337	3,925	2,551	110	57	166	110	1,061	302	759	1,792			
Apr	0.0425	4,962	3,225	173	229	269	40	387	487	0	3,225			
May	0.0160	1,871	1,216	119	63	299	237	2,287	543	1,744	-528			
Jun	0.0183	2,133	1,386	67	28	285	257	2,484	516	1,968	-582			
Jul	0.0075	877	570	85	40	191	151	1,463	347	1,116	-546			
Aug	0.0042	492	320	163	92	68	0	0	123	0	320			
Yala total		14,260	9,269	717	508	1,278	795	7,683	2,317	5,588	3,681	288	1,496	100%
Total		36,156	23,502	2,130	1,362	2,374	1,376	15,609	4,675	11,272	12,230	889		
1988/89 Sep	0.0180	2,101	1,365	199	116	53	0	0	115	0	1,365			
Oct	0.0052	611	397	148	82	304	221	3,017	654	2,363	-1,966			
Nov	0.0679	7,925	5,151	250	150	242	91	1,243	520	723	4,429			
Dec	0.0207	2,418	1,572	43	0	199	199	2,712	428	2,284	-712			
Jan	0.0031	366	238	87	41	239	198	2,700	515	2,186	-1,948			
Feb	0.0010	116	76	0	0	59	59	802	127	675	-599			
Maha total		13,537	8,799	727	390	1,095	768	10,473	2,358	8,230	569	52	1,487	100%
Mar	0.0243	2,836	1,843	116	61	166	106	1,021	302	719	1,124			
Apr	0.0040	462	301	0	229	269	40	387	487	0	301			
May	0.0010	116	76	116	60	299	239	2,310	543	1,768	-1,692			
Jun	0.0116	1,348	876	52	0	285	285	2,751	516	2,235	-1,358			
Jul	0.0235	2,741	1,782	171	98	191	94	907	347	560	1,222			
Aug	0.0108	1,262	820	259	157	68	0	0	123	0	820			
Yala total		8,765	5,697	714	604	1,278	763	7,376	2,317	5,282	416	33	1,241	100%
Total		22,303	14,497	1,442	994	2,374	1,531	17,849	4,675	13,512	985	64		
1989/90 Sep	0.0036	418	272	308	189	53	0	0	115	0	272			
Oct	0.0135	1,570	1,020	268	162	304	141	1,928	654	1,274	-254			
Nov	0.0446	5,205	3,383	966	630	242	0	0	520	0	3,383			
Dec	0.0135	1,572	1,022	0	0	199	199	2,712	428	2,284	-1,262			
Jan	0.0091	1,058	688	0	0	239	239	3,259	515	2,745	-2,057			
Feb	0.0162	1,885	1,225	288	176	59	0	0	127	0	1,225			
Maha total		11,707	7,610	1,829	1,157	1,095	579	7,899	2,358	6,303	1,307	119	1,554	100%
Mar	0.0330	3,854	2,505	124	66	166	100	967	302	666	1,840			
Apr	0.0152	1,776	1,154	107	229	269	40	387	487	0	1,154			
May	0.0272	3,178	2,066	382	239	299	60	584	543	41	2,025			
Jun	0.0104	1,213	788	100	50	285	235	2,267	516	1,752	-964			
Jul	0.0056	649	422	500	318	191	0	0	347	0	422			
Aug	0.0023	847	551	102	51	68	17	164	123	41	510			
Yala total		11,517	7,486	1,315	953	1,278	452	4,370	2,317	2,499	4,987	390	1,598	100%
Total		23,224	15,096	3,144	2,111	2,374	1,031	12,269	4,675	8,802	6,294	610		

Table 6.4.3.2-8 Proposed Water Balance Study Kirama Oya Scheme(1984/85~1994/95)

Command Area = 1,511 ha Proposed Cropping Area (Maha: 95%) (Yala : 80%) A=1,435 ha A=1,208 ha Success Rate (Maha: 95%) (Yala : 93%)

	Calculation for Kirama Oya Flow			Rainfall		Field Water Requirement (FWR)	Field Irrigation Requirement (FIR)				Water Balance			
	Muruthawela Runoff	Kirama Inflow	Effective Flow		ER		FIR Paddy (Maha: 95%) (Yala : 80%)		Re-used Water	Actual Required FIR	Volume	Area	Success Area	Rate
	CA=45km2 (a) (m3/s/km2)	(b) (ax45 km2 (000'm3)	(c) (bx65%) (000'm3)	(mm)	(d) (mm)	(f) (mm)	(h) (f-d) (mm)	(i) (h x A) (000'm3)	(j) (g x 15%) (000'm3)	(l) (i-j) (000'm3)	(m) (c-l) (000'm3)	(n) (m / f) (ha)	(o) (n > A) (ha)	(p) (%)
1990/91 Sep	0.0078	909	591	56	0	53	53	727	115	612	-21			
Oct	0.0299	3,483	2,264	116	61	304	243	3,313	654	2,659	-395			
Nov	0.1074	12,525	8,141	182	105	242	137	1,865	520	1,345	6,797			
Dec	0.0384	4,483	2,914	76	34	199	165	2,248	428	1,820	1,094			
Jan	0.0116	1,355	881	53	0	239	239	3,259	515	2,745	-1,864			
Feb	0.0090	1,046	680	44	0	59	59	802	127	675	5			
Maha total		23,801	15,471	527	200	1,095	896	12,213	2,358	9,855	5,615	513	1,948	100%
Mar	0.0052	602	391	19	0	166	166	1,608	302	1,307	-915			
Apr	0.0268	3,122	2,029	35	229	269	40	387	487	0	2,029			
May	0.0105	1,224	796	32	0	299	299	2,894	543	2,351	-1,556			
Jun	0.0335	3,913	2,544	111	57	285	228	2,199	516	1,684	860			
Jul	0.0110	1,284	835	79	36	191	156	1,507	347	1,160	-325			
Aug	0.0097	1,130	734	98	48	68	20	189	123	66	668			
Yala total		11,276	7,329	372	370	1,278	909	8,785	2,317	6,568	761	60	1,268	100%
Total		35,077	22,800	900	569	2,374	1,805	20,999	4,675	16,423	6,377	353		
1991/92 Sep	0.0010	116	76	53	0	53	53	727	115	612	-537			
Oct	0.0213	2,484	1,614	308	190	304	114	1,554	654	901	714			
Nov	0.0388	4,527	2,943	147	81	242	160	2,185	520	1,665	1,277			
Dec	0.0094	1,100	715	37	0	199	199	2,712	428	2,284	-1,569			
Jan	0.0047	551	358	0	0	239	239	3,259	515	2,745	-2,386			
Feb	0.0036	422	274	0	0	59	59	802	127	675	-401			
Maha total		9,200	5,980	545	271	1,095	824	11,240	2,358	8,882	-2,902	-265	1,170	82%
Mar	0.0010	116	76	0	0	166	166	1,608	302	1,307	-1,231			
Apr	0.0034	391	254	469	229	269	40	387	487	0	254			
May	0.0168	1,963	1,276	57	0	299	299	2,894	543	2,351	-1,075			
Jun	0.0083	968	629	103	52	285	232	2,247	516	1,731	-1,102			
Jul	0.0061	711	462	147	81	191	110	1,065	347	718	-256			
Aug	0.0018	214	139	36	0	68	68	657	123	534	-395			
Yala total		4,364	2,837	812	362	1,278	916	8,859	2,317	6,642	-3,805	-298	911	75%
Total		13,563	8,816	1,357	633	2,374	1,741	20,099	4,675	15,523	-6,707	-385		
1992/93 Sep	0.0130	1,513	984	103	52	53	1	16	115	0	984			
Oct	0.0131	1,531	995	172	98	304	205	2,796	654	2,143	-1,148			
Nov	0.0539	6,283	4,084	163	92	242	150	2,042	520	1,522	2,563			
Dec	0.0199	2,322	1,509	26	0	199	199	2,712	428	2,284	-774			
Jan	0.0010	116	76	0	0	239	239	3,259	515	2,745	-2,669			
Feb	0.0113	1,319	857	50	0	59	59	802	127	675	182			
Maha total		13,085	8,505	515	243	1,095	853	11,627	2,358	9,368	-863	-79	1,356	95%
Mar	0.0171	2,000	1,300	0	0	166	166	1,608	302	1,307	-7			
Apr	0.0102	1,186	771	150	83	269	185	1,790	487	1,303	-533			
May	0.0614	7,161	4,655	100	50	299	249	2,411	543	1,868	2,786			
Jun	0.0416	4,853	3,154	130	70	285	215	2,076	516	1,561	1,594			
Jul	0.0344	4,013	2,609	82	38	191	154	1,484	347	1,137	1,471			
Aug	0.0059	683	444	0	0	68	68	657	123	534	-90			
Yala total		19,896	12,932	462	241	1,278	1,037	10,028	2,317	7,711	5,222	408	1,617	100%
Total		32,981	21,437	976	484	2,374	1,890	21,655	4,675	17,079	4,359	231		
1993/94 Sep	0.0050	585	381	4	0	53	53	727	115	612	-232			
Oct	0.0416	4,855	3,156	468	229	304	75	1,023	654	369	2,787			
Nov	0.0753	8,778	5,706	301	185	242	57	777	520	257	5,449			
Dec	0.0132	1,536	998	339	210	199	0	0	428	0	998			
Jan	0.0275	3,209	2,086	0	0	239	239	3,259	515	2,745	-659			
Feb	0.0199	2,322	1,509	0	0	59	59	802	127	675	834			
Maha total		21,286	13,836	1,111	623	1,095	483	6,588	2,358	4,658	9,178	838	2,273	100%
Mar	0.0102	1,196	777	0	0	166	166	1,608	302	1,307	-530			
Apr	0.0113	1,317	856	107	55	269	214	2,069	487	1,582	-726			
May	0.0098	1,142	742	21	0	299	299	2,894	543	2,351	-1,609			
Jun	0.0023	265	173	100	50	285	235	2,267	516	1,752	-1,579			
Jul	0.0061	716	465	158	89	191	103	992	347	645	-180			
Aug	0.0088	1,025	666	99	49	68	19	181	123	57	609			
Yala total		5,661	3,680	485	243	1,278	1,036	10,012	2,317	7,694	-4,015	-314	894	74%
Total		26,947	17,515	1,596	866	2,374	1,519	16,600	4,675	12,353	5,163	340		
1994/95 Sep	0.0147	1,714	1,114	164	93	53	0	0	115	0	1,114			
Oct	0.0273	3,182	2,068	232	138	304	165	2,254	654	1,600	468			
Nov	0.0779	9,091	5,909	380	229	242	13	178	520	0	5,909			
Dec	0.0473	5,516	3,585	202	119	199	80	1,096	428	668	2,917			
Jan	0.0250	2,918	1,896	242	145	239	94	1,281	515	766	1,130			
Feb	0.0119	1,391	904	103	52	59	7	90	127	0	904			
Maha total		23,812	15,478	1,323	776	1,095	359	4,899	2,358	3,035	12,443	1,136	2,571	100%
Mar	0.0082	955	621	56	0	166	166	1,608	302	1,307	-686			
Apr	0.0357	4,168	2,709	366	228	269	40	391	487	0	2,709			
May	0.0562	6,557	4,262	125	67	299	233	2,249	543	1,706	2,556			
Jun	0.0292	3,408	2,215	230	137	285	147	1,425	516	909	1,306			
Jul	0.0069	807	524	52	0	191	191	1,851	347	1,504	-980			
Aug	0.0086	1,007	655	123	65	68	3	29	123	0	655			
Yala total		16,901	10,986	951	497	1,278	781	7,553	2,317	5,426	5,559	435	1,643	100%
Total		40,713	26,464	2,274	1,273	2,374	1,141	12,452	4,675	8,461	18,003	1,578		

6.4.3.3 Water Requirement Plan for Badagiriya Scheme

(1) Water source plan

Water source is via Badagiriya tank and feeder canal. Observation data applied to the water source plan are as follows.

Badagiriya tank water level and discharge records: 1984/85~1995/96 (11 years)
Feeder canal supplemental discharge: November 1993 ~ February 1996

(2) Design irrigated area

Design irrigated area is 686 ha.

(3) Design crops

Paddy, OFCs and banana are the design crops given the soil conditions of the area.

(4) Design irrigation period

The following design irrigation period is planned given the discharge performance from the tank.

Crop	Maha season	Yala season	Remarks
Paddy	135 days from October 15 (including 30 days of land preparation)	135 days from April 1 (including 30 days of land preparation)	3 step stagger (30%, 40% 30%)
OFC	same as above	same as above	same as above
Banana	throughout the year		to start in October

(5) Design irrigation requirement

Irrigation requirements for paddy (3.5 month variety), OFC (ground nuts applied to water requirement calculation), and banana (value for Uda Walawe area applied) are given in Table 6.4.3.3-1 ~ 6.4.3.3-3.

(6) Cropping ratios for design crops

Results of present water balance calculation indicate a water shortage in the area. Design cropping areas are as per below based on the cropping pattern under the farm management plan.

Unit: ha

Design crop	Maha	Yala	Total
Paddy	617 (90%)	343 (50%)	960
OFC	0	69 (10%)	69
Banana	69 (10%)	69 (10%)	138

(7) Irrigation efficiency

Irrigation efficiency (Ec, Ea) are as follows with consideration to the effect of canal rehabilitation.

Item	Present	Design	Remarks
Conveyance efficiency (Ec)	50%	65%	Ec = 65%, from ID design criteria
Farm loss (Ea)	60%	60%	Ea = 60%, from ID design criteria

(8) Design water balance calculation

Results of design water balance calculation are summarized below. (refer to Table 6.4.3.3-4)

Unit: %

Calculation Period	1984/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	Average
Maha	100	100	-	88	-	-	100	70	100	100	92	93
Yala	100	75	-	87	90	100	100	-	-	98	81	91

On the basis of the above, irrigation success rates are calculated at 93% in the Maha season and 91% in the Yala season for the design cropping ratios.

Table 6.4.3.3-1 Design Water Requirement for Badagiriya Scheme (Paddy 3.5 month Variaty)

					Maha						Yala					
KC:			Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage and Crop Factors	1st Stagger	GR-1,2,3	30%	30%			1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
	2nd Stagger	GR-4	40%	40%			1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
	3rd Stagger	GR-5,6,7	30%	30%			1.00	1.15	1.20	0.90			1.00	1.15	1.20	0.90
ETo (Evapotranspiration of Reterence Crop)					4.93	4.63	3.72	3.72	4.30	4.19	4.64	4.69	4.96	5.18	5.28	5.36
1. LP (Land Preparation)	Ls	(4.0inch/5days)				1.20	1.60 1.20					1.20 1.60	1.20			
	Lt	(7.5inch/25days)				0.90	1.35 3.00 0.90	1.35				2.25 1.20	1.80 2.25			
	Total LP				0.00	2.10	8.05	1.35			0.00	6.25	5.25			
2. E (Evapo. during LP) (E=ETo)						0.69	0.56 1.49 0.56	0.56				1.41 0.94	0.99 1.49			
	Total Evapo				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Sd (Standing Water)		(3.0inch)					2.10	0.90				0.90	2.10			
4. ETc Crop Water Requirement (ETc=ETo x KC)	ETc (S_1)						0.84	0.28 1.07	0.25 1.29	0.25 1.13			1.49 0.57	1.19 0.62	1.27 1.43	
	ETc (S_2)							1.49 0.57	1.32 0.69	1.34 1.51			1.49	0.52 1.99	0.40 2.11	0.43 1.93
	ETc (S_3)							0.84	0.32 1.24	0.24 1.26	0.28 1.25			1.55 0.60	1.21 0.63	1.29 1.45
	Total ETc				0.00	0.00	0.84	4.24	5.10	5.73	1.53	0.00	3.55	6.47	7.06	5.09
5. Farm Loss at ETc (Farm Loss = ETc)		Total ETc/60%			0.00	0.00	1.40	7.07	8.50	9.55	2.55	0.00	5.91	10.78	11.76	8.49
6. FWR (1+2+3+5) Field Water Requirement	Average	(inch/month)			0.00	2.10	11.55	9.32	8.50	9.55	2.55	7.15	13.26	10.78	11.76	8.49
		(mm/month)			0	53	293	237	216	243	65	182	337	274	299	216
		(mm/day)			0.00	1.78	9.77	7.89	7.20	8.09	2.16	6.05	11.23	9.12	9.96	7.19
	Peak	(mm/day)					13.79						13.47			

Total FWR = 2,413 mm

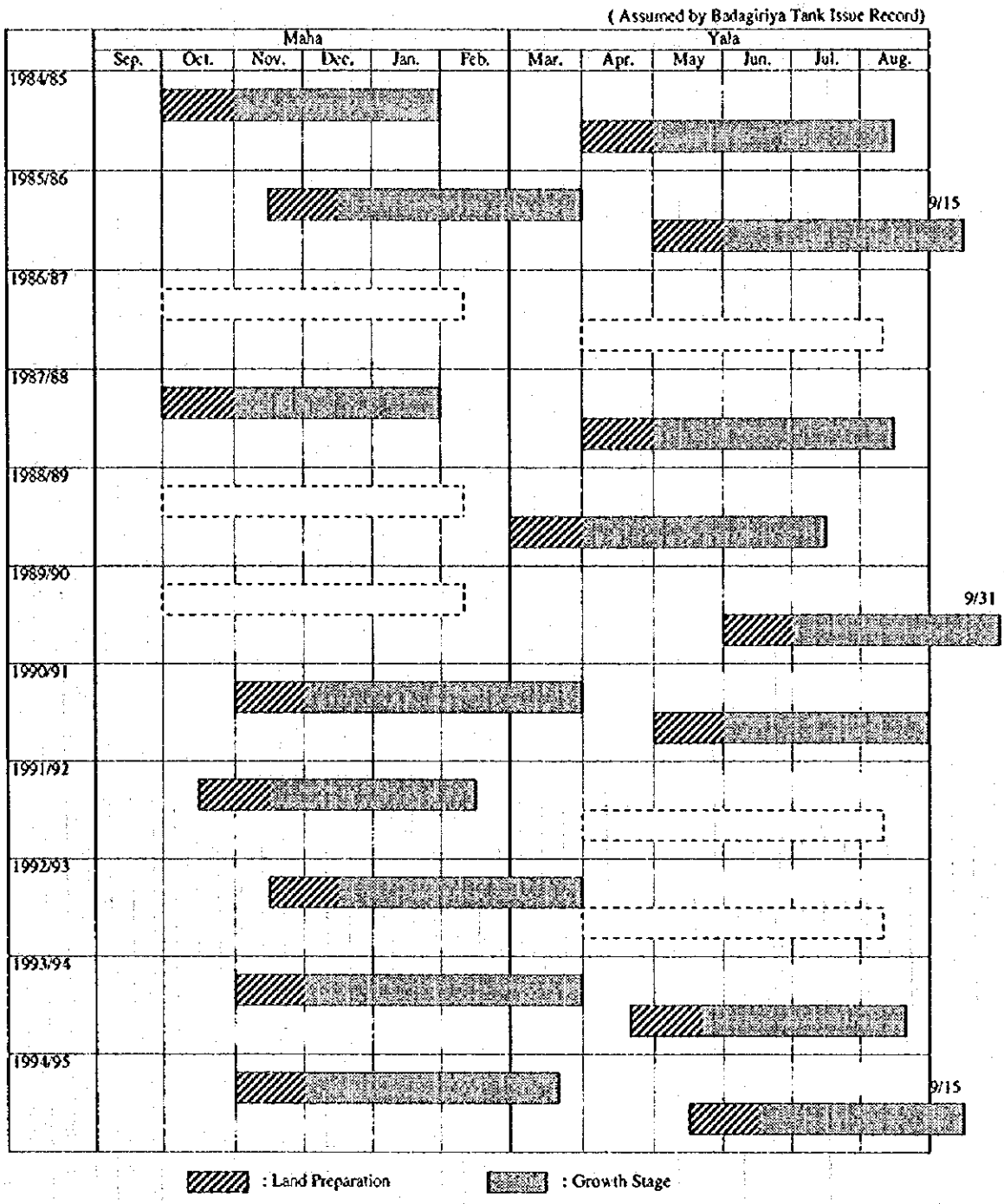


Figure 6.4.3.3-1 Irrigation Period for Badagiriya Scheme (1984/85~1994/95)

Table 6.4.3.3-2 Design Water Requirement for Badagiriya Scheme (OFC)

					Maha						Yala					
KC:		Maha	Yala	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage	1st Stagger	30%	30%			0.65	0.80	1.00	0.80		0.65	0.80	1.00	0.80	
and Crop Factors	2nd Stagger	40%	40%			0.65	0.80	1.00	0.80		0.65	0.80	1.00	0.80	
	3rd Stagger	30%	30%			0.65	0.80	1.00	0.80		0.65	0.80	1.00	0.80	
ETo (Evapotranspiration of Reterence Crop)				4.93	4.63	3.72	3.72	4.30	4.19	4.64	4.69	4.96	5.18	5.28	5.36
1. LP (Land Preparation)	(1.5inch/15days)				0.45	0.60 0.45				0.15	0.30 0.60 0.15	0.30			
	Total LP			0.00	0.45	1.05	0.00			0.15	1.05	0.30			
2. ETc Crop Water Requirement	ETc (S_1)					0.73 0.30	0.60 0.28	0.97	1.01		0.91	1.59	1.17	0.40 1.27	
	ETc (S_2)					0.73	0.24 0.99	0.23 1.08	0.63 1.01	0.37	0.30	0.97 0.79	0.83 0.78	1.32 0.42	1.29
(ETc=ETo x KC)	ETc (S_3)						0.48 0.30	0.69 0.32	0.94	1.11		0.97	1.24	1.19	0.40 1.29
	Total ETc			0.00	0.00	1.75	2.89	3.28	3.58	1.48	1.22	4.32	4.01	4.59	2.97
3. Farm Loss at ETc (Farm Loss + ETc)	Total ETc/60%			0.00	0.00	2.91	4.82	5.47	5.97	2.47	2.03	7.19	6.69	7.66	4.96
4. FWR (1+2+3) Field Water Requirement	Average	(inch/month)		0.00	0.45	3.96	4.82	5.47	5.97	2.62	3.08	7.49	6.69	7.66	4.96
		(mm/month)		0	11	101	122	139	152	67	78	190	170	194	126
		(mm/day)		0.00	0.38	3.36	4.08	4.63	5.06	2.22	2.61	6.34	5.66	6.48	4.20
	Peak	(mm/day)													

Total FWR = 1,351 mm

Table 6.4.3.3-3 Design Water Requirement for Badagiriya Scheme (Banana)

				Maha						Yala					
KC:				SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Grouwth Stage	1st Stagger		30%	1.00	0.80	0.75	0.70	0.70	0.75	0.90	1.05	1.05	1.05	1.00	1.00
and Crop Factors	2nd Stagger		40%	1.00	1.00	0.80	0.75	0.70	0.70	0.75	0.90	1.05	1.05	1.05	1.00
	3rd Stagger		30%	1.00	1.00	1.00	0.80	0.75	0.70	0.70	0.75	0.90	1.05	1.05	1.05
ETo (Evapotranspiration of Reterence Crop)				4.93	4.63	3.72	3.72	4.30	4.19	4.64	4.69	4.96	5.18	5.28	5.36
1. ETc	ETc (S_1)			1.48	1.11	0.84	0.78	0.90	0.94	1.25	1.48	1.56	1.63	1.58	1.61
Crop Water Requirement	ETc (S_2)			1.97	1.85	1.19	1.12	1.20	1.17	1.39	1.69	2.08	2.18	2.22	2.14
	ETc (S_3)			1.48	1.39	1.12	0.89	0.97	0.88	0.97	1.06	1.34	1.63	1.66	1.69
(ETc=ETo x KC)	Total ETc			4.93	4.35	3.14	2.79	3.07	3.00	3.62	4.22	4.98	5.44	5.46	5.44
2. Farm Loss at ETc															
(Farm Loss + ETc)	Total ETc/60%			8.22	7.25	5.24	4.65	5.12	4.99	6.03	7.04	8.31	9.07	9.11	9.07
3. FWR	Average	(inch/month)		8.22	7.25	5.24	4.65	5.12	4.99	6.03	7.04	8.31	9.07	9.11	9.07
Field Water		(mm/month)		209	184	133	118	130	127	153	179	211	230	231	230
Requirement		(mm/day)		6.96	6.14	4.44	3.94	4.34	4.23	5.11	5.96	7.03	7.68	7.71	7.68
	Peak	(mm/day)													

Total FWR = 2,136 mm

Table 6.4.3.3-4 Proposed Water Balance Study in Badagiriya Scheme(1984~1995)

Command Area = 686 ha

Success Rate (Maha: 93%) (Yala : 91%)

	Badagiriya Tank Issue Records					Rainfall		Unit FWR			Unit FIR			Field Irrigation Requirement (FIR)				Water Balance			
	Tank Issue (at Shike)	Feeder Canal	Total Issue			(at Badagiriya ER		Paddy	OFC	Banana	Paddy	OFC	Banana		Paddy	OFC	Banana	Total	Volume	Area	Success Area	Success Rate
														Maha	(90%)	(0%)	(10%)					
														Yala	(50%)	(10%)	(10%)					
	(a)	(b)	(c) (a+b)	(d)	(e) (d×65%)		(f)	(g)	(h)	(i)	(j) (g-f)	(k) (h-f)	(l) (i-f)		(m) (h x A)	(n) (k x A)	(o) (l x A)	(p) (m+n+o)	(q) (c-p)	(r) (p / q)	(s)	(t)
	(Ac-ft)	(Ac-ft)	(Ac-ft)	(1000m3)	(1000m3)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		(1000m3)	(1000m3)	(1000m3)	(1000m3)	(1000m3)	(ha)	(ha)	(%)
1984/85 Sep	0	0	0	0	0	27	0	0	0	209	0	0	209		0	0	143	143	-143			
Oct	1,350	0	1,350	1,666	1,083	173	99	53	11	184	0	0	85		0	0	59	59	1,024			
Nov	840	0	840	1,037	674	147	81	293	101	133	242	49	52		1,307	0	35	1,343	-669			
Dec	2,360	0	2,360	2,912	1,893	148	82	237	122	118	155	40	36		955	0	25	980	913			
Jan	2,160	0	2,160	2,665	1,733	161	91	216	139	130	125	48	39		773	0	27	800	933			
Feb	0	0	0	0	0	251	151	243	152	127	91	1	0		564	0	0	564	-564			
Maha total	6,710	0	6,710	8,280	5,382	907	505	1,042	525	901	583	108	421		3,599	0	289	3,888	1,494	143	829	100%
Mar	0	0	0	0	0	27	0	65	67	153	65	67	153		222	46	105	373	-373			
Apr	1,400	0	1,400	1,839	1,195	173	99	182	78	179	83	0	80		284	0	55	338	857			
May	1,400	0	1,400	1,728	1,123	147	81	337	190	211	255	109	130		876	75	89	1,039	84			
Jun	465	0	465	574	373	148	82	274	170	230	192	88	148		657	60	102	819	-446			
Jul	1,420	0	1,420	1,752	1,139	161	91	299	194	231	208	104	140		713	71	96	881	258			
Aug	730	0	730	901	586	251	151	216	126	230	64	0	79		221	0	54	275	310			
Yala total	5,505	0	5,505	6,793	4,416	907	505	1,371	826	1,235	867	367	730		2,973	252	501	3,726	690	50	530	100%
Total	12,215	0	12,215	15,073	9,798	1,814	1,009	2,413	1,351	2,136	1,450	475	1,151		6,573	252	790	7,614	2,184			
1985/86 Sep	0	0	0	0	0	39	0	0	0	209	0	0	209		0	0	143	143	-143			
Oct	0	0	0	0	0	156	88	53	11	184	0	0	97		0	0	66	66	-66			
Nov	665	0	665	821	533	237	142	293	101	133	151	0	0		935	0	0	935	-402			
Dec	1,180	0	1,180	1,456	946	31	0	237	122	118	237	122	118		1,462	0	81	1,543	-597			
Jan	3,100	0	3,100	3,825	2,487	38	0	216	139	130	216	139	130		1,334	0	89	1,423	1,064			
Feb	1,885	0	1,885	2,326	1,512	82	38	243	152	127	205	114	89		1,263	0	61	1,324	188			
Maha total	6,830	0	6,830	8,428	5,478	583	267	1,042	525	901	809	375	643		4,994	0	441	5,435	43	4	690	100%
Mar	1,065	0	1,065	1,314	854	139	76	65	67	153	0	0	77		0	0	53	53	801			
Apr	0	0	0	0	0	68	29	182	78	179	153	50	150		525	34	103	662	-662			
May	1,100	0	1,100	1,357	882	32	0	337	190	211	337	190	211		1,455	131	145	1,431	-548			
Jun	1,155	0	1,155	1,425	926	77	35	274	170	230	239	135	196		820	93	134	1,047	-121			
Jul	410	0	410	506	329	9	0	299	194	231	299	194	231		1,025	133	159	1,317	-988			
Aug	1,065	0	1,065	1,339	870	4	0	216	126	230	216	126	230		739	86	158	984	-113			
Yala total	4,815	0	4,815	5,942	3,862	329	139	1,371	826	1,235	1,243	696	1,096		4,265	477	752	5,494	-1,632	-119	361	75%
Total	11,645	0	11,645	14,370	9,340	912	406	2,413	1,351	2,136	2,052	1,071	1,738		9,259	477	1,192	10,929	-1,588			
1986/87 Sep	875	0	875	1,080	702	80	37	0	0	209	0	0	172		0	0	118	118	584			
Oct	0	0	0	0	0	61	0	53	11	184	53	11	184		329	0	126	456	-456			
Nov	0	0	0	0	0	60	0	293	101	133	293	101	133		1,810	0	91	1,902	-1,902			
Dec	0	0	0	0	0	71	30	237	122	118	206	92	88		1,275	0	60	1,335	-1,335			
Jan	50	0	50	62	40	21	0	216	139	130	216	139	130		1,334	0	89	1,423	-1,383			
Feb	0	0	0	0	0	71	30	243	152	127	212	121	96		1,310	0	66	1,376	-1,376		(not Issued)	
Maha total	925	0	925	1,141	742	364	97	1,042	525	901	981	464	804		6,058	0	551	6,609	-5,867	-563	123	18%
Mar	20	0	20	25	16	89	43	65	67	153	22	24	111		76	17	76	169	-153			
Apr	30	0	30	37	24	45	0	182	78	179	182	78	179		623	54	123	799	-775			
May	80	0	80	99	64	0	0	337	190	211	337	190	211		1,155	131	145	1,431	-1,366			
Jun	0	0	0	0	0	0	0	274	170	230	274	170	230		939	117	158	1,213	-1,213			
Jul	60	0	60	74	48	9	0	299	194	231	299	194	231		1,025	133	159	1,317	-1,269			
Aug	110	0	110	136	88	32	0	216	126	230	216	126	230		739	86	158	984	-896		(not Issued)	
Yala total	300	0	300	370	241	175	43	1,371	826	1,235	1,329	783	1,192		4,558	537	818	5,913	-5,672	-414	67	14%
Total	1,225	0	1,225	1,512	983	539	140	2,413	1,351	2,136	2,310	1,247	1,996		10,616	537	1,369	12,522	-11,539			
1987/88 Sep	45	0	45	56	36	289	177	0	0	209	0	0	32		0	0	22	22	14			
Oct	1,350	0	1,350	1,666	1,083	0	0	53	11	184	53	11	184		329	0	126	456	627			
Nov	840	0	840	1,037	674	0	0	293	101	133	293	101	133		1,810	0	91	1,902	-1,228			
Dec	2,360	0	2,360	2,912	1,893	0	0	237	122	118	237	122	118		1,462	0	81	1,543	350			
Jan	2,160	0	2,160	2,665	1,733	161	91	216	139	130	125	48	39		773	0	27	800	933			
Feb	0	0	0	0	0	32	0	243	152	127	243	152	127		1,498	0	87	1,585	-1,585			
Maha total	6,755	0	6,755	8,336	5,418	482	268	1,042	525	901	951	434	634		5,872	0	435	6,307	889	-85	601	88%
Mar	0	0	0	0	0	42	0	65	67	153	65	67	153		222	46	105	373	-373			
Apr	1,400	0	1,400	1,839	1,195	103	52	182	78	179	130	26	127		445	18	87	550	646			
May	1,400	0	1,400	1,728	1,123	158	89	337	190	211	248	101	122		851	70	84	1,004	119			
Jun	465	0	465	574	373	16	0	274	170	230	274	170	230		939	117	158	1,213	-840			
Jul	1,420	0	1,420	1,752	1,139	27	0	299	194	231	299	194	231		1,025	133	159	1,317	-178			
Aug	730	0	730	901	586	77	35	216	126	230	181	91	196		621	63	134	818	-232			
Yala total	5,505	0	5,505	6,793	4,416	423	175	1,371	826	1,235	1,196	650	1,059		4,102	416	727	5,275	-859	-63	418	87%
Total	12,260	0	12,260	15,129	9,834	905	443	2,413	1,351	2,136	2,147	1,084	1,693		9,974	416	1,161	11,582	-1,748			
1988/89 Sep	0	0	0	0	0	116	61	0	0	209	0	0	148		0	0	101	101	-101			
Oct	0	0	0	0	0	201	118	53	11	184	0	0	67		0	0	46	46	-46			
Nov	0	0	0	0	0	112	58	293	101	133	235	43	75		1,454	0	52	1,506	-1,506			
Dec	0	0	0	0	0	0	0	237	122	118	237	122	118		1,462	0	81	1,543	-1,543			
Jan	40	0	40	49	32	43	0	216	139	130	216	139	130		1,334	0	89	1,423	-1,391			
Feb	120	0	120	148	96	58	0	243	152	127	243	152	127		1,498	0	87	1,585	-1,488		(not Issued)	
Maha total	160	0	160	197	128	529	236	1,042	525	901	931	456	665		5,747	0	456	6,203	-6,075	-583	103	15%
Mar	3,070	0	3,070	3,788	2,462	41	0	65	67	153	65	67	153		222	46	105	373	2,089			
Apr	1,390	0	1,390	1,715	1,115	37	0	182	78	179	182	78	179		623	54	123	799	316			
May	1,040	0	1,040	1,283	834	11	0	337	190	211	337	190	211		1,155	131	145	1,431	-596			
Jun	490	0	490	605	393	95	47	274	170	230	227	123	183		778	84	126	988	-595			
Jul	315	0	315	389	253	1	0	299	194	231	299	194	231		1,025	133	159	1,317	-1,064			
Aug	200	0	200	247	160	0	0	216	126	230	216	126	230		739	86	158	984	-823			
Yala total	6,505	0	6,505	8,027	5,218	185	47	1,371	826	1,235	1,324	779	1,188		4,543	534	815	5,892	-674	-49	431	90%
Total	6,665	0	6,665	8,225	5,346	714	283	2,413	1,351	2,136	2,255	1,235	1,853		10,290	534	1,271	12,095	-6,749			
1989/90 Sep	80	0	80	99	64	70	30	0	0	209	0	0	179		0	0	123	123	-59			
Oct	0	0	0	0	0	184	106	53	11	184	0	0	78		0	0	53	53	-53			
Nov	0	0	0	0	0	0	0	293	101	133	293	101	133		1,810	0	91	1,902	-1,902			
Dec	60	0	60	74	48	72	31	237	122	118	206	93	87		1,271	0	60	1,331	-1,283			
Jan	0	0	0	0	0	0	0	216	139	130	216	139	130		1,334	0	89	1,423	-1,423			
Feb	0	0	0	0	0	39	0	243	152	127	243	152	127		1,498	0	87	1,585	-1,585		(not Issued)	
Maha total	140	0	140	173	112	365	167	1,042	525	901	958	493	734		5,913	0	504	6,416	-6,304	-605	81	12%
Mar	0	0	0	0	0	102	51	65	67	153	14	16	102		47	11	70	128	-128			
Apr	0	0	0	0	0	67	28	182	78	179	154	51	151		528	35	104	667	-667			
May	0	0	0	0	0	11	0	337	190	211	337	190	211		1,155	131	145	1,431	-1,431			
Jun	2,161	0	2,161	2,666	1,733	0	0	274	170	230	274	170	230		939	117	158	1,213	520			
Jul	2,045	0	2,045	2,523	1,640	0	0	299	194	231	299	194	231		1,025	133	159	1,317	323			
Aug	2,941	0	2,941	3,629	2,359	65	27	216	126	230	189	99	204		648	68	140	856	1,503			
Yala total	7,146	0	7,146	8,818	5,732	244	105	1,371	826	1,235	1,266	720	1,130		4,342	464	775	5,581	120	9	489	100%
Total	7,286	0	7,286	8,991	5,844	608	272	2,413	1,351	2,136	2,224	1,213	1,864		10,255	464	1,278	12,028	-6,184			

Table 6.4.3.3-4 Proposed Water Balance Study in Badagiriya Scheme(1984~1995)

Command Area = 686 ha

Success Rate (Maha: 93 %) (Yala : 91 %)

	Badagiriya Tank Issue Records					Rainfall		Unit FWR			Unit FIR			Field Irrigation Requirement (FIR)				Water Balance			
	Tank Issue (at Sluice)	Feeder Canal	Total Issue			(at Badagiriya ER		Paddy	OFC	Banana	Paddy	OFC	Banana		Paddy (90%)	OFC (0%)	Banana (100%)	Total	Volume	Area	Success Area	Rate
														Maha / Yala	(m)	(n)	(o)					
	(a)	(b)	(c) (a+b)	(d)	(e) (d×65%)		(f)	(g)	(h)	(i)	(j) (g-f)	(k) (h-f)	(l) (i-f)		(h x A)	(k x A)	(l x A)	(p) (m+n+o)	(q) (e-p)	(r) (p / g)	(s)	(t)
	(Ac-ft)	(Ac-ft)	(Ac-ft)	(000m3)	(000m3)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		(000m3)	(000m3)	(000m3)	(000m3)	(000m3)	(ha)	(ha)	(%)
1990/91 Sep	1,656	0	1,656	2,043	1,328	96	47	0	0	209	0	0	162		0	0	111	111	1,217			
Oct	81	0	81	100	65	234	140	53	11	184	0	0	45		0	0	31	31	34			
Nov	1,883	0	1,883	2,323	1,510	288	176	293	101	133	117	0	0		724	0	0	724	786			
Dec	2,465	0	2,465	3,041	1,977	69	29	237	122	118	207	93	89		1,280	0	61	1,341	636			
Jan	3,715	0	3,715	4,584	2,980	0	0	216	139	130	216	139	130		1,334	0	89	1,423	1,557			
Feb	2,500	0	2,500	3,085	2,005	0	0	243	152	127	243	152	127		1,498	0	87	1,585	421			
Maha total	12,299	0	12,299	15,177	9,865	687	392	1,042	525	901	783	384	552		4,836	0	379	5,214	4,651	446	1,132	100%
Mar	1,875	0	1,875	2,313	1,504	61	0	65	67	153	65	67	153		222	46	105	373	1,130			
Apr	245	0	245	302	196	87	41	182	78	179	140	37	137		481	25	94	600	-404			
May	1,638	0	1,638	2,021	1,314	116	61	337	190	211	276	129	150		947	89	103	1,138	175			
Jun	1,630	0	1,630	2,012	1,308	27	0	274	170	230	274	170	230		939	117	158	1,213	94			
Jul	1,642	0	1,642	2,026	1,317	52	0	299	194	231	299	194	231		1,025	133	159	1,317	0			
Aug	1,216	0	1,216	1,501	976	0	0	216	126	230	216	126	230		739	86	158	984	-8			
Yala total	8,246	0	8,246	10,175	6,614	343	102	1,371	826	1,235	1,269	723	1,033		4,353	496	727	5,626	988	72	552	100%
Total	20,545	0	20,545	25,353	16,479	1,030	494	2,413	1,351	2,136	2,052	1,107	1,684		9,188	496	1,106	10,840	5,639			
1991/92 Sep	0	0	0	0	0	105	53	0	0	209	0	0	156		0	0	107	107	-107			
Oct	831	0	831	1,025	666	102	51	53	11	184	2	0	133		12	0	91	103	563			
Nov	1,170	0	1,170	1,444	939	150	83	293	101	133	210	17	50		1,296	0	34	1,330	-392			
Dec	1,133	0	1,133	1,399	909	8	0	237	122	118	237	122	118		1,462	0	81	1,543	-634			
Jan	1,338	0	1,338	1,651	1,073	0	0	216	139	130	216	139	130		1,334	0	89	1,423	-350			
Feb	489	0	489	604	393	0	0	243	152	127	243	152	127		1,498	0	87	1,585	-1,192			
Maha total	4,961	0	4,961	6,122	3,980	364	188	1,042	525	901	907	430	713		5,602	0	489	6,091	-2,111	-203	483	70%
Mar	0	0	0	0	0	11	0	65	67	153	65	67	153		222	46	105	373	-373			
Apr	0	0	0	0	0	84	40	182	78	179	142	39	139		487	27	95	609	-609			
May	0	0	0	0	0	0	0	337	190	211	337	190	211		1,155	131	145	1,431	-1,431			
Jun	0	0	0	0	0	0	0	274	170	230	274	170	230		939	117	158	1,213	-1,213			
Jul	0	0	0	0	0	0	0	299	194	231	299	194	231		1,025	133	159	1,317	-1,317			
Aug	0	0	0	0	0	0	0	216	126	230	216	126	230		739	86	158	984	-984		(not issued)	
Yala total	0	0	0	0	0	95	40	1,371	826	1,235	1,332	786	1,195		4,568	539	820	5,927	-5,927	-432	48	10%
Total	4,961	0	4,961	6,122	3,980	460	227	2,413	1,351	2,136	2,239	1,216	1,909		10,170	539	1,309	12,018	-8,039			
1992/93 Sep	0	0	0	0	0	0	0	0	0	209	0	0	209		0	0	143	143	-143			
Oct	0	0	0	0	0	244	147	53	11	184	0	0	38		0	0	26	26	-26			
Nov	1,000	0	1,000	1,234	802	89	42	293	101	133	251	58	91		1,549	0	82	1,631	-809			
Dec	3,520	0	3,520	4,344	2,824	17	0	237	122	118	237	122	118		1,462	0	81	1,543	1,281			
Jan	3,167	0	3,167	3,908	2,540	0	0	216	139	130	216	139	130		1,334	0	89	1,423	1,117			
Feb	2,879	0	2,879	3,553	2,309	33	0	243	152	127	243	152	127		1,498	0	87	1,585	725			
Maha total	10,567	0	10,567	13,039	8,476	383	189	1,042	525	901	946	471	712		5,842	0	489	6,331	2,145	206	892	100%
Mar	1,801	0	1,801	2,223	1,445	63	0	65	67	153	65	67	153		222	46	105	373	1,071			
Apr	0	0	0	0	0	121	64	182	78	179	118	14	115		404	10	79	492	-492			
May	0	0	0	0	0	29	0	337	190	211	337	190	211		1,155	131	145	1,431	-1,431			
Jun	0	0	0	0	0	45	0	274	170	230	274	170	230		939	117	158	1,213	-1,213			
Jul	0	0	0	0	0	0	0	299	194	231	299	194	231		1,025	133	159	1,317	-1,317			
Aug	0	0	0	0	0	18	0	216	126	230	216	126	230		739	86	158	984	-984		(not issued)	
Yala total	1,801	0	1,801	2,223	1,445	275	64	1,371	826	1,235	1,307	762	1,171		4,484	523	803	5,810	-4,366	-318	162	34%
Total	12,368	0	12,368	15,262	9,920	658	253	2,413	1,351	2,136	2,254	1,233	1,883		10,327	523	1,292	12,141	-2,221			
1993/94 Sep	28	0	28	35	22	145	80	0	0	209	0	0	129		0	0	88	88	-66			
Oct	0	0	0	0	0	110	56	53	11	184	0	0	128		0	0	88	88	-88			
Nov	1,797	0	1,797	2,217	1,441	278	169	293	101	133	124	0	0		766	0	0	766	675			
Dec	747	0	747	922	599	293	179	237	122	118	58	0	0		356	0	0	356	243			
Jan	2,347	0	2,347	2,896	1,882	50	0	216	139	130	216	139	130		1,334	0	89	1,423	459			
Feb	1,982	0	1,982	2,446	1,590	0	0	243	152	127	243	152	127		1,498	0	87	1,585	5			
Maha total	6,901	0	6,901	8,516	5,535	621	485	1,042	525	901	640	291	513		3,954	0	352	4,306	1,229	118	804	100%
Mar	1,153	0	1,153	1,423	925	58	0	65	67	153	65	67	153		222	46	105	373	552			
Apr	841	0	841	1,038	675	15	0	182	78	179	182	78	179		623	54	123	799	-125			
May	2,565	0	2,565	3,165	2,057	12	0	337	190	211	337	190	211		1,155	131	145	1,431	627			
Jun	1,858	0	1,868	2,306	1,499	0	0	274	170	230	274	170	230		939	117	158	1,213	285			
Jul	248	480	728	898	584	43	0	299	194	231	299	194	231		1,025	133	159	1,317	-733			
Aug	272	0	272	336	218	28	0	216	126	230	216	126	230		739	86	158	984	-766			
Yala total	6,948	480	7,428	9,166	5,958	156	0	1,371	826	1,235	1,371	826	1,235		4,704	566	847	6,117	-160	-12	469	98%
Total	13,848	480	14,328	17,681	11,493	777	485	2,413	1,351	2,136	2,012	1,116	1,748		8,657	566	1,199	10,423	1,070			
1994/95 Sep	0	0	0	0	0	145	80	0	0	209	0	0	129		0	0	88	88	-88			
Oct	69	0	69	86	56	115	60	53	11	184	0	0	124		0	0	85	85	-30			
Nov	1,833	24	1,857	2,291	1,489	210	123	293	101	133	170	0	10		1,048	0	7	1,055	435			
Dec	1,616	0	1,616	1,994	1,296	52	0	237	122	118	237	122	118		1,462	0	81	1,543	-247			
Jan	957	433	1,390	1,715	1,115	58	0	216	139	130	216	139	130		1,334	0	89	1,423	-308			
Feb	888	274	1,162	1,434	932	100	50	243	152	127	193	102	77		1,189	0	53	1,242	-310			
Maha total	5,363	731	6,094	7,520	4,888	679	313	1,042	525	901	815	363	588		5,033	0	403	5,436	-549	-53	633	92%
Mar	669	113	782	965	627	7	0	65	67	153	65	67	153		222	46	105	373	254			
Apr	0	0	0	0	0	267	162	182	78	179	20	0	17		69	0	12	81	-81			
May	872	0	872	1,076	699	122	64	337	190	211	272	126	147		934	86	101	1,121	-422			
Jun	663	0	663	818	532	29	0	274	170	230	274	170	230		939	117	158	1,213	-682			
Jul	1,108	0	1,108	1,367	889	15	0	299	194	231	299	194	231		1,025	133	159	1,317	-428			
Aug	1,334	0	1,334	1,646	1,070	23	0	216	126	230	216	126	230		739	86	158	984	86			
Yala total	4,645	113	4,758	5,872	3,817	462	226	1,371	826	1,235	1,145	683	1,009		3,929	468	692	5,089	-1,372	-93	387	81%
Total	10,008	844	10,852	13,391	8,704	1,141	539	2,413	1,351	2,136	1,961	1,046	1,597		8,962	468	1,095	10,525	-1,921			

6.5 Plan to Strengthen Farmer Organizations

6.5.1 Basic Approach

On the basis of problem issues identified through assessment of the present status of FOs, measures to address these are to be formulated to further upgrade the sustained functionality of these organizations.

Major problem points identified through field survey are as follows.

- An integrated system of all FOs in the scheme area has not yet been achieved in the case of the Urubokka Oya and Kirama Oya under the Muruthawela Reservoir scheme
- No FO has been created in the Lunama unit (A = 542 ha; 250 households) at the extreme downstream of the Walawe RB sub-scheme under the Liyangastota scheme.
- Many of the existing FOs are weakly organized.

Specific measures to address the above are defined, and the plan to strengthen FOs formulated.

6.5.2 Establishment of PMCs

With the exception of Badagiriya, the other two schemes under the Project are comprised of smaller sub-schemes, within which the INMAS and MANIS programs have been carried out on a sub-scheme basis.

Relation of scheme to program is as follows.

Scheme	Sub-scheme	Executing agency	Program
Liyangastota	Walawe LB	Irrigation Management Departmetnt (IMD)	INMAS
	Walawe RB	Irrigation Department (ID)	MANIS
Muruthawela Reservoir	Muruthawela LB	IMD	INMAS
	Urubokka Oya	ID	MANIS
	Kirama Oya	ID	MANIS
Badagiriya		IMD	INMAS

The difference between the FOs created under the two programs is that PMCs have been established in the case of the INMAS program, while in the case of the MANIS program, although FOs have been recently created for the Walawe RB under the Liyangastota scheme, they have as yet not been formed for the Urubokka Oya and Kirama Oya sub-schemes.

The reasons for this are that Project Managers have not been assigned for the sub-schemes (the INMAS PM doubles as the Project Manager; in 1995 a PM was assigned to the WRB); furthermore, to take the case of the Kirama Oya sub-scheme as an example, although water source for the entire sub-scheme area is from the same river source, diversion is by means of 18 anicuts whose individual canal systems are operated as separated entities without any overall integration. As a result of this situation a PMC has not been created as yet; however, in light of more effective water use and system management in the future, it is urgent that a PMC within the MANIS program framework be established as soon as possible.

(1) New O&M Road Plan

A major constraint to effective integration of the said sub-schemes is the lack of roads along the Kirama and Urubokka oyas to connect the anicut sites. Accordingly, the construction of such connector roads is considered a pre-condition to establishing PMCs for the areas. Thus, new road construction along the rivers is to be included under the rehabilitation plan to remove the constraint of poor access.

6.5.3 Promotion of the Formation of FOs

No FO has been formed in the Lunama Unit (A = 542 ac; 250 households) at the downstream terminus of the Walawe RB sub-scheme under the Liyangastota scheme. The ID indicates that a consensus among the farmers to create an FO has not been achieved, and during field survey the Study Team discovered the farmers are to dissatisfied with the current state of the system in the unit to have incentive to organize. As a result, it is concluded that upgrading of the Lunama unit system is a precondition to forming and FO, and under the rehabilitation plan for the Project 2.5 km of D-canal will be newly constructed in the unit. Upon this basis, it would then be anticipated that farmers would move to form FOs on their own initiative.

6.5.4 Strengthening of Presently Weak FOs

As the quantitative results of assessment of present conditions in the scheme areas indicate, many FOs in the Project area are only very weakly organized. A plan to strengthen the FOs would focus on the following.

- Analysis of the appropriateness of the demarcated areas (units) for FOs
- Support and human resource development efforts by the related government agencies

(1) Plan to Reorganize the FOs

1) Problems with the demarcated areas (units) for FOs

In principal it is optimum if FOs are formed based on the D-canals benefit areas. However, this is not necessarily the case in the scheme areas, where FO units may

fragment the benefit area for a single D-canal, or straddle portions of benefit area of more than 1 D-canal.

In the case of the Liyangastota WLB sub-scheme, there are 16 units with average area of 277 acs; however, there are 4 units with actual area under 100 acs. Unit area sizes range from a minimum of 25 acs to a maximum of 609 acs, the former being only 4% the size of the latter.

A similar situation is seen in the Muruthawela scheme area. In general, with the exception of the Badagiriya scheme area where units are relatively close in size, the trend throughout the Project area is one of varied FO unit sizes.

Nation-wide under the INMAS program, D-canal level units average 500 acs in size, with some units as large as 1,000 acs. Average FO membership is 200~400 persons. The only scheme in the Project area roughly close to this standard is the Badagiriya scheme.

Also, in the case of the FO units in the Liyangastota and Muruthawela schemes, even where the FOs have been formed on a D-canal basis, there are many instances of separate FOs for right and left banks with the overall canal benefit area unintegrated. This is one reason why unofficial transfer of responsibility for D-canals to the FOs has occurred only in the Badagiriya scheme area.

Also the results of marking under evaluation of the present situation, it was found that the smaller the FO unit area, the lower the marking rank.

On the basis of the above analysis, it is planned under the Project to integrate the FO units, restructure the farmer organizations where necessary and strengthen the FO base from the standpoint of future transfer of responsibility for irrigation facilities to the FOs, create a more equitable selection of FO representatives, increase the efficiency of PMC operations and rationalize water use management under the schemes. The present 129 FOs would be reorganized into 64 organizations as indicated below.

Scheme	Present	Design
Badagiriya	4	4
Liyangastota LB	24	14
Liyangastota RB	30	15
Muruthawela		
Muruthawela LB	27	15
Urubokka Oya	22	9
Kirama Oya	22	7
Total	129	64

Badagiriya scheme would remain as it is in this regard.

The overall reorganization plan for FOs is shown in Tables 6.5.4-1~3 and in Figures 6.5.4-1~6.

Table 6.5.4-1 Reorganization of Farmer Organizations in Uyangastota Scheme

	No.	F.O.O	Present			Proposed Combination			
			Households	Cultivated Area (Ac.s)	(ha)	No.	Households	Cultivated Area (Ac.s)	(ha)
WRB Scheme									
MAMADALA UNIT	1	SAMAGI	85	128	52				
	2	WILE ELA	42	156	63	①	127	284	115
	3	HANGANWAGURA EAST	46	163	66				
	4	IHALA JUNSGAMA	121	232	94				
	5	PAHALA JUNSAGAMA	92	250	101	②	259	645	261
	6	D1-RB1	38	153	62				
	7	D1/7-ELA	42	89	36				
	8	D1/8-ELA	39	121	49				
	9	D1/14,15	34	44	18	③	153	408	165
	10	MAIN CANAL CPO-8 TO CPO-11 AND D2 CANAL	278	294	119	④	278	294	119
	11	PARANAGAMA YAYA	68	311	126				
	12+13	KABALDETTA YAYA	60	175	71	⑤	128	487	197
		Sub-total	945	2,118	857		945	2,118	857
OLUWILA UNIT	14	ROTA WALA	72	348	141				
	15	WALAWE WATTA-THREESINGNE	78	101	41				
	16	PUHUL YAYA	32	153	62	⑥	182	603	244
	17	WATA ELA	53	161	65	⑦	53	161	65
	18	D4 SEETHAWAKA-ROTAWALA	52	204	83				
	19	D3 WICKRAMANAYAKE ELA	32	181	73	⑧	84	385	156
	20	PUHUULGODA (Wdibalanwila LB Canal)	48	253	102				
	21	WELIPATANWILA RB	78	339	137	⑨	126	592	240
	22	OLUWILA RB THENNAKOONGAMA	26	119	48				
	23	OLUWILA LB	55	126	51	⑩	81	245	99
		Sub-total	526	1,985	803		526	1,985	803
LUNAMA UNIT	24	LUNAMA ELA	235	206	83	⑪	235	206	83
	25	PITTENI YAYA	48	237	96				
	26	AKKARA 12-YAYA	38	114	46				
	27	ALUTH YAYA	47	129	52	⑫	133	480	194
	28	PINGAMA	58	131	53				
	29	32-ELA	42	173	70	⑬	100	304	123
	30	DENIYA PERAKUM	65	330	134				
	31	ETHBATUWA - KIRIMETIYA	38	100	40	⑭	103	430	174
		NOT FORMED		542		⑮	0	542	219
		Sub-total	571	1,962	575		571	1,962	794
		WRB Total	2,042	6,065	2,235		2,042	6,065	2,454
WLB Scheme									
RIDIYAGAMA UNIT	1	MAHANAGA	59	146	59				
	2	PARAKUM	130	319	129	①	189	465	188
	3	GAJABA	90	198	80				
	4	EKAMUTHU	44	69	28	②	134	267	108
	5	NEELA	67	425	172	③	67	425	172
	6	RUHUNU	86	314	127				
	8	PUBUDU	86	195	79	④	172	509	206
	7	WEERA	51	208	84	⑤	51	208	84
		Sub-total	613	1,873	758		613	1,873	758
BOLANA UNIT	1	SENANAYAKA	66	203	82				
	2	WIJAYA	73	210	85	⑥	139	413	167
	3	PRAGATHI	42	106	43				
	4	ISURU	59	304	123	⑦	101	410	166
	5	SAMAGI	83	230	93				
	6	GAMINEE	30	324	131	⑧	113	553	224
	7	KAWANTISSA	186	814	329	⑨	186	814	329
	8	SARUKETHA	99	425	172	⑩	99	425	172
	10	DIMUTHU	56	136	55				
	11	AKBAR	63	358	145	⑪	119	494	200
	9	EKSATH	35	25	10				
	12	MAHASEN	34	91	37				
	13	SUHADA	92	609	246	⑫	161	725	293
	14	WALAWE	148	385	156				
	15	GOTABHAYA	68	54	22	⑬	216	440	178
	16	THERAPUTTHA	43	163	66	⑭	43	163	66
		Sub-total	1,177	4,438	1,796		1,177	4,438	1,796
		WLB Total	1,790	6,311	2,554		1,790	6,311	2,554
Uyangastota Scheme Total			3,832	12,375	4,789		3,832	12,375	5,008

Table 6.5.4-2 Reorganization of Farmer Organizations in Muruthawela Reservoir Scheme

	No.	F.O.O	Present			Proposed Combination			
			Households	Cultivated Area (Ac.s)	(ha)	No.	Households	Cultivated Area (Ac.s)	(ha)
Muruthawela LB Scheme									
Tract I	4	PUBUDO		90	36				
	1	WEERA No.1		66	27	⑪		156	63
	2	WEERA No.2		8	3				
	3	BALASAKITHI		151	61				
	6	PRIYAKARU		33	13				
	7	EKAMUTHU		53	21	⑫		245	99
	5	EKSATH		186	75	⑬		186	75
	8	KUDA VIVULA LIGHT		295	119	⑭		295	119
	9	MEEGASARA		167	68	⑮		167	68
		Sub-total		1,049	425			1,049	425
Tract II	1	IHALA SAMAGI (D-1A)	190	121	49				
	2	PAHALA PARAKUM (D-1B)	25	145	59	①	215	266	108
	3	THISARA (D-2,3)	37	113	46				
	4	SAMAGI (D-4)	60	83	34	②	97	196	79
	5	GOUISANVIDANAYA (D-5)	30	111	45				
	6	PARAKUM (D-6)	80	196	79				
	7	SINGHEGIRI (D-7)	87	131	53	③	197	438	177
	8	EKSATH (D-8)	76	178	72	④	76	178	72
	9	D-9 (D-9)	174	363	147	⑤	174	363	147
		Sub-total	759	1,441	583		759	1,441	583
Tract III	10	D-1 DCO (D-1)	117	136	55				
	11	D-2 DCO (D-2)	157	202	82	⑥	274	338	137
	12	D-3 DCO (D-3)	55	171	69				
	13	D-4 DCO (D-4)	29	143	58	⑦	84	314	127
	14	D-5 DCO (D-5)	42	79	32				
	15	D-6 DCO (D-6)	112	236	96	⑧	154	315	128
	16	D-7 DCO (D-7)	65	159	64				
	17	D-8 DCO (D-8)	89	155	63	⑨	154	314	127
	18	D-9 DCO (D-1,9)	162	426	172	⑩	162	426	172
		Sub-total	828	1,707	691		828	1,707	691
		Total	1,587	4,197	1,699		1,587	4,197	1,699
Urubokka Oya Scheme									
Urubokka	1	RALUWA NAWARATHE RB	100	193	78				
	2	KINCHIGUNE LB	160	373	151	①		566	229
	3	UDUKILIWILA LB (HALMILLA ELA)	300	334	143				
	4	UDUKILIWILA RB (MARAKADA HARTHIS)	100	171	69	②		524	212
	7	WAKAMULLA LB	69	196	79				
	8	WAKAMULLA RB	500	385	156				
	9	HUNNAKUMBURA LB/RB	300	400	162	③		981	397
	10	HAKUREWALA LB	200	351	142				
	11	HAKUREWALA RB	360	523	212	④		874	354
	12	ANDUPELENA LB	250	657	266				
	13	ANDUPELENA RB	65	196	80	⑤		853	345
	14	RANNA LB	110	240	97				
	15	RANNA RB	200	276	112	⑥		516	209
		sub-total	2,714	4,315	1,746			4,315	1,746
High Level	5	UDUKILIWILA LOW (MANDARADUWA)	75	126	51				
	6	UDUKILIWILA HIGH (MAMADADU MULAWA)	19	49	20	⑦		175	71
	16 -a	POTHU							
	-b	THALAKANATHU YAYA	150	136	55				
	17	KADAWALA YAYA							
	18	ETHUNNSWQALA	26	44	18				
	19 -a	NUGAGAHA WEWA							
	19 -b	GALWALA YAYA	72	133	54				
	19 -c	KULASINGEWELA							
	20	RANASHINHAGAMA	16	44	18				
	21	ROTE YAYA	300	165	67	⑧		523	212
	22	PATTIYAPOLA MAHA							
	23	NETOLPITIYA	350	578	234	⑨		578	234
		Sub-total	1,008	1,276	516			1,276	516
		Total		5,591	2,263			5,591	2,263
Kirama Oya Scheme									
	1	Hambumandiya LB	450	224	91				
	2	Ethpitiya LB	400	185	75	①		409	166
	3	Uda Debarawa RB	386	110	45				
	4	Arachchi LB	150	160	65				
	5	Arachchi RB	200	104	42				
	6	Wijerathne Pubodu	250	82	33	②		456	185
	7	Wauwa	500	245	99				
	8	Okewela LB	60	128	52				
	9	Okewela RB	90	115	47	③		488	197
	10	Pansala (LB/RB) Dewamedineya	125	84	34				
	11	Pattiyawela (LB/RB) Dammulla Yaya	200	130	53				
	12	Warakawara RB -Proposed-	133	178	72				
	13	Unnansege LB	150	50	20				
	14	Kahawatte LB	75	156	63	④		598	242
	15	Pinoda	60	146	59				
	16	Liyanagedeniya	55	194	79	⑤		340	138
	17	Nalagama LB	35	156	63				
	18	Nalagama RB	150	173	70				
	19	Daranda Eksath	150	285	115				
	20	Wile	60	127	51	⑥		741	300
	21	Maha	40	417	169				
	22	Danketiya	400	284	115	⑦		701	284
		sub-total	4,119	3,733	1,511			3,733	1,511
		Total		3,733	1,511			3,733	1,511
Muruthawela Reservoir Scheme Total				13,521	5,472			13,521	5,472

Table 6.5.4-3 Reorganization of Farmer Organizations in Badagiriya Scheme

No. F.O.O	Present			Proposed Combination			
	Households	Cultivated Area			Households	Cultivated Area	
		(Ac.s)	(ha)	No.		(Ac.s)	(ha)
1 Badagiriya No.1	158	457	185	①	158	457	185
2 Badagiriya No.2	205	625	253	②	205	625	253
3 Badagiriya No.3	143	388	157	③	143	388	157
4 Badagiriya No.4	46	228	92	④	46	228	92
Badagiriya Scheme Total	**552**	**1,698**	**687**		**552**	**1,698**	**687**

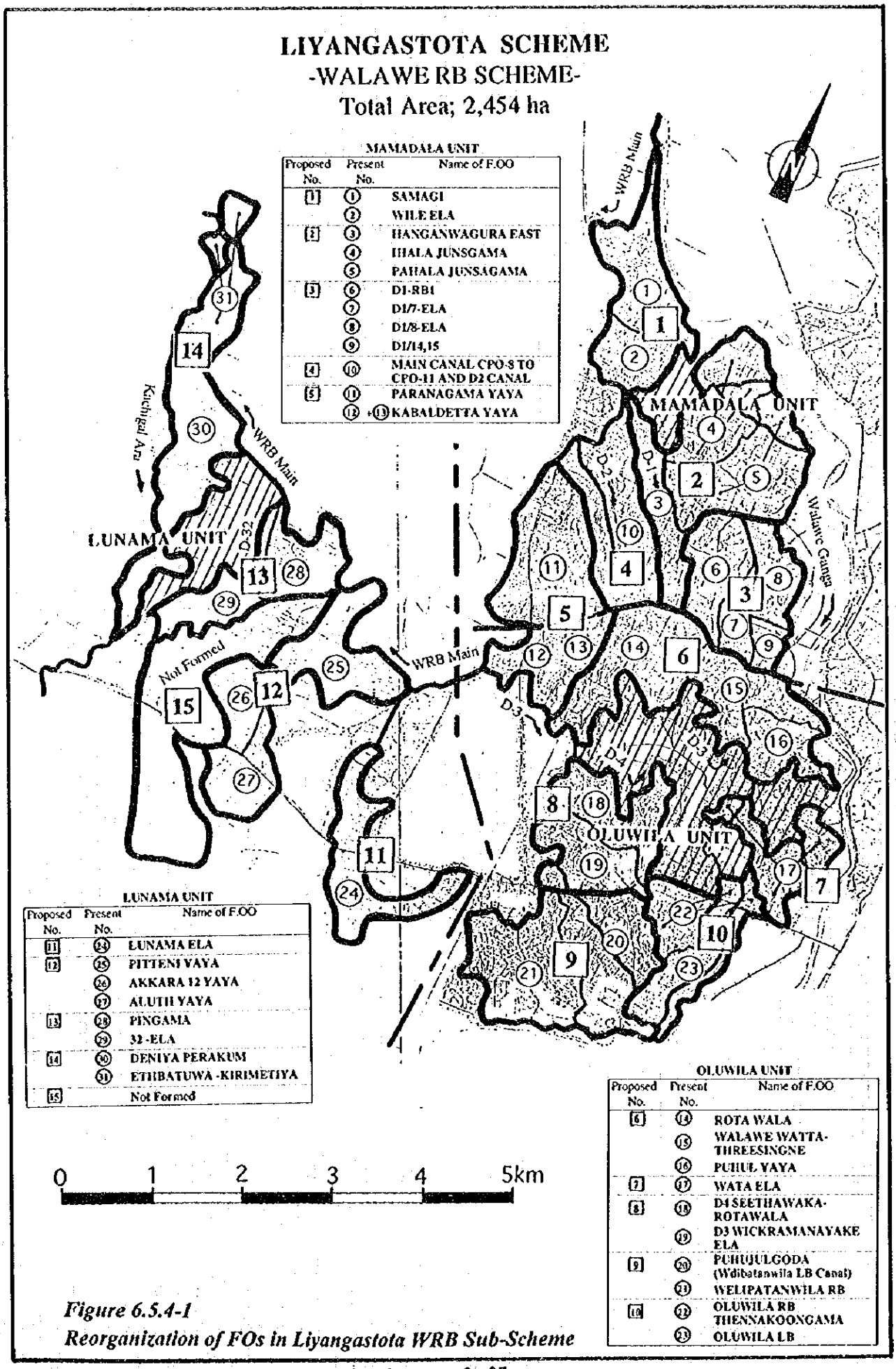


Figure 6.5.4-1
Reorganization of FOs in Liyangastota WRB Sub-Scheme

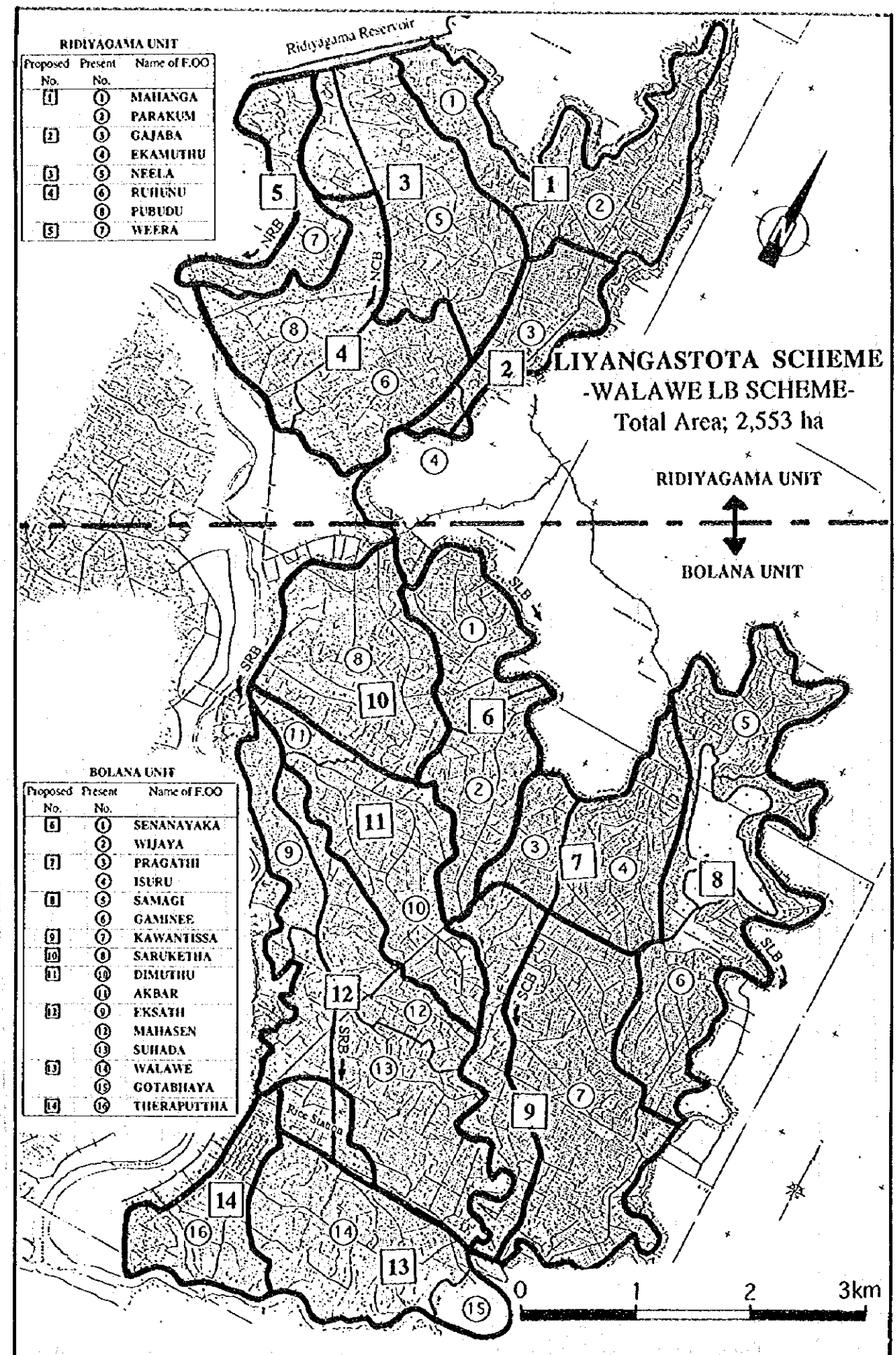


Figure 6.5.4-2 *Reorganization of FOs in Liyangastota WLB Sub-Scheme*

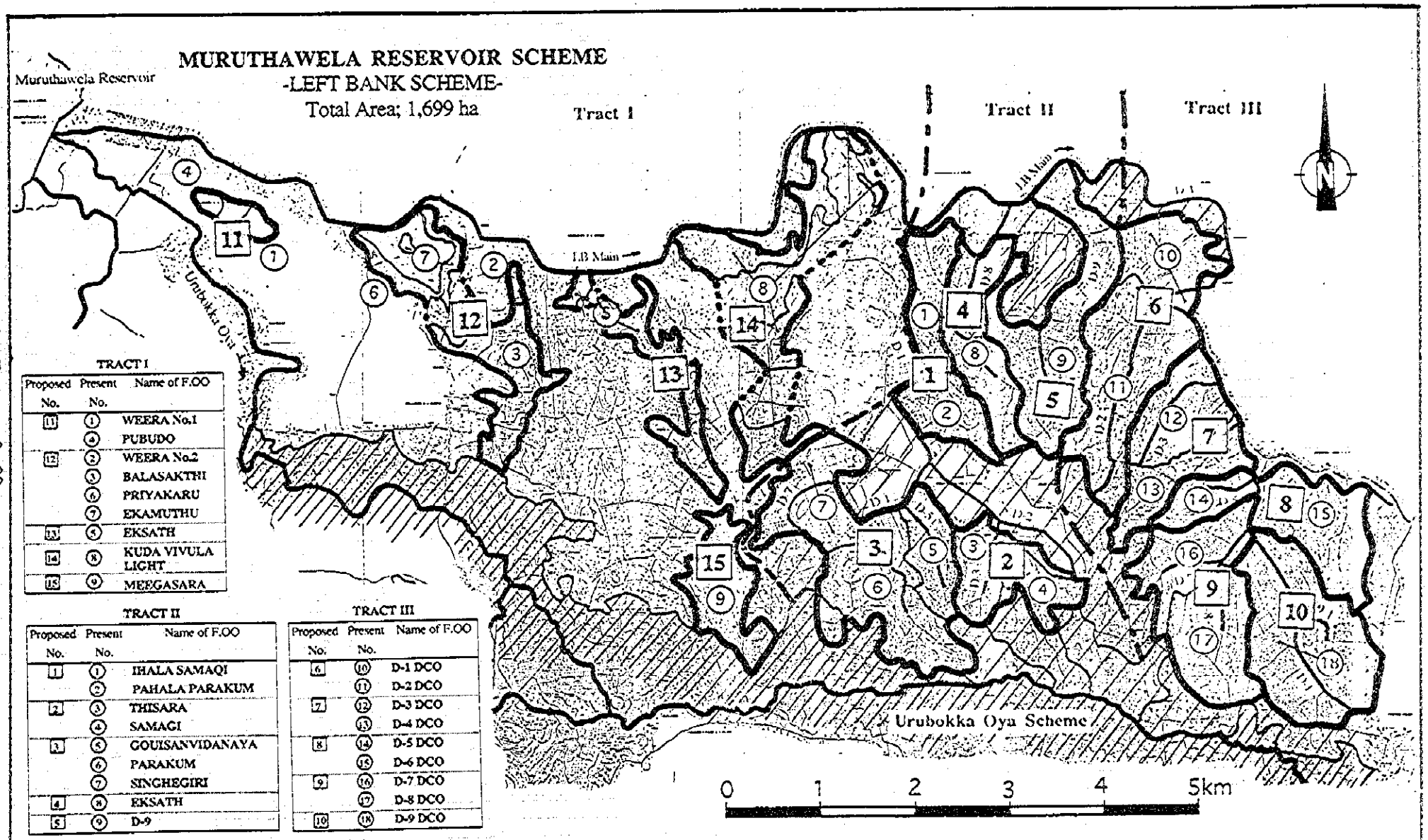
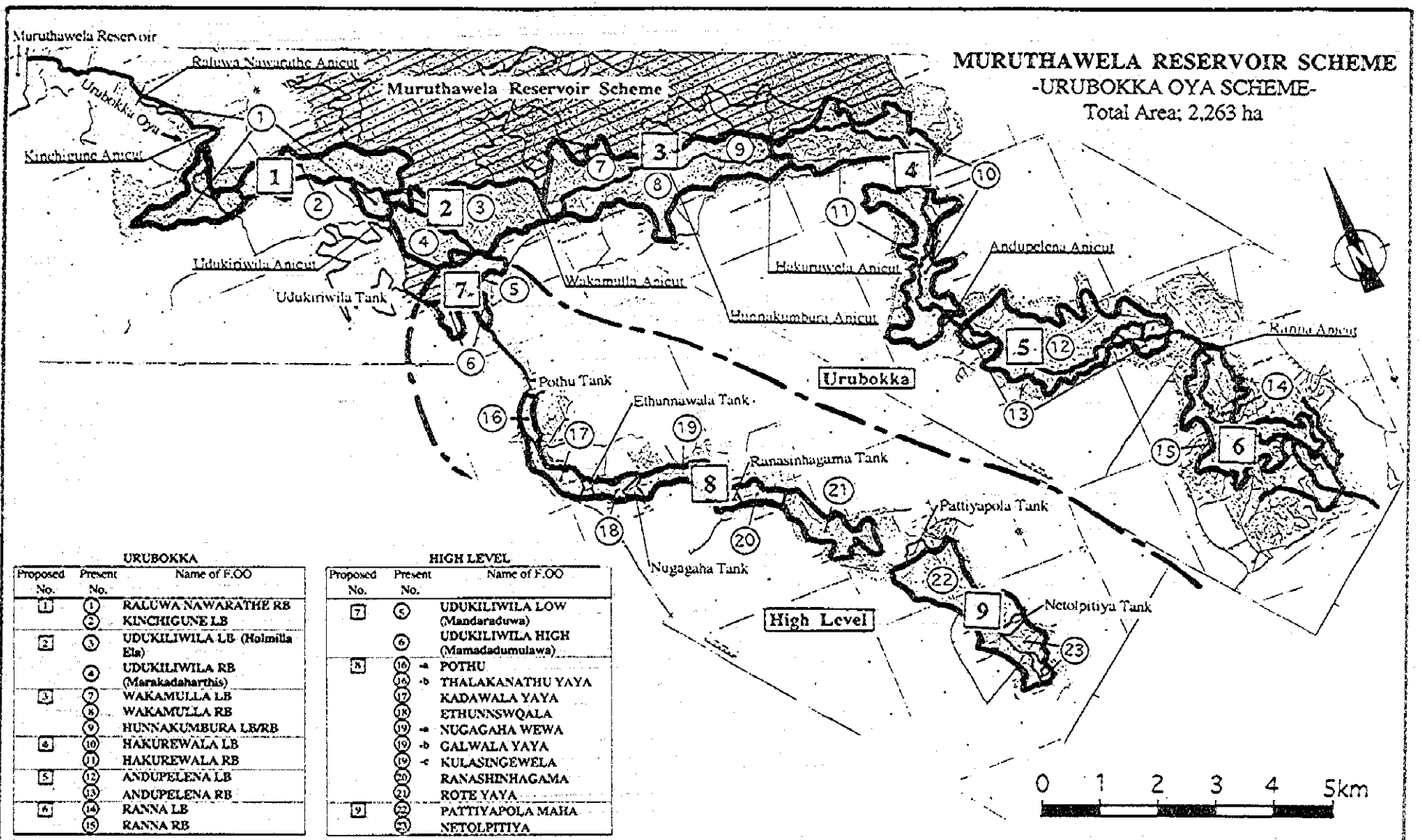


Figure 6.5.4-3 Reorganization of FOs in Muruthawela LB Sub-Scheme



URUBOKKA

Proposed No.	Present No.	Name of F.OO
1	1	RALUWA NAWARATHE RB
	2	KINCHIGUNE LB
2	3	UDUKILIWILA LB (Holmilla Ela)
	4	UDUKILIWILA RB (Marakadaharthis)
3	7	WAKAMULLA LB
	8	WAKAMULLA RB
	9	HUNNAKUMBURA LB/RB
4	10	HAKUREWALA LB
	11	HAKUREWALA RB
5	12	ANDUPELENA LB
	13	ANDUPELENA RB
6	14	RANNA LB
	15	RANNA RB

HIGH LEVEL

Proposed No.	Present No.	Name of F.OO
7	5	UDUKILIWILA LOW (Mandaraduwa)
	6	UDUKILIWILA HIGH (Mamadadumulawa)
8	16-a	POTHU
	16-b	THALAKANATHU YAYA
	17	KADAWALA YAYA
	18	ETHUNNSWQALA
	19-a	NUGAGAHA WEWA
	19-b	GALWALA YAYA
	20	KULASINGEWELA
	21	RANASHINHAGAMA
	22	ROTE YAYA
9	23	PATTIYAPOLA MAHA
		NETOLPITIYA

Figure 6.5.4-4 Reorganization of FOs in Urubokka Oya Sub-Scheme

MURUTHAWELA RESERVOIR SCHEME
-KIRAMA OYA SCHEME-
Total Area; 1,511 ha

Proposed No.	Present No.	Name of F.OO
1	1	HAMBUMANDIYA LB
	2	ETHPITIYA LB
2	3	UDA DEBARAWA RB
	4	ARACHCHI LB
	5	ARACHCHI RB
	6	WIJERATHNE PUBUDU
3	7	WAUWA
	8	OKEWELA LB
	9	OKEWELA RB
4	10	PANSALA (LB/RB) Dewamedimeya
	11	PATTIYAWELA (LB/RB) Dammulla Yaya
4	12	WARAKAWARA RB -Proposed-
	13	UNNANSEGE LB
	14	KAHAWATTE LB
5	15	PINODA
	16	LIYANAGEDENIYA
6	17	NALAGAMA LB
	18	NALAGAMA RB
	19	DARANDA EKSATH
	20	WILE
7	21	MAHA
	22	DANKETIYA

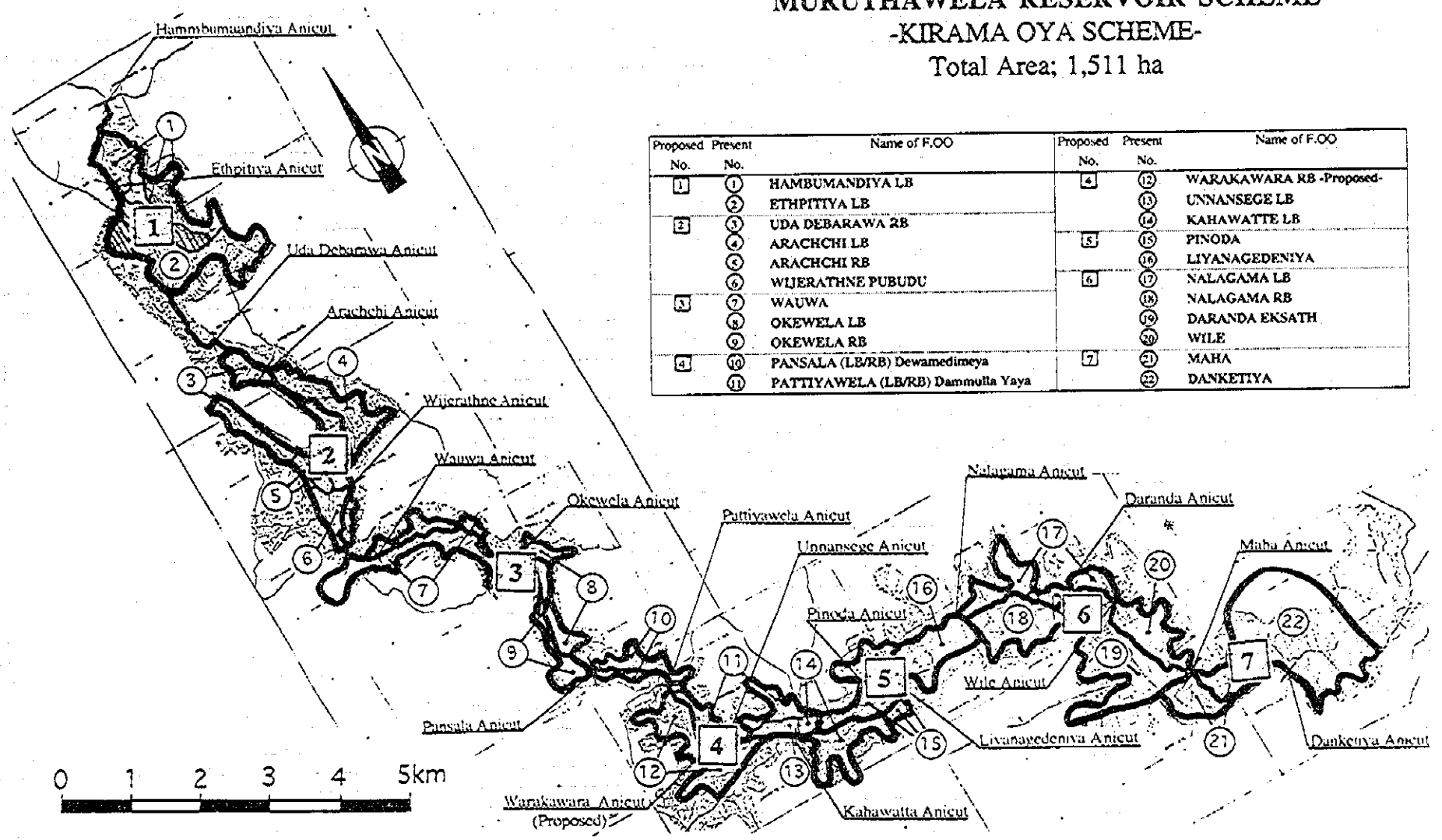


Figure 6.5.4-5 Reorganization of FOs in Kirama Oya Sub-Scheme

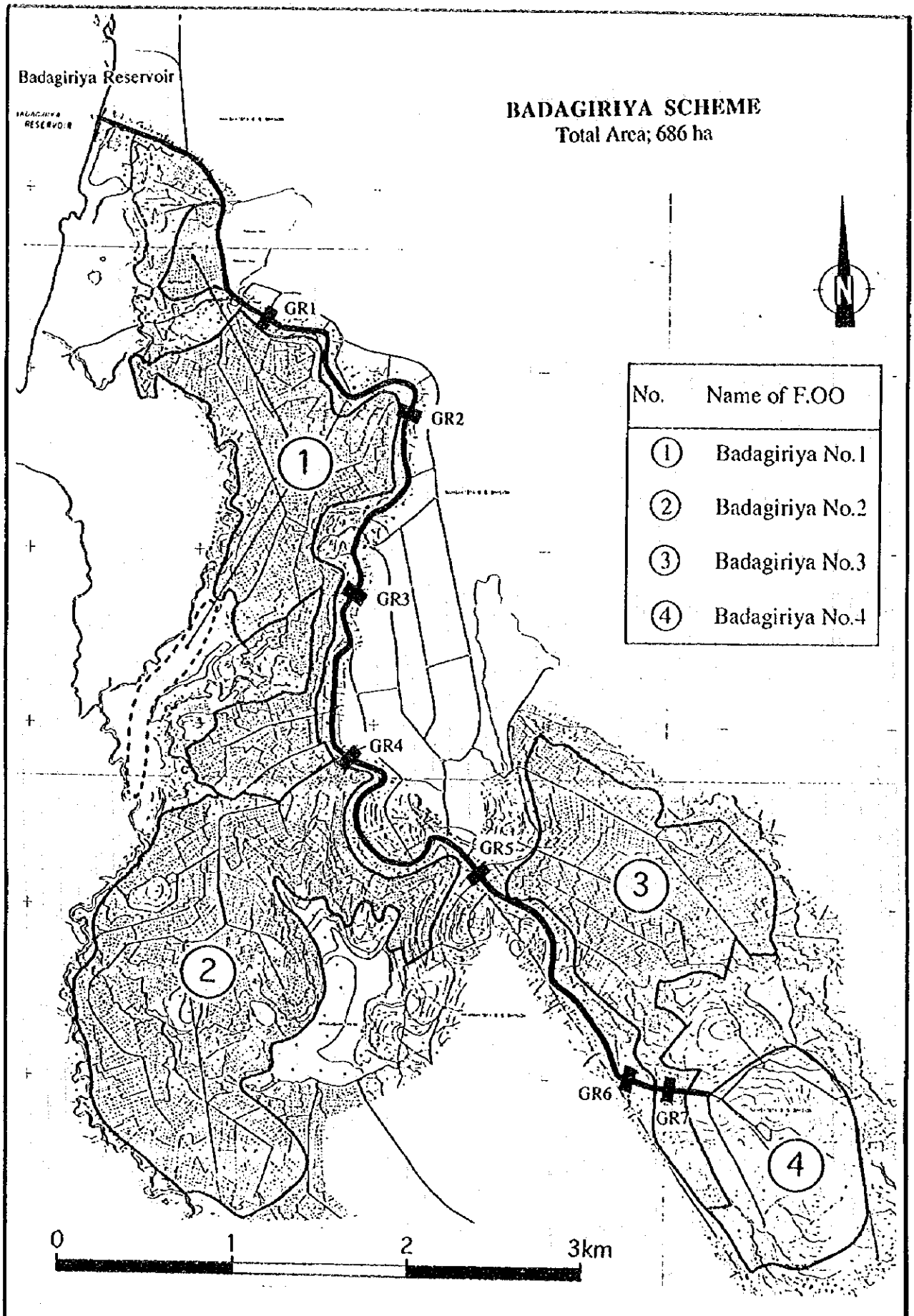


Figure 6.5.4-6 ***Reorganization of FOs in Badagiriya Scheme***

(2) Plan to Support and Strengthen FOs

The continuation and promotion of the ongoing INMAS and MANIS programs is the base of the government policy towards support of FO activities. In this line, the following facilities and equipment are included under the Project to foster greater farmer initiated activity.

Scheme	No. of locations	Building construction works			Equipment deployment		
		Conference room, office (150 m²)	Fertilizer, seed storage (45m²×2)	Garage (75m²)	2 wheel tractor	Motorbike	Office equipment
1. Liyangastota	WRB × 3 locations	3 buildings	3 buildings	3 buildings	6 nos.	3 nos.	1 set
	WLB × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
Total		6 buildings	6 buildings	6 buildings	12 nos.	6 nos.	1 set
2. Muruthawela Reservoir	LB × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
	Urubokka × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
	Kirama × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
Total		9 buildings	9 buildings	9 buildings	18 nos.	9 nos.	1 set
3. Badagiriya	1 location						
Total		1 building	1 building	1 building	2 nos.	1 nos.	1 set
Total	16 locations	16 building	16 building	16 building	32 nos.	16 nos.	16 sets

(3) Training and Human Resources Development

The Irrigation Management Section is carrying out a nationwide farmer training program. The training program is targeted at FO representatives and administrative staff of the FOs, and encompasses O&M, financial management, agricultural development, basin conservation, farmer exchange, etc. However, since the Irrigation Management Section lacks instructors, there is concern that program objectives may not be met, making it necessary to augment instructional staff from NGOs and the private sector.

6.6 Operation and Maintenance Improvement Plan

6.6.1 Participatory Plan

Field survey of the target scheme areas indicated a decline in their function which is primarily the result of facility deterioration and inadequate operation and maintenance activities. If following the envisioned rehabilitation under the Project, if the O&M of the systems is not improved and carried out in a sustainable manner, the facilities will again deteriorate, and eventual transfer of all responsibility for the facilities to the farmers will become even more difficult. In the formulation of such a sustainable O&M plan, it is considered essential to analyze both problem issues and objectives by the participatory method. Towards this end, the logical frame analysis was carried out.

(1) Participatory Analysis

Under management of the systems, F-canals are the responsibility of the farmers, while the rest of the system is the responsibility of the ID according to irrigation ordinance.

With the present policy of promoting participatory system management, farmer participation in the O&M of D-canals and below has been encouraged. However, complete transfer of this responsibility to the farmer has not yet been achieved. As a result, the present budget for O&M works is almost completed allocated by the ID. Unfortunately, lack of budget has caused scheme O&M management to deteriorate. In this light, analysis of current problems in the O&M structure for the schemes was carried out centering on the following participants.

- ID head office	:	integrated management of the regional Irrigation Offices and O&M budget allocation
- Hambantota Irrigation Office	:	integrated O&M of Muruthawela Reservoir and Liyangastota schemes
Weerakitiya branch office	:	O&M of Muruthawela Reservoir scheme
Ambalantota branch office	:	O&M of Liyangastota scheme
- Kirindi Oya Irrigation and Settlement Project Office	:	integrated O&M of Badagiriya scheme
Weelawila branch office	:	O&M of Badagiriya scheme
- FOs in the scheme areas	:	participants in O&M and water users under the schemes

- Related government agencies : implementation of seasonal cropping plan and agrarian support services

Under the above problem analysis, focus was first place on identifying the capacity and execution method of the ID in carrying out designated O&M responsibilities, and towards this end staff at the ID, regional offices and branches in charge of O&M activities were met with and a log frame problem analysis carried out. In cases were it was necessary to clarify the cause and effect relationship under the log frame with the FOs and related government agencies, separate meetings with these were held were necessary to sound out views and opinions.

(2) Problem Analysis

The decline in system function was established as the central problem under this analysis. A problem flow chart was formulated based on a "cause and effect" relationship. The principal causes for the decline in system function are (i) system facility deterioration and (ii) poor system O&M. Furthermore, even with rehabilitation of the schemes, if the present O&M structure is not improved the rehabilitated structures will again deteriorate over time.

Also, since the direct cause of the deteriorated O&M of the overall systems is the overextended position of the ID in having to be responsible for the management of almost all of the system facilities, it was concluded that a major improvement of the schemes cannot be expected if the present O&M structure is continued.

Accordingly, capacity building of ID O&M activities was given major emphasis under target analysis.

As an approach to capacity improvement, study focused on shift (i) from manual execution of O&M works to mechanization, and (ii) from individual to group execution of O&M works.

1) Manual execution of O&M works

ID labor personnel currently carry out their O&M work duties using only such implements as the hoe and scythe. As a result, it is impossible to clear out sediment buildup in feeder and main canals with water depth in excess of 4 m.

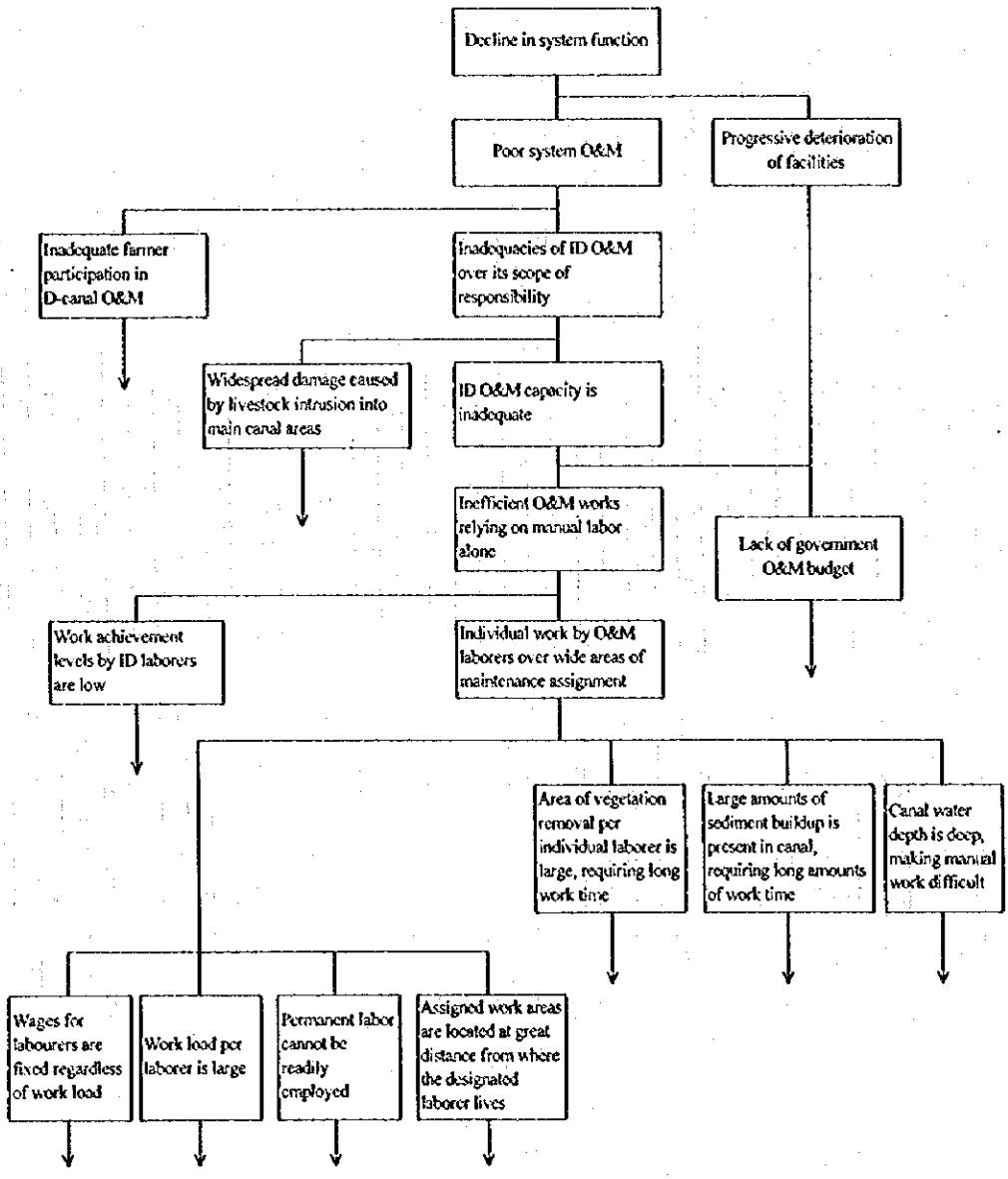
The feeder canals indicated below are particularly outside the capability of manual O&M due to steep canal slope for much of their length, and water depth over 4.0 m.

Scheme	Feeder canal (m)
Liyangastota WLB	6,475
Badagiriya	6,400
	1,200

In the case of main canals as well, there are many segments which exhibit the same conditions as above, and the laborers assigned to these have basically had to give up on the idea of sediment removal from the outset. With regards to canal slope and O&M road repair as well, there has been no machinery made available to the assigned laborers.

Furthermore, although in principal it is intended to assign laborers who live in the vicinity of their assigned maintenance areas, in many cases they live at considerable distance making access timely and work efficiency low.

Figure 6.6.1-1 Problem Flow for System Management (Logical Frame)



2) Problem with individual work pattern

The scope of work area for which a single ID laborer is responsible is as follows.

Scheme	Canal length (m)		No. of laborers	Size of area of assignment (m/person)
Muruthawela LB	Main C	14,443	9	1,604
Liyangastota				
Walawe LB	Main C	18,678	16	1,167
	Feeder			
Walawe RB	Main C	26,300	15	1,753
Badagiriya	Main C	8,604	4	2,151
	Feeder C	7,600		1,900

note: O&M of tanks and anicuts is done by other personnel;
the above are responsible for canal maintenance only

In the case of the Badagiriya scheme, length of main canal for which a single laborer is responsible exceeds a total of 4 km which is far greater than the other schemes under which a single labor carries out maintenance for 1.2~1.7 km of canal length.

Water conveyance along main canals stops during the 1 month from the end of one planting season to the start of another, during which time dredging of sediment buildup in the canal is required. In addition to difficult topographical conditions, time constraints make it impossible to expect that this work can be done. As a result, levels of work achievement are low, and segments of canal where water blockage occurs are basically left as they are.

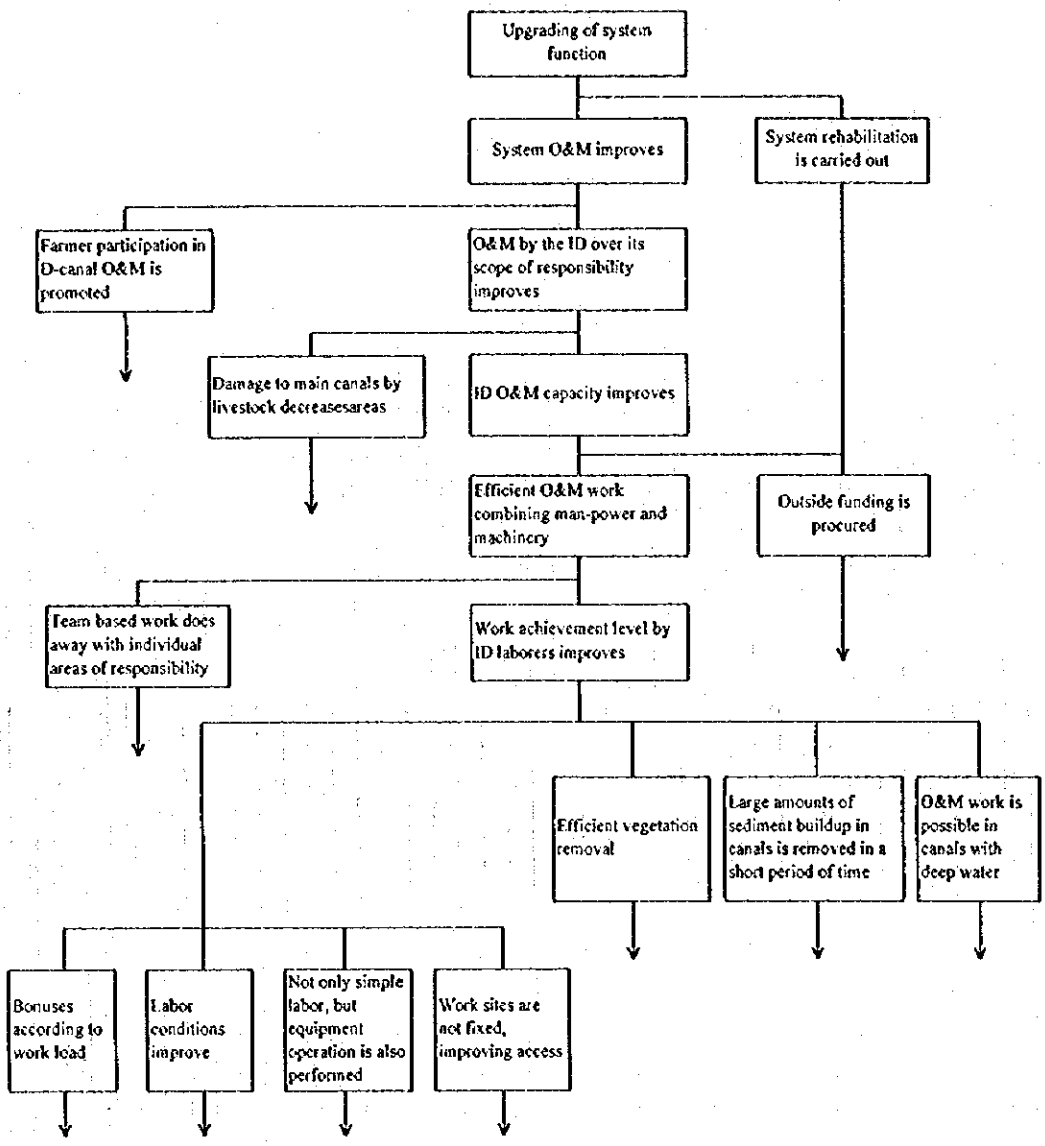
(3) Target Analysis

On the basis of the problem flow chart, mitigating measures and their impact were considered. In order to significantly improve the O&M capacity of the ID, it is necessary to establish a maintenance unit whereat the minimal requirement of light and heavy equipment are deployed and the a shift be made to joint O&M operations among the assigned laborers utilizing this machinery. In order to effectively realize such team based operations, it is necessary that laborers be transported from their homes to the work sites. This transport would be provided by the tractors, etc. deployed at the said unit. In the same manner, transport of farmers to the D-canal work areas would also be possible. Furthermore, by strengthening the FOs, farmer participation in D-canal maintenance would be promoted and through cautioning of livestock owners of the stipulations under the Agrarian Services Act regarding responsibility for damage caused by animals, such damage can be reduced. The

combination of the above mitigating measures will serve to address the central problem of upgrading system function.

A target flow chart is shown in Figure 6.6.1-2.

Figure 6.6.1-2 Target Flow for System Management (Logical Frame)



6.6.2 Examination of Shift of O&M Responsibilities to the Farmers · Private Sector

In addition to considering the establishment of a maintenance unit equipped with necessary machinery, the following scenarios are also considered.

C-1 : Increase of government O&M budget, thereby increasing labor staff and procuring vehicles

C-2 : Contracting of O&M responsibilities now under the jurisdiction of the ID to the private sector

C-3 : Total transfer of system O&M responsibility to the FOs

C-4 : Restructure the ID's O&M capabilities by establishing a maintenance unit, deploying sufficient labor and machinery, and carrying out team based operations

1) Scenario analysis

Case-1

National government financial situation is under duress, with O&M budget fixed (in real terms this budget is decreasing in actual value due to inflation). Increase in O&M budget is not practical.

Case-2

As most O&M works are civil construction related, civil contractors would be primarily considered.

Such contractors in Hambantota district are all small, and do not possess construction equipment. Contractors in Sri Lanka are classified according to 7 grades on the basis of contract amount.

Categorization of Financial Terms

GRADE 1	.....	Unlimit (43 firms, maximum ¥ 800,000,000)		
GRADE 2	.....	Up to	Rs. 50	Million (approx. ¥ 100,000,000)
GRADE 3	.....	Up to	Rs. 15	Million (approx. ¥ 30,000,000)
GRADE 4	.....	Up to	Rs. 5	Million (approx. ¥ 10,000,000)
GRADE 5	.....	Up to	Rs. 3	Million (approx. ¥ 6,000,000)
GRADE 6	.....	Up to	Rs. 1	Million (approx. ¥ 2,000,000)
GRADE 7	.....	Up to	Rs. 1.5	Million (approx. ¥ 1,000,000)

All such contractors in Hambantota district are at grade 6 or below, with almost all at grade 7. Contractors with their own equipment or capability of leasing equipment are grade 3 and above, and these are located in the Colombo

metropolitan area. In light of above, the following problems would be anticipated under a scenario of contracting of O&M works to the private sector.

- Under the present system in effect in Sri Lanka, O&M works are contracted out on an overall work package basis. Accordingly, the ID must undertake confirmation survey of work volume, preparation of tender documents, tendering procedure, work supervision, and confirmation of achieved work quantities. This enormous amount of work is overly taxing on the ID's present capacity.

- Confirmation survey of work volume as well as the actual works themselves would have to be done within the limited 1 month period while water flow in the canals is stopped. To accomplish all this in such a restricted time frame would be extremely difficult.

- As work site areas are narrow and long, work efficiency is low and costly

- As the nature of the required works is large volume, short-term and intensive, it is not expected that they would be attractive to many civil construction firms.

- For system operation, it would be necessary to permanently assign 4~5 persons. Such personnel would need to have good knowledge and experience with irrigation systems, and such personnel are extremely few in private sector contracting firms.

In addition to the fact that the nature of the O&M works do not lend themselves to a commercial base, the biggest problem is would be the issue of the present ID permanent laborers who have labor guarantees until retirement. As a result, even after contracting of works to the private sector, the ID would remain responsible for the employment of this labor force which is outside its current budgetary capacity to do so.

In light of the above problems, contracting of O&M works to the private sector over the mid-term (5~6 years) is considered extremely difficult. In order to do this over the long term, a fundamental national policy would be necessary comprehensively dealing with procedures for such contracting, budget procurement, and the presently employed ID laborers.

As of the present, there have been no cases where irrigation system O&M has been contracted out to the private sector.

Case-3

In order to effect complete transfer of responsibilities for the systems to the farmers, the following stage wise pre-conditions should be considered.

a) Formal transfer of responsibility for all D-canals to the FOs

b) Restructuring of the O&M capacity of the ID to a level where it can satisfactorily maintain its scope of responsibility for the systems

c) Maintaining the system at a satisfactory level while steadily increasing FO participation in O&M activities

d) Transfer of system O&M technology and know how to the farmers

e) The system functions well, high and sustainable agricultural productivity is achieved, farmer income increases, FO financial base is sound, and farmer desire is high for complete transfer of responsibility for the system

In the case of the target schemes, no official transfer of responsibility for D-canals has as yet taken place. Outside of the Badagiriya scheme, no unofficial transfer has been effected. Furthermore, as discussed earlier, the overall O&M status of the schemes is poor due to inadequacies in ID capacity to perform the same. With consideration to the foregoing, mid term goals (around 5 years) would be a) and b), after which the long term goals (10 years) of c), d) and e) would be aimed at.

In order to achieve the ultimate goal, the following conditions would have to be met over the mid-term.

- Official transfer of responsibility for D-canals and anicuts to the FOs
- Improved O&M, and scheme management capacity of the ID

Case-4

O&M activities of the ID with regards to the schemes is carried out by staff at the Irrigation Department branch offices under the Irrigation Department Hambantota Range. As discussed earlier, work is inefficiently carried out manually with a low level of achievement. It is considered necessary that at least a minimal level of machinery be deployed and that a maintenance unit (1 location) be established under the Hambantota Range, and operational units (3 locations) under each branch office.

On the basis of the above, Case-4 is to be adopted with specific measures for implementation to be pursued under the Project.

6.6.3 Plan to Improve the Operational and Maintenance Capacity of the Irrigation Department

(1) Range Maintenance Unit (RMU)

A Range Maintenance Unit would be established near the Liyangastota scheme area roughly in the center of the overall Project area. The unit would be under the jurisdiction of the Hambantota ID Range.

The RMU would comprise an office, garage and small workshop, and lodging facilities for equipment operators and staff.

Under the RMU would be 3 Operations Units (OU). Each would be responsible for an individual scheme under the Project. They would be established at the Weeraketiya branch office (Muruthawela Reservoir scheme), the Ambalantota branch office (Liyangastota scheme) and the Weelawila branch office (Badagiriya scheme). Each would have an office and garage within the branch office compound.

Machinery deployment at the RMU and OUs would be as follows.

List of Machines Required in Range Machine Unit (3 Operation Units)

No.	Machine	Per OU	RMU
1	Dozer 130 HP	1	3
2	Crawler excavator (drag line)		1
3	Back hoe cum loader (JCB)	1	3
4	Motor grader		1
5	Tractor trailer	5	15
6	Mechanical rammer compactors	4	12
7	Portable vibrator rollers	2	6
8	Water pumps (2")	2	6
9	Concrete mixers (self driven and portab	2	6
10	Trailer type water bowser	1	3
11	Poker vibrators	3	9
12	Low bed trailer		1
13	3T lorry		1
14	Weeding machine	15	45

(2) Personnel Deployment Plan

Number of permanent laborers currently employed by the ID reach 87 persons, and are deployed as follows.

ID permanent laborers	Hambantota Range
Weeraketiya Office	45 persons
Ambarantota Office	36 persons
Badagiriya	6 persons
Total	87 persons

Duties of the above laborers include a range of operation only, operation and maintenance, and maintenance only. After establishment of the RMU as well, operational labor would be necessary.

1) System operational staff

Operational staff assigned to each scheme would be as follows.

Scheme	Operation
Muruthawela	
LB	2
Urubokka Oya	2
Kirama Oya	2
Liyangastota	
WLB	3
WRB	3
Badagiriya	2
Total	14 persons

2) PMU

Personnel assigned to the small workshop at the PMU would be as follows

Work supervisor	1
Mechanic	2
Laborer	3
Inspection mechanic	3
	9 persons

In principal, the above work force would be supplied from among personnel already employed at the subject offices. Training would be a combination instruction at the ID workshop at Galle, and dispatch of instructors to the PMU. Operators would also be trained and every effort made to maximize use of currently employed labor.

3) Equipment operators

It is intended that the equipment deployed at the PMU be utilized simultaneously under all 3 schemes. Accordingly, the following equipment operators would be deployed.

	Operator
Weeraketiya OU	3
Ambalantota OU	3
Badagiriya OU	2
PMU	4
	12 persons

4) ID labor

Ten ID laborers for work in combination with machine use would be assigned for a total O&M staff included that in 1)~3) above of 45 persons for the 3 schemes. In getting the O&M system up and running, training of labor as well as a natural diminishing of the labor work force would be prerequisites. Laborers performing O&M works with light machinery in collaboration with the farmers would be an impetus for the latter's greater participation in system O&M activities.

6.6.4 Operational Plan for the Maintenance Units (RMU, OU)

Given present government policy towards management of irrigation systems and current financial constraints, it is a pre-condition that the operational costs for the RMU and OU do not exceed the current level of funding outlay. Although a natural diminishing of the ID labor force cannot be anticipated over the short term, and thus the labor force would increase over its current labor, a contribution by the farmers to O&M cost to be allocated to the RMU and OU operation would enable sustained and efficient O&M within current spending levels over the mid term.

(1) Collection of O&M Fees

1) Request for the PMC

With regards to dispatch of maintenance teams from the RMU and OUs, the PMC would meet at the end of the growing season to determine scope and time period for required maintenance works, and make request to the RMU accordingly. The RMU would then draw up a work plan, and enter into contract with the PMC for the desired works. Of the costs required for such works, the farmers would bear the expenses for fuel, operator fees, etc.

2) Analysis of cost to be borne by the farmers

Taking the Liyangastota WLB scheme (6,310 acs) as an example, cost to be borne by the farmers was analyzed. Operational plan and expenses for principal equipment are as follows.

Machinery Working Plan and Expenditures (Liyangastota / WLB schemes)

Machinery	Nos.	Working days/year	Working hrs/year	Plant unit rates	Plant expiry year	Operation expiry year
				Rs	Rs	Rs
Dozer 130 HP	1	60	360	2,047	736,920	221,076
Drag line	1	30	180	2,300	414,000	124,200
Back hoe	1	60	360	1,605	577,800	173,340
Motor grader	1	30	180	1,798	323,640	97,092
Tractor trailer	5	100	3,000	351	1,053,000	315,900
						931,608

Area: 6,310 acs (2,553.4 ha)

Equipment costs are based on the ID's Unit Rates for Construction Works, 1995. On the basis of the above calculation, equipment operating cost (to be borne by the farmer) is Rs 148 / ac (Rs 365 / ha).

3) Farmer willingness

During the period 1984~88, the IMD collected water use tariffs of Rs 100 per acre under the INMAS program in the Muruthawela LB, Liyangastota WLB and Badagiriya scheme areas.

One of the reasons for suspension of the collection program was a consensus among the farmers that the paid tariffs were not being applied to the upkeep of their irrigation systems. As one part of the Study Team's base line survey, farmers were asked as to whether they would be willing to bear a portion of the rehabilitation works cost. Their responses are tabulated below.

Willingness to Constribute 10% of Rehabilitation Costs and Methods of Contribution by Type of Irrigation Scheme

Willingness/ method	Muruthawela		Liyangastota		Badagiriya		Total	
	No.	%	No.	%	No.	%	No.	%
Willingness								
Yes	163	84.9	65	81.3	14	73.7	242	83.2
No	37	15.1	21	18.8	7	26.3	65	16.8
Total	200	100.0	86	100.1	21	100.0	307	100.0
Methods								
Cash	35	18.0	18	21.4	6	28.6	59	19.7
Labor	157	80.9	66	78.6	15	71.4	238	79.6
Kind	2	1.0					2	0.7
Total	194	100.0	84	100.0	21	100.0	299	100.0

It was evident from discussions with the farmers that they would be willing to bear a portion of the said cost if there were tangible evidence as a result in terms of scheme improvement.

It is considered that a water use tariff in the range of Rs 150~200 per acre could be collected on a sustainable basis if (i) water use fees were paid by the farmer to his own FO, which would then take responsibility for the consequences of payment on behalf of the organization, and (ii) the RMU carries out a high level of maintenance and repair works.

6.7 Environmental Conservation Plan

6.7.1 Environmental Conservation Plan and Official Guiding Agencies

The environmental conservation plan under the Project will be carried out under the supervision of the Hambantota District Environmental Agency (DEA). The DEA comprises the following District Environmental Committee members.

Environment related item	Member	Relation to the Project Strongly related : O somewhat related: Δ
1. Integrated rural development	Director, Hambantota IRDP office	O
2. Health and sanitation	Deputy Director, Southern Province Health Services	O
3. Agriculture	Assistant Director, Agriculture, Hambantota	O
4. Forest preservation	Staff, Mirijawila Forestry and Forest Preserve Office	O
5. Education	Deputy Director, District Educational Office (Tangalle)	Δ
6. Wildlife preservation	Staff, Department of Wildlife Conservation Agency (Kataragama)	O
7. Land issues	Staff, District Land Issues Office	Δ
8. Poverty issues	Staff, District Savodaya Office	Δ
9. Women's issues	Staff, Women's Development Federation	O

6.7.2 National Environmental Action Plan (NEAP)

The environmental conservation plan under the Project is defined by 2 of the 11 sections contained in the NEAP (sections 2.0 and section 3.0). These 2 sections pertain to water sources, and stipulate the following with regards to the prevention of adverse environmental impacts under irrigation schemes.

<Section 2 : Alleviation of Water Quality Problems>

Water contamination is the result of residue from agro-chemical and chemical fertilizers, and soil erosion stemming from poor agricultural management. The cause of this is cited as lack of a continuous monitoring program, lack of technical facilities, inadequate professional know-how, and inadequacies in the related institutional system. Further to this, it is indicated that research and information dissemination with regards to these problems is not being carried out.

<Section 3 : Prevention of Adverse Environmental Impact due to Irrigation>

The compound negative effect to the environment of salt damage, forest inundation, ecological destruction, fostering of water borne diseases and land loss due to burrow and quarry pits as a result of irrigation / drainage projects is quantitatively unknown. Accordingly, measures to mitigate these impacts must be based on precise data from observations in the field.

6.7.3 Environmental Conservation Plan

Based on the above NEAP, the following environmental conservation plan will be carried out under the Project.

(1) Plan to mitigate impacts from agro-chemicals
(2) Plan to contain malarial infection
(3) Green belt plan
(4) Environmental educational program

6.7.4 Items of Concern Officially Cited by the Central Environmental Authority (CEA)

In official correspondence from the CEA to the executing agency for the Project (MIP&E), the following 3 points were cited as items of concern with regards to this specific Project.

(1) Liyangastota scheme

On the basis of discussions with the Forest Department, trees should be planted on main and feeder canal embankment.

(2) Muruthawela Reservoir scheme

On the basis of discussions with the Forest Department, trees should be planted on the left and right embankments of the main canal.

(3) Badagiriya scheme

- On the basis of discussions with the Forest Department, trees are to be planted on the embankment of the right bank feeder canal and the main canal.

- The abandoned farm land (80 ha) at the most downstream part of the scheme is reportedly an area through which elephants for the Bundala national park move. Measures in this regard to be taken to protect corps during the planting season should be discussed with the Department of Wildlife Conservation.

Under the environmental conservation plan for this Project, the above environmental issues are to be handled as per below.

With regards to the tree planting stipulated in (1)~(3) above, collaboration would be maintained with the Forest Department during the implementation stage, and a green belt plan pursued in accordance with the following program. In the same manner, close consultation would be maintained with the Department of Wildlife Conservation during the implementation stage of the Project concerning elephant movement in the stipulated area.

6.7.5 Implementation Program

The above environmental plan will be carried out under the following implementation program.

(1) Plan to Mitigate Impacts from Agro-Chemicals

<Extension under IPM>

In Hambantota district, policy to control the use of agro-chemicals is pursued under the demonstration schools held within the framework of the IPM (Integrated Pest Management) program. Based on the achievements of the program to date, it is the intention of the district to extend the same to farmers throughout the district. It is thus anticipated under the Project that the district Agricultural Office will convene such demonstration schools in each of the scheme area as early as possible for systematic extension to the farmers in these areas. In effecting the foregoing, it is recommended that the following precondition be met.

<Manual preparation and Instruction>

Residue from agro-chemical use builds up in the soil, groundwater, and still water bodies such as marsh, etc., steadily working its way in more concentrated amounts up the food chain to eventually impact on the health of human beings. Thus, instruction to farmers in the appropriate application amounts of such chemicals is necessary, and towards this end manuals would be prepared centering on the efforts of the district Agricultural Office with guidance from the AD main headquarters. Through instruction in the field an distribution of manuals, proper application methods for agro-chemicals and measures to mitigate impacts on human health would be promoted. From the first to the second year of the program, instruction to farmers would be carried out at least 1 time before the chemical spraying period, and during spraying itself in-situ instruction would be provided. From the 3rd year, instruction would be provided once yearly.

(2) Plan to contain malarial infection

Malaria chronically affects Hambantota district within which the 3 schemes are located. Incidence of the disease is particularly noted in the Badagiriya scheme area. Treatment and preventive measures targeted at the general populace are carried out centered on hospitals and the RMOs (Regional Malaria Offices). In addition, a malarial containment campaign and educational program are carried out to heighten

awareness of the citizenry regarding general preventive practices for those living near water bodies, mosquito repelling methods, and services available at health facilities for infected persons.

Efforts to contain the spread of malaria would include:

- An anti-malaria campaign
- An insecticide spray campaign

With regards to the above efforts, it is essential that the PMCs in the scheme areas establish measures in collaboration with the concerned health and medical agencies, the Regional Malaria Office and the ID.

(3) Green belt plan

Under the land resources component of the NEAP, the responsibility over the long term of the ID to development a green belt plan to preserve reservoir areas is a topic. Also, tree planting along main canals is an environmental criteria under the project approval procedures of CEA.

As a result, under the Project, steps will be taken to plant areas denuded in the course of rehabilitation works at water edges, creating a green belt along main canals, tanks, etc.

The said planting will be done in consultation with the Forest Department with regards to planting method and tree varieties.

(4) Environmental Education

Environmental education with regards to (1), (2), and (3) above would be carried out within the framework of the training program to strengthen FOs, and done in collaboration with the district Agricultural Office and other related agencies. This would include basic education on environmental issues to heighten the general awareness of scheme residents as to the importance of environmental conservation.

In the course of the above educational efforts, the full cooperation of the Women's Development Federation and the Savodaya would be sought in light of the need for maximum women's participation in such an educational program given their close contact with water sources in the course of household chores including meal preparation, home garden tending, laundry, etc., and overall central role in household sanitation and health.

6.8 Project Monitoring and Environmental Impact Assessment Plan

The following monitoring system will be formulated during implementation of the Project, so as to immediately begin observations and recording upon completion of the construction works. The results of such monitoring in the initial stages would be analyzed, and Project impacts identified as feedback data for analysis of any necessary countermeasures or Project modifications over the long-term. Monitoring would cover the following.

- Irrigation system efficiency
- Agricultural production
- Environment related aspects

(1) Monitoring of Irrigation System Efficiency

1) Rainfall observations

At present, there are no rainfall gauging facilities in the scheme areas. Such facilities would be established in all 3 scheme areas under the Project and rainfall records kept. In the case of schemes which include a reservoir, the said gauging facility will be established at the reservoir site.

2) Canal discharge observations

Under the Project, discharge gauging facilities will be established at key points along canals. Such observation points would comprise start points for main canals, and start points and terminal points for major branch canals. Observations would be carried out daily during the planting season.

3) Executing agency

The above monitoring would be carried out by the Project Manager for each scheme, or TA and operation related ID labor under the guidance of the ID engineer in charge.

4) Analysis of system efficiency, and feedback

At the end of the cropping season, rainfall and discharge records, as well as the results of agricultural productivity monitoring described below, would be applied to analysis of irrigation efficiency under the schemes. Results of this analysis would be submitted to the relevant government agencies and the scheme PMCs. Particularly in the case of the PMCs, these findings would be applied to formulation of cropping and water distribution plans for the coming season. With the collaboration of the branch office engineers in charge and the ID main office, observed records would be converted to a computer data base.

(2) Agricultural Production Monitoring

The agricultural officer (AI) in charge at the Project Office would monitor harvest on a crop-wise basis at the end of each planting season to assess achievement levels under the agricultural development plan, provide base data for cropping plan for the coming season.

1) Target farmers

For each crop, the number of target farmers for monitoring survey would be equal to 1% (1 household out of 100) of the total number of farmers cultivating that crop. Target households would be the same each season in order to clearly grasp yearly and seasonal fluctuations in crop production. They would be selected by the FO representatives and AI during the course of the rehabilitation works, and it would be important the AI thoroughly brief the selected households to be monitored on the details of the monitoring program.

No. of households to be monitored, and number of monitoring stat-sheets are planned as follows.

	No. of households	Households to be monitored	No. of stat-sheets
1) Liyangastota RB	2,600	26	3
2) Liyangastota LB	3,100	31	3
3) Muruthawela LB	2,500	25	3
4) Urubokka Oya	3,700	37	4
5) Kirama Oya	4,100	41	4
6) Badagiriya	686	7	1
Total	16,700		

note: The approx. 3,000 nos. of landless households under the Liyangastota scheme have not been included in the total number of households.

2) Monitoring items

The AI would prepare the monitor stat-sheets to be distributed to each household to be monitored, as well as the stat-cards to be filled out for each 10 households, and on the basis of the results of the same, compile a report on the findings of monitoring on a 1,000 household unit basis and make recommendations for the coming cropping season.

Monitoring items would be as follows:

① Paddy		② Banana		③ Chili	
1. Cropped area	( ) ac	1. Cropped seedling no.	( ) nos.	1. Cropped seedling no.	( ) ac
2. Superior seed from DOA	(Y.N.)	2. Remaining no.	( ) nos.	2. Fertilizer application	( ) kg
3. 4 mo. variety	( ) kg	3. Fertilizer application	( ) kg	3. Agro-chemical cost	Rs ( )
4. Fertilizer application	( ) kg	4. Manure use	( ) kg	4. Yield (raw)	( ) kg
5. Agro-chemical cost	Rs ( )	5. Agro-chemical cost	Rs ( )	5. Yield (dried)	( ) kg
6. Total yield (per season)	( ) bu	6. Semi-annual yield (per season)	( ) kg		

3) Environmental monitoring

Environmental related monitoring would cover the 3 stages of present conditions, construction period, and post-construction operational period. Monitoring would provide data for emergency mitigation measures or prior prevention of adverse Project impacts, and in line with the environmental action plan, would focus principally on those items for which some concern for negative impacts under the Project would be warranted, i.e. (i) water quality, (ii) soil erosion and (iii) impacts to the environment from agro-chemicals. This environmental monitoring would be done by the following agencies at the designated times.

Executing agency	Monitoring content	Time period
Agricultural Research Center (ARC)	water quality	2 times per year (1 time per cropping season)
Agricultural Research Center (ARC)	soil quality	2 times per year (1 time per cropping season)
District Agricultural Office	agro-chemical use; status of IPM	2 times per year (1 time per cropping season)
District Environmental Committee (DEC)	overall environmental status of schemes; mitigating measures	2 times per year (1 time per cropping season)

1) Water quality monitoring

Water quality monitoring would be carried out at designated location at tank intakes, irrigation canals, drainage canals, etc. under each scheme. This would be commenced after start of construction works and be done in collaboration with the ID and ARC Water Management Laboratory with reference to the water quality standards of the CEA.

2) Soil quality monitoring

Soil monitoring would be done of a selected area in the Badagiriya scheme, focusing on saline concentration. Analysis would be done at the ARC Soil Science Laboratory in line with IIMI criteria.

3) Monitoring of agro-chemical use

The DAO is currently monitoring the progress of the Integrated Pest Management (IPM) program. It is thus important that the DAO continue this monitoring including that of application amounts of agro-chemicals and fertilizer. Within the framework of the IPM demonstration program, base line survey would be carried out for comparative analysis of targets and actual achievement.

4) Monitoring of overall environmental situation

It is necessary to monitor the scheme areas with regards overall environmental conditions, including the occurrence of any abnormal phenomenon, through information gathering form the FOs and the various related agencies in the district. This information would be collated by the District Environmental Committee in collaboration with the CEA and related government agencies in the district.

6.9 Training Program

6.9.1 Training Program to Strengthen Farmer Organizations

A training program in line with the items indicated below is planned for personnel of concerned government agencies (ID, IMD, DAS, Provincial Government), representatives of farmer organizations and farmers in the Project area. Number of trainees would comprise approximately 50 persons from the concerned government agencies, 2 farmer representatives from each subject unit (total of 300 persons) and around 20 farmers from each FO unit. Total number of trainees would be 3,000 for whom the courses indicated below would be given. Instructors would be upper level experts from the concerned government agencies and personnel from the Consultant.

Training course	No. of trainees	Duration of course (days)	Total number of trainee days
Overseas training (government personnel)			
FO managment	10	30	3,000
Transfer of responsibility for irrigation system management	10	30	3,000
In-country training (government personnel)			
Rehabilitation project planning	50	2	100
System O&M	30	2	60
Water management	20	2	40
Accounting management	30	2	60
Project management	20	5	100
Environmental conservation	50	3	150
Computer skills	20	5	100
Rehabilitation project implementation	50	3	150
Farmer representative training			
Finacial management	300	2	600
Participation in rehabilitation projects	300	2	600
Environmental conservation	300	2	600
System O&M	300	3	900
Agricultural technology	300	2	600
Farmer training			
Awareness of the nature and import of rehabilitation projects	3,000	1	3,000
System O&M	3,000	1	3,000
System O&M	3,000	1	3,000
Agricultural technology	3,000	1	3,000
Participation in rehabilitation projects	3,000	1	3,000

6.9.2 Training System for O&M System Strengthening

A training program in line with the items indicated below is planned for personnel of the ID, IMD and Provincial Government (total of 230 trainees).

Training course	No. of trainees	Duration of course	Total number of trainee-days	Remarks
Overseas training (ID, IMD personnel)				
Master course				
Water management	2	16 mo.	32 m/m	
Quality control	1	16 mo.	16 m/m	
System management	10	3 mo.	30 m/m	
Water management	6	2 mo.	12 m/m	
Machinery O&M	3	2 mo.	6 m/m	
In-country training (ID, IMD, Provincial Government personnel)				
Mechanic training	20	3 mo.	60 m/m	Targeted at ID permanent laborers
Master course				
Quality control	3	12 mo.	36 m/m	
Rehabilitation planning	40	3 days	120 m/d	
System O&M	40	7 days	280 m/d	
Quality control	30	5 days	150 m/d	
Project management	10	7 days	70 m/d	
Awareness seminar	230	1 day	230 m/d	
Computer skills	30	5 days	150 m/d	
Office and administrative skills	60	7 days	420 m/d	
Heavy equipment operation	20	3 mo.	60 m/m	Targeted at ID permanent laborers

Chapter 7

CHAPTER 7 PROJECT PLAN

7.1 Project Components

The Project comprises the following 3 plans and 2 programs.

Plan and program	Main content and objectives
<Plan>	
i. Rehabilitation plan for existing irrigation / drainage system	Rehabilitation works for deteriroated canal (total length: 355 km), anicuts, turnouts and appurtenant facilities to recover system function.
ii. Plan to strengthen operation and maintenance capability	In order to strengthen the O&M capability for canal system under the jurisdiction of ID, an equipment procurement and maintenance unit (1 location), and an operator unit (3 locations).
iii. Plan to strengthen and support farmer organizations	FO management offices to be established at 16 locations in the 3 scheme benefit areas to facilitate management of FO activities.
<Program>	
i. Program to strengthen participatory management system	A program for training of ID staff (responsible for O&M in the scheme areas), FOs and related government agency staff. This program would begin prior to actual start of construction. Knowledge gained during the training would then be applied to the participatory management system to actually commence during the construction period.
ii. Monitoring and environmental impact assessment program	To systematically track project progress through quantitative evaluation of achievement of project goals (3 stages of pre-construction ~ construction ~ post construction) and assessment of environmental impact.

7.2 Plan and Program Components

(1) Rehabilitation Plan for Existing Irrigation / Drainage Systems

This plan comprises the following 3 schemes, with rehabilitation content as follows.

Scheme	Sub-scheme	Design area (ha)	Canal rehabilitation (km)		Appurtenant works		
			Masonry lining	Unlined	Structural works	Intake works	Farm / O&M roads (new)
1. Liyangastota	WRB	2,454	28.6	44.0	274	1	12
	WLB	2,553	43.1	41.9	446	-	13
Total		5,007	71.7	85.9	720	1	25
2. Muruthawela	Left Bank	1,700	41.5	33.1	750	-	-
Reservoir	Urubokka	2,262	52.1	36.1	475	8	11
	Kirama	1,511	31.9	17.6	619	18	27
Total		5,473	125.5	86.8	1,844	26	38
3. Badagiriya							
Total		686	16.2	2.3	341	-	-
Total		11,166	213.4	175.0	2,905	27	63

(2) Plan to strengthen operation and maintenance capability

The following O&M construction equipment will be procured (total of 112 nos.) for deployment at the Maintenance Unit (1 location) and Operation Unit (3 locations) to be established under the Project.

Plan	Qty.	Building construction works				Equipment item and deployment plan	
		Work shop (300 m²)	Office (150m²)	Garage (300 m²)	Management office (96 m²)	Dragline, motorgrader, trailer, lorry	Bulldozer, backhoe, trailer, compressor, etc.
1. Equipment procurement	all 14 types (112 units)					procurement of 4 types (1 unit each = 4 units)	procurement of 10 types (total 108 units)
2. Range Maintenance Unit (RMU)	1 location	1 building	1 building	1 building	1 building	deployment of total 4 units of above	
3. Operation Unit	3 locations		1 building	1 building			deployment of total 108 units of above

(3) Plan to strengthen and support farmer organizations

The following facilities will be constructed, and equipment deployed in the scheme areas to support the activities of FOs.

Scheme	No. of locations	Building construction works			Equipment deployment		
		Conference room, office (150 m²)	Fertilizer, seed storage (45m²×2)	Garage (75m²)	2 wheel tractor	Motorbike	Office equipment
1. Liyangastota	WRB × 3 locations	3 buildings	3 buildings	3 buildings	6 nos.	3 nos.	1 set
	WLB × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
Total		6 buildings	6 buildings	6 buildings	12 nos.	6 nos.	1 set
2. Muruthawela Reservoir	LB × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
	Urubokka × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
	Kirama × 3 locations	3 buildings	3 buildings	3 buildings	6 nos	3 nos	1 set
Total		9 buildings	9 buildings	9 buildings	18 nos.	9 nos.	1 set
3. Badagiriya	1 location						
Total		1 building	1 building	1 building	2 nos.	1 nos.	1 set
Total	16 locations	16 building	16 building	16 building	32 nos.	16 nos.	16 sets

(4) Program to strengthen participatory management system

The participatory management system will be promoted under the Project, whereby D-canal and below will be transferred to the FO jurisdiction as early as practical. Up till now however, irrigation ordinance has stipulated that the responsibility for all system operation and management be under the ID. Accordingly, it will be essential the ID personnel have prior, thorough training in this new type of participatory management system. Furthermore, the participatory type system is not aimed solely at facility O&M. Staff of the AD who are in charge of the schemes will be called upon to provide farm management training to the farmers, including guidance in crop diversification technology, post harvest processing and storage of farm produce, extension, marketing, etc. under the agricultural development component of this Project.

A training and demonstration program is accordingly included under the Project, to be based on the currently on-going INMAS and MANIS programs, and to be targeted at the farmers, irrigation office personnel, and concerned AD personnel.

Also, during the above training period, steps will be taken to prepare farmers for sub-contract participation in the rehabilitation works during construction.

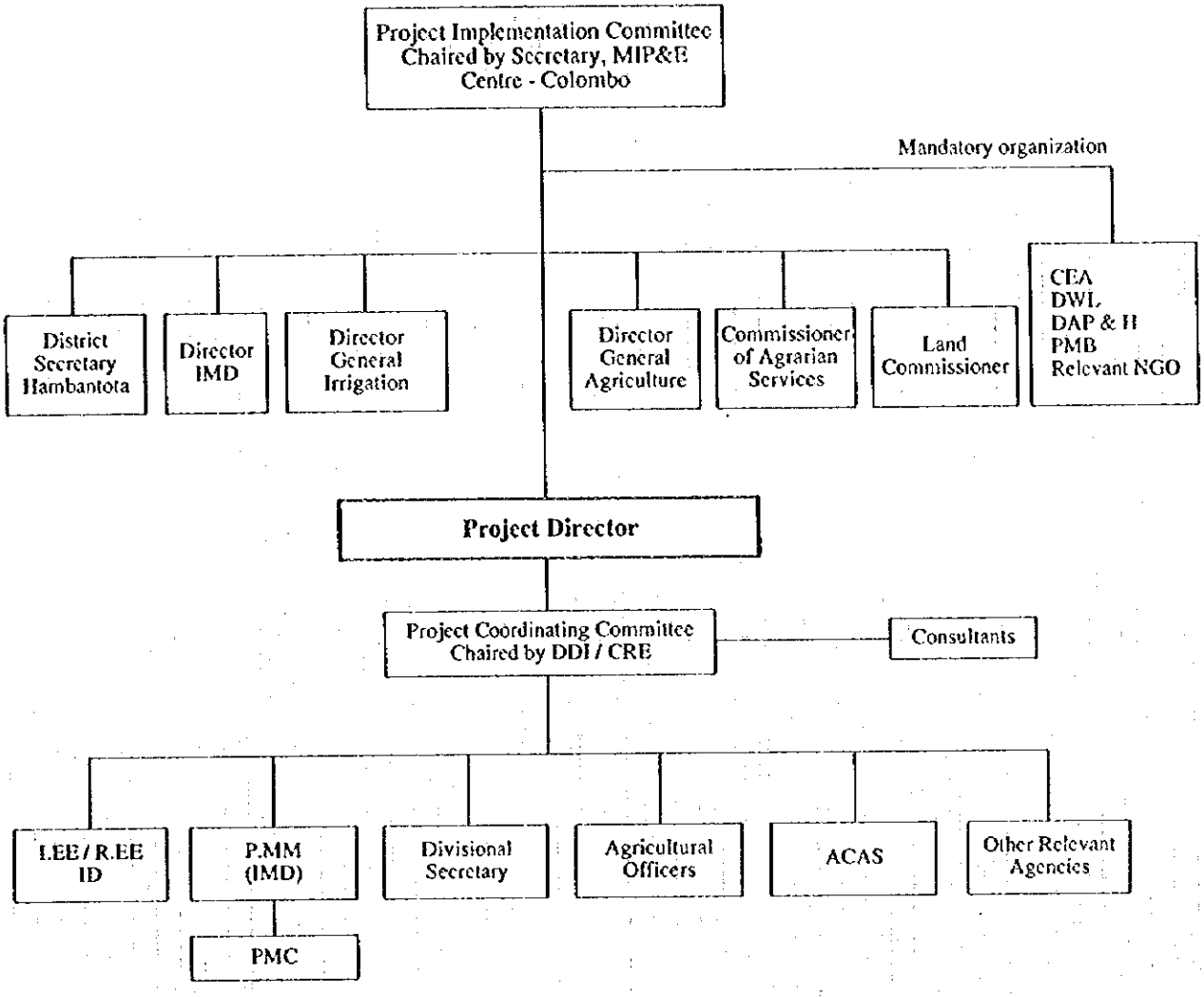
(5) Monitoring and Environmental Impact Assessment Program

This is to be carried out as follows.

Program	Executing agency	Content	Implementation method
i. Irrigation efficiency	Irrigation Office in the scheme area	· Installation of automatic rainfall gauges · Discharge observations	· 1 site for each of the 3 schemes · During good weather during the planting season
ii. Farm production	Project Office in each scheme area	· Preparation of monitoring sheet	· 2 times per year
iii Environment	Agricultural Research Center (ARC) District Agricultural Office (DAO) District Environmental Agency (DEA)	· Soil and water quality monitoring · Preparation of monitoring sheet for agro-chemical and fertilizer use · Survey of existing conditions pertaining to water quality, soil, agro-chemical contamination, malaria	· 2 times per year · 2 times per year (at holding of committee meetings · Report on environmental findings for the 3 schemes

7.3 Project Implementation Set-up

The subject rehabilitation project is not directed solely at the improvement of irrigation facilities, but rather aims at well at a range of related aspects including the strengthening of farmer organizations, upgrading the functioning of the various farmer support activities, implementation of project monitoring programs, etc. In order to effectively implement all of the foregoing a well coordinated executing structure involving on related agencies is essential. In this regard, it is planned that the Ministry of Irrigation, Power and Energy select appropriate personnel to be responsible for project implementation (Project Director). Centering on the function of the PD, it is anticipated the a coordinating set-up in line with the following figure be established to pursue Project implementation.



MIP & E	- Ministry of Irrigation, Power & Energy
CEA	- Central Environment Authority
DWL	- Department of Wild Life Conservation
DAP & H	- Dept. of Animal Production and Health
PMB	- Paddy Marketing Board
ACAS	- Asst. Commissioner of Agrarian Services
PMC	- Project Management Committee
DDI	- Deputy Director, Irrigation
CRE	- Chief Resident Engineer
I.EE	- Irrigation Engineers
R.EE	- Resident Engineers
P.MM	- Project Managers

Figure 7.3-1 Project Implementation Set-up

7.4 Implementation Plan

Detailed design of rehabilitation works for the existing irrigation systems would commence in August 1997 following funding allocation preparations by the Sri Lankan government. Completion of tendering procedures is targeted for June 1998, with construction to last for 3.5 years from July 1998 to 2001. Implementation schedule is indicated in Figure 7.4-1.

7.4.1 Implementation Schedule

(1) Preparation period (Sept. 1996 ~ June 1998 : 1 year and 9 months)

Funding allocation preparations : Sept. 1996 ~ June 1997 (10 months)

Consultant selection : Jan. 1997 ~ July 1997 (7 months)

Detailed design : Aug. 1997 ~ Jan. 1998 (6 months)

Tender document preparation (tendering and tender evaluation) :
Feb. 1998 ~ June 1998 (5 months)

(2) Construction period

Start: July 1998
Finish: 2001 (3.5 years)

(3) Early start of Plan to Strengthen Operation and Maintenance Capability and Plan to Strengthen and Support Farmer Organizations

Either coinciding with or prior to start of the rehabilitation construction works, it is proposed that the equipment procurement and building facility construction works be commenced for these 2 plans.

(4) Program to Strengthen Participatory Management System

It is proposed that this program be initiated prior to actual start of construction works. Program period would last for 6 months from January to June 1998.

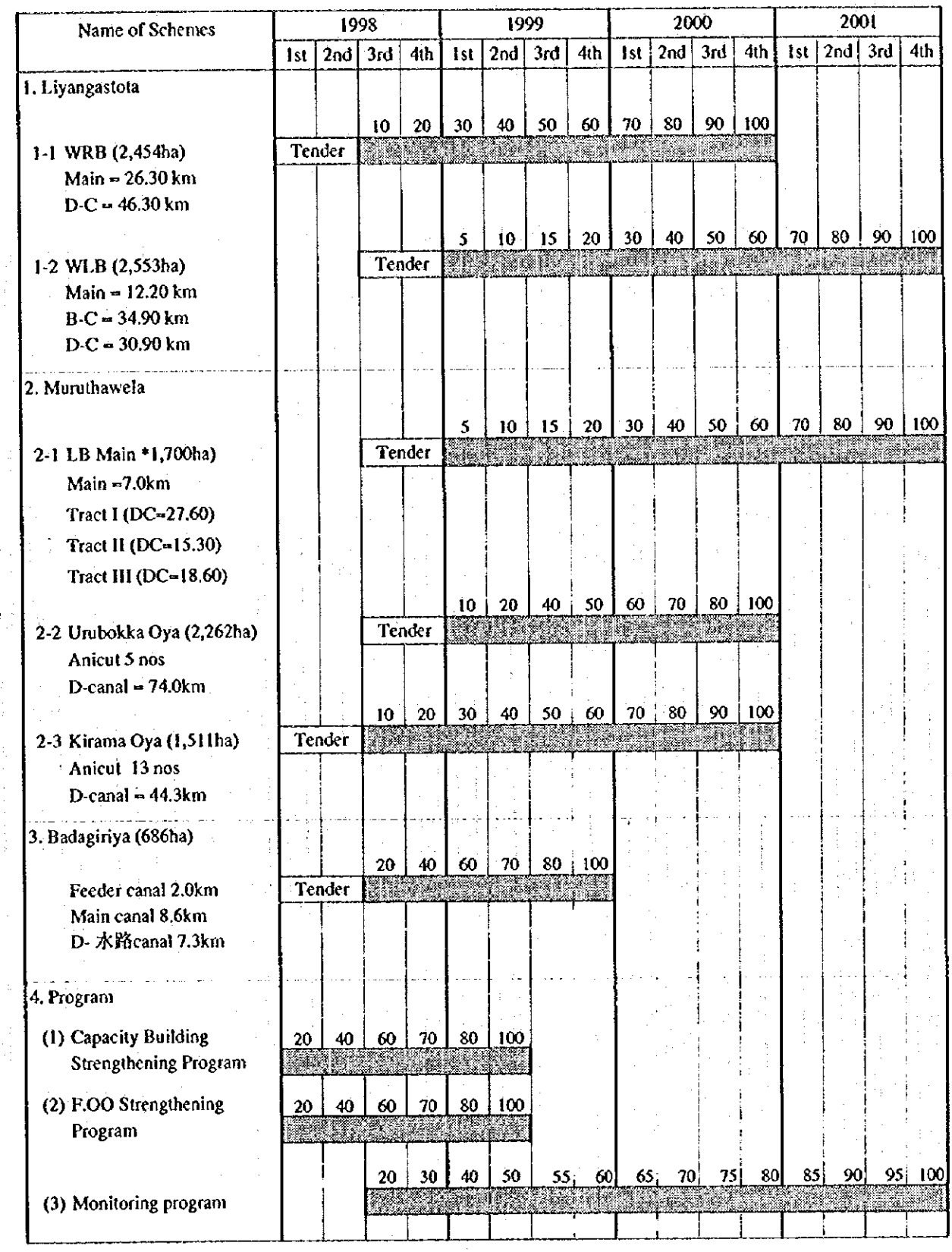


Figure 7.4-1 Project Implementation Schedule