No.	Name of Scheme	Location		Irrigation Area (May 2000)			Beneficies (May 2000)			Irrigation Area (Oct 2001)			Beneficies (Oct. 2001)			Construction Period			Construction Cost			Water Sources	Intake Structure	Headworks				
		Zone	District (Wareda)	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	commnenced	Completed	Years	Plan (Birr 1000)	Actual (Birr 1000)	Unit (Birr/ha)			Type	Length of weir/dam crest (m)	Height of weir/dam (m)	Intake size (dia, mm)	Water Duty (l/sec/ha)
1.	Kawa	Arsi	Gedeb	200	20	10	500	80	16													River	Pump&HW					
2.	Meti Metana	Arsi	Nunesa	40	30	76	160	140	88	40	14	35	180	90	50	1994	1996	3	396		9,900	River	Headworks	Broad crest weir	7.0	1.5	400	2.0
3.	Sadi Sadi	Arsi	Nunesa	60	50	83	221	221	100	65		0	221	221	100	1995	1996	2	351		5,397	Spring	Headworks	Broad crest weir	13.0	1.0		
4.	Arata Chufa	Arsi	Ziway Dugda	100	100	100	317	317	100	100	100	100							587	587	5,870	River	Headworks	Broad crest weir	42.0	2.2		2.4
5.	Shalad-01	Arsi	Tiyo	50	47	94	196	184	94	50	47	94	197	185	94	1989	1990	2	220		4,400	Spring	Headworks	Intake			600	2.5
6.	Shalad-02	Arsi	Tiyo	25	0	0	100	0	0	25		0	100		0	1995	1996	2	656		26,256	Spring	Headworks					
7.	Bosha-01	Arsi	Tiyo	100	80	80	233	320	137	100	50	50	233	320	137	1991	1993	3	455		4,554	Spring	Headworks					
8.	Bosha-02	Arsi	Tiyo	60	35	58	220	140	64	60	40	67	44		0	1993	1993	1	580	580	9,667	Spring	Headworks	Broad crest weir	14.0	1.0	150	1.0
9.	Shoba	Arsi	Munesa	100	60	60	279	270	97	100	60	60	279	270	97	1994	1994	1	636		6,360	Spring	Headworks	Broad crest weir	11.0	2.0	600	2.2
10.	Gedamso-01	Arsi	Munesa	80	58	72	250	73	29	80	79	99	245	65	27				707		8,838	River	Headworks	Ogee weir	12.0	2.5	600	2.3
11.	Gedamso-02	Arsi	Munesa	90	10	11	320	20	6	80	5	6	300		0				1,367		17,093	River	Headworks					
12.	Lafa	Arsi	Munesa	80	64	79	150	140	93													River	Headworks					
13.	Sole Bakekisa	Arsi	Tena	100	40	40	300	150	50													River	Headworks					
14.	Delali Sambaru	Arsi	Munesa	60	40	67	160	164	103	40	22	55	162	124	77	1994	1996	3	429		10,725	River	Headworks	Broad crest weir	19.0	1.2	400	2.0
15.	Dagaga Sambaro	Arsi	Munesa	40	20	50	60	40	67	40	22	55	270		0	1996	1996	1	315		7,863	River	Headworks	Broad crest weir	13.0	1.0	400	2.0
16.	Katar-01	Arsi	Tiyo	100	100	100	400	120	30													River	Headworks					
17.	Katar-02	Arsi	Tiyo	130	43	33	200	200	100													River	Headworks					
18.	Katar-03	Arsi	Tiyo	90	0	0	360	0	0													River	Headworks					
19.	Hasen Usman	Arsi	Tena	230	280	122	527	1,000	190													River	Headworks					
20.	Homba	Arsi	Merti	100	10	10	400	40	10													River	Headworks					
21.	Teltele	North Shoa	Detre Libanes	90	145	161	418	220	53													Spring	Headworks					
22.	Lemi	North Shoa	Yaya Gulale	30	56	187	200	225	113	30	56	187	200	225	113	1996	1996	1				S+R	Headworks	Trapizoidal	4.8	0.6	400	
23.	Indris	West Shoa	Ambo	175	380	217	875	1,087	124													River	Headworks					
24.	Laku	West Shoa	Bako-Tibe	50	6	12	40	9	23													River	Headworks					
25.	Walga	West Shoa	Wanchi/Waliso	150	518	345	637	1,070	168	150	518	345	637	1,000	157							River	Headworks					
26.	Walshamo	West Shoa	Chaliya	50	0	0	160	0	0													River	Headworks					
27.	Robi	West Shoa	Meta Robi	120	123	103	410	410	100													River	Headworks					
28.	Chole	West Shoa	Ambo	100	200	200	464	500	108													River	Headworks					
29.	Lugo	East Shoa	Fentale	57	53	93	70	64	91	57	53	93	70	64	91							River	Headworks	Trapizoidal	17.4	1.15	500	3.0
30.	Sogido Bandira-01,02	East Shoa	Fentale	140	110	79	117	65	56	140	140	100	292		0	1998	1999	2	155	1,799	12,847	River	Headworks	Broad crest weir	8	2.5	330	3.71
31.	Godino	East Shoa	Adama	219	183	84	270	182	67	219	183	84	270	182	67	1996	1997	2	708	607	2,770	River	Dam	Ogee weir	21	1		3
32.	Balbala	East Shoa	Adama	100	42	42	400	182	46													River	Dam					
33.	Fultino	East Shoa	Adama	85	33	39	182	165	91	85	33	39	177		0				1,104	1,104	12,986	River	Dam					5
34.	Laftu	East Shoa	Shashamene	30	3	8	60	14	23	30	30	100	191	30	16	1996	1997	2	450	313	14,990	River	Headworks	Arched-broad c.w.	9.7	0.4	300	2.37
35.	Kararo Arsi	East Shoa	Arsi Negele	42	38	90	253	85	34				200	112	56	1993	1993	1				River	Headworks	Broad crest weir				
36.	Tiliku Debeda	East Shoa	Arsi Negele	50	25	51	200	101	51													River	Headworks					
37.	Meki-Zway	East Shoa	Duguda Bora	1,500	33	2	3,375	132	4	3,500	216	6		337					13,915		3,976	Lake	Pump					2.53
38.	Dadaba Guda	East Shoa	Arsi Negele	50	50	100	200	85	43	50	50	100	200	85	43	1995	1997	3		416	8,312	River	Headworks	Broad crest weir	28	4	600	1.6
				4,873	3,084	78	13,684	8,215	67	5,041	1,718	80	4,468	3,310	56						9,600							

No.		Coveyance Structure (km)			Related Structure (no.)										Drainagee Structure (km)			Night Storage		Headworks											
	Design Discharge (m^3/sec)	Main	Secondary	Tertiary	Division box	Turn-out	Off-take	Drop	Culvert	Flume	Aquiduct	Chute	Check Str.	Cross drain	Main	Secondary	Tertiary	Capacity (m^3)	Conditions	No/damaged sluice gate	No/damaged Intake gate	Silt deposit in u/stream	Damaged wing walls	Damaged Intake	Outlet protection	Uncontrolled water distribution	Low weir height	Weed infestation	Deteriorated dam structures	Crest submerged	Total
1.																															
2.	0.08	1.50	1.15	0.65	1	8			7						0.65			403.2	good	1	1	0	0	0	0	0	1	0	0	0	3
3.	0.08	0.83	0.80	7.30	2	12		135	32											1	0	1	0	0	0	0	0	0	0	0	2
4.	0.10	0.95	0.58	4.04	5	28		115	11						4.69			500	good	0	0	1	0	0	0	0	0	0	0	0	1
5.	0.125	0.50		3.20	5		16	4	2											0	0	0	0	0	0	0	0	0	0	0	0
6.	0.0625	0.60		2.50	5		22	13	35									3,150	good	0	0	0	0	0	0	0	0	0	0	0	0
7.		1.65	3.18	4.46	5	34	56		4	1					2.591			504	good	0	0	0	0	0	0	1	0	1	0	0	2
8.	0.011		2.01	2.68	3	61		37		2					0.804			1,960	seepage	0	1	0	0	1	0	0	0	0	0	0	2
9.	0.300	1.87	1.87	1.70	2	45		72	6						5		18.3		seepage	1	1	0	0	0	0	0	0	0	0	0	2
10.	0.185	2.40	1.20	6.00	2	63		46	12						7.2					0	0	1	0	0	0	0	0	0	0	0	1
11.	0.185	2.30	3.90	6.88	3	180		230	4						9.18			16,000	good	0	0	0	0	0	0	0	0	0	0	0	0
12.																															
13.																															
14.	0.08	0.75	0.46	0.60		8		30	10						0.55			6,210		1	0	1	0	0	0	0	0	0	0	0	2
15.	0.08	0.54						6	2											0	0	0	0	0	0	0	0	0	0	0	0
16.																															
17.																															
18.																															
19.																															
20.																															
21.																															
22.	0.045	5.10			31			39	14		2	1								0	1	0	1	1	1	0	0	0	0	0	4
23.																															
24.																															
25.	2.3	5.00	5.00		4	19			12	1										0	1	0	0	0	0	0	0	0	0	0	1
26.																															
27.																															
28.																															
29.		3.50	0.50				12		2				2	6						0	1	0	1	0	1	0	0	0	0	0	3
30.	1.6	9.234			2		35	85		3										0	0	0	0	0	0	0	0	0	0	0	0
31.	0.65	8.75	0.48		3	2	24		5					2						1	1	0	0	0	0	0	0	0	0	0	2
32.																															
33.	0.735	3	1.72	6.51	2		80	49	4				45							1	0	1	0	0	0	0	0	0	1	0	3
34.	0.072	2.25	0.285		1		15	51	2									1,285		1	0	0	0	0	0	0	0	0	0	0	1
35.		1.4																		1	1	1	1	0	0	1	0	0	0	1	6
36.																															
37.	5.34	2.5	3.98	4.234																0	0	0	0	0	0	0	0	0	0	0	0
38.		1.7	1.1	6	1	4	32	135	5											0	0	1	0	0	0	0	0	0	0	0	1
					77	464	292	1,047	169	7	2	1	47	8						8	8	7	3	2	2	2	1	1	1	1	36

No.	Main Canal																		SC, TC, FD and Drainage Canals									
	Silt deposit	Weed growth	Cracks lined canals / concrete structures	Seepage/Leakage/Breached	Embank. damaged by animals	No design canal shape	Embank. damaged by human	Overtopping of water	Small longitudinal slope	Illicit water tapping	No gates for division boxes	Deblis dropped from banks	Damaged drops & division boxes	Embank. damaged by flood	Missing structures (turn-out)	Missing structures (canal ext.)	Missing structures (intercept drain)	Emergency spillway	Total	Weed growth	Embank. Damaged	Erosion of bank fill materials	Submerged off-take to TC	Removal of fill soil	Lack of cross drainage structures	No gates for division boxes	SC Construction not yet completed	No design canal shape	Poor draingae facilities	Missing structures (intercept drain)
1.																													
2.	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3	0	1	0	0	1	0	0	0	0	0	0
3.	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0	0	0	0	0	0	0	0
4.	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1	0	0	0	0	0	0	0
5.	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0	0	0	0	0
6.	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	4	1	0	0	0	1	0	0	0	0	0	0
7.	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	1	1	0	1	1	1
8.	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	4	1	0	1	0	0	0	1	0	0	0	0
9.	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	4	1	0	1	0	0	0	0	1	0	0	0
10.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
11.	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	1	0	0	1	0	0	0	0	0
12.																													
13.																													
14.	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4	1	1	0	0	0	0	0	0	0	0	0
15.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
16.																													
17.																													
18.																													
19.																													
20.																													
21.																													
22.	0	0	1	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0
23.																													
24.																													
25.	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
26.																													
27.																													
28.																													
29.	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
30.	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
31.	1	1	0	1	1	1	0	0	0	0	0	1	1	1	0	0	1	1	9	1	1	0	0	0	0	0	0	0	0	0
32.																													
33.	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0
34.	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
35.	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
36.																													
37.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38.	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	1	1	1	0	0	0	0	0	0	0	0
	10	10	9	8	8	7	4	3	2	2	2	2	2	1	1	1	1	1	64	11	7	6	2	2	2	2	2	1	1	1

No.					Monitoring Information																			WUA						
	Lack of division box	Silt deposit	Canal breaching	Total	Design document	Working drawing	Construction completed	Siltation	Training to beneficieries	Beneficieries Operation	Beneficieries Maintain	OIDA DA	OM Manual	O&M Charge	O&M Charge (Birr/Year)	Bank Account	Farm input shortage	Water shortage	Dispute in water use	Conflict between US/DS	Full use of scheme	Scheduled cropping pattern	Salimity problem	WUA Members	Established	Legal Registration	Water Master	By-law	Meeting (no./month)	Record of meetng
1.																														
2.	0	0	0	3	No	Partial	Yes	Yes	Yes	Yes	Yes	Yes	No	No		No														
3.	0	0	0	4	No	Partial	Yes	Yes	Yes	Yes	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No							
4.	0	0	0	5	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No				Yes	No	No	No	Yes	No	No	317						
5.	0	0	0	6	No	Partial	Yes	No	Yes	Yes	Yes	Yes					Yes		No	No		No		59	1991	1993	Exist			
6.	0	0	0	7	No	Partial	Yes	No	No	No	No.	Yes					Yes	No	No	No	No	No	No							
7.	0	0	0	13	No	Partial	Yes	Yes	Yes	Partial	Partial	Yes	No	No		No	Yes	Yes	No	No	No	No	No	180			Exist	Not		Not
8.	0	0	0	10	No	Yes	Yes	No	Yes	Yes	Yes	Yes					Yes	Yes	No	No	No	No	No							
9.	0	0	0	11	No	No	No	Yes	Yes	No	Yes	Yes	No	No		No	Yes	Yes	Yes	No	No	No	No	280	1999		Exit	Exit	4	Not
10.	0	0	0	10	No	Partial	Yes	Yes	Yes	Yes	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No							
11.	0	0	0	13	No	Partial	Yes	Yes	Yes	Yes	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No							
12.																														
13.																														
14.	0	0	0	14	No	Partial		No	Yes	Yes	Yes	Yes	No				Yes	Yes	No	No	No	No	No				Exit			
15.	0	0	0	15	No	Partial	Yes	No	Yes	Yes	Yes	Yes	No																	
16.																														
17.																														
18.																														
19.																														
20.																														
21.																														
22.	0	0	0	23			No	No	No	No	Yes	No	No	Yes	3	Yes	Yes	Yes	Yes	No	Yes	No	No	280	1997		Exit	Exit	1	Exit
23.																														
24.																														
25.	0	0	0	25	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	No		No	Yes	Yes	Yes	Yes	Yes	No	No	673			Not	Not		Not
26.																														
27.																														
28.																														
29.	1	0	0	30	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No		No		Yes	No	No	No	No	No	320						
30.	0	0	0	30	No	Partical	Yes	Yes				Yes	No				Yes	No	No		No	No	No							
31.	0	1	0	32	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No		No	Yes	Yes	Yes	No	No	Yes	No	346			Exit	Not		Not
32.																														
33.	0	1	0	34	No	Partical	Yes	Yes	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes	No	No	No							
34.	0	0	0	34			Yes	Yes	Yes	Yes	Yes	Yes					Yes	Yes	No	No	No	No	No							
35.	0	0	0	35	No	No	Yes	No	Yes	Yes	Yes	Yes					Yes	Yes	No	No	No	No	No							
36.																														
37.	0	0	0	37	No	No	No	Yes				Yes																		
38.	0	1	1	41	No	Partial	Yes	Yes	Yes	Yes	Yes	Yes					Yes	Yes		No	No	No	No							
	1	3	1	432																										

No.	Name of Scheme	Location		Irrigation Area (May 2000)			Beneficies (May 2000)			Irrigation Area (Oct 2001)			Beneficies (Oct. 2001)			Construction Period			Construction Cost			Water Sources	Intake Structure	Headworks				
		Zone	District (Wareda)	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	commenced	Completed	Years	Plan (Birr 1000)	Actual (Birr 1000)	Unit (Birr/ha)			Type	Length of weir/dam crest (m)	Height of weir/dam (m)	Intake size (dia, mm)	Water Duty (l/sec/ha)
1.	Kujur	West Walaga	Najo	57	0	0	110	0	0	57	31	54	110	60	55	1998	1999	2	699		12,269	River	Headworks	Broad crest weir	20	1.1	400	1.05
2.	Borta	West Walaga	Sayo	40	7	18	120	31	26	40	23	57	150			1995	1996	2	140	222	5,550	River	Headworks	Barrage			400	
3.	Bondo	West Walaga	Sayo	50	8	16	150	25	17	50			250	36	14	1993	1994	2	494	385	7,694	River	Headworks	Broad crest weir	20	1.2	400	2.1
4.	Degaro	West Walaga	Nadijo	120	28	23	296	120	41	71	12	17	296			1996	1997	2	1,537	1,294	18,293	River	Headworks	Broad crest weir	20	1.2	500	
5.	Gi'i .	West Walaga	Gimbi	60	8	13	228	26	11	60	50	84	450						300	330	5,501	River	Headworks	Broad crest weir	20	1.2	400	
6.	Sokoru	West Walaga	Rharasibu	30	25	83	267	37	14	30	18	58	265			1997	1998	2	339		11,309	River	Headworks	Broad crest weir	15	1.2	500	
7.	Waja	East Walaga	Limu	25	25	99	200	198	99	25	25	100	200			1996	1997	2	210	322	12,897	River	Headworks	Broad crest weir	12.0	1.5	600	
8.	Dhangago-01+02	East Walaga	Jima-Rare	30	21	71	253	129	51	50	26	52	253	78	31	1995	1996	2	168		3,356	River	Headworks	Broad crest weir	14	0.95	500	1.68
9.	Jato-01+02	East Walaga	Jima-Rare	54	46	85	515	419	81	114	80	70	515						630	630	5,525	River	Headworks	Ogee weir	20	1.45	600	
10.	Gambela Tare	East Walaga	Guto-Wayu	150	59	39	235	86	37	150	34	23	272						711	711	4,742	River	Headworks	Broad crest weir	20	1.5	600	3.0
11.	Negeso	East Walaga	Bila-Sayo	30	30	100	128	160	125	30	30	100	180	128	71	1996	1997	2	247	210	7,008	River	Headworks		6.8	0.8	600	
12.	Abono-02	East Walaga	Jima-Arjo	80	67	83	248	160	65	80	78	97	248			1994	1995	2				River	Headworks	Barrage	6.8	0.8		1.5
13.	Tate	East Walaga	Leka-Dulacha	20	0	0	75	0	0	18			54			not completed			171		9,507	River	Headworks		18	1		
14.	Jato-02 (see No.9)	East Walaga	Guto-Wayu	60	0	0	157	0	0																			
15.	Dhangago-02(see No.8)	East Walaga	Guto-Wayu	20	0	0	162	0	0																			
16.	Gibe Lamu-01	East Walaga	Jima-Rare	53	53	100	250	54	22	113	52	46	250			1994	1997	4	680	816	7,224	River	Headworks	Broad crest weir	30	1	600	
17.	Gibe Lamu-02	East Walaga	Bila-Sayo	60	23	39	250	37	15													River	Headworks					
18.	Jare	East Walaga	Bila-Sayo	40	0	0	112	0	0	40	20	50	112	44	39	1998	1999	2				River	Headworks	Broad crest weir	8		500	
19.	Koba Guda	Ilu Aba Bora	Gachi-Boracho	56	0	0	57	0	0	50	6	12	49			1994	1997	4		1,500	30,000	River	Headworks	Ogee weir	24	2	400	
20.	Nada Guda	Jima	Omo-Nada	120	31	26	340	48	14	120	41	34	480	78	16	1994	1995	2				River	Headworks	Ogee weir	32.25	1.50		
21.	Kawa	Jima	Dedo	120	54	45	270	54	20	120	34	28	270									River	Headworks	Ogee weir	12	1		2.3
22.	Birbirsa	Jima	Qarsa	70	5	7	150	52	35	70	35	50	62			1996	1997	2				River	Headworks	Barrage	3.8	1.5	500	
23.	Abono	Jima	Sayo Chokorsa	160	0	0	300	0	0	160	35	22	200									River	Headworks		3			
24.	Waro	Jima	Dedo	180	25	14	300	40	13	150	76	51	300			1987	1995	9	311		2,076	River	Headworks	Ogee weir	20	3.6	600	2.4
				1,685	514	36	5,173	1,676	29	1,598	706	53	4,966	424	38													

No.		Coveyance Structure (km)			Related Structure (no.)										Drainagee Structure (km)			Night Storage		Headworks									
	Design Discharge (m^3/sec)	Main	Secondary	Tertiary	Division box	Turn-out	Off-take	Drop	Culvert	Flume	Inlet outlet	Chute	Syphone	Cross drain	Main	Secondary	Tertiary	Capacity (m^3)	Consitions	No/damaged sluice gate	Temporary diversion problems	Silt deposit in u/stream	No/damaged Intake gate	Damaged weir	River bank erosion	Stilling basin problems	Stoplog of barrage broken	Back fill behind wing wall eroded	Total
1.		3.6		2.1		23		18		2									poor	0	0	0	0	0	0	0	0	0	0
2.	0.04	2.70				13	1		2		3									0	0	0	0	0	0	0	0	0	0
3.	0.18	1.80	0.60	0.30	1	11		7	2											1	0	1	0	0	0	0	0	0	2
4.	0.16	8			1	47		7	2	3		4						8,064	very poor	0	0	1	0	0	0	0	0	0	1
5.	0.130	2.47	0.95		1	14		3	1	2	2									0	0	1	0	0	0	0	0	0	1
6.	0.08				1	13														0	0	0	0	0	0	0	0	0	0
7.	0.2	1.50	0.45		1	18	2													0	1	0	0	0	0	0	0	0	1
8.	0.45	1.95	0.56			8		1	3								0.54			0	0	0	0	0	0	0	0	0	0
9.	0.214	2.5	0.8		2	31	64	64	3			1							seepage	1	0	0	0	0	0	0	0	0	1
10.	0.250	7.30	3.06	2.38		45		20	10								2.35	8,400	fair	0	0	0	0	0	0	0	0	0	0
11.	0.200	2				22	2	1												0	0	0	0	0	1	0	1	1	3
12.		3.60				46		19		1										0	0	0	0	0	0	1	0	0	1
13.		only headworks completed																		0	0	0	0	0	0	0	0	0	0
14.																													
15.																													
16.	0.45	5.15	1.70	1.48	2	60	32	11	2	2										0	0	0	0	0	0	0	0	0	0
17.																													
18.	0.10	1.74	0.60		2	32		7	11	1										0	0	0	0	0	0	0	0	0	0
19.		3.02	1.00	2.426	1	31		29	5	1						1.72	1.77			1	1	0	1	1	0	0	0	0	4
20.	0.50	1.60			1	9		81		1					2.0					0	1	0	0	0	0	0	0	0	1
21.		3.50	2.925	11.60	4	58		43	5	2						2.766	1.526			1	0	0	0	0	0	0	0	0	1
22.	0.154	5.85			1	14		3		3				4	2.0					0	0	0	0	0	0	0	0	0	0
23.		3.25	4.76			5		5					3							0	1	0	0	0	1	0	0	0	2
24.		2.95	1.655	16.55		15		15	2				1		4.0					1	0	0	1	1	0	1	0	0	4
					18	515	101	334	48	18	5	5	4	4						5	4	3	2	2	2	2	1	1	22

No.	Main Canal													SC, TC, FD and Drainage Canals									Monitoring Information					
	Seepage/Leakage of canal	Silt deposit	Canal breach	Cracks lined canals / concrete structures	Embank. damaged by animals	Damaged by land slide	Insufficient slope	No design canal shape	Additional turn out requird	Damaged by scoring	Missing structures (canal ext.)	Broken turn out	Total	Seepage/damage of flume	Seepage of culvert	Drainage culvert less capacity	Less footpath and cattle crossing	Leakage of TC	More structures (drop, off take)	Incomplete construction (flume)	Silt deposit	Total	Design document	Working drawing	Construction completed	Siltation	Training to beneficieries	Beneficieries Operation
1.	1	0	0	1	0	1	1	0	0	0	0	0	4	0	0	1	0	0	0	0	0	1	Yes	Yes	Yew	Yes	No	Yes
2.	1	0	1	0	0	0	1	0	0	0	0	0	3	0	1	0	1	0	0	0	0	1	Yes	Yes	Yes	Yes	No	Yes
3.	0	1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	1	Yes	Yes	Yes	Yes	No	Yes
4.	1	0	1	0	1	1	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	1	Yes	Yes	Yes	Yes	No	Yes
5.	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	No	No	Yes	Yes	No	Yes
6.	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	Yes	Yes		Yes	No	Yes
7.	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	No	No	Yes	Yes	No	Yes
8.	1	1	1	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	Yes	Yes	Yes	Yes	Yes	Yes
9.	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	No	No	Yes	Yes	No	Yes
10.	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1	No	No	Yes	No	No	Yes
11.	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	Partial	Partial	Yes	Yes	No	Yes
12.	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	No	No	No	Yes	No	Yes
13.						only headworks completed								0	0	0	0	0	0	0	0	0	No	No	No		No	No
14.																												
15.																												
16.	1	0	0	0	0	0	0	0	1	0	0	1	3	0	0	0	0	0	0	0	0	0	No	Partial	Yes	Yes	No	Yes
17.																												
18.	1	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	Yes	Yes	Yes	Yes	No	Yes
19.	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	1	No	Yes	Yes	No	No	Yes
20.	1	0	1	1	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	No	No	Yes	Yes	Yes	Yes
21.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	No	No	Yes	No	No	Yes
22.	1	0	0	1	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	0	Yes	Yes	No	Yes	Yes	Yes
23.	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	No	Partial	Yes	Yes	No	No
24.	0	1	0	1	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	No	Partial	Yes	Yes	No	Yes
	13	5	5	4	3	2	2	2	2	1	1	1	41	4	3	2	2	1	1	1	1	8						

No.														WUA						
	Beneficieries Maintain	OIDA DA	OM Manual	O&M Charge	O&M Charge (Birr/Year)	Bank Account	Farm input shortage	Water shortage	Dispute in water use	Conflict between US/DS	Full use of scheme	Scheduled cropping pattern	Salimity problem	WUA Members	Established	Legal Registration	Water Master	By-law	Meeting (no./month)	Record of meetng
1.	Yes	No	No	No		No	No	Yes	No	No	No	No	No	60	1999		Exist	Exist	Not regularly	Exist
2.	Yes	Yes	Yes	No		No	Yes	No	No	No	No	No	No	148	1995		Exist	Exist	Not regularly	Exist
3.	Yes	Yes	Yes	No		No	Yes	Yes	Yes	Yes	No	No	No	36	2000		Exist	Exist	2	Not
4.	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No	296	1997		Exist	Exist	Not regularly	Not
5.	Yes	Yes	Yes	No		No	Yes	No	No	No	No	No	No	450	1997	2000	Not	Not	Not regularly	Exist
6.	Yes	Yes	No	No		No	Yes	Yes	Yes	No	No	No	No	56	1997		Exist	Exist	Not regularly	Exist
7.	Yes	Yes	No	No		No	Yes	No	No	No	Yes	No	No	200	1997		Exist	Exist	Not regularly	Exist
8.	Yes	Yes	No	No		No	Yes	No	Yes	No	No	No	No	78	1995		Exist	Exist	Not regularly	Exist
9.	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No	515	1995		Not	Not	Not regularly	Exist
10.		Yes	No	No		No	Yes	No	No	No	No	No	No	160	1995		Exist		Not regularly	Exist
11.	Yes	Yes	No	No		No	Yes	No	No	No	Yes	No	No	128	1997		Exist	Exist	Not regularly	Exist
12.	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No	248	1995		Exist	Exist	Not regularly	Not
13.	No	only headworks completed									No	No	No							
14.																				
15.																				
16.	Yes	Yes	No	No		No	Yes	No	No		No	No	No	90	1997		Exist	Not	Not regularly	Exist
17.																				
18.	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No	44	1998		Exist	Exist	Not regularly	Exist
19.	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No	49	1997		Not	Not	Not regularly	Not
20.	Yes	Yes	No	No		No	Yes	Yes	Yes	Yes	No	No	No	78	1995		Exist	Exist	2	Not
21.	Yes	Yes	Yes	No		No	Yes	No	No	No	No	No	No	270	1989	2000	Exist	Not	1	Exist
22.	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No	62			Exist	Not	2	Exist
23.	Yes						Yes	No	No	No	No	No	No							
24.	Yes	Yes	No	No		No	Yes	Yes	Yes	Yes	No	No	No	300	1997		Exist	Not	Not regularly	Not

No.	Name of Scheme	Location		Irrigation Area (May 2000)			Beneficies (May 2000)			Irrigation Area (Oct 2001)			Beneficies (Oct. 2001)			Construction Period			Construction Cost			Water Sources	Intake Structure	Headworks				
		Zone	District (Wareda)	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	commnenced	Completed	Years	Plan (Birr 1000)	Actual (Birr 1000)	Unit (Birr/ha)			Type	Length of weir/dam crest (m)	Height of weir/dam (m)	Intake size (dia, mm)	Water Duty (l/sec/ha)
1.	Arara-01	Eastern Branch	East Harar	40	50	125	276	276	100	40	40	100	276			1995	1995	1		225	5,630	Spring	Headworks	Spring intake			600	
2.	Arara-02	Eastern Branch	East Harar	25	25	100	100	100	100													Spring	Headworks					
3.	Babi Ali	Eastern Branch	East Harar	46	60	130	130	220	169	46	60	130	130			1995	1995	1		244	5,313	Spring	Headworks		32	3.0	600	
4.	Burka Deneba	Eastern Branch	East Harar	76	76	100	215	216	100													Spring	Headworks					
5.	Chulul	Eastern Branch	East Harar	75	64	86	275	256	93													Spring	Headworks					
6.	Erer Meda Talila	Eastern Branch	East Harar	100	100	100	550	550	100	100	100	100	600			1995	1995	1		503	5,034	Spring	Headworks	Spring intake	13	2.6	608	
7.	Galan Sadi	Eastern Branch	East Harar	100	100	100	360	360	100	100	100	100	627			1997	1997	1		719	7,189	Spring	Headworks		13.0	1.6	600	
8.	Jarjartu	Eastern Branch	East Harar	60	36	60	240	240	100													River	Headworks					
9.	Mudana Silo	Eastern Branch	East Harar	51	56	110	120	175	146													Spring	Headworks					
10.	Melba	Eastern Branch	East Harar	51	44	86	107	107	100													Spring	Headworks					
11.	Ramis	Eastern Branch	East Harar	60	51	85	273	273	100	60	80	133	273			1997	1997	1		206	3,435	River	Headworks	Broad crest weir	18.0	2.7	600	
12.	Burka Burbursa	Eastern Branch	East Harar	40	0	0	100	0	0													Spring	Headworks		5.0	0.6	400	1.5
13.	Said Ali	Eastern Branch	East Harar	46	71	154	160	270	169													Spring	Headworks					
14.	Water-01	Eastern Branch	East Harar	60	60	100	130	130	100	60	60	100	130			1997	1997	1		391	6,509	Spring	Headworks	Gabion type weir	20.0	1.5		
15.	Water-02	Eastern Branch	East Harar	71	60	85	150	150	100	75	60	80	150							194	2,591	Spring	Headworks	Gabion type weir	16.0	2.0		
16.	Water-03	Eastern Branch	East Harar	40	40	100	260	260	100	40	40	100	160			1996	1996	1		517	12,925	River	Headworks	Metal sheet gate	13	2		
17.	Harewo	Eastern Branch	East Harar	40	15	38	133	60	45													Spring	Headworks					
18.	Amir Nur Decho	Eastern Branch	West Harar	40	17	43	80	28	35													Spring	Headworks					
19.	Chafe Gurati	Eastern Branch	West Harar	60	35	58	86	139	162													River	Headworks					
20.	Hirna	Eastern Branch	West Harar	70	40	57	80	63	79	70	40	57	150			1995	1995	1		367	5,241	River	Headworks	Broad crest weir	35	0.4	60	
21.	Homicho	Eastern Branch	West Harar	375	212	57	600	200	33													River	Headworks					
22.	Kaseheja	Eastern Branch	West Harar	187	139	74	748	556	74													River	Headworks					
23.	Midhagudu	Eastern Branch	West Harar	235	105	45	250	53	21													River	Headworks					
				1,948	1,456	82	5,423	4,682	92	591	580	100	2,496								5,985							

Attchment X-3-5.xls / Eastern Branch Office (2001) (2/4)

No.	Design Discharge (m^3/sec)	Coveyance Structure (km)			Related Structure (no.)										Drainagee Structure (km)			Night Storage		Headworks									
		Main	Secondary	Tertiary	Division box	Turn-out	Off-take	Drop	Culvert	Flume	Inlet outlet	Chute	Syphon	Cross drain	Main	Secondary	Tertiary	Capacity (m^3)	Consitions	No/damaged intake gate	No/damaged sluice gate	Damaged weir structures	River bank erosion	Silation	Lack of spillway, sluice and others	Sliding soils into spring	Stilling basin problems	Approach canals broken	Weed growth	Total
1.		2																		0	0	0	0	0	0	1	0	0	0	1
2.																														
3.																				1	1	1	0	1	0	0	0	0	0	4
4.																														
5.																														
6.		6.6																		1	1	0	1	0	0	0	0	0	0	3
7.																				1	1	1	1	0	0	0	0	0	0	4
8.																														
9.																														
10.																														
11.																				1	1	1	1	0	0	0	1	0	0	5
12.		7.0					100		4											1	1	1	0	0	0	0	0	0	0	3
13.																														
14.		4.0																2,430	not functional	1	0	0	0	0	1	0	0	1	0	3
15.		4.20				55														1	0	0	0	0	1	0	0	0	0	2
16.		3.0																		1	1	0	0	0	0	0	0	0	1	3
17.																														
18.																														
19.																														
20.		3.25	0.725	4.50	1		11	25	1				1							1	1	1	0	1	0	0	0	0	0	4
21.																														
22.																														
23.																														
					1	55	111	25	5	0	0	0	1	0						9	7	5	3	2	2	1	1	1	1	32

Attchment X-3-5.xls / Eastern Branch Office (2001) (3/4)

No.	Main Canal							SC, TC, FD and Drainage Canals							Monitoring Information											
	Seepage/Leakage of canal	Silt deposit	No design canal shape	Damaged structures by flood	Damaged by land slide	Cracks lined canals / concrete structures	Total	Seepage of canals	No SC	No TC	Drainage culvert not functional	Syphon not functional	Drainage problem	Total	Design document	Working drawing	Construction completed	Siltation	Training to beneficieries	Beneficieries Operation	Beneficieries Maintain	OIDA DA	OM Manual	O&M Charge	O&M Charge (Birr/Year)	Bank Account
1.	0	0	1	1	0	0	2	0	0	1	0	0	0	1	No	No	Yes	Yes	No	Yes	Yes	No	No	No		No
2.																										
3.	0	1	0	1	0	0	2	0	1	1	0	0	0	2	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No		No
4.																										
5.																										
6.	0	1	0	1	1	0	3	0	0	0	1	0	0	1	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No		No
7.	1	1	0	0	0	0	2	0	0	0	1	0	0	1	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No		No
8.																										
9.																										
10.																										
11.	0	0	1	0	0	0	1	0	0	1	1	0	0	2	No	No	No	Yes	No	Yes	Yes	Yes	No	No		No
12.	1	0	0	0	0	0	1	0	0	0	1	0	0	1	No	No	Yes	No	No	Yes	Yes	No	No	No		No
13.																										
14.	0	1	0	0	0	0	1	0	0	1	0	0	0	1	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No		No
15.	0	0	1	0	0	1	2	0	0	0	1	1	0	2	No	No	No	Yes	No	Yes	Yes	Yes	No	No		No
16.	1	0	0	0	1	0	2	0	0	1	0	0	0	1	No	No	Yes	No	No	Yes	Yes	Yes	No	No		No
17.																										
18.																										
19.																										
20.	1	0	0	0	0	0	1	1	0	0	0	0	1	2			Yes	No	No	Yes	Yes	Yes	No	No		No
21.																										
22.																										
23.																										
	4	4	3	3	2	1	17	1	1	5	5	1	1	14												

Attchment X-3-5.xls / Eastern Branch Office (2001) (4/4)

No.								WUA						
	Farm input shortage	Water shortage	Dispute in water use	Conflict between US/DS	Full use of scheme	Scheduled cropping pattern	Salimity problem	WUA Members	Established	Legal Registration	Water Master	By-law	Meeting (no./month)	Record of meetng
1.	No	Yes	Yes	No	No	Yes	No	No WUA	Not		Not	Not	Not	Not
2.														
3.	Yes	Yes	Yes	No	Yes	No	No	No WUA	Not		Not	Not	Not	Not
4.														
5.														
6.	Yes	No	No	No	Yes	No	No	No WUA	Not		Not	Not	Not	Not
7.	Yes	No	No	No	Yes	No	No	No WUA	Not		Not	Not	Not	Not
8.														
9.														
10.														
11.	Yes	Yes	Yes	Yes	Yes	No	No	No WUA	Not		Not	Not	Not	Not
12.	Yes	Yes	Yes	Yes	Yes	No	No	No WUA	Not		Not	Not	Not	Not
13.														
14.	No	Yes	Yes	No	Yes	No	No	No WUA	Not		Not	Not	Not	Not
15.	Yes	Yes	Yes	No	No	No	No	No WUA	Not		Not	Not	Not	Not
16.	Yes	Yes	Yes	No	Yes	No	No	No WUA	Not		Not	Not	Not	Not
17.														
18.														
19.														
20.	Yes	No	Yes	Yes	No	No	No	5	1997		Not	Not	Not	Not
21.														
22.														
23.														

No.	Name of Scheme	Location		Irrigation Area (May 2000)			Beneficies (May 2000)			Irrigation Area (Oct 2001)			Beneficies (Oct. 2001)			Construction Period			Construction Cost			Water Sources	Intake Structure	Headworks				
		Zone	District (Wareda)	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	Plan (ha)	Actual (ha)	%	Plan (HH)	Actual (HH)	%	commnenced	Completed	Years	Plan (Birr 1000)	Actual (Birr 1000)	Unit (Birr/ha)			Type	Length of weir/dam crest (m)	Height of weir/dam (m)	Intake size (dia, mm)	Water Duty (l/sec/ha)
1.	Haya Oda	Bale	Mana Angetu	100	96	96	220	178	81	100	38	38	220	178	81	1996	1996	1		1,313	13,129	River	Headworks	Ogee type	10.9	1	800	2.472
2.	Hora Boka	Bale	Sinana Dinsho	32	0	0	183	0	0	26			188			1994	1996	3				River	Headworks	Rock fill type				
3.	Gomgoma	Bale	Mana Angetu	71	51	72	156	182	117	71			156			1994	1995	2		733	10,331	River	Headworks	H. circle	8.0	2.5	800	
4.	Chiri	Bale	Mana Angetu	50	50	100	140	152	109	50	49	98	140	142	101	1995	1996	2		364	7,281	River	Headworks	Broad crest weir	10.0	1.0	800	2.4
5.	Dinki	Bale	Ginir	200	169	84	450	265	59	200	186	93	450	370	82					1,641	8,206	River	Headworks	Ogee type		1.0	600	
6.	Melko Buta	Bale	Goro	85	0	0	340	0	0	85	7	9	340			1988	1988	1				River	Headworks	Ogee type	20.0			
7.	Shaya	Bale	Sinana Dinsho	230	0	0	271	0	0	230	0	0	271	0	0	1987	1987	1				River	Headworks		20.0	1.0	600	
8.	Ukuma	Bale	Dodola	100	0	0	400	0	0	77	76	99	288			1998	1998	1		884	11,482	River	Headworks	Ogee type	10.0	1.0	600	
9.	Arada Tare	Bale	Ginir	120	120	100	288	300	104	120	218	181	288	429	149				1,722	1,257	10,474	River	Headworks	Broad crest weir	4.5	0.8	400	2.47
10.	Oda-Roba	Bale	Ginir	70	70	100	120	200	167	70	77	110	200			1997	1997	1		760	10,851	River	Headworks	Ogee type	12.0	1.0	600	
11.	Melka Hida	Borana	Galana-Abaya	70	0	0	136	0	0	70	39	56	138		0	1999	1999	1		426	6,086	River	Headworks	Broad crest weir	15.0	1.0	600	2.0
12.	Abeda Chambe	Borana	Adola	60	0	0	200	0	0	60	0	0	200	0	0	1995	1995	1	1,200		20,000	River	Headworks		20.0	0.6	800	
13.	Ambentu	Borana	Tena							200	186	93	450	192	43	1995	1996	2		884	4,421	River	Headworks		10.0	0.6		
				1,188	556	46	2,904	1,277	53	1,359	876	71	3,329	1,311	57						10,226							

No.	Design Discharge (m^3/sec)	Coveyance Structure (km)			Related Structure (no.)										Drainagee Structure (km)			Night Storage		Headworks										
		Main	Secondary	Tertiary	Division box	Turn-out	Off-take	Drop	Culvert	Flume	Spillway	Chute	Road crossing/bridge	Syphon	Cross drain	Main	Secondary	Tertiary	Capacity (m^3)	Consitions	No/damaged sluice gate	Silt deposit	No/damaged intake gate	No back fill behind wing wall	Damaged intake structure	Weed infestation	No inspection box on pipe intake	River course not excavated in d/s	River bank erosion	River course changed	No wing wals	Total
1.		0.423	1.5	3.095	3	19		16	2		1		6								1	1	1	1	1	0	0	0	0	0	0	5
2.		1.725				7	16	3	1												0	0	0	0	1	0	0	0	0	0	0	1
3.		3.516	1.636	1.760	1	8	10	103	4				2	2							0	0	0	1	0	1	1	0	0	0	0	3
4.		2.79	0.932	2.931	2	9		29	5				4								0	0	0	1	0	1	0	0	0	0	0	2
5.					2	25		36	6		1										1	1	0	1	0	1	0	1	0	0	0	5
6.						28	14	3	1		1		4							good	1	1	1	0	1	0	0	0	0	0	0	4
7.																					1	1	1	0	1	0	0	0	0	0	0	4
8.					5	28		90	4	1			13		3					good	1	1	0	0	0	0	0	0	0	0	0	2
9.	0.058	1.55	4.127		1	45		47	2	2			5		1				1,024.0	Not	1	1	1	0	0	0	0	0	1	0	0	4
10.					1	4		11		1		2	6								1	1	1	0	0	0	0	0	0	1	0	4
11.	0.15	1.055	0.485	2.20	4	31	3	11	1	1											0	1	0	0	0	1	0	0	0	0	0	2
12.		1.10	1.450			5	8	8	2												1	0	0	0	0	0	0	0	0	0	0	1
13.		8.00	2.75	7.20	11	22	36	23			1										0	0	0	0	0	0	0	0	0	1	1	1
					30	231	87	380	28	5	4	2	40	2	4						8	8	5	4	4	4	1	1	1	1	1	38

No.	Main Canal																		SC, TC, FD and Drainage Canals														No.
	Seepage/Leakage/Breached	Cracks lined canals / concrete structures	Silt deposit	Gates fixed not properly	Embank. Damaged	Weed growth	Erosion of bank fill materials	No design canal shape	Structures no strength	Canal body used for cultivation	Illicit water tapping	No spillway	Missing structures (slabs)	Missing structures (catch drain)	Miss use of drainage crossing	Lined canals not back filled	Construction incomplete	Total	No gates for division boxes	Seepage/ Leakage	Canal breached	Weed growth	Silt deposit	Structures destloyed	No design canal shape	Canal damaged by animals	Poor draingae facilities	Lack of back fill	Lack of cross drainage structures	Canal body used for cultivation	Poor plastering	Total	
1.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	2	1.
2.	0	2	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2.
3.	1	0	1	0	0	0	1	1	0	1	1	0	0	0	0	0	0	5	1	1	1	0	1	0	0	0	1	1	0	0	0	6	3.
4.	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	1	1	0	1	0	0	7	4.
5.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	3	5.
6.	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2	1	1	1	0	0	0	0	1	0	0	0	0	0	4	6.
7.	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2	0	1	1	0	0	1	0	1	0	0	0	0	0	4	7.
8.	0	1	1	0	0	0	0	0	1	0	0	0	1	1	1	0	0	5	0	0	0	0	0	1	0	0	0	0	0	0	0	1	8.
9.	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	1	2	9.
10.	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	1	10.
11.	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	3	11.
12.	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.
13.	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	1	1	0	0	0	0	0	0	7	13.
	7	7	5	4	3	3	3	2	2	2	1	1	1	1	1	1	1	31	7	6	5	4	4	3	3	3	2	1	1	1	1	41	

Monitoring Information																			WUA						
Design document	Working drawing	Construction completed	Siltation	Training to beneficiaries	Beneficiaries Operation	Beneficiaries Maintain	OIDA DA	OM Manual	O&M Charge	O&M Charge (Birr/Year)	Bank Account	Farm input shortage	Water shortage	Dispute in water use	Conflict between US/DS	Full use of scheme	Scheduled cropping pattern	Salimity problem	WUA Members	Established	Legal Registration	Water Master	By-law	Meeting (no./month)	Record of meetng
F/S	No	Yes	No	No	Yes	Yes	Yes	Yes	No		No	Yes	No	No	No	No	No	No	Not			Not	Not		
No	No	No	Yes	No	No	No	No	No	No		No	Yes	No	No	No	No	No	No	Not			Not	Not		
No	No			No	Yes	No	No	Yes	No		No	Yes	Yes	Yes	Yes	No	No	No	Not			Not	Not		
No	No	Yes	No	No	Yes	Yes						Yes	No	No	No	Yes	No	No	Not			Not	Not		
No	No	Yes	Yes	No	Yes	No		No	No		No	Yes	Yes	Yes	Yes	No			Not			Not	Not		
No	No	Yes	No	No	Yes	No	No	No	No		No	Yes	No	No	No	No	No	No	Not			Not	Not		
No	No		No	No	No	No	No	No	No		No	Yes	No	No	No	No	No	No	Not			Not	Not		
F/S	Partial	No	No	No	Yes	Yes		No	No		No	Yes	No	No	No	No	No	No	Not			Not	Not		
F/S	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No		No	Yes	Yes	Yes	Yes	Yes	No	No	Not			Not	Not		
F/S	No		Yes	No	Yes	Yes						Yes	No	No	Yes	Yes			Not			Not	Not		
Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No		No	Yes	No	No	No	No	No	No	Not			Not	Not		
No	Partial	No	No	No	No	No	Yes		No		No		No	No	No	No	No	No	Not			Not	Not		
No	No	Yes		No	Yes	Yes	Yes	No	No		No		No	No	No	Yes	No	No	Not			Not	Not		

Chapter 4

Program 3 of Verification Study

Environmental Monitoring – Irrigation Water Use in the Meki Area

CHPTER 4 ENVIRONMENTAL MONITORING – IRRIGATION WATER USE IN THE MEKI AREA

4.1 Policy and Institutional Background

4.1.1 National Environmental Policy

One of the most significant changes in public awareness in recent years in Ethiopia is the growing concern about maintaining the integrity of the environment, on which the country is fully dependent on the natural resource base for most economic activities. The commitment of the Government to environmental conservation and sustainable use of resources has been stated in all national development plans over the past decade. A national environmental policy, which is stated in the Environmental Action Plan (1997), provides guidance for actions in all sectors. The key objectives of the policy are:

1) To facilitate optimal use of the national land base and water;
2) To promote sustainable use of natural resources to meet the needs of present generations while preserving their ability to meet the needs of future generations;
3) To treat environmental conservation and economic development as integral aspects of the same process of sustainable development; and
4) To generate income and meet national goals and international obligations by conserving biodiversity, reversing desertification, mitigating effects of disasters including drought.

4.1.2 Institutional, Policy and Legal Framework

(1) Institutional Framework

Socio-economic reforms in Ethiopia during 1970s and 1980s disregarded the conservation of natural resources, which have seen unprecedented depletion. A century ago, closed forest covered 40% of the country, but barely 4% is left today, suggesting that deforestation rate has been and continues to be very high. Desertification, which is due to destructive developmental activities, inadequate and erratic rainfall, and frequent droughts, is also threatening the country. Both sheet and gully erosion is also widespread in the country. Fertile soil losses due to erosion is estimated at 42 tons of top soil per hectare per year, and soil erosion amounts to 1.5 billion tons per year. And water resources are shrinking and being degraded with problems of high salinity and fluoride.

To address these issues, the Government has over the years, set up institutions on environmental matters, notably the Environmental Protection Authority (EPA), which was established in 1995, and other environment-related agencies. These institutions were set up at Federal and Regional levels to help the Federal Government to integrate development plans within overall national set goals. The EPA is the Coordinating Agency for the Federal Policy on Natural Resources and the Environment. Other agencies are: Ministries of Agriculture; Water Resources; Mines and Energy; Public Works and Urban Development; Education; Information and Culture; Health; Labor and Social Affairs; Trade and Industry; and Economic Development. However, these institutions have several deficiencies: (i) lack of capacity to deliver environmental management services; (ii) extension system is strongly crop-bias with less attention to the environment; (iii) inadequate research on natural resources conservation and water hydrology; (iv) inadequate budget for extension services; and (v) inadequate participatory process in conservation.

(2) Policy and Legal Framework

Environmental legislation is found in various sectoral statutes under the different line ministries dealing with agriculture, health, water, forestry, fisheries and livestock, which have competing and exclusive interests in the use and management of natural resources. These statutes face fundamental constraints in enforcement mainly due to adoption of a sectoral approach rather than an integrated one. The policies also tend to contradict or overlap each other, rendering their implementation difficult. Although the Ethiopian constitution has a clear provision for some aspects of integrated development such as on land ownership, sub-sector specific policies are lacking for forestry, wildlife resources, land use, settlement and socio-economics at both national and regional levels. Where new policies exist, explicit guidelines for implementation, monitoring, evaluation and regulation are lacking. For example, the Water Resources Management Policy is comprehensive enough, but lacks guidelines on minimum maintenance flow in rivers and on minimum water levels for lakes to facilitate monitoring and regulation of development actions that would ensure ecological balance.

(3) Economic Causes of Water and Land Degradation in Ethiopia

Overexploitation of natural resources in Ethiopia is mainly because the net revenues currently being earned by the local population for conserving natural resources are quite inadequate to cover the opportunity costs of the land, i.e. the forgone benefits of alternative land uses). The relatively high opportunity costs create economic incentives to destroy, for example, water catchment areas including soil, water and

vegetation at the expense of conservation. This is because the current economic and environmental policies in Ethiopia do not generate the scale of revenues needed to prevent the wide spread water and land degradation. Unless the compensation to landowners for not developing say, land in catchment areas is raised adequately, significant water and degradation will continue as the opportunity cost of conservation increases. And the productivity of land will decline as water and productive soil cover diminishes.

The JICA Study identified several but inter-related causes of water and land degradation Ethiopia. The *proximate* cause of degradation is due to habitat conversion, while the fundamental causes are considered to be 'economic policy failures'. Policy failures include *absence of policies* and *market failure* (absence of prices to reflect the true costs or benefits of conservation). And *implementation failure* is failure to manage the environment due to weak institutions, inadequate technical capacity and funding, while *information failure* is failure to demonstrate and communicate the values of conservation to decision-makers and stakeholders. What these economic and institutional failures do is to make conservation appear less investment-worthy than alternative land uses. If these economic distortions are identified and removed and good policies are provided, the resulting incentives can be used more effectively to divert land, capital and labor towards conservation of the environment and watershed areas in the country.

4.2 Irrigation Water Use in the Meki Area

4.2.1 Environmental Background of the Meki Area

The Meki area lies on the bottomland of the Rift Valley system, which is prone to drought because of erratic nature of limited rainfall, i.e. 774 mm per year at Meki. The supplemental irrigation is one the means to minimize drought risk and sustain the agricultural production by peasants. The construction of dam and diversion weir on the Meki river are alternatives for irrigation water supply to the study area.

The Meki-Ziway-Abijata sub-basin is important in the Rift Valley system in terms of potentials for water resources exploitation. However, the lakes and rivers have interconnected system and the constraints for water resources are complex. Therefore, the diversion of water from the Meki river will affect the water recharge of the Ziway lake, which can lead to change in outflow to Bulbula river and will ultimately affect water level of the Abijata lake. The irrigation development of the basin requires a judicious planning for protection of the fragile eco-system. The existing irrigation schemes in the Meki area are summarized below.

4.2.2 Meki-Ziway Irrigation Scheme

(1) Outline of Scheme

The Meki-Ziway Irrigation Project is located 5 km west of Meki town. The project is established in 1989 with a technical assistance arranged with the previous government. It was envisaged to develop 3,000 ha, out of which 1,500 ha was to be a state farm, while the balance was to be allocated to local farmers. So far, 930 ha of land on the right bank of the lower Meki river has been developed, including intake channel from the Ziway lake, pump station, delivery pipeline, main, secondary, tertiary canals and related structures. The pump station have nine (9) pumps, of which two (2) were reserved as stand-by, and pumps having a capacity of 764 liter/sec./unit and a head of 16.3 m have been established. Currently, the facilities are under the control of OIDA, while electricity is supplied by Ethiopia Lightening and Power Authority (ELPA).

(2) Operation and Maintenance

The project was ceased in 1992 due to the change of the government policy. In the previous period, free water was supplied to farmers under full control of the government. After the governmental reform, however, the responsibility of the government is limited only to security control of the pumping station by the Oromia Water, Mine & Energy Resources Development Bureau (OWMEDB) and the main canal system by OIDA. Without any subsidy, farmers are obliged to pay electricity supply charges against operation hours. Except for some 300 ha planted in 1990, the project has been substantially lying idle since then.

Two (2) sets of pumps out of nine (9) are currently functioned, while seven pumps need repair works. In order to activate the scheme to some extent, the rehabilitation work is required. It is suggested that an inventory survey to be conducted to clarify the defect of the scheme and to estimate cost for the rehabilitation and availability of spare parts. It is noted that spare parts are not of the international standard.

Only 300 ha are activated out of 3,000 ha. Increase of farmers, who will commence cultivation in the remaining area, could relieve the burden for the farmers to pay the pump operation charge. It is worth, therefore, while considering the farmland re-allocated to farmers, who are residing outside of the scheme.

4.2.3 Small Irrigation Schemes

(1) Commercial Horticultural Production

The irrigation water use is not controlled and regulated under the government law. Some 180 small pumps are currently installed for irrigation purposes in the Dugda Bora Wareda. Most of these pumps are owned by rich farmers and private investors, who generally hire peasants as farm labor force. The pumps are used for horticultural crops throughout the year.

(2) Community-based Irrigation Schemes

On the other hand, the community-based irrigation activities are limited in terms of both number of farmers and extent of irrigation area. They organize the water users associations and seek assistance from NGOs to start irrigation farming. They operate on their plots on individual basis but share the common service given by the motor pumps, which are usually provided by NGOs.

There are 15 farmers groups, water user associations, composed of 500 peasants who irrigate 404.6 ha mainly for horticultural crop production. The irrigation farmers groups in Dugda Bora Wareda are listed in Table X.4.1.

Table X.4.1 Irrigation Farmers Groups in Dugda Bora Warada

No.	Name of WUA	PA	Members			Irrigation Area	Source of Water	Year of Establish-ment
			Male	Female	Total	(ha)		
1	Lega Meki-1	Gemu Sbubi	10	-	10	32.5	Meki river	1997
2	Lega Meki-2	Bekere Girrisa	19	5	24	6.0	Meki river	1998
3	Bekere Girrisa	Bekere Girrisa	130	5	135	218.0	Ziway lake	1997
4	Melka Cherecha	Welda Mekdela	34	-	34	14.1	Ziway lake	1998
5	Meika Korma	Welda Kelina	28	9	37	16.6	Ziway lake	1998
6	Melka Aba Godana	Welda Kelina	18	1	19	7.8	Meki river	1998
7	Oda Bokota	Oda Bokota	-	23	23	5.0	Meki river	1999
8	Teppo-140	Teppo Chareke	40	-	40	13.0	Ziway lake	1997
9	Cheleleka Denbel	Dodola Denber	34	1	35	10.9	Ziway lake	1998
10	Dodoata Denbel	Dodola Denber	15	-	15	18.1	Ziway lake	1997
11	Wayyo Gabrier	Wayyo Gabrier	19	5	24	13.8	Ziway lake	1996
12	Wedia Kelina	Wedia Kelina	30	1	31	8.6	Ziway lake	1998
13	Wayyo Serrit	Wayyo Gabrier	28	4	32	17.0	Ziway lake	1999
14	Tuchi Denbel	Tuchi Denbel	16	-	16	15.3	Ziway lake	1996
15	Jara Wayu	Elen	20	5	25	8.0	Elen lake	1998
	Total	-	441	59	500	404.6	-	-

Except for Bekere Girrisa located in the command area of the Meki-Ziway irrigation project, they have been developed using the surface water resources of the Meki river and the Ziway lake by use of small pumps.

(2) Operation and Maintenance

Water abstracted by pumps is discharged to the raised earth canals, which convey the water to distribution canals. Irrigation is applied through furrows. The schemes run in accordance with discussion and consensus by all members. All members participate in operation and maintenance works of the scheme. Further, decision of the group is made by members meetings when problems arise.

Pump operation and water distribution in some schemes are entrusted to water masters employed by the groups, with an average allowance of Birr 50 per month. The water master attends the water distribution work, forming canal embankment and furrows per each farm lot. The group members and the water master share irrigation benefits in accordance with the agreement. This system contributes to proper water distribution, even without concrete water diversion structures in these schemes.

At present, success of the small-scale pump irrigation schemes leads to increase of application by farmers, who are anxious for new schemes. However, it should be mentioned that increase of the schemes might cause disordered water use along the Meki river. The government agencies including OIDA is expected, therefore, to involve in the schemes positively, restricting and monitoring of the existing and new schemes in terms of water resources development

4.3 Climatic Conditions of the Meki Area

The Meki area is located between latitude 8° 03'N and 8° 24'N and longitude 38° 32'E and 39° 02'E in the Ethiopian Rift Valley; a huge volcano-tectonic sunken block basically formed in the Tertiary period. The Ethiopian Rift Valley traverses in the SW-NE direction incising between the Ethiopian plateau and the Somalian plateau with a formation of a 35 to 80 km wide corridor between the faults. In north of Nazarethe, this corridor opens out into a triangle on the Afar, which is the junction of three tectonic directions, namely the Red Sea, the Gulf of Aden and the Ethiopian Rift. In the Quaternary, occurrence of heavy rains led to the formation of large lakes including the Ziway lake, which is charged by the Meki river.

The climate in the study area and around the lakes is arid or semi-arid. However, it is humid to dry sub humid in the river catchment areas in the highlands, west of Butajira and east of Assela. The climate of the basin is governed mainly by the

movement of Equatorial low-pressure zones as summarized in Table X.4.2.

Table X.4.2 Rainfall Season in the Area

S.N.	Season	Month	Location of Low Pressure	Wind Direction	Rainfall Condition
1	Dry	November to February	South of the Equator	Dry northeast Trade winds from the Arabian Peninsula	Dry
2	Light rain (Belg)	March to June	Southern Sudan	Southeast winds from the Indian Ocean	Light and less reliable rainfall
3	Rainy (Meher)	July to October	Arabian Peninsula & Central Asia	Moist southwest winds from the south Atlantic ocean and central Africa	Area receives most of its rains from July to September

The Meki meteorological station is located at the center of the study area; it receives an average annual precipitation (1966-1999) of 774 mm. The annual rainfall is rather erratic. It ranges from a low of 344 mm in 1995 to a high of 1,091 mm in 1983. About 64% of the annual rainfall is recorded during the period from June to September. The drier months are from November to February, only 8% of the annual rainfall are recorded during this period. The heaviest precipitation usually falls during August as much as 21% of the annual precipitation occurring during this period.

4.4 Hydrology

4.4.1 General

The northern rift valley sub catchment has seven (7) major water bodies in its hydrologically closed basins; Meki river, Katar river, Ziway lake, Bulbula river, Horakelo river, Abijata lake, and Langano lake. The location of water bodies and streamflow gauging station is shown in Attachment X-4-1. Main features of lakes are shown in Table X.4.3.

Table X.4.3 Main Features of Lakes

S.N.	Lake	Lake Area (km^2)	Storage Volume (MCM)	Mean Depth (m)	Altitude (m)	Catchment Area (km^2)	Annual Inflow (MCM)
1.	Ziway	440	1,466	2.5	1,636	7,380	704
2.	Langano	230	3,800	17.0	1,590	2,006	-
3.	Abijata	180	954	7.6	1,580	10,740	227
4.	Shala	370	37,000	86.0	1,567	2,300	-

The Meki and Katar rivers replenish the Ziway lake, which in turn give rise to the outflow to the Bulbula river that flows south for 30 km before draining into the terminal lake Abijata. Other rivers, which flow into Abijata, are the Horakelo river from the Langano lake and the Gogessa river, a branch of the Gidu river draining from west of the Abijata. These lakes and rivers have interconnected system and the constraints for water resources are complex. Therefore, the water resources development of the basin requires a judicious planning for protection of the fragile eco-system. Their main features are presented in Table X.4.4.

Table X.4.4 Main Features of Rivers

No.	River	Station	Catchment Area (km^2)	Annual Rainfall (mm)	Annual Discharge (MCM)	Runoff Coefficient	Drain Into Lake
1	Meki	Meki Village	2,433	1,006	291	0.12	Ziway
2	Katar	Abura	3,350	874	413	0.14	Ziway
3	Kekersitu	Adamitulu	7,488		180		Abijata
4	Horakelo	Near Bulbula	2,050		47		Abijata

4.4.2 Meki River

The Meki river originates in the highlands of Guraghe and travels a distance of about 100 km from the highlands at altitude of 3,600 m to 1,636 m before draining into the Ziway lake. The upper reaches of the basin are steep and mountainous, while the lower basin is flat with broad valley. The total catchment area of the river near Meki town is 2,433 km^2. According to discharge data recorded near Meki town (1965-1999), average annual discharge of the river is 291 MCM or 9.18 m^3/s. Monthly discharge of the river at Meki town station is summarized in Table X.4.5.

Table X.4.5 Monthly Discharge of Meki river Near Meki Town

Average River Discharge (m^3/s)													Annual Volume (MCM)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
0.94	2.28	5.01	7.01	7.31	6.29	18.75	29.64	19.93	8.77	3.29	0.90	9.18	291

The high discharge occurs during the months of August and September, while low discharge generally occurs during the dry season from December to February. The river discharge sometimes becomes zero during these months.

4.4.3 Ziway Lake

The main water source for the lake is the flows of the Katar and Meki rivers. The Meki river is gauged at Meki town (CA = 2,433 km^2), while the Katar river is gauged near Abura (CA = 3,350 km^2). The mean annual flows recorded at the two stations are 291 MCM and 413 MCM, respectively. The total catchment area of the Ziway lake is about 7,380 km^2. The remaining catchment that is surrounding lake passing through swamp contributes little as the large part of the water is evaporating before it contributes to the lake effectively. The total annual average inflow in the lake can be safely be estimated by the sum of the Katar and Meki river flows as recorded at the gauging stations, which is about 704 MCM.

The water balance of the Ziway lake consists of inflow, outflow from the lake (Bulbula river) and evaporation from and precipitation on the lake surface.

4.4.4 Bulbula River

The water level of Ziway lake influences the outflow to the Bulbula river. The upper part of the Bulbula river is also known as the Kekersitu river. The water level of the Ziway lake is controlled by a natural basalt bar on the Bulbula river lying some 6 km downstream the from river outflow at the lake. An average annual flow of 180 MCM flow down to the Abijata lake. The average lake water level and monthly discharge of the river recorded at the Adamitulu station are shown in Table X.4.6.

Table X.4.6 Average Water Level of Ziway Lake and Outflow to Bulbula River

Station Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
Ziway Water Level (m)	1.06	0.95	0.85	0.80	0.76	0.74	0.83	1.19	1.50	1.53	1.34	1.23	1.07
River Q at Adami (m^3/s)	4.07	2.56	1.23	1.34	1.27	1.38	1.98	6.16	13.68	15.09	11.84	7.50	5.70

4.4.5 Abijata Lake

The Abijata lake is located in the Abijata-Shella National Park and particularly known for its migratory pelican and flamingo birds. The lake is recharged mainly by the Bulbula and Horakelo rivers. These rivers outflow or spill from the Ziway and Langano lakes respectively, therefore, the three lakes form an interconnected sub-system. The Bulbula river contributes about 125 MCM annually to the Abijata lake, while the Horakelo rivers from the Langano lake contributes about 46 MCM to the Abijata lake. The rest of the Abijata catchment contributes relatively little. The Gogessa river, which is a small eastern tributary of the Jidu river, has some old data

from which the yield is estimated at 10 MCM. The other wetter catchment between Shala and Abijata with a catchment area of 60 km^2 and a runoff coefficient of 20% yields to about 7 MCM. The remaining catchment of Abijata do not have any permanent drainage and only contribute water to the lake during heavy rains as overland flow. The Abijata lake is highly mineralized and is not important for use in irrigated agriculture. However, the Abijata Soda Ash Enterprise is extracting about 2 MCM of water annually for soda ash production from the lake water since 1990.

4.5 Water Use

Figure X.4.1 shows the water use for irrigation in the Meki-Ziway water resources system. Most of irrigation schemes in the area are pumping water from the Ziway lake or the Bulbula river.

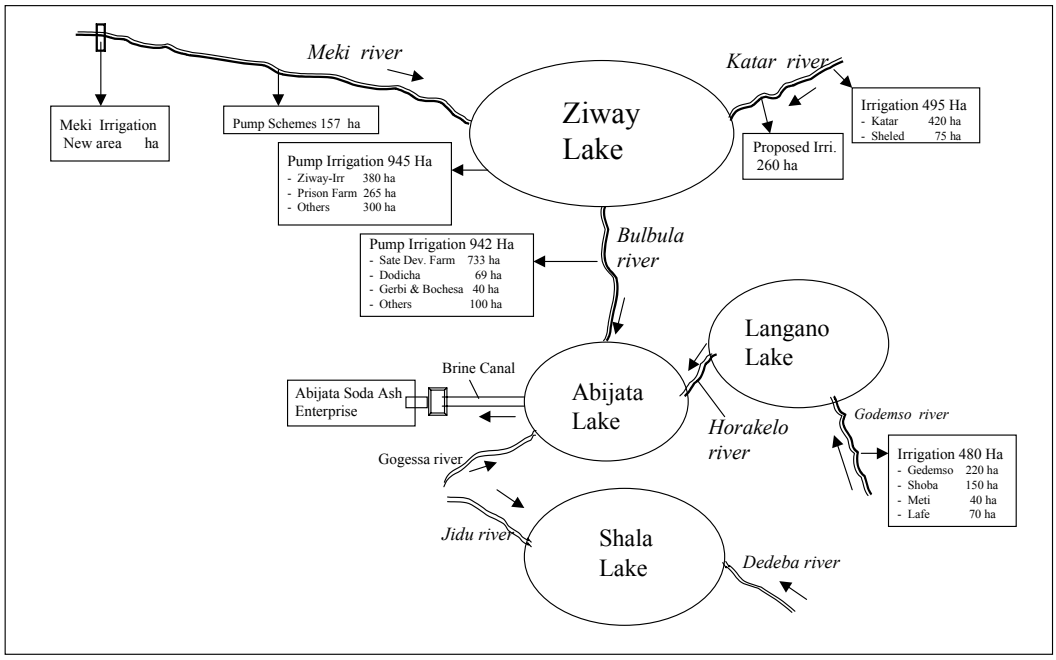


Figure X.4.1 Water Use for Irrigation in the Meki-Ziway Water Resources System

There are several small and medium scale irrigation schemes and state farm developed by abstraction of water from the Ziway lake, Bulbula, and Katar rivers. Table X.4.7 presents the irrigation system utilizing the water abstraction from lakes and rivers.

Table X.4.7 Water Use in the Meki-Ziway System

No.	Irrigation System	Irrigation Area (ha)	Water Source
1.	Katar Irrigation	420	Katar River
	Sheled	75	
2	Pumping Schemes on Meki	157	Meki river
3.	Meki Ziway Project	380	Ziway Lake
	Ziway Prison Farm	265	
	Others	300	
4.	Ziway State Hort. Farm	733	Bulbula
	Dodicha	69	
	Gerbi and Bochessa	40	
	Others	100	

4.6 Objectives of Environmental Monitoring under Program 3

In line with poverty alleviation and food security policies, OIDA has embarked on the community-based irrigation development in the Meki area through Program 4 of the Verification Study (the V/S). In future, with demonstration effects of the V/S, the small-scale irrigation farming will be rapidly expanded within the Meki area. As the executing agency of irrigation sector in Oromia, OIDA' responsibility will accordingly expand not only the financial and technical supports to the peasants but also the control of water use.

At present, OIDA has no particular environmental monitoring department/section although the environmental conservation and the watershed management related to irrigation development are under the responsibility of OIDA. Program 3 aims at initiating the environmental monitoring and assessment in the Meki area, as a model area. Environmental monitoring will be additional workload especially for the OIDA staff assigned to the Meki area with further financial burden. Taking such conditions of OIDA into consideration, Program 3 envisaged to select essential environmental parameters, optimize the OIDA's scope of work and prepare realistic and sustainable environmental monitoring activities.

4.7 Inventory of Small Irrigation Pumps

4.7.1 Data Collection

Neither water rights nor regulation in the Meki river basin, probably in a whole country, are officially introduced. Therefore, any enterprises and investors can install irrigation pumps in the basin. The inventory survey in 2000 verified that there were 160 pumps in Dugda Bora wareda of which 75 pumps were installed in the Meki river and the Ziway lake. The number of pumps tends to increase in recent years. The inventory survey was carried out in June 2001 by the OIDA Meki office.

The results are presented in Attachment X-4-2. In total, 181 units of the small pumps have been introduced in the Meki and Ziway basins. Program 3 of the verification study focused on water use for the irrigation sector. Most of investors do not keep records of their pump operation and are negative to submit their records to the government organizations.

4.7.2 Location and Pump Owners

The distribution of the 181 pumps in terms of location (PA) and owners is summarized in Table X.4.8.

Table X.4.8 Summary of Inventory of Small Pumps

Location	Pump (No.)	Area (ha)	Land Ownership (No.)		
			Rent	Private/ Share	Unknown
Malina	46	208	-	-	46
Meki Town	36	65	23	12	1
Shubi Gamo (Gemu Shubi)	33	62	12	1	20
Bekele Girisa	27	96	20	2	5
Elen	10	39	-	-	10
Tuchi Dambel	7	87	5	1	1
Wayo Gabriel	3	31	-	-	3
Others	19	246	-	-	19
Total	181	834	60	16	105

4.7.3 Pump Capacity (horsepower) and Irrigated Areas

The relationship between the pump capacities (horsepower) and the irrigated areas is presented below.

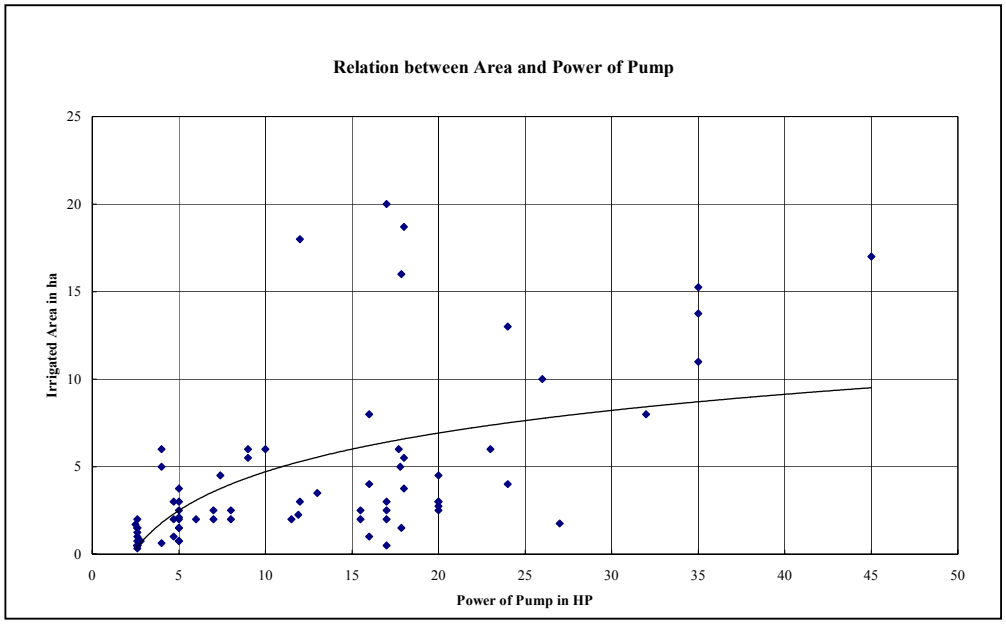


Figure X.4.2 Relationship between Pump Capacity and Irrigation Area

4.7.4 Estimated Water Use by the Small Pumps

It is highly difficult for the OIDA Meki office to obtain the records of operation hours of the existing pumps due to several reasons. Firstly, the legal status of the OIDA local staff is unclear and not authorized in terms of the current monitoring activities. Secondly, the pump owners do not keep the operation records and reluctant to disclose their actual water use, if any record. With the engineering and agronomic sense, the water consumption will be estimated through further study.

4.8 Water Consumption of Meki-Ziway Irrigation Project

4.8.1 Pump Operation in 2001

The Project is operational in 2001. By obtaining the crop credit from Oromia Cooperative Development Bureau, 337 farm households in Bekele Girisa PA organized the farmers association. The Bureau financed Birr 301 per 0.25 ha. The total irrigated area amounts to 216 ha. This means that the total credit financed by the Bureau amounted to Birr 260,064 (US$ 30,960).

The credits are used for procurement of farm inputs for irrigated maize and electricity charge. The operation was started in April 2001. The association paid Birr 36,895 (US$ 4,400) against the total electricity bills from April 2001 to August 2001. This amount is equivalent to Birr 171 (US$ 20) per ha. It is noted that this

electricity cost is much cheaper than the average fuel cost of the prevailing small pump irrigation.

4.8.2 Operation Records

The operation records of the pumps of the Meki-Ziway Irrigation Project in 2001 are presented in Attachment X-4-3. Out of nine (9) units of pumps, only two (2) units of No. 5 and No. 8 are operated. This crop season started on 10th April 2001. In the period from 10th April to 4th July, they were operated for 103:20 hours and 70:11 hours, respectively.

Since the pumping capacity is 0.72 m^3/sec/unit, the total water volume pumped up amounted to 449,800 m^3. This water consumption is equivalent only to 0.06% of the annual inflow of the Meki and Katar rivers to the Ziway lake, i.e. 704 MCM. It is noted that the water use of the Meki-Ziway Project is extremely small. Although further monitoring is required, the environmental impact of the Project may also be negligible.

4.9 Tree Planting in the Meki Area

Soil conservation measures are categorized into two (2), namely agronomic and engineering conservation measures. The agronomic conservation measures include water harvesting, contour farming, grassed waterways, mulcting, etc., while the engineering conservation measures include terrace channel with stepped chute, erosion and torrent control, sedimentation tank, waterway-road, bench terrace, gully protection dam, disaster preventing dam, hillside works, etc. World Food Program (WFP) applies mainly agronomic conservation measures by farmers, while few engineering conservation measures are applied.

The nationwide soil conservation program phase-IV is in progress in Ethiopia by WFP. Under the program, local farmers are involved in afforestation by providing labor force. Farmers are provided wheat flour and edible oil as wages. In the past, Nazareth (Adama) and Lume Wareda of East Showa Zone were covered by the program. As a continuation of the program, WFP embarked on soil conservation practices in Dugda Bora Wareda in 2000. Out of nine (9) candidate micro-catchments, the following four (4) were selected and the afforestation program will be started for the target year of 2005.

Table X.4.9 Tree Planting Program under WFP

Micro-catchments	Peasant Association (PA)	Beneficiaries	Area (ha)
①Mati	Dalota Mati (54)	955	787
②Wede Weji	Menjegso Weji (15)	451	1,493
③Lube	Menjegso Weji (15)	450	1,100
④Jero Raka	Jero Raka(16)	360	1,157

The use of vegetative material in gully control offers an inexpensive and permanent protection. Vegetation protects the gully floor and banks from scouring. Grass on the gully floor slows down the velocity of runoff and causes deposition of silt. It can also be of economic value to the land user. There are two ways of establishing vegetation in the gully: (i) natural recover and (ii) use of planting material. A gully will re-vegetate naturally if the water causing erosion is conserved or diverted before it reaches the gully and if livestock are kept away. Costs are minimal but recovery will be slow if the soil is poor. Furthermore, if the gully sides are steep, vegetation may not establish itself.

In selecting the type of vegetation the conservationist will be guided by the use to be made of the stabilized gully. Material for the floor should grow thickly and should have a deep and dense rooting system. It should have a spreading habit and form a mat. Examples of common grasses used are Star grass (*Cynodon spp.*), *Paspalum spp, Kikuyu grass* (*Pennisetum clandestinum*) and Rhodes grass (*Chloris gayana*). Although Vetiver (vetivaria zizanioides) is not a spreading grass, it can be used to form barriers at intervals across the gully floor. Where the inflow has been stopped, Napier grass (*Pennisetum purpurem*) can be useful but if there is a high discharge, it may cause runoff to cut round the sides and enlarge the gully. In such a situation it can be planted at the foot of the sidewalls. In dry areas, grasses may be difficult to establish and succulents such as sisal and finger Euphorbia (*E. tirucalli*) can be useful. Trees should not normally be planted in the bed of the gully but can be planted on the gully sides if they are not too steep.

The following table shows the tree seedlings released by the Meki tree nursery under the control of OADB.

Table X.4.10 Number of Seedlings Planted in 1999/2000

No.	Type of Seedling	Seedlings Planted by Individuals	Seedlings Planted by WFP Project	Seedlings Planted by Government	TOTAL
1	Eucalyptus spp.	1,135,319	80,113	10,403	1,225,835
2	Shinus molle	145,969	32,370	1,310	179,649
3	Acacia saligna	113,533	58,120	5,500	177,153
4	"Muliyaa"	129,750	18,018	3,850	151,618
5	Lucenea	97,314	25,310	7,000	129,624
6	Dovyalis abyssinica	-	17,200	5,570	22,770
7	Casurina equisetifolia	-	2,210	5,518	7,728
8	Delonix regia	-	-	1,205	1,205
9	Spathodea campanulata	-	5,013	1,895	6,908
10	Pawpaw	-	-	786	786
11	Moringa oleifera	-	8,600	1,600	10,200
12	Gravillea spp	-	750	741	1,491
13	Jacaranda	-	8,496	9,272	17,768
14	Cordea africana	-	3,010	-	3,010
	TOTAL	1,621,885	259,210	54,650	1,935,745

Source: Dugda Bora Agricultural Bureau, 2000

Spacing for the seedlings depends on tree species, soil type, whether trees are planted for hill side revegetation or afforestation. For example, common spacing used in Ethiopia and Kenya for Eucalyptus species range from 1 m x 1m , 2 m x 2m to 2.5 m x 2.5 m. Although the details of the actual spacing requirement have to be clarified with OADB, the total area planted with 1.9 million seedling is estimated to cover some 400 ha to 500 ha.

4.10 Monitoring Program

4.10.1 Selection of Monitoring Aspects

Program 3 concentrated and embarked on the first four environmental monitoring aspects in Table 4.11, namely (1) river discharge recording, (2) water use by Meki-Ziway Project, (3) estimated water use by small pump irrigation and (4) afforestation, which are strongly related to irrigation water use and watershed management.

Although further assessment and discussion are required, the JICA Study Team recommends adding three (3) more monitoring aspects to them. They are (5) water quality analysis, (6) farm economy of irrigation farmers and (7) water resource development activities including irrigation and drinking water supply by donors and NGO. These aspects are also very important to evaluate the environmental changes by water use. Further study will be made in Tokyo by obtaining comments and advises from Hydrologist of the JICA Study Team. The recommendable monitoring program is summarized below.

Table X.4.11 Environmental Monitoring under Program 3

Monitoring Aspect	Methodology	Frequency
(1) River discharge of Meki and Bulbula rivers	− Automatic water level recorders installed by the JICA study team	− Throughout the year
(2) Meki-Ziway Irrigation Project	− Operation records of pumping facilities − Irrigated area − Use of farm inputs − Pump failures and repairs	− Monthly records − Interview to Bureau of Agriculture and Bureau of Cooperatives at the end of crop seasons − Benchmark survey of typical farmers
(3) Small pumps	− Inventory of pump owners − Operation records	− Annual basis − Interview to Bureau of Agriculture and Bureau of Cooperatives at the end of crop seasons − Benchmark survey of representative pump owners
(4) Afforestation	− Questionnaire survey to Bureau of Agriculture − Interview to Meki tree nursery − Inventory survey of activities of donors (WFP) and NGOs (Self-help)	− Annual basis
(5) Water quality analysis of Meki and Bulbula rivers	− Labo-test will be done on the contract basis − Test items to be discussed	− Highest and lowest periods
(6) Farm economy of irrigation areas	− Crops, production, etc. − Farm gate prices − Marketing − Gross revenue and crop production cost − Use of farm inputs − Financial analysis	− Questionnaire survey to Bureau of Agriculture, pump owners and farmers
(7) Activities of donors and NGOs in water resources development, e.g. drinking water, irrigation, etc.	− Interview survey of activities of donors (WFP) and NGOs (Self-help)	− Annual basis

4.10.2 Assessment Required

(1) Organizational set-up and training

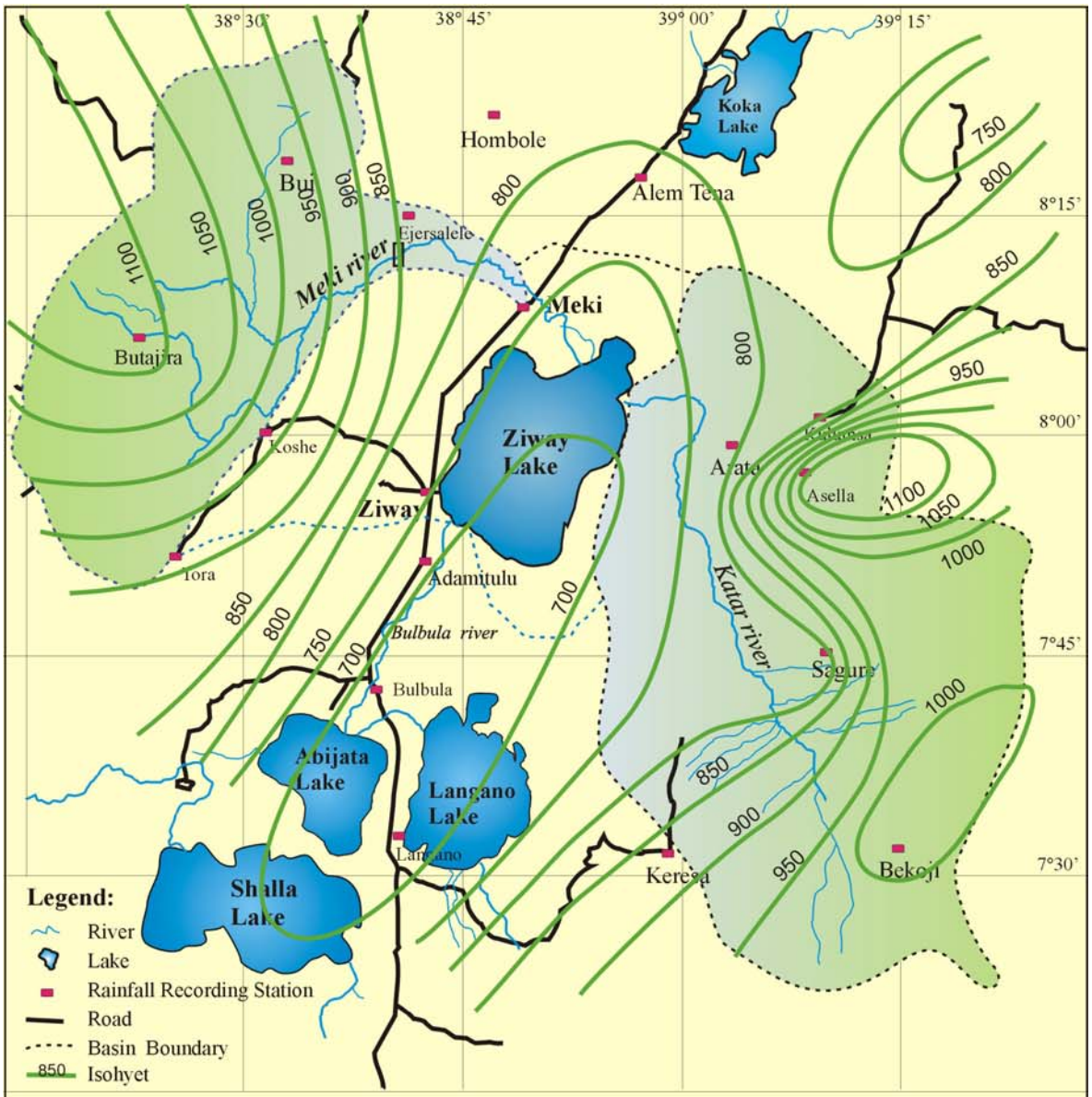
The field works according to the recommended monitoring program are actually new tasks not for the OIDA HQ but for the OIDA Meki office. This additional workloads of the OIDA Meki office should be carefully assessed.

As far as the technical capacity is concerned, OIDA is able to execute monitoring of these aspects. However, the training for environmental monitoring should be

considered in order to perform the sustainable and reliable monitoring data collection.

(2) Budgetary arrangement

Lack of transportation facilities is crucial not only for the OIDA's regular duties but also additional environmental monitoring program, which are proposed under the Study. Budgetary arrangement should also be discussed prior to expand their scope.



List of Rainfall Recording Stations

S.N.	Station Name	Coordinates		S.N.	Station Name	Coordinates	
		Latitude	Longitude			Latitude	Longitude
1.	Alem Tena	8° 18' N	38° 56' E	10.	Hombole	8° 22' N	38° 46' E
2.	Adamitulu	7° 51' N	38° 42' E	11.	Keresa	7° 33' N	38° 58' E
3.	Arata	7° 59' N	39° 04' E	12.	Koshe	8° 01' N	38° 32' E
4.	Asella	7° 57' N	39° 08' E	13.	Kulumsa	8° 04' N	39° 08' E
5.	Bekoji	7° 32' N	39° 15' E	14.	Langano	7° 31' N	38° 48' E
6.	Bui	8° 21' N	38° 33' E	15.	Meki	8° 09' N	38° 49' E
7.	Bulbula	7° 43' N	38° 40' E	16.	Sagure	7° 46' N	39° 09' E
8.	Butajira	8° 09' N	38° 22' E	17.	Tora	7° 52' N	38° 25' E
9.	Ejersalele	8° 15' N	38° 41' E	18.	Ziway	7° 56' N	38° 43' E

Meki-Ziway-Abijata System

List of Irrigation Pumps in Dugda Bora Wareda

No	PA	Owner's Name	Type of Engine	Type of Engine			Area of Land (ha)		Land Ownership
				Horse Power	Capacity	Diameter (inch)	To be Developed	Developred	
1	Walda Maqdala	Tasfaye Abedi	Diesel Engine	17.0		3.0		2.00	Rent Land
2	Wayo Gaberial	Walda Wayo Gaberial (WUA)	Diesel Engine	35.0		4.0		13.75	(WUA)
3	Wayo Gaberial	Walda Wayo Sarit (WUA)	Diesel Engine	45.0		6.0		17.00	(WUA)
4	Wayo Gaberial	Danbi Agro- industry	Diesel Engine	45.0		6.0			
5	Walda Meqdela	Lamma Gelana	Diesel Engine	17.0					
6	Walda Meqdela	Tesfaye Terune	Diesel Engine	20.0					
7	Walda Meqdela	Ayalewe Mokria	Diesel Engine	15.2					
8	Walda Meqdela	Eskender Negusee and Worku Hunde	Diesel Engine	17.0					
9	Tuchi Danbal	Green Denbal Pvt.Lt	Diesel Engine	18.0		6.0	13.00	30.00	Rent Land
10	Tuchi Danbal	Mulegata Ababa	Diesel Engine	16.0		4.0	2.00	1.00	Rent Land
11	Tuchi Danbal	Thahaye and Dane	Diesel Engine	24.0		6.0	3.00	4.00	Rent Land
12	Tuchi Danbal	Motuma Disissa	Diesel Engine	50.0		6.0		37.00	Rent
13	Tuchi Danbal	Meskel Flower PlV	Diesel Engine			6.0			Rent
14	Tuchi Danbal	Walda Tuchi Danbal (WUA)	Diesel Engine	35.0		4.0		15.25	(WUA)
15	Tuchi Danbal		Diesel Engine			3.0			
16	Tepo Korika		Diesel Engine	17.0		4.0		20.00	Rent
17	Tepo Koroke	Walda Tepo-140 (WUA)	Diesel Engine	24.0		4.0		13.00	(WUA)
18	Tepo Goroke	Tepoo Vally Farm	Diesel Engine	25.0		6.0		35.00	Rent
19	Shubi Gemu	Dametwe Nigatu	Diesel Engine	15.5	46.90			2.50	Rent,Share and Private
20	Shubi Gemu	Belete G/Silase	Diesel Engine	17.0		4.0		0.50	Rent Land
21	Shubi Gemu	Mamere Baheru	Diesel Engine			3.0		1.50	Rent and Share
22	Shubi Gemu	Woji Gulale	Diesel Engine	17.7		8.0		6.00	Rent and Share
23	Shubi Gemu	Mesele Mengasha	Diesel Engine	10.0		2.0		6.00	Rent and Share
24	Shubi Gemu	Mokennen Tola	Diesel Engine	4.0	16.70	3.0		6.00	Rent and share
25	Shubi Gemu	Kidane Kelalaw	Gasoline Moter	16.0		6.0		4.00	Rent and Share
26	Shubi Gemu	Abu Kushnia	Diesel Engine	18.0		4.0		5.50	Rent and Share
27	Shubi Gemu	Teshome G/Mariyam and Asafa G/mariyann	Diesel Engine	74.0	50.00	6.0		4.50	Rent and Share
28	Shubi Gemu	Kinfe Geberu	Diesel Engine	20.0		4.0		2.75	Rent and Share
29	Shubi Gemu	Ayimut Equbiay	Gasoline Moter	5.0	16.74	3.0		0.75	Rent
30	Shubi Gemu	Zewdu Gutama	Gasoline Moter	2.8	15.50	3.0			Private and Share
31	Shubi Gemu	Zewdu Gutama	Diesel Engine	5.0	15.50	3.0		2.50	Private and Share
32	Shubi Gemu	Kedir Godana	Diesel Engine	5.0		3.0		1.50	Private and Share
33	Shubi Gemu	Chinko Danye and	Diesel Engine	5.0	15.50	3.0		1.50	Private and Share
34	Shubi Gemu	Girma Mamo(B)	Diesel Engine	15.5		6.0		2.00	Private
35	Shubi Gemu	Chatolic Dev't No moter	Diesel Engine						Land uncultivated
36	Shubi Gemu	Girma Yanimar	Diesel Engine			5.0		6.25	Rent and Share
37	Shubi Gemu	Eshetu	Diesel Engine	11.5		4.0		2.00	
38	Shubi Gemu	Abrahum Halie	Diesel Engine			3.0			
39	Shubi Gemu	Monyu	Diesel Engine	5.6	18.30	3.0			
40	Shubi Gemu	Temesgen G/Mariam	Diesel Engine	20.0	26.50				
41	Shubi Gemu	Temesgen G/Mariam	Diesel Engine	17.9		5.0			
42	Shubi Gemu	Wojii Gullalle	Diesel Engine	17.0		6.0			
43	Shubi Gemu	Gidaye G/Esgabiher	Diesel Engine	17.8					
44	Shubi Gemu	G/slasie W/Mariaym	Diesel Engine	37.0					
45	Shubi Gemu	Negussie	Gasoline Moter	4.0	16.70	3.0	2.00	0.63	
46	Shubi Gemu	Mesele Mengasha	Diesel Engine	5.0					
47	Shubi Gemu	Mokennen Tola	Gasoline Moter	2.6	15.50	3.0			
48	Shubi Gemu	Getachaw Teka	Gasoline Moter						
49	Shubi Gemu		Diesel Engine	18.0		6.0			
50	Shubi Gemu	Kufa Endo	Diesel Engine	17.0		3.0		2.50	
51	Shubi Gemu	Bonasa Tola	Diesel Engine	17.0		4.0		3.00	
52	Shubi Gemu	Tuna Nadhi	Diesel Engine	2.6	15.50				
53	Oda Bokota	Dawit Haile	Diesel Engine	27.0					
54	Oda Bokota	Walda Oda Bogota	Diesel Engine	35.0					
55	Malina	Abara Gelata	Diesel Engine					4.00	Not operational
56	Malina	?	Diesel Engine					6.00	
57	Malina	Bokana Guda	Diesel Engine					6.00	
58	Malina	Asafa Jimma	Diesel Engine					6.00	
59	Malina	Tashom Guda	Diesel Engine					6.00	
60	Malina	Dolo ?	Diesel Engine					4.00	
61	Malina	Sanbato Guda	Diesel Engine					0.25	
62	Malina	Ayano Hunde	Diesel Engine					0.25	
63	Malina	Burkune Oda	Diesel Engine					0.25	
64	Malina	Tuju Rago	Diesel Engine					0.25	
65	Malina	Savuy Oda	Diesel Engine					0.25	
66	Malina	Biyo Oda	Diesel Engine					0.25	
67	Malina	Tena Negatu	Diesel Engine		3.00			10.00	
68	Malina	Nadhi Hunde	Diesel Engine		1.00			3.00	
69	Malina	G/Hiwat Tafari	Diesel Engine		1.00			4.00	
70	Malina	Fitala Hawas	Diesel Engine		1.00			6.00	
71	Malina	Abrahame H/giorgis	Diesel Engine		1.00			10.00	
72	Malina	Gada Dagaga	Diesel Engine		1.00			4.00	
73	Malina	Abrahame Eshetu	Diesel Engine		2.00			14.00	
74	Malina	Dabo Tera	Diesel Engine		1.00			8.00	
75	Malina	Bulbual Erba	Diesel Engine		1.00			6.00	
76	Malina	?	Diesel Engine		1.00			4.00	
77	Malina	Godana Dadhi	Diesel Engine		1.00			7.00	
78	Malina	Midhaga Tere	Diesel Engine		1.00			6.00	
79	Malina	Gemmechu Badhadla	Diesel Engine		1.00			8.00	
80	Malina	Badho Tere	Diesel Engine		1.00			4.00	
81	Malina	Oda Bulbula	Diesel Engine		1.00			6.00	
82	Malina	Saltu Tumbi	Diesel Engine		1.00			10.00	
83	Malina	Dabo Busa	Diesel Engine		1.00			10.00	
84	Malina	Erenso Hawas	Diesel Engine		1.00			10.00	
85	Malina	Namagugdi Eresnso	Diesel Engine		1.00			10.00	
86	Malina	Abiti Bekele	Diesel Engine		1.00			5.00	
87	Malina	Jimma Boters	Diesel Engine		1.00			1.00	
88	Malina	Dejene Ayala	Diesel Engine		1.00			8.00	
89	Malina	Haji Sayifadin Abdala	Diesel Engine		1.00			10.00	
90	Malina	Alamayhu	Diesel Engine		1.00			10.00	
91	Elen	Pro. Jara Wayo	Diesel Engine	2.0				8.00	
92	Elen		Diesel Engine						

List of Irrigation Pumps in Dugda Bora Wareda

No	PA	Owner's Name	Type of Engine	Type of Engine			Area of Land (ha)		Land Ownership
				Horse Power	Capacity	Diameter (inch)	To be Developed	Developred	
93	Elen		Diesel Engine						
94	Elen	Tekola	Diesel Engine	2.0				15.00	
95	Elen		Diesel Engine	1.0					
96	Elen	Ashenafi Mamo	Diesel Engine	1.0				2.00	
97	Elen	Soresa Balda	Diesel Engine	1.0				6.00	
98	Elen	Adana Bekele	Diesel Engine	1.0				4.00	
99	Elen	( )	Diesel Engine						
100	Elen	NGO	Diesel Engine						
101	Elen	Zerehun Tena	Diesel Engine	1.0				2.00	
102	Elen	Abera Bekele	Diesel Engine	1.0				2.00	
103	Dodota Danbal	Hiyout Farm (Getachaw Worku)	Diesel Engine	26.0		4.0	6.00	10.00	Defect in motor
104	Dodota Danbal	Walda Dodota Danbel (WUA)	Diesel Engine	12.0		4.0		18.00	(WUA)
105	Dodota Danbal	Walda Kalalaga Danbel (WUA)	Diesel Engine	35.0		4.0	14.00	11.00	(WUA)
106	City 01	Arbi Gari	Gasoline Moter	2.6		3.0		1.25	Share and Rent
107	City 01	Abata Water	Gasoline Moter	2.6	15.50	3.0		1.50	Rent Land (City)
108	City 01	Tanda Mola	Gasoline Moter	8.0	30.00	4.0		2.50	Rent Land (City)
109	City 01	Girma Alemu	Gasoline Moter	2.6	16.70	3.0		0.50	Rent Land (City)
110	City 01	Dagaga Debele	Gasoline Moter	2.6	15.50	3.0		0.33	Rent Land (City)
111	City 01	Negussie Eshete	Gasoline Moter	2.6	15.50	3.0		0.50	Rent Land (City)
112	City 01	Alemayhu Getahun	Gasoline Moter	4.0	16.70	3.0		5.00	Rent Land (City)
113	City 01	Girma Mamo (A)	Eletrcal Moter					2.00	Rent (City)
114	City 01	Samuel W/Yohannes	Diesel Engine					1.00	Rent (City)
115	City 01	Kasa Amba	Diesel Engine			5.0		2.50	Rent (City)
116	City 02	Ababa Tasfaye (A)	Diesel Engine	7.0		3.0		2.50	Rent Land
117	City 02	Asaminew Nigatu	Diesel Engine			4.0		2.00	Rent Land
118	City 02	Abadi G/mariyame	Diesel Engine	23.0		5.0		6.00	Rent Land
119	City 02	Abara Nagasa	Diesel Engine	7.0		4.0		2.00	Rent Land
120	City 02	Abara	Gasoline Moter	2.6	15.00	2.0		1.00	Rent Land
121	City 02	Ababa Tasfaye (A)	Diesel Engine	5.0		4.0		0.75	Rent Land
122	City 02	Dasta Bayisa (A)	Diesel Engine			4.0		1.00	Rent Land
123	City 02	Tasfaye Abedi	Diesel Engine	8.0		3.0		2.00	Rent Land
124	City 02	Berga Tilahune	Diesel Engine			4.0		1.50	Rent Land
125	City 02	Matwos Wagkuma	Diesel Engine			4.0		1.00	Rent Land
126	City 02	Niguisse Ararso	Diesel Engine			4.0		2.00	Rent Land
127	City 02	Gugesa Yadate	Diesel Engine			4.0		1.00	Rent Land
128	City 02	Getu Abebe	Diesel Engine					2.00	Rent Land
129	City 02	Eshetu Gabiso	Diesel Engine					2.00	Private
130	City 02	Abadi G/mariyame	Diesel Engine	38.0		6.0			
131	City 03	Gaber Wolde	Gasoline Moter	2.6		3.0		0.75	Share
132	City 03	Mokennen Abebe	Gasoline Moter	2.8	15.50	3.0		0.75	Share
133	City 03	Lakewe Nagashe	Diesel Engine	20.0		6.0		2.50	Share
134	City 03	Haron W/yesuse (B)	Diesel Engine	6.0		2.0		2.00	Share
135	City 03	Mokennen Hebiro	Gasoline Moter			3.0		0.50	Share
136	City 03	Tadase Tabore	Diesel Engine			4.0		1.00	Rent Land
137	City 03	Desta Bayesa (B)	Diesel Engine			4.0		2.00	Private,Rent and Share
138	City 03	Haron W/yesuse	Diesel Engine	27.0		6.0		1.75	Private and Share
139	City 03	Abraham G/Hiwot	Diesel Engine	16.0		6.0		8.00	Private and Rent Land
140	City	A/mako Temamo	Gasoline Moter	2.6		3.0		0.50	Share
141	City	Abraham Asfaw	Gasoline Moter	2.6		3.0		1.50	Share
142	Bekele Girisa	Miftah Mohammed	Diesel Engine			5.0		2.00	Rent and Share
143	Bekele Girisa	Tedi Kabada	Diesel Engine	4.7		3.0		2.00	Rent and Share
144	Bekele Girisa	Muzamil Abdo	Diesel Engine	2.6	15.00	3.0		2.00	Rent and share
145	Bekele Girisa	Tesfaye Gashew	Diesel Engine	5.0	16.70	3.0	1.00	2.00	Rent and share
146	Bekele Girisa	Misba Yasin	Diesel Engine	5.0	16.70	3.0		3.75	Rent and share
147	Bekele Girisa	Turamo Asefa	Diesel Engine	9.0		4.0		5.50	Rent and Share
148	Bekele Girisa	Gennen G/sabsibe	Diesel Engine			6.0	2.00	5.00	Rent and Share
149	Bekele Girisa	Getachaw Birega	Diesel Engine	5.0		3.0		3.00	Rent and Share
150	Bekele Girisa	Biyo Hola	Diesel Engine	20.0		6.0		3.00	Rent and Share
151	Bekele Girisa	Badaso Balcha	Diesel Engine	20.0		6.0		3.00	Rent and Share
152	Bekele Girisa	Bayena Badore	Diesel Engine	4.7	15.50	3.0		3.00	Rent and Share
153	Bekele Girisa	Mamush Kasa	Diesel Engine	20.0		6.0			Rent and Share
154	Bekele Girisa	Ababa Tesfaye	Diesel Engine	12.0	33.30	5.0		3.00	Rent and Share
155	Bekele Girisa	Ashama and Shamgo	Diesel Engine	11.9	30.00	4.0		2.25	Rent and Share
156	Bekele Girisa	Dr. Fekere Tekele	Diesel Engine			5.0	4.00	10.00	Rent
157	Bekele Girisa	Buffa Kushina	Diesel Engine	17.8		6.0		5.00	Rent
158	Bekele Girisa	Silu Adara	Diesel Engine	20.0		5.0		4.50	Rent
159	Bekele Girisa	Tekelu Adara	Diesel Engine	13.0		6.0		3.50	Rent
160	Bekele Girisa	Andaregchew Sahile	Diesel Engine			4.0		4.00	Rent
161	Bekele Girisa	Dammis Alemu	Diesel Engine	2.6	15.50	3.0		0.50	Rent
162	Bekele Girisa	Asaminuw Nigatu	Diesel Engine	17.9		6.0		16.00	Rent & Share
163	Bekele Girisa	Walda Laga Niagi-2 (WUA)	Diesel Engine			4.0		4.00	(WUA)
164	Bekele Girisa	Milo Ido	Diesel Engine	4.7	15.50	3.0		1.00	
165	Bekele Girisa	Asaminuw Nigatu	Diesel Engine	17.9		6.0		1.50	
166	Bekele Girisa	Mana Barumsa Bekele	Diesel Engine			4.0		4.00	
167	Bekele Girisa	Firala Hawas	Diesel Engine			3.0		2.00	
168	Bekele Girisa	Hagos Berhe	Diesel Engine	10.0		3.0			
169	Bagale Girisan	Ayalewe Mokria	Diesel Engine	17.0					
170	Abono Gaberial	Hadish i	Diesel Engine	32.0	44.44	4.0		80.00	Rent
171	Abono Gaberial	Hadish iii (WUA)	Diesel Engine			5.0		40.00	(WUA)
172	Abono Gaberial	Hadish ii	Diesel Engine			5.0			
173	Garaba Chorike Addi	Kider Negeso	Diesel Engine	18.0	18.00	3.0	3.75	3.75	Rent and share
174	Giraba Korki Adi	Kidane Kelalaw	Diesel Engine			2.0	37.25	2.75	Rent
175			Diesel Engine	25.0	15.83	4.0			
176		Hagos Berhe	Diesel Engine			4.0		5.50	Rent and Share
177		Mamush Kasa	Diesel Engine	9.0		4.0		6.00	Rent and Share
178									
179			Diesel Engine	24.0		4.0			
180		Wojii Gullalle	Diesel Engine						
181		Ayalewe Mokria	Diesel Engine	17.0					
182		Asaminuw Nigatu	Diesel Engine		19.50	4.0			

MEKI-ZIWAY IRRIGATION PROJECT
PUMP OPERATION RECORD
(PUMP NO. 5)

Date	Time				Kwh			
	Started	Stopped	Duration (hr)	Accum.(hr)	Started	Stopped	Consumed	Accum.
10-Apr-01	10:30	14:00	3:30	24x0 + 3:30	045607			
11-Apr-01	14:10	15:10	1:00	24x0 + 4:30				
18-Apr-01	7:10	11:10	4:00	24x0 + 8:30				
19-Apr-01	6:30	11:30	5:00	24x0 + 13:30				
20-Apr-01	6:30	11:00	4:30	24x0 + 18:00				
21-Apr-01	6:50	10:40	3:50	24x0 + 21:50				
23-Apr-01	7:00	9:25	2:25	24x1 + 0:15				
24-Apr-01	6:35	10:45	4:10	24x1 + 4:25				
24-Apr-01	2:50	3:50	1:00	24x1 + 5:25				
25-Apr-01	6:20	11:00	4:40	24x1 + 10:05				
26-Apr-01	4:20	4:50	0:30	24x1 + 10:35		046716	1,109	1,109
27-Apr-01	6:40	11:00	4:20	24x1 + 14:55	046716	046849	133	1,242
28-Apr-01	6:35	10:45	4:10	24x1 + 19:05	046849	046980	131	1,373
29-Apr-01	6:27	9:11	2:44	24x1 + 21:49	046980	047062	82	1,455
3-May-01	7:05	10:55	3:50	24x2 + 1:39	047062	047176	114	1,569
4-May-01	6:33	8:15	1:42	24x2 + 3:21	047176	047227	51	1,620
6-Jun-01	6:15	10:20	4:05	24x2 + 7:26	047227	047350	123	1,743
6-Jun-01	2:12	4:02	1:50	24x2 + 9:16	047350	047407	57	1,800
8-Jun-01	6:30	10:00	3:30	24x2 + 12:46	047407	047512	105	1,905
9-Jun-01	6:46	8:30	1:44	24x2 + 14:30	047512	047557	45	1,950
10-Jun-01	6:12	8:41	2:29	24x2 + 16:59	047557	047632	75	2,025
11-Jun-01	6:40	9:45	3:05	24x2 + 20:04	047632	047724	92	2,117
27-Jun-01	7:35	12:00	4:25	24x3 + 0:29	047724	047855	131	2,248
28-Jun-01	6:20	12:00	5:40	24x3 + 6:09	047855	048022	167	2,415
28-Jun-01	2:50	4:55	2:05	24x3 + 8:14	048022	048085	63	2,478
29-Jun-01	6:50	9:10	2:20	24x3 + 10:34	048085	048156	71	2,549
30-Jun-01	8:05	11:00	2:55	24x3 + 13:29	048156	048242	86	2,635
1-Jul-01	6:30	11:20	4:50	24x3 + 18:19	048242	048384	142	2,777
2-Jul-01	6:10	12:00	5:50	24x4 + 0:09	048384	048546	162	2,939
3-Jul-01	2:05	4:30	2:25	24x4 + 2:34	048546	048616	70	3,009
4-Jul-01	6:30	11:30	5:00	24x4 + 7:34	048616	048766	150	3,159
Total				24x4 + 7:34				3,159

MEKI-ZIWAY IRRIGATION PROJECT
PUMP OPERATION RECORD
(PUMP NO. 8)

Date	Time				Kwh			
	Started	Stopped	Duration (hr)	Accum.(hr)	Started	Stopped	Consumed	Accum.
10-Apr-01	10:30	2:00	3:30	24x0 + 3:30	036673			
11-Apr-01	2:10	3:10	1:00	24x0 + 4:30				
18-Apr-01	7:10	11:10	4:00	24x0 + 8:30				
19-Apr-01	6:30	11:30	5:00	24x0 + 13:30				
20-Apr-01	6:30	11:00	4:30	24x0 + 18:00				
21-Apr-01	6:50	10:40	3:50	24x0 + 21:50				
23-Apr-01	7:00	9:25	2:25	24x1 + 0:15				
24-Apr-01	6:35	10:45	4:10	24x1 + 4:25				
24-Apr-01	2:50	3:50	1:00	24x1 + 5:25				
25-Apr-01	6:20	11:00	4:40	24x1 + 10:05				
26-Apr-01	6:20	12:00	5:40	24x1 + 15:45			1,109	1,109
26-Apr-01	2:20	4:50	2:30	24x1 + 18:15		037957	133	1,242
27-Apr-01	6:35	10:00	3:25	24x1 + 21:40	037957	038058	131	1,373
28-Apr-01	6:35	10:10	3:40	24x2 + 1:20	038058	038165	82	1,455
29-May-01	6:25	9:11	2:46	24x2 + 4:06	038165	038246	114	1,569
3-May-01	7:05	10:55	3:50	24x2 + 7:56	038246	038359	51	1,620
4-May-01	6:30	8:15	1:45	24x2 + 9:41	038359	038403	123	1,743
6-Jun-01	6:13	10:18	4:05	24x2 + 13:46	038403	038514	57	1,800
6-Jun-01	2:11	4:01	1:50	24x2 + 15:36	038514	038565	105	1,905
8-Jun-01	6:30	10:00	3:30	24x2 + 19:06	038565	038666	45	1,950
9-Jun-01	6:53	8:30	1:37	24x2 + 20:43	038666	038705	75	2,025
10-Jun-01	6:12	8:40	1:28	24x2 + 22:11	038705	038775	92	2,117
Total								

Chapter 5

Program 4 of Verification Study

Guideline for Formation and Operation of Water Users Associations (WUA)

Chapter 5 Guideline for Formation and Operation of Water Users Associations (WUA)

5.1 Introduction

5.1.1 Background

The Master Plan proposes [1－2] Meki Irrigation and Rural Water Supply Project to introduce a gravity irrigation system to drought prone zone of the Maki area by means of proposed headwork and the irrigation system on the Meki River, covering 2,300 ha and 9,200 households. Toward a realization of the project, [1－1] Water Users Associations (WUAs) Support Program will be implemented so the beneficiary farmers will organize water users' associations (WUA), and their capacity of the project management shall be strengthened.

The community-based irrigation development in Dugda Bora Wareda extends to 400ha under the management of 15 WUAs organized by 500 household. These irrigation schemes contribute to the regional economy through production of both food crops and vegetables as well as creation of employment opportunities to local farmers. Successful performance also empowers local farmers, who are not involved in the irrigation projects, as a whole. The farmers groups are listed below.

Table X.5.1 Farmers Groups in Dugda Bora Wareda

No.	Name of WUA	PA	Members			Irrigation Area	Source of Water	Year of Establish-ment
			Male	Female	Total	(ha)		
1	Lega Meki-1	Gemu Sbubi	10	-	10	32.5	Meki river	1997
2	Lega Meki-2	Bekere Girrisa	19	5	24	6.0	Meki river	1998
3	Bekere Girrisa	Bekere Girrisa	130	5	135	218.0	Ziway lake	1997
4	Melka Cherecha	Welda Mekdela	34	-	34	14.1	Ziway lake	1998
5	Meika Korma	Welda Kelina	28	9	37	16.6	Ziway lake	1998
6	Melka Aba Godana	Welda Kelina	18	1	19	7.8	Meki river	1998
7	Oda Bokota	Oda Bokota	-	23	23	5.0	Meki river	1999
8	Teppo-140	Teppo Chareke	40	-	40	13.0	Ziway lake	1997
9	Cheleleka Denbel	Dodola Denber	34	1	35	10.9	Ziway lake	1998
10	Dodoata Denbel	Dodola Denber	15	-	15	18.1	Ziway lake	1997
11	Wayyo Gabrier	Wayyo Gabrier	19	5	24	13.8	Ziway lake	1996
12	Wedia Kelina	Wedia Kelina	30	1	31	8.6	Ziway lake	1998
13	Wayyo Serrit	Wayyo Gabrier	28	4	32	17.0	Ziway lake	1999
14	Tuchi Denbel	Tuchi Denbel	16	-	16	15.3	Ziway lake	1996
15	Jara Wayu	Elen	20	5	25	8.0	Elen lake	1998
	Total	-	441	59	500	404.6	-	-

Except for Bekere Girrisa located in the command area of the Meki-Ziway irrigation project, they have been developed using the surface water resources of the Meki river and the Ziway lake by use of small pumps. [1－1] Water Users Associations (WUAs) Support Program will be carried out through strengthening those existing WUAs as well as other farmers groups in rainfed area.

Under the above-mentioned circumstances, it is vital for OIDA to establish a systematic approach and method for establishment of WUA.

5.1.2 Objectives

This verification study program focus on standardization of community mobilization for establishment of WUAs for small-scale irrigation development (5 ha) in line with the concept of [1-1] Water Users Association Support Program.

5.1.3 Approach to the Study

The Study aims at establishment of WUA with participatory approach, which enables sustainable irrigation farming, learning from past experience of projects under support of ESRDF and NGO. The sustainability will consists of (1) financial sustainability, (2) technical sustainability, and (3) institutional sustainability.

The Study will provide the training to the OIDA community development experts and social workers under Community Participation Department. According to the OIDA Wareda Office at Meki, some groups have already requested OIDA to provide both technical and financial supports for the small-scale irrigation development. Among already recognized groups, three (3) groups will be selected and actually participate in the small-scale irrigation development. The OIDA staff will organize PRA, in which direct interview, questionnaire survey, focus group discussion and community resources mapping, etc. The PRA will lead the groups to formulate group fund under the registered bank accounts. A pumping facility will be supplied to a group after consensus and mutual agreement will be attained within a group. Management of the schemes by the group will be monitored by OIDA. The lesson leant from a series of process will be compiled “a guideline for community-based small-scale pump irrigation project in Meki”.

5.1.4 Plan of Operation

Work flow of the Study is presented in Figure X.5.1, showing identification of constraints and prospects, preparatory works, verification of the draft guidelines in the field, and feed-back to the guideline.

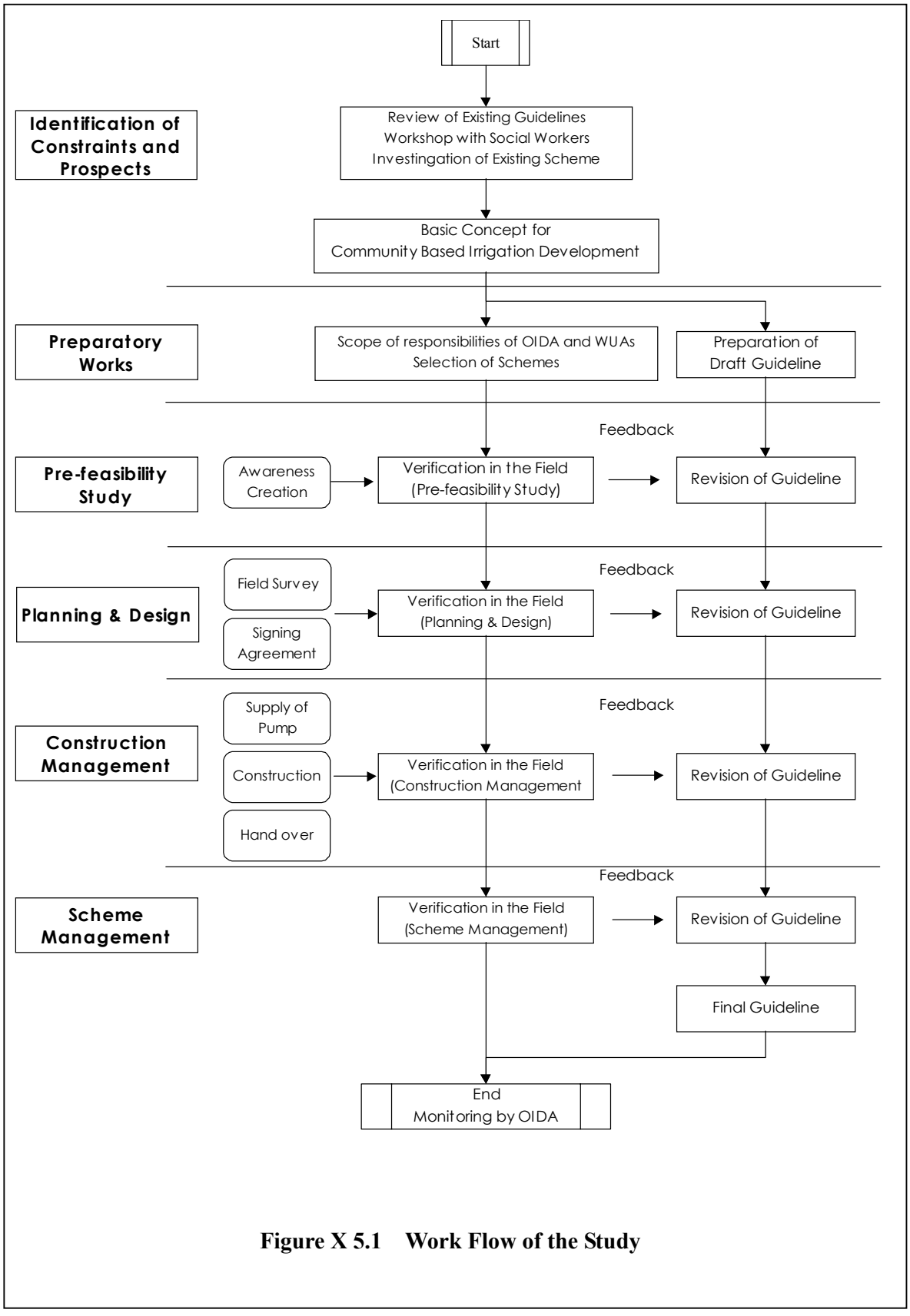


Figure X 5.1 Work Flow of the Study

5.2 Identification of Constraints and Prospects

5.2.1 Review of Existing Guidelines and Manuals

Present guidelines of community mobilization prepared by IFAD and ESRDF were reviewed. They only describe concept and principle for the community mobilization. Thus, preparation of practical manuals and guidelines for the community mobilization have been expected so that even less experienced social workers can attain the required the work performance.

5.2.2 Workshop with OIDA's Social Workers

A workshop with OIDA's social workers was held on 5th and 6th of July 2001 in order to evaluate their capacity of community mobilization and to interview their needs for the revised guideline. 9 social workers in the head office and 4 branch offices were present on the workshop.

The findings through a questionnaire and discussion are summarized as follows:

- Although they have experience of community mobilization for planning, design, construction, and operation and maintenance stages to some extents, their performances tend to depend on personal experience.
- It is necessary for social works to get broad knowledge and information for irrigation farming, especially cost – benefit analysis of agricultural crops, e.g., benefit, production cost, and even – break point.
- All the attendance point out that land holding is major prevailing constraint for irrigation development. Numbers of small-scale landowners with a small number of large-scale landowners could cause difficulty for censuses for delineation of irrigated lands. The large-scale landowners tend to entrust their farmlands to cultivators living out of the community, and are reluctant to share their land to the small-scale landowners. This situation may cause conflict among the community and a decline of the irrigation scheme. It is also commented that the land issue derives from unsatisfactory legislation in terms of land and water rights.
- At operation and maintenance (O&M) stage, the social workers are in engaged in technical guidance to WUA for operation and maintenance of the irrigation schemes and assistance to WUA for conflict management. The technical guidance consists of operation and maintenance of irrigation facilities, water management, farming practices, and marketing. They mentioned that the lack of the O&M fund is the most constraint in existing irrigation schemes, and the awareness creation on this issue at the planning stage is essential for sustainable irrigation scheme management. Further special care should be given to preparation of by-law and financial management to strengthen WUA management capacity in cooperation with the Bureau of Co-operatives.

The comments and suggestion arisen in the discussion were incorporated to prepare

the draft guideline.

5.2.3 Farmers' Groups Applied for Pump Irrigation Scheme

Several farmers' groups in Dugda Bora have submitted application form to start small-scale pump irrigation schemes. They are listed below, and their locations are shown in Figure X 5.2.

Table X 5.2 Farmers Groups Applying Pump Irrigation Scheme

	Name of group	No. of members	Command area	Water source
1.	Shubi	15	15.0 ha	Meki river
2.	Sombo Ganet	25	12.5 ha	Meki river
3.	Sombo Aleltu	20	5.0 ha	Meki river
4.	Abono	47	23.5 ha	Ziway Lake
5.	Giraba Korte Adi	23	15.0 ha	Ziway Lake
6.	Dodota Dembel	65	23.5 ha	Ziway Lake

Field investigation for the above schemes were conducted by OIDA and JICA Study Team. General features of them are summarized below.

As long as All of the farmers' groups, who apply OIDA to supply a pump for irrigation, have an experience of irrigation farming, sharing farming lands with a private pump owner, residing in the same PA or Meki. The farmers rent a part of their land to the owner, and the owner supply irrigation water to the farmers in return for land rental charge.

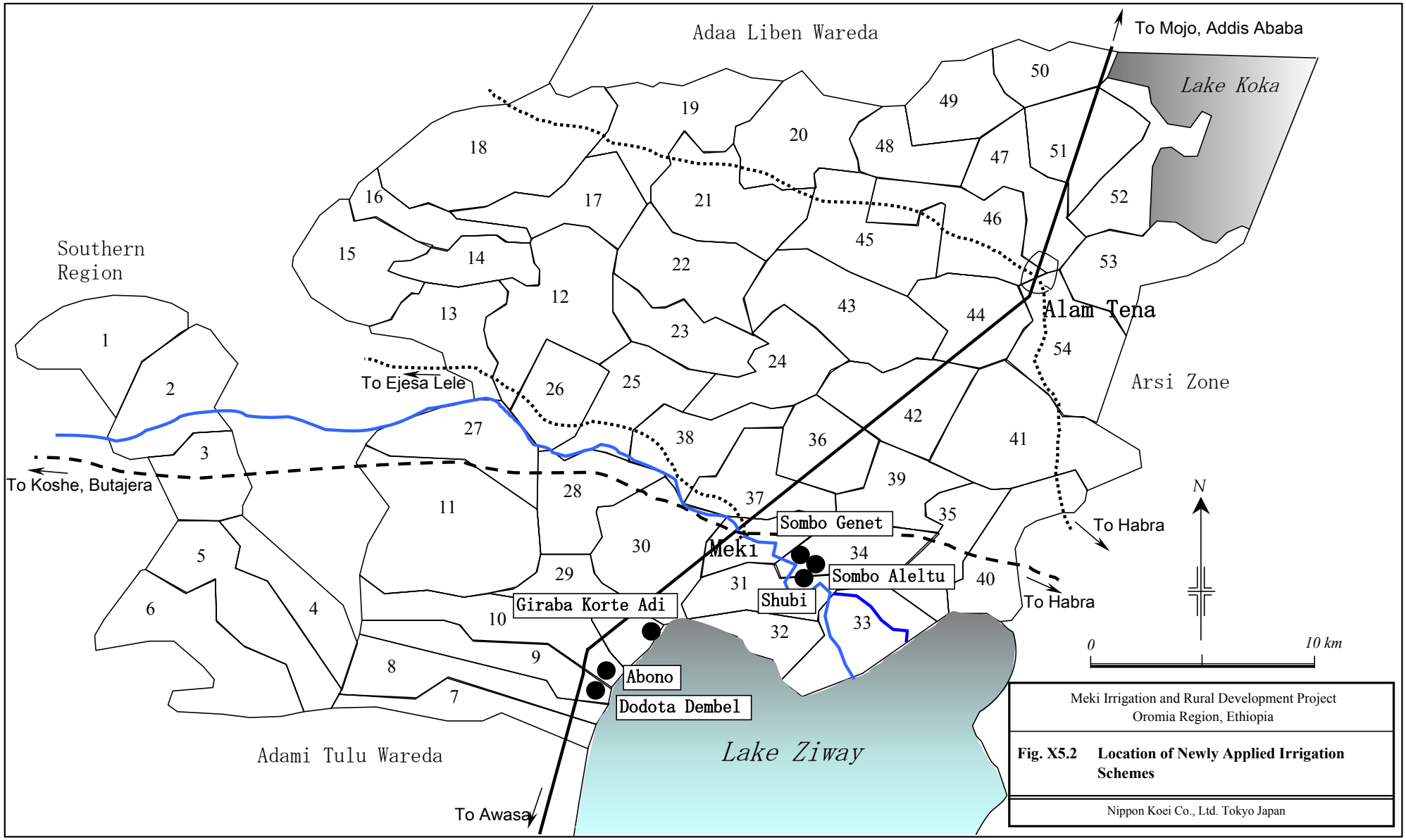
However, the farmers are not satisfied with that system due to frequent conflict with the pump owner regarding water distribution, and share of profits from the lands.

Further, because of shortage of money, the farmers are obliged to get their farm inputs from the owner in advance, and to repay in kind after harvest. The farmer mentioned that the inputs through the pump owner were too expensive compared with market price, and that it should result in loss even from irrigation farming.

Under the above circumstances, the farmers wish to organize a WUA so as to manage irrigation scheme, being independent from the pump owner.

It was observed, however, that the interviewed farmers had too much expectation for irrigation. In fact, they estimated their net benefit on the basis of the highest price of agricultural products in a year, and they were not aware of risk accompanied with irrigation farming due to decline of the price. Moreover, asked whether introduction of irrigation practice would resolve shortage of funds for farm input, they had little distinct prospects.

Figure X.5.2


Adaa Liben Wareda
To Mojo, Addis Ababa
Lake Koka
Southern Region
Alam Tena
Arsi Zone
To Ejesa Lele
To Koshe, Butajera
Sombo Genet
Meki
Sombo Aleltu
Shubi
Giraba Korte Adi
Abono
Dodota Dembel
To Habra
To Habra
To Awasa
Adami Tulu Wareda
Lake Ziway
N
0
10 km
Meki Irrigation and Rural Development Project
Oromia Region, Ethiopia
Fig. X5.2 Location of Newly Applied Irrigation Schemes
Nippon Koei Co., Ltd. Tokyo Japan

5.3 Basic Concept for Community-based Irrigation Development

Several discussion and field investigation reached the basic concept of community-based irrigation development with sustainability as described below.

(1) Economical sustainability

Allocation of Irrigated land

Special attention is paid to an equal irrigated land allocation to all WUA members with optimum scale to avoid economical imbalance among the members. An area of 0.25 ha per each member will be proposed taking into consideration previous OIDA's experience and family labor force.

Group fund formation

Group fund formation by WUA shall be promoted for securing the funds for the initial cultivation. In stead of 10% labor contribution in construction cost, wages for the construction works will be paid to the farmers. The wages will be saved into a bank account of WUA and they will be utilized as the initial cost for cultivation. OIDA will help WUA to open the bank account.

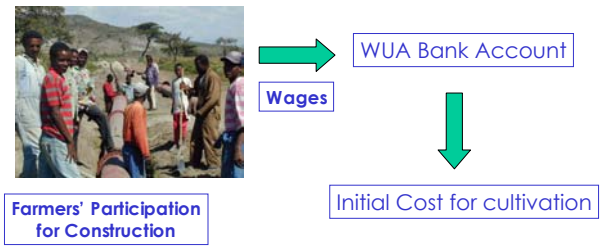


Figure X.5.3 Group Fund Formation of WUA

Saving for replacement of pump

OIDA is requested to instruct WUA members to save money annually for replacement of a pump considering a life of the pump.

(2) Technical sustainability

Land consolidation

Land consolidation of irrigated land near water resource shall be facilitated in order to enhance irrigation performance. This measure could reduce canal length and water seepage, and consequent fuel cost, improving irrigation efficiency and performance of the pump. It is essential to exchange of farmland among the WUA members to achieve the effect of land consolidation, discussing thoroughly among the members.

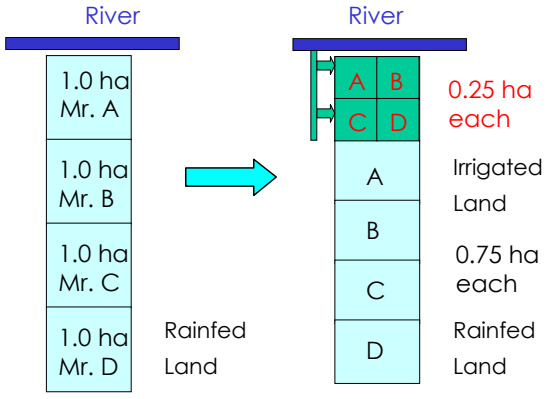


Figure X.5.4 Consolidation and Exchange of Lands

(3) Institutional sustainability

Support to WUA to be self-help organization

From planning stage, OIDA will be requested to support WUA continuously so that the WUA become a self-help organization. This will include mechanism of decision-making, operation and maintenance of the scheme facilities, water management, and financial management.

Strengthening of monitoring & evaluation by OIDA

Function of OIDA for monitoring and evaluation of the schemes shall be strengthened, determining their method, such as frequency, monitoring index, and so on.

(4) Exchange of information through awareness creation

An emphasis shall be put on an awareness creation to farmers is, so that they have knowledge of responsibility and management of WUA as well as general information of irrigation farming. It is expected that OIDA also get farmers' intention for proposed schemes so as to realize sustainable irrigation development.

(5) Revised guideline

The revised guideline, focusing on process to establish WUA in community-based small-scale pump irrigation schemes in the Meki area, will aim to cover engineering aspect as well as social matters, and all development stage, such as preliminary study, planning, design, construction, and scheme management.

5.4 Preparatory Works

5.4.1 General

In line with the basic concept discussed in the previous section, preparatory works for the study was conducted. It includes scope of (1) responsibilities of OIDA and WUAs, (2) selection of the study sites and communities, (3) cost and benefit analysis, (4) preparation of draft guideline, (5) organization set-up for the field study.

5.4.2 Scope of Responsibilities of OIDA and WUAs

On the basis of the concept discussed in the section 5.3, the scope of responsibilities of OIDA and WUAs are set as described below. The scope shall be presented to the WUA members at the beginning.

Responsibilities of OIDA and the group in the scheme

- OIDA is responsible for
  - Procurement and installation of a small pump of 10 HP for irrigation, which enable them to feed 5 ha of land.
  - Planning and design of irrigation facilities, including mapping
  - Construction of pump house
  - Assistance and guidance for construction of irrigation canal
  - Construction of related structures of irrigation canal, if needed.
  - Provision of initial training of the pump operation.
  - Provision of guidance for WUA establishment and management, such as water management, financial management, farming, marketing.
  - Monitoring of performance of irrigation scheme

- WUA are responsible for:
  - Selection of leader, secretary, accountant, and auditor
  - Selection of a pump operator
  - Coordination of irrigation farming size of 0.25 ha per household
  - Conducting land consolidation and exchange among farmers so that every member can make benefit with irrigated farming
  - Construction of irrigation canals under guidance of OIDA
  - Operation and maintenance of the scheme, such as procurement and management of fuel, repair and maintenance of the pump, water distribution, maintenance of canals.
  - Opening bank account in the name of WUA
  - Saving money for depreciation cost of the pump
  - Keeping account records of WUA, income and expenditure
  - Keeping records of fuel procurement and consumption
  - Opening the account records to the member
  - Procurement of agricultural input, like seed, fertilizer, pesticide, and marketing of agricultural products
  - Reporting regularly to OIDA
  - Preparation of by-law of WUA

5.4.3 Selection of the Study Sites and Communities

The following three groups were selected for the verification of the WUA establishment process, taking into consideration access to the site and scale of command area scale as a development model in the Study area:

Table X.5.3 Selected Farmers Groups of the Study

	Name of group	No. of members	Command area	Water source
1.	Shubi	15	15.0 ha	Meki river
2.	Sombo Ganet	25	12.5 ha	Meki river
3.	Sombo Aleltu	20	5.0 ha	Meki river

They are neighboring communities along the Meki river belong and located in Shubi Gamo PA, some 5-km west of Meki town.

5.4.4 Cost and Benefit Analysis

For the awareness creation to the WUA members, data Collection for cost and benefit analysis was carried as shown below.

- Benefit
  - Farm gate price of the products with range from annual minimum and maximum price (trend of annual fluctuation).
  - Factors the price varies, such as mass production and production in another areas
  - Yield of the products with range from minimum and maximum yields.
  - Gross income per household
- Cost
  - Composition of production cost
  - Input (seed, fertilizer, and pesticide)
  - Fuel
  - Maintenance cost for the pump including its spare parts.
  - Depression cost for the pump

5.4.5 Preparation of Draft Guideline

Based on review of existing irrigation scheme and comment by the social works in the workshop, the draft guideline for small-scale community based irrigation project in Meki area was prepared.

5.4.6 Organizational Set-up for the Field Study

The team for the study was organized by community mobilization department of the head office (1), community mobilization team of the central branch office (2), planning and study team of the head office (2), construction team of the central branch office (1), and Meki Wareda Office (3).

5.5 Work Flow of Community-based Irrigation Development

5.5.1 General

Field works for formation and operation of WUA is conducted according to the following stages:

- Awareness Creation
- Planning and Design
- Construction management
- Scheme management

Activities for each stage are presented in the proceeding section.

5.5.2 Activities

(1) Awareness Creation

Awareness creation through PRA was described hereinafter

1) Mapping by WUA members

The WUA members prepared a map, showing farm lots of individual farmer with border, roads, households, proposed location of pump house, proposed layout of irrigation canals, and so on.

2) Responsibility of OIDA and WUA

As per the contents described in the Section 5.4.2, responsibility of OIDA and WUA was presented to the WUA members. The following items were explained carefully:

- Irrigated land size
- Necessity of land consolidation
- Necessity of saving money for pump replacement

3) Management of Scheme

Management to be done by the WUA was explained according to the following aspects:

- Organizing committee members,
- Meeting,
- Irrigation scheduling and water distribution plan,
- Water distribution,
- Maintenance,
- Financial management,
- By-law, and
- Conflict management.

Items discussed in the meeting are shown in Attachment X 5.1.

4) Cost and Benefit Analysis

As for production cost and income, the interviews to the WUA members were carried out to grasp knowledge and information what they have. Consequently, the JICA Study team presented cost and benefit analysis for major crop, adding the following comments and suggestion to the WUA members:

- Irrigation farming may result in loss according the price of the products,
- Proper farming management with optimum use of farm inputs is essential for economical farming,
- To avoid the risk for price decline of a particular crop, crop diversification is recommended, and
- Cultivation period shall be determined taking into consideration an annual fluctuation of the price of products.

5) Group Fund Formation

After discussion on whether the WUA members are able to afford the funds for purchasing farm input or not, the concept group fund formation shown in the Section 5.3 was presented to them.

(2) Signing of agreement between OIDA and WUA

The number of meeting for each WUA was five for one and half month. In accordance with the series of discussion in the meetings, draft agreement for community-based small-scale irrigation project was prepared in Oromo language and discussed with the WUA members. After confirmation of responsibility and undertaking of both OIDA and the WUA, the agreement was signed. It is observed that some of the applicants withdrew the WUA because they did not agree to exchange the lands according to the agreement, and that the equal number of new members joined the WUA. The final number of members with their command area is shown below

Table X 5.4 WUAs Signing Agreement

	Name of group	No. of members	Command area	Date PRA starts	Date of Agreement
1.	Shubi	15	3.75 ha	July. 9, 2001	Aug. 27, 2001
2.	Sombo Ganet	28	7.00 ha	July. 10, 2001	Aug. 21, 2001
3.	Sombo Aleltu	20	5.00 ha	Sep. 1, 2001	Sep. 20, 2001
	Total	63	15.75 ha		

The draft agreement is shown in Attachment X 5.2.

(3) Physical planning and Design

1) Delineation of irrigation area and plan of facilities layout

Based on the map prepared by WUA member, delineation of irrigation area with land consolidation and exchange was discussed. Further location of the

pump station and irrigation canal network is also decided tentatively.

2) Mapping and canal route survey

After the agreement was made, a surveyor in the OIDA head office commenced a survey in the field, including some benchmark, grid survey at intervals of 20 meters to prepare the topography map with a scale of 1 to 1000.

3) Design and cost estimate

Based on the topographic map, engineers of the planing and design department in the Head office carried out design and cost estimate for the main canal with related structure and pump house. The salient features of the irrigation schemes are as follows:

Table X 5.5 Salient Features of Irrigation Schemes

Facilities	Description
Irrigation canals	600-800 m long earth canal
Structures on the canal	drops and off-takes
Pump house	an area of 9 m2 (3m x 3m), block wall, corrugated iron sheet roof

4) Confirmation of the plan with WUA

Location of the pump house and irrigation canal route were discussed and confirmed with WUA members in the field.

(4) Construction management

1) Preparatory works

In accordance with the design drawing, setting of canal route and pump station was carried out in the field by the surveyor and Meki Wareda staff in cooperation with the WUA members. In response to the request of WUA members, minor revision of the canal alignment was made in the field.

Result of the canal design indicated that soil for canal embankment was needed. Field investigation concluded that the soil would be borrowed near the project area of the Meki Ziway Irrigation project, Bekera Girrisa PA.

OIDA dispatched dump truck and wheel loader for transportation of the borrowed material to the project area.

2) Construction of irrigation canal

Construction of the irrigation canal was carried out by farmers' participation. The work, consisting of site clearing, excavation, embankment, structure, was supported by OIDA providing guidance and equipment for transportation of embankment materials. Short of the workers was supplemented by daily casual labors. Special care was given for embankment work with proper watering and compaction.

3) Construction of pump house

OIDA constructed the pump house, purchasing the construction materials, and employing carpenters, masons, and labors. The work consisted of excavation of foundation, concrete block wall, corrugated iron sheet roof, iron window and door, plastering, and transition outlet to the irrigation canal.

4) Procurement of pump

Taking in consideration availability of after-care support and intention of the WUA members, it was decided that 12 HP of pumps made in Italy were purchased. The procurement was carried out in Addis Ababa after approval of JICA.

5) Installation of the pump

After pre-delivery inspection, the pumps were transported to the site and installed. Training for pump operation was carried out to the OIDA staff and the representative of the WUAs.

6) Handing over the pump

With document of handing over, the pumps were handed over to the WUAs.

(5) Scheme management

1) Selection of committee members

Committee members, consisting of chairman, vice chairman, secretary, cashier, and auditor, were selected in the WUA meeting. The minutes of the discussion was prepared for opening of the WUA bank account.

2) Water management and operation and maintenance of the pump

OIDA assisted the WUA in terms of irrigation rotation, operation and maintenance of the pump, fuel management. It was decided that the spare parts and consumable of the pumps were kept by OIDA. OIDA also provided the WUAs the formats of fuel management, and accounting. Those activities are expected to be supported continuously by OIDA

3) Preparation of a model by-law

The community mobilization department of the OIDA Head Office prepared a model by-law for the WUA. The discussion with the WUA members is needed for finalization of the document.

5.6 Lesson Learnt

5.6.1 Awareness Creation

After the heated discussion with the WUA members, they understood the responsibly taken by the WUA, such as land allocation per member, land

consolidation, saving of depreciation cost for a pump, and so on. It was confirmed that the land holding among the members is key issue to go forward the implementation of the project.

The members were not satisfied with the condition for the project implementation, such as output of the pump, irrigated land size, expecting all of their land could be fed with the project. After explanation by OIDA, explaining that the project starts with optimum size of farm land, and that the condition does not prohibit extension of irrigated land in future.

It is notable, in Sombo Genet and Sombo Aleltu, that some members withdrew from the WUA because they did not agree land consolidation and exchange. And then, other members agreeing the condition entered the WUA. This fact indicates that awareness creation through PRA methods, providing clear information regarding responsibility of the WUA and its members, enable each member to select an option whether he (she) enter the WUA or not.

The mapping by the WUA members helped them to be aware of their land resource and to think about land consolidation although the social workers were in doubt that the WUA members could draw the map. It is concluded that the mapping will be helpful for preliminary discussion for a project planning.

5.6.2 Membership

It is noted the membership of WUA is entitled for sons of the members over 18 years old as well as the head of household if the members of WUA approve that the children have membership. Thus, it is necessary to check the membership by not only the authorized application but also interview of the WUA member.

5.6.3 Land Consolidation

It was understood that the land consolidation was primary issue for consensus with the WUA member. Though, at first, the WUA members hope that all of the farm lands applied could be irrigated, they agreed to consolidate the irrigated land near the Meki river, and to exchange their lands. The JICA study team analyzed a primary factor why the agreement was made in the study area, focusing the following factors:

- Little difference of land productivity enabled the member exchange their land.
- A farmers' willingness for the pump irrigation was more than that an attachment of present land holding.

It was useful to explain the WUA members the effect of land consolidation by use of tool

5.6.4 Cost and Benefit Analysis with WUA

The production cost estimated by the WUA members tends to be lower that those by

the JICA Study Team. The JICA Study Team, taking into consideration the optimum usage of the agricultural inputs, reviewed the cost-benefit analysis for major crops. The result of the analysis is presented in Appendix III. It is essential that social workers shall be familiar with the crop budget and marketing mechanism of irrigated farming.

5.6.5 Group Fund Formation

It was revealed that the WUA had difficulty to open the bank account in the name of the WUA. The Commercial Bank of Ethiopia need a recommendation by the Zonal Administration, with recommendation by the Wareda administration, and minutes of meeting of the WUA showing names of the three committee members. OIDA will be requested to support the WUA to obtain the recommendation letter by the governmental organizations.

5.6.6 Engineering Support Required

For the implementation of the projects, an engineering supports required by OIDA are, survey and mapping, design of the irrigation canals, arrangement of borrowed material for canal embankment, and employment of daily hired labor.

In the Shubi scheme, it was observed that a part of the command area decided by the WUA members were in difficulty for irrigation due to elevation of the area. Thus, an assessment of land potential from the engineering aspects will be needed, conducting leveling survey and topography mapping by OIDA.

Although alignment of canal network and hydraulic design of irrigation canals are carried out by a design engineer of OIDA, the feedback of the results to the WUA members would be necessary. In fact, as for the Sombo Genet, revision of tertiary canal alignment were carried out at field, taking into account intention of the WUA members.

At first, it was assumed that some of excavated materials could be used for the embankment material. But the borrowed material for canal embankment was more that that expected in the design because the excavated materials had problems of quality and transportation measure.

Although all the WUA members agreed to participate in the construction works, some 50% of the members were absent from the works because the construction period was during harvesting season. Thus, it was decided that the daily hired labors were employed to expedite the works.

5.6.7 Construction period

Even though the development plan, such as location of the pump station, canal route, and location of off-takes, were consented by the WUA members, different opinions or objection were raised by them during the construction period. The OIDA staff expected to be flexible for minor design revision requested by the WUA members at the field as long as it does not affect total construction cost and work seriously.

Prior to the construction, location of an access road to the site shall be discussed carefully with the WUA members to minimize damage of crops under cultivation.

The construction time schedule should have been informed clearly to the WUA members. It was observed that some of the members commenced the irrigation farming without knowing the schedule.

Before the borrowed soils are gathered, discussion with farmers residing near the site is be necessary through the Wareda administration and PA chairman to avoid the conflict between the construction team and the farmers. Some farmers refused the team to collect the soils because depression by the soil collection might cause breeding of mosquitoes in the rainy season.

5.7 Feedback to Guideline

The lessons leant obtained from the field verification were incorporated in the final guideline of the community-based irrigation project. The guideline is presented in Attachment X-5-3.

5.8 Recommendations

Through the verification study, the process of establishment of WUAs for small-scale irrigation development is being standardized, involving staff of OIDA into the field verification. Further, the staff is having a grasp of the WUA establishment process. It is recommended that the process will be scrutinized by OIDA and be extended to other areas and other work category like small-scale surface irrigation scheme.

After construction, the activities of the WUAs shall be monitored continuously and carefully by OIDA. The monitoring will focus on whether equity of land and water resources allocation will be ensured among the WUA members, and whether the members hold the regular meeting for solving their problems in the scheme. It is also of importance that they can form the fund for replacement of the pump and farm inputs. Further impacts resulting from the implementation of the project shall be monitored carefully, consisting of reaction of outsiders, such as private investors, and existing water users.

Attachment X-5-1

Management of WUA

Points to be stressed (Creation of ownership to scheme)

- Farmers' managed scheme by self-help. Free from dependency on the Government
- Create and follow the rule and regulation by Farmer themselves
- Member should follow leader's instruction
- Difficulty of irrigation farming should be solved by farmers themselves
- Irrigation farming could lead to not only more benefits but also more cost.
- Operation cost of the scheme should be borne by farmer themselves. Farmer should save money.
- Life of a pump is 5 years. Farmer should save money for replacement. No assistance for the cost by the government.

Responsibility and Obligation of Farmers

It cost very much to operate an irrigation scheme. Let farmers understand the facts as shown below

Responsibilities of farmers' Group

	Item	Leader and Committee members	Members
1.	Organizing group	-	-Selection of leader and committee member
2.	Meeting	-Chair a meeting -Participation in committee meeting	-Participation in a general meeting
3.	Irrigation scheduling and water distribution plan		-Decision of irrigation plan in general meeting -Follow cropping season according to irrigation schedule
4.	Water distribution	-Water distribution by water master	-Follow water distribution plan -Follow instruction by water master
5.	Maintenance	-Preparation of maintenance plan -Maintenance of pump -Maintenance of canals	-Patrol of facilities -Communal work for maintenance -Cleaning of canals -Pay fuel charge -Saving for pump replacement
6.	Financial management	-Book keeping by accountant -Internal auditing by auditor -Opening of account book to members	
7.	Rule and penalty	-Preparation of rule and regulation -Action to violator	-Follow rule and regulation
8.	Conflict management	-Settle dispute among farmers	-Communication in case of dispute -Self-help concept by WUA

Attachment X-5-2

AGREEMENT

Implementation of Community-based Small-scale Pump Irrigation Project
for
The Study on Meki Irrigation and Rural Development Project
in Oromia Region, Ethiopia

This *AGREEMENT ON* **Implementation of Community-based Small-scale Pump Irrigation Project** (hereinafter referred to as ***WORK***) is made between Oromia Irrigation Development Authority (hereinafter referred to as ***OIDA***) and _____ Water Uers' Association (hereinafter referred to as ***WUA***) on the date of _____, 1993 (_____, 2001). The terms and conditions set for performance of the WORK are as follows:

WITNESS

Whereas:

1. Both OIDA and WUA shall undertake the WORK complying with the "Condition of Agreement" attached herewith.

2. Both OIDA and WUA agree to the terms and conditions in respect to the WORK as specified hereunder.

(i) The following documents are considered as a part of this agreement, viz.:
   (a) The General Conditions of the Agreement, and
   (b) List of Applicants with their Signatures

(ii) The Contract shall be effective on the date the agreement is signed by the OIDA and the WUA.

Both OIDA and WUA agreed in witness hereof, and the Agreement is being effective on the date of _____, 1993 (_____, 2001) through signing of the authorised representatives.

Signature of OIDA	Signature of WUA
_____	_____
Mr. Oromia Irrigation Development Authority. (OIDA)	Mr. Representative of _____ Users' Association

Implementation of Community-based Small-scale Pump Irrigation Project
for
The Study on Meki Irrigation and Rural Development Project in Oromia Region, Ethiopia

General Condition of Agreement

1. Obligations of OIDA

1.1 OIDA is responsible for

- Procurement and installation of a small pump of some **10 HP** for irrigation with spare parts.
- Construction of pump house and related facilities
- Construction of irrigation canals and related structure
- Provision of initial training of the pump operation.
- Provision of guidance for WUA establishment and management, such as water management, financial management, farming, marketing.
- Monitoring of performance of irrigation scheme

2. Obligations of WUA

2.1 WUA are responsible for:

- Selection of committee members, such as leader, secretary, accountant, and auditor, and other committee members required
- Selection of a pump operators
- Coordination of irrigation farming land size of **0.25 ha** per each member
- Conducting land exchange among farmers so that every member can make benefit equally with irrigated farming
- Construction of irrigation canals under supervision of OIDA
- Conducting excavation, land clearing, filling & embankment, and others works directed by OIDA,
- Operation and maintenance of the scheme, such as procurement and management of fuel, repair and maintenance of the pump, water distribution, maintenance of canals.
- Opening bank account for communal money saving
- Saving all money obtained from wages of the construction works in the bank account of WUA
- Saving money for depreciation reserve of the pump
- Keeping account records of WUA, income and expenditure
- Keeping records of fuel procurement and consumption
- Opening the account records to the member
- Procurement of agricultural input, like seed, fertilizer, pesticide,
- Marketing of agricultural products
- Reporting regularly to OIDA according to the specified formats
- Preparation of rule and regulation for management of the scheme

3 Cautions

3.1 The performance of irrigation scheme shall be monitored regularly by OIDA, especially in financial status of the scheme.

3.2 If, in the opinion of OIDA, WUA shows that he is unable to perform the Works due to the following reasons, OIDA reserves the right to withdraw the pump from community:

- Saving money for depreciation reserve is not carried out properly.
- No cultivation is made during two consecutive years after installation of the pump.
- Unclearness or dishonesty is observed in the account book.
- Unfairness is observed for irrigation water distribution,
- Unfairness is observed for land consolidation and exchange

3.3 The farmers shall not entrust cultivation of their land to an outsider without consent of WUA committee.

3.4 The WUA shall not resell of the pump in all cases. In such case, the pump should be compensated by the WUA. The act will be illegal and accused.

3.5 The WUA shall not transfer the Work or the benefits or obligations to any other person.

4 Construction

4.1 The schedule of procurement and installation of the pump shall be decided by OIDA taking into consideration progress of the construction works.

4.2 The work quantity and specification for construction of irrigation canal and related structures, if any, shall be specified in other documents.

4.3 The amount or labor wage rate for participation in the construction works shall also be specified in other documents

4.4 The time of completion for construction of irrigation canals and related structures, if any, shall be specified in other documents.

5. Others

5.1 If there are some issues, which are not specified in the agreement, it shall be settled by mutual discussion between both parties.

5.2 If any dispute shall arise between OIDA and WUA in connection with the agreement, it shall be settled by mutual discussion between both parties.