Appendix 1

Result of Pumping Test

Appendix 1 Results of Pumping Tests (1/2)

Well No.	UTM E	UTM N	AQUIFER	T(m2/day)	SATURATED THICKNESS(m)	ESTIMATED PERMEABILITY (m/day)
ST3	417700	1692750	Alluvial Aquifer	10		
SE5	417700	1692800	Alluvial Aquifer	105	115	0.91
1 - P	413680	1697830	Alluvial Aquifer	30	86.6	0.35
6 - P	413510	1698910	Alluvial Aquifer	33	28.2	1.17
WELL 41	411500	1681500	Alluvial Aquifer	16.8	5.05	3.33
WELL 126	421500	1684500	Alluvial Aquifer	3.6	45.4	0.08
WELL 646	403500	1698500	Alluvial Aquifer	35.8	3.7	9.68
WELL O467	416500	1688500	Alluvial Aquifer	10.9	3.5	3.11
WELL O734	420500	1717500	Alluvial Aquifer	0.25	1.4	0.18
WELL O867	415500	1715500	Alluvial Aquifer	82	5.2	15.77
WELL O874	416500	1714500	Alluvial Aquifer	2.4	9.6	0.25
HIZIAZ	419400	1683950	Alluvial/Volcanics	50	200	0.25
	Maximum			105		15.77
	Minimum			0.25		0.08
	Median			23.4		0.91
	Average			31.6		3.2
BOREHOLE	401500	1703500	Volcanic Rocks	4.5		
DAR SALM	418600	1688800	Volcanic Rocks	75	90	0.83
SE4	414850	1695300	Volcanic Rocks	113	311.1	0.36
2 - P	420600	1679490	Volcanic Rocks	0.41	189.1	0.002
3 - P	403700	1697970	Volcanic Rocks	4.7	30.0.16	
5 - P	413510	1698910	Volcanic Rocks	3.2	148.2	0.02
WELL 20(*)	415500	1678500	Volcanic Rocks	0.5	1	0.5
WELL 25	414500	1678500	Volcanic Rocks	14.6	9.2	1.59
WELL 47(*)	431500	1674500	Volcanic Rocks	29.5	3.1	9.52
WELL 160	432500	1699500	Volcanic Rocks	3	10.1	0.3
WELL 261	402500	1695500	Volcanic Rocks	2.4	7.1	0.34
WELL O125(*)	433500	1689500	Volcanic Rocks	21.8	1.3	16.77
WELL O128(*)	431500	1688500	Volcanic Rocks	30.2	2.5	12.08
BOREHOLE 48	415500	1681500	Volcanic Rocks	4	137.5	0.03
BOREHOLE 707(*)	403500	1694500	Volcanic Rocks	200.4	126	1.59
BOREHOLE 1126	413500	1691500	Volcanic Rocks	184.5	141.1	1.31
	Maximum			200.4		16.77
	Minimum			0.41		0.002
	Median			9.65		0.67
	Average			43.2		3.2
SABAEEN	414150	1694650	Tawilah Sandstone	26	200	0.13
BAYAT AD DAYL	387300	1708300	Tawilah Sandstone	400	300	1.33
SE1	414930	1701500	Tawilah Sandstone	551	353	1.56
SE2	414930	1701490	Tawilah Sandstone	526		
SE3	420860	1707950	Tawilah Sandstone	411	170	2.42
SE6	4088600	1704000	Tawilah Sandstone	5		
SE7	410550	1707625	Tawilah Sandstone	377	178.3	2.25
SE8	405550	1714200	Tawilah Sandstone	---		
SE9	411900	1699350	Tawilah Sandstone	274		
ST1	414860	1701495	Tawilah Sandstone	555	212	2.62
ST2	420800	1707950	Tawilah Sandstone	400	53	7.55
ST4	410620	1707625	Tawilah Sandstone	380	144.2	2.64
ST5	414300	1702850	Tawilah Sandstone	30	166	0.18
ST6	412700	175300	Tawilah Sandstone	2000	87	22.99
ST7	412400	1704800	Tawilah Sandstone	38	164	0.23
ST8	412700	1702200	Tawilah Sandstone	120	162	0.74
ST9	412775	1705650	Tawilah Sandstone	300	162	1.85
ST10A	413324	1704880	Tawilah Sandstone	430	160	2.69
ST11	413901	1704054	Tawilah Sandstone	120	148	0.81
ST12	412446	1706500	Tawilah Sandstone	110	170	0.65
ST13	412097	1707294	Tawilah Sandstone	120	164	0.73
EX2	419000	1704450	Tawilah Sandstone	50	151	0.33
EX3	421251	1706952	Tawilah Sandstone	20	145	0.14
EX4	421852	1708250	Tawilah Sandstone	100	155	0.65
P1	409566	1707426	Tawilah Sandstone	250	137	1.82
P6	412177	1702960	Tawilah Sandstone	34	160	0.21
P7(*)	408972	1707805	Tawilah Sandstone	140	143	0.98
P8	413047	1704606	Tawilah Sandstone	102	170	0.6
P9	409339	1707743	Tawilah Sandstone	170	121	1.4

Source: SWAS, NWSA

Appendix 1 Results of Pumping Tests (2/2)

Well No.	UTM E	UTM N	AQUIFER	T(m2/day)	SATURATED THICKNESS(m)	ESTIMATED PERMEABILITY (m/day)
P10	413503	1703816	Tawilah Sandstone	40	173	0.23
P13	413295	1704211	Tawilah Sandstone	200	171	1.17
P14	410593	1706303	Tawilah Sandstone	85	179	0.47
P15(*)	409405	1709557	Tawilah Sandstone	100	98	1.02
P16	413945	1701124	Tawilah Sandstone	500	161.5	3.1
P17	409559	1708837	Tawilah Sandstone	150	120	1.25
P18(*)	414209	1700572	Tawilah Sandstone	570	162	3.52
P19(*)	414028	1700030	Tawilah Sandstone	450	164	2.74
P20	409972	1708292	Tawilah Sandstone	60	153	0.39
P21	410159	1709961	Tawilah Sandstone	100	154	0.65
O2(*)	408894	1707637	Tawilah Sandstone	570	53	10.75
O3	411401	1707565	Tawilah Sandstone	50	168	0.3
O4	410628	1707093	Tawilah Sandstone	16	119	0.13
O5	411401	1707171	Tawilah Sandstone	10	169	0.06
O11	413524	1703238	Tawilah Sandstone	12	163	0.07
O12	412601	1704029	Tawilah Sandstone	12	170	0.07
B	418589	1701321	Tawilah Sandstone	430	222	1.94
C(*)	417228	1701086	Tawilah Sandstone	930	156	5.96
D(*)	417250	1702470	Tawilah Sandstone	2000	157	12.74
E(*)	418005	1703262	Tawilah Sandstone	600	158	3.8
F	419324	1703904	Tawilah Sandstone	80	155	0.52
G	419194	1702725	Tawilah Sandstone	310	176	1.76
H	421050	1706000	Tawilah Sandstone	10	123	0.08
I	419850	1705750	Tawilah Sandstone	30	157	0.19
J	420128	1706922	Tawilah Sandstone	70	178	0.39
K	419480	1704601	Tawilah Sandstone	45	200	0.23
L(*)	417093	1700443	Tawilah Sandstone	1016	203	5
M	420642	1705129	Tawilah Sandstone	65	119	0.55
N	416505	1702166	Tawilah Sandstone	20	146	0.14
Q	419956	1703132	Tawilah Sandstone	140	192	0.73
5 - P	413510	1698910	Tawilah Sandstone	100	211	0.47
9 - P	421660	1711940	Tawilah Sandstone	39.7	99	0.4
B 1	387300	1708300	Tawilah Sandstone	400	280	1.43
BOREHOLE O423A	427500	1710500	Tawilah Sandstone	131	149	0.88
M19 A (Alsbahi)	417176	1689477	Volcanics/Tawilah	535.37	219.34	2.44
H-8 (Haddah)	411300	1690690	Tawilah Sandstone	99.263		
HA(HADDAH AREA)	411005	1691410	Tawilah Sandstone	314.373	63.6	4.94
EX-S(Haddah)	414157	1691674	Tawilah Sandstone	80.5	117	0.69
KA(Kadisia)	417245	1693470	Tawilah Sandstone	177.1	148.71	1.19
SP -Sabeen park)	414245	1694334	Tawilah Sandstone	81.1	51.93	1.56
OS (Orphanage school)	416750	1694655	Tawilah Sandstone	234.185	109.5	2.14
SA-1(Zubairy Park)	413594	1696222	Tawilah Sandstone	200	62.77	3.19
ASR-12(Asser)	410938	1696367	Tawilah Sandstone	98.78	132.78	0.74
ASR-(Asser)	410938	1696367	Tawilah Sandstone	145.2	207.72	0.70
MR(Musaik)	417059	1698263	Tawilah Sandstone	200		
TP-1(Hasabah)	415350	1701200	Tawilah Sandstone	159	103.8	1.53
NWSA(Hasabah)	414480	1701500	Tawilah Sandstone	111.1	196.09	0.57
TP-2 (Hasabah)	415540	1702000	Tawilah Sandstone	111.1		
DH(Dahban)	413470	1706400	Tawilah Sandstone	28	121.03	0.23
	Maximum			2000		22.99
	Minimum			5		0.06
	Median			120		0.81
	Average			259.2		2.0
7 - P	441180	1733760	Amran Limestone	1.4	27	**0.05**
WELL 551/3(*)	444500	1728500	Amran Limestone	104.2	16.1	6.47
WELL 559/2	444500	1728500	Amran Limestone	11.3	9.4	1.2
WELL O971	433500	1723500	Amran Limestone	10.5	3	3.5
BOREHOLE O988	430500	1720500	Amran Limestone	0.5	146	0.003
	Maximum			104.2		6.47
	Minimum			0.5		0.003
	Median			10.5		1.2
	Average			25.58		2.24

Source: SWAS, NWSA

Appendix 2

Result of Water Level Monitoring

Appendix 2 Results of Water Level Monitoring (1/2)

	Code No.	Site Name	District	North	East	Elev.m.	Aquifer	Well Typ	Aug-03	Jan-04	Oct-04	Dec-04	May-05	Jul-05
1	**P8**	W.F.Wes	Ban-Alhar	1704571	412810	2218	Sandstone		178.1	Pump	Pump	Pump	Pump	Pump
2	**O5**	W.F.Wes	Ban-Alhar	1707273	411188	2238	Sandstone		75.52	75.73	76.4	78.41		77
3	**P17**	W.F.Wes	Ban-Alhar	1708945	409750	2248	Sandstone		Pump	113.5	118.93	118.52		
4	**P15**	W.F.Wes	Ban-Alhar	1709656	409305	2234	Sandstone		Pump	121.75	131.3	135.8	135.3	
5	**P21**	W.F.Wes	Ban-Alhar	1710064	410067	2209	Sandstone		Pump	Pump	133.65	128.6	133	
6	**F783A**	Al Hawri	Hamdan	1715555	411390	2232	Volcanic		Pump		117.2	118.7	98.98	99.57
7	**A2069**	Maribcamp	Ban-Alhar	1714346	418244	2206	Volcanic	Borehole	105.2	102.3	107.92	104.32	102.75	104.77
8	**F 2356**	B-alhally	Ban-Alhar	1715014	416162	2192	Volcanic	Dug+Drill	23.5	22.92	23.6	23.9	23.1	21.9
9	**F 2357**	B-alhally	Ban-Alhar	1715109	416242	2145	Alluvium		25.4	25.5	23.62	26.5		Pump
10	**F 1446**	B-alhally	Ban-Alhar	1718865	416298	2182	Alluvium	Borehole	33.1	34.6	34.9	35.05	38.7	38.2
11	**F2131**	Bossan	Arhab	1728956	417429	2217	Limestone		63.66	64.3	Pump	64.47		62.2
12	**F2143**	Makarib	Arhab	1730178	421335	2136	Limestone		Pump	64.5	Pump	64.6		64.13
13	**F 1445**	B-Mosaed	Ban-Alhar	1716838	417904	2188	Alluvium	Borehole	Pump	27.5	27.8	27.9		27.3
14	**F1947A**	Almasham	Ban-Alhar	1727571	421495	2129	Limestone	Borehole	65.92	35.05	34.9	34.6	55	55.37
15	**F 2003**	W-dogish	Arhab	1729224	425801	2052	Limestone	Dug+Drill	16.12	9.98	9.96	12.25		14.48
16	**C1849**	Al-req val.	Ban-Alhar	1711873	424320	2237	Volcanic		14	11.5	11.03	13.02		11.5
17	**C1564**	Al-grass	Ban-Alhar	1716018	428437	2239	Sandstone	Dugwell	28.2	24.65	25.3	25.8	25.75	24.68
18	**D25**	Dharhan	Bani-Hus	1699850	426648	2400	Alluvium	Dugwell	33.1	22.42	22.1	23.1	25.18	24.73
19	**C1 146**	Alqariah	Bani-Hus	1700113	425179	2367	Alluvium	Dugwell	25.4	16.9	16.85	22.75	24.6	24.25
20	**U358A**	Aswad	Sanhan	1686709	418990	2341	Volcanic	Dugwell	23.5	102.5		102.8	31	
21	**U1146A**	Rihm	Sanhan	1678618	419008	2400	Volcanic	Borehole						
22	**B-665A**	Maqwalah	Sanhan	1675449	429994	2500	Volcanic	Dugwell		66.2		66.8		13.6
23	**B-683**	Bit saani	Sanhan	1677294	426909	2502	Volcanic	Dugwell		97.4		98.2		84.6
24	**E-2366**	Safiat Tamash	Sanhan	1690120	422210	2349	Alluvium			21.2		21.9		
25	**E-2377**	Shahik	Sanhan	1701896	439685	2582	Alluvium	Dugwell		36.7		38.6	28.42	28
26	**E-1749**	Bani Bahlul	Sanhan	1698001	430469	2460	Volcanic	Dugwell		23.3		24.1		26.78
27	**U-427A**	Al Nahdeen	Sana'a	1692469	414845	2302	Volcanic	Borehole		Pump		121	97.37	50.88
28	**U-502A**	Haddah/azal	Al amanh	1692422	413170	2326	Volcanic	Borehole		81.3		81.8	122.28	125.7
29	**A878**	Almasjed	Bani mater	1692294	401298	2576	Alluvium			11.3		11.7		19.66
30	**A-1038**	Raas Alhissin	Bani Matar	1695434	402468	2548	Alluvium			19.5		43.2		
31	**A874A**	Aser Almwred	Sana'a	1696814	408818	2411	Alluvium			21.6		22.4		
32	**A-848-A-**	Alkhasmah	Bani Matar	1695167	403380	2566	Alluvium			121.5		122.4		19.98
33	**A-691-A**	Shamlan	Hamdan	1703827	407993	2342	Volcanic			72.5		73.1		
34	SBH1	bit handal	Bani al-har	1715809	414259	2191								

Appendix 2 Results of Water Level Monitoring (2/2)

	Code No.	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jan-07
1	**P8**	Pump	Pump	Pump	Pump	* P +205.30	*p 206.34	p 205.52 *	*p204.40	192.65	193.53	197.87
2	**O5**	77	77.16	77.24	77.28	77.43	77.58	77.62	77.76	77.76	77.85	78.42
3	**P17**	120.57	118.72	116.7	116.88	118.29	118.16	117.41	117.27	118.24	118.99	117.4
4	**P15**	140.17	139.56	136.64	134.12	133.45	138.65	140.45	141.68	143.47	147.28	143.49
5	**P21**	138	136.9	133.83	131.49	130.65	134.84	135.10	138.60	140.99	143.41	137.79
6	**F783A**		99.75	99.9	99.9	99.80	99.86	99.98	D	D	141.56	141.9
7	**A2069**	105.6	104.7	103.4	102.45	101.10	101.48	102.28	102.35	103.65	105.00	100.62
8	**F 2356**	21.1	20.94	21.61	22	22.27	23.06	23.09	23.13	22.90	22.73	21.55
9	**F 2357**	25.5	Pump	24.89	25.34	25.30	27.05	26.26	26.60	27.10	27.77	24.67
10	**F 1446**	37.23	36.38	35.98	35.87	35.77	37.68	37.60	37.15	36.74	36.84	35.82
11	**F2131**	62.2	62.23	62.3	62.32	62.34	62.46	62.94	63.10	63.31	63.58	60.95
12	**F2143**	60.58	60.74	60.6	58.87	58.00	58.24	58.07	59.81	59.79	55.00	57.29
13	**F 1445**	26.95	27.12	27.34	27.58	27.85	27.93	28.00	28.12	28.16	28.28	26.29
14	**F1947A**	55	56.4	53.98	53.72	53.55	53.65	53.62	53.82	54.40	56.13	53.7
15	**F 2003**	8	9.48	10.24	10.13	10.60	11.58	12.58	13.75	14.30	14.16	11.16
16	**C1849**	10.68	10.98	12.7	11.32	11.80	12.78	13.37	11.74	11.87	11.80	11.7
17	**C1564**	25.63	25.64	25.61	25.64	25.70	26.75	25.72	25.68	25.70	25.66	25.8
18	**D25**	29.6	26.1	25.67	25.78	25.00	25.65	25.49	26.00	26.00	26.02	24.4
19	**C1 146**	24.5	24.27	24.23	24.46	24.55	24.82	24.00	24.97	25.06	24.99	25.9
20	**U358A**	30.93	30.95	30.94	30.94	30.99	31.23	30.97	30.90	31.08	30.92	30.94
21	**U1146A**	103	103.5	103.1	103.2	103.23	103.26	103.35	103.40	103.45	103.62	104.13
22	**B-665A**	13.7	15.43	13.7	14.7	14.70	14.86	14.86	15.07	15.30	15.52	16.18
23	**B-683**	85.42	92.8	86.55	86.75	87.05	79.35	80.13	80.54	81.36	83.28	86.73
24	**E-2366**	28.98	29	29.4	29.9	28.22	29.26	29.33	29.40	29.45	29.49	30.08
25	**E-2377**	26.86	24.41	22.98	23.37	24.05	27.73	27.25	27.90	28.08	29.38	25.15
26	**E-1749**	25.74	27.56	28.1	28.9	27.05	27.63	28.27	27.90	29.00	27.20	27.8
27	**U-427A**	50.45	50.1	DRY	DRY	50.69	Dry	DRY	D	50.25	50.14	49.45
28	**U-502A**	121.9	120.94	119.9		119.30	120.67	120.18	120.80	120.00	120.00	12.1
29	**A878**	5.6	4.9	5.15	5.52	6.20	6.07	8.04	P+19.00	13.00	25.00	10.2
30	**A-1038**	40.9	40.91	41.5	41.78	42.04	42.04	42.05	42.60	42.69	42.46	42.89
31	**A874A**	15.5	16.54	16.39	16.2	18.25	18.00	18.67	16.85	18.60	16.52	17.2
32	**A-848-A-**	19.8	19.43	19.67	19.82		Dry	19.80	19.90	19.80	19.79	DRY
33	**A-691-A**	21.44	21.13	21.38	21.5	21.60	21.83	21.73	21.10	21.15	21.25	20.94
34	SBH1										45.78	…

Appendix 3

Detailed Result of Well Inventory (2002)

Appendix 3 Detailed Result of Well Inventory 2002 (1/3)

Zone	Sub Basin	Well Type	No. of Well by Status						No. of Operational Well by Water Use								Abstraction (m3/year) by Water Use								Irrigated Area (ha) by Source of Water							
			Operating	Intermittent	Temporaly not in use	Abandoned	Dry	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total
1	Wadi Al Mashamini	Borehole	12	0	4	7	0	23	9	3	0	0	0	0	0	12	472,985	256,871	0	0	0	0	0	729,855	76.8	0.2	0.0	0.0	0.0	0.0	0.0	77.0
		Dug Well	3	0	2	0	0	5	3	0	0	0	0	0	0	3	71,280	0	0	0	0	0	0	71,280	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3
		Dug / Bore	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	0.0	0.0	0.0	0.0
		Spring	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	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	15	0	6	7	0	28	12	3	0	0	0	0	0	15	544,265	256,871	0	0	0	0	0	801,135	78.1	0.2	0.0	0.0	0.0	0.0	0.0	78.3
2	Wadi Al Madini	Borehole	50	0	4	18	0	72	46	3	0	1	0	0	0	50	2,588,763	150,032	0	84,942	0	0	0	2,823,737	404.1	0.7	0.0	6.8	0.0	0.0	0.0	411.5
		Dug Well	1	0	2	1	0	4	1	0	0	0	0	0	0	1	5,087	0	0	0	0	0	0	5,087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dug / Bore	1	0	0	0	0	1	1	0	0	0	0	0	0	1	25,639	0	0	0	0	0	0	25,639	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		Spring	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	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	52	0	6	19	0	77	48	3	0	1	0	0	0	52	2,619,489	150,032	0	84,942	0	0	0	2,854,463	404.3	0.7	0.0	6.8	0.0	0.0	0.0	411.7
3	Wadi Al Kharid	Borehole	42	1	7	22	0	72	38	1	1	2	0	0	0	42	2,283,516	31,450	20,008	169,179	0	0	0	2,504,153	300.8	0.0	2.3	14.4	0.0	0.0	0.0	317.5
		Dug Well	62	6	8	5	3	84	56	0	4	0	0	2	0	62	1,263,064	0	36,655	0	0	22,226	0	1,321,946	81.1	0.0	0.0	0.0	0.0	0.0	0.0	81.2
		Dug / Bore	1	0	1	0	0	2	1	0	0	0	0	0	0	1	28,318	0	0	0	0	0	0	28,318	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		Spring	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	106	7	16	27	3	159	96	1	5	2	0	2	0	106	3,574,898	31,450	56,663	169,179	0	22,226	0	3,854,416	391.1	0.0	2.3	14.4	0.0	0.0	0.0	407.8
4	Wadi Al Ma'adi	Borehole	14	0	4	23	1	42	12	0	2	0	0	0	0	14	265,361	0	22,392	0	0	0	0	287,753	138.6	0.0	1.4	0.0	0.0	0.0	0.0	140.0
		Dug Well	148	14	29	14	51	256	127	0	15	0	0	6	0	148	1,725,073	0	133,974	0	0	56,236	0	1,915,283	214.2	0.0	6.7	0.0	0.0	0.3	0.0	221.2
		Dug / Bore	19	1	1	6	1	28	16	0	2	0	0	1	0	19	225,164	0	32,993	0	0	25,639	0	283,796	61.4	0.0	4.5	0.0	0.0	0.0	0.0	66.0
		Spring	6	0	0	0	0	6	5	0	0	0	0	1	0	6	0	0	0	0	0	0	0	0	27.6	0.0	0.0	0.0	0.0	0.0	0.0	27.6
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	187	15	34	43	53	332	160	0	19	0	0	8	0	187	2,215,598	0	189,359	0	0	81,875	0	2,486,832	441.9	0.0	12.6	0.0	0.0	0.3	0.0	454.7
5	Wadi A'sir	Borehole	17	0	3	13	0	33	16	0	1	0	0	0	0	17	774,081	0	7,862	0	0	0	0	781,943	90.5	0.0	0.0	0.0	0.0	0.0	0.0	90.5
		Dug Well	402	42	16	62	17	539	377	0	19	0	0	5	1	402	5,461,856	0	167,530	0	0	54,540	6,577	5,690,502	355.8	0.0	0.1	0.0	0.0	0.0	0.0	355.9
		Dug / Bore	25	0	1	0	0	26	25	0	0	0	0	0	0	25	702,285	0	0	0	0	0	0	702,285	69.7	0.0	0.0	0.0	0.0	0.0	0.0	69.7
		Spring	18	0	0	0	0	18	9	0	6	0	0	3	0	18	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	462	42	20	75	17	616	427	0	26	0	0	8	1	462	6,938,221	0	175,392	0	0	54,540	6,577	7,174,730	516.0	0.0	0.1	0.0	0.0	0.0	0.0	516.1
6	Wadi Khulaqah	Borehole	26	0	4	16	5	51	26	0	0	0	0	0	0	26	1,528,271	0	0	0	0	0	0	1,528,271	239.0	0.0	0.0	0.0	0.0	0.0	0.0	239.0
		Dug Well	52	3	0	7	19	81	40	0	4	0	0	8	0	52	763,344	0	43,632	0	0	87,264	0	894,240	42.4	0.0	0.0	0.0	0.0	0.0	0.0	42.4
		Dug / Bore	3	0	0	0	0	3	3	0	0	0	0	0	0	3	54,907	0	0	0	0	0	0	54,907	3.4	0.0	0.0	0.0	0.0	0.0	0.0	3.4
		Spring	2	0	0	0	0	2	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	83	3	4	23	24	137	70	0	4	0	0	9	0	83	2,346,522	0	43,632	0	0	87,264	0	2,477,418	284.8	0.0	0.0	0.0	0.0	0.0	0.0	284.8
7	Wadi Qasabah	Borehole	40	1	4	16	8	69	38	1	1	0	0	0	0	40	2,073,698	55,037	78,663	0	0	0	0	2,207,399	225.1	0.0	0.0	0.0	0.0	0.0	0.0	225.1
		Dug Well	3	0	0	0	6	9	3	0	0	0	0	0	0	3	12,046	0	0	0	0	0	0	12,046	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2
		Dug / Bore	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	0.0	0.0	0.0	0.0
		Spring	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	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	43	1	4	16	14	78	41	1	1	0	0	0	0	43	2,085,744	55,037	78,663	0	0	0	0	2,219,444	226.3	0.0	0.0	0.0	0.0	0.0	0.0	226.3
8	Wadi Al Huqqah	Borehole	189	0	20	46	22	277	187	2	0	0	0	0	0	189	14,767,549	73,382	0	0	0	0	0	14,840,931	1,935.1	0.0	0.0	0.0	0.0	0.0	0.0	1,935.1
		Dug Well	1	0	0	1	17	19	0	0	1	0	0	0	0	1	0	0	3,931	0	0	0	0	3,931	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dug / Bore	0	0	0	1	6	7	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	0.0
		Spring	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	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	190	0	20	48	45	303	187	2	1	0	0	0	0	190	14,767,549	73,382	3,931	0	0	0	0	14,844,862	1,935.1	0.0	0.0	0.0	0.0	0.0	0.0	1,935.1
9	Wadi Bani Huwat	Borehole	945	1	114	235	11	1,306	897	16	19	9	2	2	0	945	49,416,203	2,293,580	490,227	666,413	20,862	51,476	0	52,938,760	5,904.4	0.9	1.8	33.3	0.0	0.0	0.0	5,940.6
		Dug Well	278	3	26	218	292	817	202	1	71	0	1	3	0	278	3,673,572	1,685	505,436	0	15,433	14,602	0	4,210,727	411.3	0.0	3.5	0.0	0.0	0.0	0.0	414.9
		Dug / Bore	76	0	7	40	10	133	68	2	4	1	0	1	0	76	2,848,515	87,160	15,988	34,322	0	3,931	0	2,989,916	524.4	0.1	0.5	7.2	0.0	0.0	0.0	532.1
		Spring	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	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	1,299	4	147	493	313	2,256	1,167	19	94	10	3	6	0	1,299	55,938,289	2,382,425	1,011,651	700,736	36,295	70,008	0	60,139,403	6,840.1	1.0	5.8	40.5	0.0	0.0	0.0	6,887.6
10	Wadi Thumah	Borehole	12	0	2	30	7	51	10	0	1	1	0	0	0	12	513,571	0	62,165	57,658	0	0	0	633,394	78.1	0.0	0.0	0.0	0.0	0.0	0.0	78.1
		Dug Well	211	8	40	35	37	331	195	0	16	0	0	0	0	211	1,559,818	0	153,220	0	0	0	0	1,713,037	193.2	0.0	1.0	0.0	0.0	0.0	0.0	194.2
		Dug / Bore	3	0	3	6	2	14	2	0	1	0	0	0	0	3	41,008	0	25,639	0	0	0	0	66,647	2.3	0.0	0.0	0.0	0.0	0.0	0.0	2.3
		Spring	7	0	0	0	0	7	3	0	3	0	0	1	0	7	0	0	0	0	0	0	0	0	11.7	0.0	0.1	0.0	0.0	0.0	0.0	11.8
		Dam / Pool	3	0	0	0	0	3	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	236	8	45	71	46	406	213	0	21	1	0	1	0	236	2,114,397	0	241,024	57,658	0	0	0	2,413,078	285.3	0.0	1.1	0.0	0.0	0.0	0.0	286.3

Appendix 3 Detailed Result of Well Inventory 2002 (2/3)

Zone	Sub Basin	Well Type	No. of Well by Status						No. of Operational Well by Water Use								Abstraction (m3/year) by Water Use								Irrigated Area (ha) by Source of Water							
			Operating	Intermittent	Temporaly not in use	Abandoned	Dry	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total
11	Wadi As Sirr	Borehole	587	0	32	134	0	753	577	0	9	0	0	1	0	587	33,549,859	0	222,486	0	0	57,142	0	33,829,487	2,976.3	0.0	0.0	0.0	0.0	4.5	0.0	2,980.8
		Dug Well	742	285	51	269	123	1,470	646	1	87	0	0	6	2	742	5,612,464	562	751,949	0	0	65,448	21,816	6,452,239	783.8	0.0	2.7	0.0	0.0	0.0	0.0	786.6
		Dug / Bore	30	0	0	6	1	37	28	0	2	0	0	0	0	30	528,968	0	80,336	0	0	0	0	609,304	99.6	0.0	0.0	0.0	0.0	0.0	0.0	99.6
		Spring	26	0	0	0	0	26	13	0	9	0	0	4	0	26	0	0	0	0	0	0	0	0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
		Dam / Pool	2	0	0	0	0	2	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		Total	1,387	285	83	409	124	2,288	1,265	1	107	0	0	12	2	1,387	39,691,291	562	1,054,772	0	0	122,590	21,816	40,891,031	3,866.9	0.0	2.7	0.0	0.0	4.5	0.0	3,874.1
12	Wadi Al Furs	Borehole	189	0	12	53	2	256	187	1	1	0	0	0	0	189	12,464,041	117,936	2,246	0	0	0	0	12,584,224	1,195.9	0.0	0.0	0.0	0.0	0.0	0.0	1,195.9
		Dug Well	86	4	18	63	69	240	57	0	29	0	0	0	0	86	712,708	0	132,878	0	0	0	0	845,586	101.5	0.0	1.4	0.0	0.0	0.0	0.0	102.9
		Dug / Bore	0	0	0	3	0	3	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	0.0
		Spring	3	0	0	0	0	3	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	3.6
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	278	4	30	119	71	502	247	1	30	0	0	0	0	278	13,176,749	117,936	135,124	0	0	0	0	13,429,809	1,301.0	0.0	1.4	0.0	0.0	0.0	0.0	1,302.4
13	Wadi Al Iqbal	Borehole	262	0	31	53	3	349	255	5	2	0	0	0	0	262	15,852,949	276,759	62,899	0	0	0	0	16,192,607	2,850.9	19.4	0.0	0.0	0.0	0.0	0.0	2,870.3
		Dug Well	1	0	0	0	2	3	1	0	0	0	0	0	0	1	5,869	0	0	0	0	0	0	5,869	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		Dug / Bore	0	0	0	0	2	2	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	0.0
		Spring	2	0	0	0	0	2	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	265	0	31	53	7	356	258	5	2	0	0	0	0	265	15,858,817	276,759	62,899	0	0	0	0	16,198,476	2,851.2	19.4	0.0	0.0	0.0	0.0	0.0	2,870.5
14	Wadi Zahr & Al Ghayl	Borehole	306	3	25	142	54	530	253	39	10	1	2	0	1	306	10,876,097	1,441,962	265,505	60,024	60,485	0	30,888	12,734,962	1,418.3	63.9	15.6	4.5	0.0	0.0	0.0	1,502.3
		Dug Well	28	0	0	31	117	176	10	0	14	0	0	4	0	28	153,953	0	111,858	0	0	43,632	0	309,443	14.1	0.0	1.4	0.0	0.0	0.0	0.0	15.5
		Dug / Bore	3	0	0	5	4	12	1	1	1	0	0	0	0	3	47,018	79,913	27,145	0	0	0	0	154,076	2.5	1.1	0.9	0.0	0.0	0.0	0.0	4.5
		Spring	5	0	0	0	0	5	1	0	3	0	0	1	0	5	0	0	0	0	0	0	0	0	0.9	0.0	0.5	0.0	0.0	0.0	0.0	1.4
		Dam / Pool	1	2	0	0	0	3	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	343	5	25	178	175	726	265	40	28	1	2	6	1	343	11,077,068	1,521,875	404,508	60,024	60,485	43,632	30,888	13,198,481	1,435.8	65.0	18.3	4.5	0.0	0.0	0.0	1,523.7
15	Wadi Hamdan	Borehole	81	1	20	21	6	129	55	10	8	7	1	0	0	81	1,732,525	397,173	197,957	490,444	21,370	0	0	2,839,468	263.6	26.8	9.9	5.9	0.0	0.0	0.0	306.1
		Dug Well	4	0	1	15	25	45	4	0	0	0	0	0	0	4	39,204	0	0	0	0	0	0	39,204	6.1	0.0	0.0	0.0	0.0	0.0	0.0	6.1
		Dug / Bore	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	0.0	0.0	0.0	0.0
		Spring	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	0.0	0.0	0.0	0.0
		Dam / Pool	0	0	1	0	0	1	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	0.0
		Total	85	1	22	36	31	175	59	10	8	7	1	0	0	85	1,771,729	397,173	197,957	490,444	21,370	0	0	2,878,672	269.6	26.8	9.9	5.9	0.0	0.0	0.0	312.2
16	Wadi Al Mawrid	Borehole	336	0	65	101	27	529	148	52	80	46	6	0	4	336	7,400,492	12,024,460	4,816,535	3,755,350	247,915	0	103,680	28,348,431	651.5	0.7	16.2	25.5	0.1	0.0	2.1	696.1
		Dug Well	126	3	5	36	106	276	66	4	44	10	0	0	2	126	951,634	72,911	341,276	458,555	0	0	26,633	1,851,009	25.3	0.0	1.2	1.5	0.0	0.0	0.0	28.0
		Dug / Bore	10	0	0	2	2	14	5	1	2	1	0	0	1	10	183,137	36,953	68,763	49,896	0	0	1,134	339,883	6.7	0.0	0.5	0.0	0.0	0.0	0.0	7.1
		Spring	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dam / Pool	7	0	1	0	1	9	7	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	80.1	0.0	0.0	0.0	0.0	0.0	0.0	80.1
		Total	480	3	71	139	136	829	227	57	126	57	6	0	7	480	8,535,263	12,134,324	5,226,574	4,263,801	247,915	0	131,446	30,539,323	763.5	0.7	17.9	26.9	0.1	0.0	2.1	811.3
17	Wadi Sa'wan	Borehole	80	0	13	17	0	110	77	2	1	0	0	0	0	80	4,017,134	377,395	10,109	0	0	0	0	4,404,638	1,183.1	0.0	0.0	0.0	0.0	0.0	0.0	1,183.1
		Dug Well	556	53	41	152	160	962	459	1	92	0	0	4	0	556	3,463,285	5,584	582,633	0	0	43,632	0	4,095,133	254.5	0.0	3.9	0.0	0.0	0.0	0.0	258.4
		Dug / Bore	1	0	0	0	0	1	1	0	0	0	0	0	0	1	3,931	0	0	0	0	0	0	3,931	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		Spring	12	0	0	0	1	13	5	0	3	0	0	4	0	12	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dam / Pool	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	650	53	54	169	161	1,087	543	3	96	0	0	8	0	650	7,484,350	382,979	592,742	0	0	43,632	0	8,503,703	1,437.8	0.0	3.9	0.0	0.0	0.0	0.0	1,441.7
18	Wadi Shahik	Borehole	118	0	15	66	0	199	103	0	8	7	0	0	0	118	3,317,478	0	234,402	502,587	0	0	0	4,054,467	613.6	0.0	0.0	6.3	0.0	0.0	0.0	619.9
		Dug Well	823	152	85	123	189	1,372	758	2	59	0	0	2	2	823	6,678,658	21,816	561,567	0	0	21,816	21,816	7,305,673	770.1	0.0	1.1	0.0	0.0	0.0	0.0	771.2
		Dug / Bore	38	0	1	7	0	46	36	0	2	0	0	0	0	38	536,025	0	18,341	0	0	0	0	554,367	57.6	0.0	2.3	0.0	0.0	0.9	0.0	60.8
		Spring	21	0	0	0	0	21	3	0	6	0	0	12	0	21	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dam / Pool	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	1.8
		Total	1,000	152	101	196	190	1,639	900	2	75	7	0	14	2	1,000	10,532,161	21,816	814,311	502,587	0	21,816	21,816	11,914,507	1,443.0	0.0	3.4	6.3	0.0	0.9	0.0	1,453.7
19	Wadi Ghayman	Borehole	52	0	10	21	2	85	44	7	1	0	0	0	0	52	1,378,969	123,590	26,957	0	0	0	0	1,529,515	263.9	0.0	0.0	0.0	0.0	0.0	0.0	263.9
		Dug Well	314	66	27	45	65	517	293	0	16	0	0	4	1	314	2,427,664	0	172,874	0	0	43,157	10,908	2,654,603	312.1	0.0	9.2	0.0	0.0	0.0	0.0	321.4
		Dug / Bore	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.4
		Spring	15	0	0	0	0	15	2	0	2	0	0	11	0	15	0	0	0	0	0	0	0	0	2.6	0.0	0.0	0.0	0.0	0.8	0.0	3.4
		Dam / Pool	2	0	1	0	1	4	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	383	66	39	66	68	622	340	7	19	0	0	16	1	383	3,806,633	123,590	199,831	0	0	43,157	10,908	4,184,119	580.0	0.0	9.2	0.0	0.0	0.8	0.0	590.0
20	Wadi Al Mulaikhy	Borehole	34	1	4	53	8	100	26	8	0	0	0	0	0	34	1,620,382	283,270	0	0	0	0	0	1,903,651	131.9	12.2	0.0	0.0	0.0	0.0	0.0	144.0
		Dug Well	77	2	3	9	44	135	68	0	5	0	0	4	0	77	669,326	0	44,939	0	0	43,632	0	757,897	55.1	0.0	0.8	0.0	0.0	0.0	0.0	55.9
		Dug / Bore	3	0	0	2	3	8	2	1	0	0	0	0	0	3	62,905	7,919	0	0	0	0	0	70,823	8.1	0.5	0.0	0.0	0.0	0.0	0.0	8.6
		Spring	18	0	0	0	0	18	2	1	11	0	0	4	0	18	0	0	0	0	0	0	0	0	1.8	0.0	0.3	0.0	0.0	0.2	0.0	2.4
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	132	3	7	64	55	261	98	10	16	0	0	8	0	132	2,352,612	291,188	44,939	0	0	43,632	0	2,732,371	196.9	12.6	1.1	0.0	0.0	0.2	0.0	210.8

Appendix 3 Detailed Result of Well Inventory 2002 (3/3)

Zone	Sub Basin	Well Type	No. of Well by Status						No. of Operational Well by Water Use								Abstraction (m3/year) by Water Use								Irrigated Area (ha) by Source of Water							
			Operating	Intermittent	Temporaly not in use	Abandoned	Dry	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total	Irrigation	Supply	Domestic	Tankers	Industry	Animal	Other	Total
21	Wadi Hizyaz	Borehole	68	0	4	95	2	169	58	3	2	4	1	0	0	68	2,642,561	260,077	79,934	268,553	2,016	0	0	3,253,141	262.4	0.0	0.0	10.4	0.0	0.0	0.0	272.7
		Dug Well	2	3	1	33	57	96	1	0	0	0	0	1	0	2	18,208	0	0	0	0	10,908	0	29,116	3.1	0.0	0.0	0.0	0.0	0.0	0.0	3.1
		Dug / Bore	1	0	0	4	0	5	1	0	0	0	0	0	0	1	44,388	0	0	0	0	0	0	44,388	3.2	0.0	0.0	0.0	0.0	0.0	0.0	3.2
		Spring	4	0	0	0	0	4	0	0	3	0	0	1	0	4	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	75	3	5	132	59	274	60	3	5	4	1	2	0	75	2,705,156	260,077	79,934	268,553	2,016	10,908	0	3,326,645	268.6	0.0	0.0	10.4	0.0	0.0	0.0	278.9
22	Wadi Akhwar	Borehole	75	0	2	35	3	115	69	0	5	0	0	0	1	75	5,270,136	0	256,018	0	0	0	148,680	5,674,834	320.9	0.0	0.0	0.0	0.0	0.0	0.0	320.9
		Dug Well	104	12	0	13	23	152	96	0	6	0	0	1	1	104	1,886,450	0	55,426	0	0	10,908	5,292	1,958,075	95.2	0.0	0.0	0.0	0.0	0.0	0.0	95.2
		Dug / Bore	2	1	0	0	1	4	2	0	0	0	0	0	0	2	111,410	0	0	0	0	0	0	111,410	2.7	0.0	0.0	0.0	0.0	0.0	0.0	2.7
		Spring	3	0	0	0	0	3	1	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Dam / Pool	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	0.0	0.0	0.0	0.0
		Total	184	13	2	48	27	274	168	0	13	0	0	1	2	184	7,267,995	0	311,443	0	0	10,908	153,972	7,744,319	418.7	0.0	0.0	0.0	0.0	0.0	0.0	418.7

Appendix 4

Detailed Well Information for Urban Water Supply

Appendix 4 Detailed Well Information for Urban Water Supply (SWSLC) (1/5)

No	Well Field	Area	Well No	UTM N	UTM E	Altitude (masl)	Depth (m)	Dig Date	Operation date	Well situation	contract No.
1	Western well field	Omran line	ST1	1,701,599	414,786	2,251	417	1989	1990		
2	Western well field	Omran Road	ST5	1,702,935	414,328	2,260	400	1988	1989		
3	Western well field	Thahban	ST6	1,705,394	412,631	2,238	323	1990	1990		
4	Western well field	Thahban	ST7	1,704,798	412,360		374	91		decrease in production	
5	Western well field	Thahban	ST8	1,705,323	412,682		200	77		dry	
6	Western well field	Omran Road	ST9	1,705,856	412,679		335	90	93		
7	Western well field	Omran Road	ST10	1,705,170	413,247	2,249	368	92	93		
8	Western well field	Omran Road	ST11	1,703,122	414,328	2,239	400	88	89	decrease in production	
9	Western well field	Omran road- Jader	ST12	1,706,500	412,446	2,215	294	90	91	decrease in production	
10	Western well field	Omran road- Jader	ST13	1,707,294	412,097	2,211	312	90	91	decrease in production	
11	Western well field	Thahban	P1	1,707,426	409,566	2,223	292	90	91	stopped	
12	Western well field	Omran line	P6	1,703,069	413,077	2,282	410	88	91		
13	Western well field	Thakban	P7	1,707,834	409,995		190	78	2002	dry	
14	Western well field	Thahban	P8R	1,704,800	413,005	2,220	380	87		dry	(SWEP-A/2001-14)
15	Western well field	Thakban	P9	1,707,840	409,193		160	78		dry	
16	Western well field	Thahban	P10	1,703,816	413,503	2,243	355	90	91	decrease in production	
17	Western well field	Thahban	P13	1,704,211	413,296	2,236	385	2002	2002	deeping through digging	(SWEP-C/2001-16)
18	Western well field	Thahban village	P14	1,707,067	410,481		220	79		dry	
19	Western well field	Wadi Thahir Road	P15	1,709,557	409,405	2,225	212	87	88	decrease in production	
20	Western well field	Al-hasba	P16	1,701,227	413,863	2,218	340	2003	2003		(SWEP-C/2001-16)
21	Western well field	Thahban	P17	1,708,837	400,656	2,216	210	2002	2002	dry	(SWEP-C/2001-16)
22	Western well field	Al-hasba	P18	1,700,639	414,214	1,149	320	92	92		
23	Western well field	Al-Hasba-Sawad Hanash	P19	170,030	409,972	2,249	400	88	89	decrease in production	
24	Western well field	Thahban	P20	1,708,393	409,934		336	94	94		
25	Western well field	Omran Road	P21	1,709,961	410,159	2,216	213	88	89	decrease in production	
26	Western well field	Al-hasba	P22	1,700,729	414,321	2,207	410	88	90		
27	Western well field	Al-Jaraf	P23	1,703,727	414,407	????	393	89	94		
28	Western well field	Al-Jaraf	P24				300	88	99		
29	Western well field	Libyan City	P25	1,702,757	413,734	2,282	213	88	2002		
30	Western well field	Al-hasba	P26	1,700,607	414,109	2,198	428	2001	2001		(SWEP-B/2001-17)
31	Western well field	Omran line	NWSA	1,701,639	414,480	2,265	402	2001	2002		SWSSP-7

Appendix 4 Detailed Well Information for Urban Water Supply (SWSLC) (2/5)

No	Well Field	Area	Well No	UTM N	UTM E	Altitude (masl)	Depth (m)	Dig Date	Operation date	Well situation	contract No.
32	Western well field	Thahban	D.H	1,706,101	413,106	2,250	357	2001	2003		SWSSP-7
33	Eastern well field	Al-hasba	TP1	1,701,027	415,330	2,268	400	2001	2001		SWSSP-7
34	Eastern well field	Al-hasba	TP2	1,702,015	415,381	2,265	400	2001	2001		SWSSP-7
35	Eastern well field	Sawan	B	1,701,338	418,602	2,264	418	87	89		
36	Eastern well field	Al-Nasser St.	C	1,701,094	417,309	2,267	389	2003	2003		(SWEP-C/2001-16)
37	Eastern well field	Mareb Road	D	1,702,475	417,264	2,253	436	2003	2003		(SWEP-C/2001-16)
38	Eastern well field	Mareb Road	E	1,703,281	418,018	2,267	400	87	89		
39	Eastern well field	Saref Road	F	1,703,904	419,324	2,256	406	91	92		
40	Eastern well field	Al-Khaneq	G	1,702,725	419,194	2,260	383	2002	2002		(SWEP-C/2001-16)
41	Eastern well field	Mareb Road- Saref	J	1,706,903	420,207	2,245	251	82	84		
42	Eastern well field	next to Red Crescent	K	1,704,601	419,480	2,258	425	91	91		
43	Eastern well field	Hibra- Wadi Jameel	L	1,700,485	417,002		277	81	84		
44	Eastern well field	Saref Road	Q	1,703,132	419,956	2,270	410	1988	1991		
45	Eastern well field	Shoub Dam	SS	1,701,178	416,426	2,253	340	2001	2001		******
46	Eastern well field	Hibra	W	1,702,100	416,950	2,235	386	2001	2003		(SWEP-B/2001-17)
47	Eastern well field	Hibra	Y	1,700,542	417,048	2,245	389	2001	2004		(SWEP-B/2001-17)
48	Eastern well field	Sawan	T	1,701,005	417,885	2,248	400	2001	2004		(SWEP-B/2001-17)
49	Eastern well field	Sawan	MZ-2				*****	******	******		2004/16
50	Eastern well field	Mareb Road	KI				415	2005	new		2004/16
51	Haddah well field	Hadda- 14 October St.	EX-S	1,691,674	414,157	2,332	884	2001	2002		SWSSP-7
52	Haddah well field	Hadda- Housing Village	H1				260	84		dry	
53	Haddah well field	Hadda- Housing Village	H2				374	94		dry	
54	Haddah well field	Hadda	H3	1,690,912	414,092	2,315	450	2001	2001		******
55	Haddah well field	Hadda- 14 October St.	H4	1,691,719	414,127	2,343	312	92	2002		
56	Haddah well field	Hadda- Housing Village	H5	1,690,591	412,906	2,295	313	92		dry	
57	Haddah well field	Hadda	H6				306			dry	
58	Haddah well field	Hadda- Housing Village	H7	1,691,798	414,068	2,312	360	96	97		
59	Haddah well field	Hadda- 50 St. Sana	H8	1,690,907	412,506	2,367	890	2000	2000		SWSSP-7
60	Haddah well field	Hadda	H9				412	99		dry	
61	Haddah well field	Hadda	H10				300	98		failure	
62	Haddah well field	Hadda	H11	1,692,300	411,075	2,360	517			failure	(SWEP-A/2001-14)

Appendix 4 Detailed Well Information for Urban Water Supply (SWSLC) (3/5)

No	Well Field	Area	Well No	UTM N	UTM E	Altitude (masl)	Depth (m)	Dig Date	Operation date	Well situation	contract No.
63	Haddah well field	Hadda	H12	1,692,950	411,070	2,250	504			failure	(SWEP-B/2001-17)
64	Haddah well field	Hadda	H13								
65	Haddah well field	Hadda -AlAshash	HA	1,691,410	411,005	2,371	851	2002			SWSSP-7
66	Asser well field		AS1	1,695,865	411,840	2,285	465			failure	(SWEP-D/2001-15)
67	Asser well field	Al-taiseer neighbourhood	AS2	1,693,669	410,936	2,230	400	95	96		
68	Asser well field	Agricukture -AlKadir	AS3	1,697,112	413,154	2,298	320	95	96		
69	Asser well field		AS4	1,695,604	411,790	2,278	803				
70	Asser well field	Fach Atan	AS4R				272	96	97		2003/3
71	Asser well field	Political neighbourhood	AS5				332	96	97		
72	Asser well field	Green Dome	AS6	1,696,845	411,905	2,295	404	96	******	failure	(SWEP-D/2001-15)
73	Asser well field	Conference Hall	AS7				403		98	dry	
74	Asser well field	Al-qadissya	AS8				712	2001	2002		
75	Asser well field	Al-Zubairi Garden	SA-1	1,696,222	413,594	2,280	712	2001	2002		SWSSP-7
76	Asser well field	Asser	AS9	1,697,009	410,817	2,314	467	2000	2000		
77	Asser well field	Asser Village	AS10				475	2001			
78	Asser well field	Fach Atan	AS11	1,695,750	410,854	2,315	567	2001	2001		(SWEP-B/2001-17)
79	Asser well field	Fach Atan	AS12				******	******	******		
80	Asser well field	Conference Hall	ASR1	1,697,290	411,696	2,312	755	2002	2002		SWSSP-7
81	Asser well field	Asser Tanks	ASR-2	1,696,367	410,938	2,308	760	2002	2002		SWSSP-7
82	Asser well field	UN	UN	1,694,050	413,250	2,365	680	2002	2002		(SWEP-D/2001-15)
83	Asser well field	Al-Kae	Z1	1,697,198	413,281	2,298	366	99	99		
84	Asser well field	Khair and Salam neighbourhood	MZ-1				535	2004			
85	Asser well field	70 city	M70	1,694,676	414,160	2,296	850	91	93		
86	Asser well field	70 city	M71				900	2002	*****	*****	*****
87	Asser well field	70 city	SP			2,288	900	2002	2004		
88	Asser well field	حده	H3R				450				SWSSP-7
89	Asser well field	فج عطان	AS4R				803				2004/16
90	Musayek well field	Nikem	M1	1,698,282	417,745	2,312	405	90	92		
91	Musayek well field	Nikem	M2	1,697,180	417,990	2,312	446	89	91		
92	Musayek well field	Kawlan St.	M3	1,694,599	417,753	2,398	537	2001	2001		*******
93	Musayek well field	1st water area	M4	1,698,207	416,665	2,325	442	2001	2001		(SWEP-D/2001-15)

Appendix 4 Detailed Well Information for Urban Water Supply (SWSLC) (4/5)

No	Well Field	Area	Well No	UTM N	UTM E	Altitude (masl)	Depth (m)	Dig Date	Operation date	Well situation	contract No.
94	Musayek well field	Sawan- house campus	M5				360	94	94		
95	Musayek well field	Maseek Tanks	M6	1,698,090	416,825	2,318	262	94	2001	dry	
96	Musayek well field		Mr6	1,698,370	416,826	2,315	600				
97	Musayek well field	Thafar neighborhood	M7				297	94	97		
98	Musayek well field	Al-qadissya area	M8	1,693,461	417,255	2,294	204	94	2002	dry	
99	Musayek well field	majid neighbourhood	M9	1,695,625	417,193	2,312	95	295	96		
100	Musayek well field	majid neighbourhood	M9R				480	2005	******		2003/3
101	Musayek well field	Nikoum -camp	M10R				450	2001	2001		*******
102	Musayek well field	beer Abeed	M11	1,694,350	416,855	2,345	302	96	96	decrease in level	(SWEP-D/2001-15)
103	Musayek well field	beer Abeed	M11R				******	******	******	still digging	2004/16
104	Musayek well field	Nikem	M12				400	96	97	dry	
105	Musayek well field	Batel 70 Neighbourhood	M14	1,690,668	418,122	2,310	330	97	99		
106	Musayek well field	Al-Noor neighbourhood	M15	1,695,910	416,810	2,312	360	98	99		
107	Musayek well field	Sawan	M16				394	2001	2003		******
108	Musayek well field	Nikem	M17	1,698,250	416,505	2,345	420	2001	2002		(SWEP-A/2001-14)
109	Musayek well field	Nikem	M18	1,698,030	418,550	2,295	485	2002	2003		
110	Musayek well field	Nikem	M19	1,636,800	417,875	2,340	475	2002	2004		
111	Musayek well field	70 city	M20				258			dry	
112	Musayek well field	70 city	M21				200			dry	
113	Musayek well field	70 city	M22				270			dry	
114	Musayek well field	70 city	M23				200			dry	
115	Musayek well field		M24	417,679	2,262	820					
116	Musayek well field	Maseek Tanks	MR	1,698,308	416,825	2,337	600	2001	2001		SWSSP-7
117	Musayek well field	Al-qadissya area	KA	1,693,470	417,245	2,330	823	2002	2002		SWSSP-7
118	Musayek well field	70 city	M19-A	1,689,477	417,176	2,315	1000	2002	2003		SWSSP-7
119	Musayek well field	Bainoun St.	M24				854	2004	new		2003/3
120	Musayek well field	Taiz St.	OS	1,694,694	416,716	2,303	766	2001	2002		SWSSP-7
121	Musayek well field	Houzaiz - Alwahda area	HZ	1,685,107	419,176	2,343	470	2002	2004		تكليف
122	Musayek well field	Hiera	N1				360	95	96		
123	Musayek well field	Sheraton St.	N2R				482	2004	2004		2003/3
124	Musayek well field	Heira -Bank city	N3	1,699,120	416,455	2,222	350	2002	2003		(SWEP-A/2001-14)

Appendix 4 Detailed Well Information for Urban Water Supply (SWSLC) (5/5)

No	Well Field	Area	Well No	UTM N	UTM E	Altitude (masl)	Depth (m)	Dig Date	Operation date	Well situation	contract No.
125	Musayek well field	Al-Fawares Sawan Neighbourhood	MZ-2				480	2005			
126	Musayek well field	Rawda Shahran	R1	1,704,702	418,930	2,261	360	89	95		
127	Musayek well field	Rawda Al-mazafa	R2	1,707,764	420,478	2,237			93		
128	Musayek well field	Khashim Al-Bakra	R3	1,705,284	418,158	2,242			97		
129	Musayek well field	West Rawda	R4	1,706,200	415,355	2,223	335	2001	2004		(SWEP-A/2001-14)
130	Musayek well field	Khashim Al-Bakra	R3R				380	2003	new		2003/3
131	Musayek well field	Bani Harith								dry	
132	Musayek well field	Rawda								dry	
133	Musayek well field	Rawda								dry	
134	Musayek well field	Rawda								dry	
135	Musayek well field	Rawda									
136	Musayek well field	Bani harith									

Appendix 5

Summarized Wastewater Quality Analysis

Appendix 5 Summarized Monthly Waste Water Quality Analysis Results (2005-2006) (1/2)

		INFLUENT								FINAL EFFLUENT							
		TEMP (oC)	PH	T.SS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	PO4 (mg/l)	TDS (mg/l)	PH	T.SS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	PO4 (mg/l)	NO3 (mg/l)	TDS (mg/l)
Jan/2005	Min	19.8	7.19	400	994	1,680	136.2	46.3	845	7.32	14	49	99	25.5	16.3	3.5	988
	Max	25.3	7.63	1,324	1,220	2,831	213.0	97.0	1,254	7.94	82	82	284	56.3	35.6	11.3	1,302
	Ave	22.8	7.37	1,048	1,108	2,376	185.7	57.5	1,065	7.57	48	67	205	41.9	20.0	9.4	1,108
	Samples	10	31	31	10	11	10	10	10	31	31	10	10	10	8	10	10
Feb/2005	Min	21.8	7.2	480	967	1,535	102.0	39.5	780	7.4	32	50	82	34.2	14.4	3.2	907
	Max	27.3	7.6	1,246	1,162	2,561	201.0	90.0	1,216	7.8	104	88	186	59.0	35.0	10.7	1,075
	Ave	24.7	7.3	953	1,026	1,984	171.3	58.4	1,039	7.5	55	70	130	42.3	23.6	6.8	1,005
	Samples	9	28	28	9	9	9	9	9	28	28	9	9	9	5	9	9
Mar/2005	Min	**	7.2	484	875	1,340	88.0	24.3	894	7.3	13	48	99	38.6	1.3	1.4	948
	Max	26.8	7.6	1,152	1,092	2,351	194.5	83.0	1,367	7.8	236	96	184	93.0	28.4	10.6	1,317
	Ave	22.9	7.3	932	980	1,885	156.4	49.2	1,097	7.6	77	73	140	59.5	18.5	4.9	1,133
	Samples	11	31	31	10	10	10	10	10	31	31	10	10	10	10	9	10
Apr/2005	Min	23.9	7.2	546	989	1,985	149.0	38.6	922	7.3	27	45	165	38.4	4.3	13.5	975
	Max	28.3	7.5	1,292	1,187	2,733	197.5	62.0	1,217	7.9	113	104	215	78.8	7.4	28.6	1,365
	Ave	25.9	7.3	936	1,085	2,354	179.9	52.2	1,087	7.6	64	81	196	53.1	6.0	18.8	1,143
	Samples	8	30	30	9	9	9	9	9	30	30	9	9	7	9	8	9
May/2005	Min	**	7.1	396	871	1,456	143.0	46.5	866	7.2	28	58	98	39.0	17.6	5.8	940
	Max	**	7.5	1,234	1,217	2,511	193.6	60.0	1,246	7.8	708	85	220	59.0	26.2	11.5	1,210
	Ave	**	7.3	942	1,005	1,849	173.9	55.4	1,033	7.5	87	74	180	50.2	21.1	8.3	1,033
	Samples	**	26	26	8	8	8	7	8	26	26	8	8	8	3	8	8
Jun/2005	Min	**	6.9	296	944	810	167.0	**	1,044	7.4	36	68	62	30.0	41.5	4.8	950
	Max	**	7.7	994	1,184	1,893	227.0	**	1,056	8.3	320	165	275	54.5	41.5	9.4	982
	Ave	**	7.3	722	1,065	1,352	197.0	**	1,048	7.5	84	99	171	42.3	41.5	7.1	966
	Samples	**	17	24	3	2	2	**	3	17	24	4	3	2	1	2	2
Jul/2005	Min	**	7.0	256	865	880	108.0	83.5	632	7.4	26	94	155	66.0	10.5	4.6	536
	Max	**	8.2	1,792	1,236	3,680	220.0	163.7	1,252	8.3	172	278	420	114.0	49.9	128.0	1,044
	Ave	**	7.5	753	1,026	1,966	150.9	117.5	948	7.8	78	194	284	92.5	30.5	34.0	806
	Samples	**	17	27	8	9	9	4	9	17	26	8	6	9	8	8	10
Aug/2005	Min	**	7.0	342	944	1,585	105.5	119.6	678	7.4	32	22	90	36.5	6.9	0.2	656
	Max	**	7.8	1,624	1,248	2,865	250.4	151.6	1,194	8.1	100	134	115	123.0	33.1	15.5	1,093
	Ave	**	7.3	964	1,075	1,926	154.6	132.2	953	7.8	62	53	97	88.3	24.8	4.2	886
	Samples	**	18	26	6	6	6	4	8	18	26	6	6	6	6	6	10
Sep/2005	Min	**	6.7	564	908	1,880	114.5	113.3	1,129	7.6	48	56	115	59.0	23.4	0.7	1,070
	Max	**	7.6	1,832	1,372	3,430	198.0	130.0	1,147	7.9	146	88	180	103.5	38.8	9.5	1,113
	Ave	**	7.1	1,115	1,135	2,346	150.3	121.7	1,138	7.7	96	71	152	90.1	28.8	3.8	1,087
	Samples	**	20	22	5	5	5	2	3	19	22	5	5	5	5	5	3
Oct/2005	Min	**	6.3	296	1,236	2,220	110.5	100.5	600	6.9	25	36	155	50.0	10.2	4.0	646
	Max	**	7.4	3,344	1,420	2,790	164.0	100.5	600	7.8	636	46	225	82.0	58.8	11.0	646
	Ave	**	7.0	1,059	1,343	2,443	131.3	100.5	600	7.6	130	41	187	62.0	28.6	8.2	646
	Samples	**	8	28	3	3	3	1	1	7	28	3	3	3	3	3	1
Nov/2005	Min	**	7.4	416	1,128	1,724	125.6	**	**	7.6	40	31	116	40.4	22.4	6.5	**
	Max	**	7.8	1,312	1,308	2,952	159.6	**	**	8.0	3,512	277	332	113.2	48.1	9.3	**
	Ave	**	7.6	898	1,235	2,282	142.6	**	**	7.9	399	99	191	90.2	32.5	7.6	**
	Samples	**	5	19	4	4	4	**	**	5	19	4	4	4	4	4	**
Dec/2005	Min	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	Max	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	Ave	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	Samples	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
Jan/2006	Min	**	7.7	480	748	1,135	133.5	83.6	**	7.83	54	93	148	105.5	43.1	6.0	**
	Max	**	7.7	2,162	1,192	2,925	162.0	83.6	**	7.83	5,212	724	785	135.5	665.6	9.0	**
	Ave	**	7.7	1,012	1,050	1,946	143.9	83.6	**	7.83	1,559	350	497	120.2	217.9	7.8	**
	Samples	**	1	20	4	4	4	1	**	1	20	4	4	4	4	4	**
Feb/2006	Min	**	7.7	348	1,104	1,696	76.4	104.8	1,245	8.0	40	35	64	65.6	30.5	10.0	1,150
	Max	**	7.8	1,370	1,176	2,224	207.0	118.6	1,245	8.0	2,216	120	304	137.2	71.5	12.4	1,150
	Ave	**	7.7	717	1,133	1,944	151.2	112.1	1,245	8.0	328	63	163	103.9	51.5	11.2	1,150
	Samples	**	2	21	4	5	5	4	1	1	19	4	4	5	5	5	1
Mar/2006	Min	**	6.7	304	1,336	1,310	152.8	100.6	**	**	50	25	124	100.0	26.2	3.6	**
	Max	**	6.7	1,556	1,500	2,132	215.2	115.3	**	**	452	197	322	157.6	27.1	12.8	**
	Ave	**	6.7	841	1,418	1,717	182.5	108.0	**	**	123	71	183	125.9	26.6	9.7	**
	Samples	**	1	19	2	4	3	2	**	**	17	12	4	4	2	4	**
Apr/2006	Min	**	**	268	800	1,604	118.0	100.7	**	**	28	22	112	115.6	19.3	1.2	**
	Max	**	**	2,080	1,168	2,072	169.6	126.8	**	**	1,612	239	280	122.8	50.8	12.0	**
	Ave	**	**	838	1,009	1,763	145.9	111.4	**	**	248	117	177	118.1	31.9	8.2	**
	Samples	**	**	21	3	3	4	3	**	**	20	4	3	4	4	4	**
May/2006	Min	**	**	384	748	816	106.4	71.9	**	**	60	77	112	98.8	22.7	4.8	**
	Max	**	**	2,324	1,104	2,052	167.6	105.5	**	**	456	292	232	103.8	36.1	12.0	**
	Ave	**	**	970	953	1,552	130.0	88.7	**	**	144	182	171	101.0	28.2	8.9	**

Appendix 5 Summarized Monthly Waste Water Quality Analysis Results (2005-2006) (2/2)

		INFLUENT								FINAL EFFLUENT							
		TEMP (oC)	PH	T.SS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	PO4 (mg/l)	TDS (mg/l)	PH	T.SS (mg/l)	BOD5 (mg/l)	COD (mg/l)	NH4 (mg/l)	PO4 (mg/l)	NO3 (mg/l)	TDS (mg/l)
	Samples	**	**	17	3	3	3	2	**	**	18	6	3	3	3	3	**
Jun/2006	Min	**	**	340	**	**	**	**	**	**	36	28	**	**	**	**	**
	Max	**	**	2,120	**	**	**	**	**	**	280	330	**	**	**	**	**
	Ave	**	**	924	**	**	**	**	**	**	98	112	**	**	**	**	**
	Samples	**	**	19	**	**	**	**	**	**	12	8	**	**	**	**	**
Jul/2006	Min	**	**	252	936	1,344	126.4	86.6	**	**	28	25	88	61.2	8.4	8.8	**
	Max	**	**	1,708	1,408	1,972	180.0	102.2	**	**	180	208	148	104.8	62.7	14.0	**
	Ave	**	**	878	1,177	1,583	143.7	95.8	**	**	90	82	116	90.9	33.7	11.5	**
	Samples	**	**	23	4	4	4	4	**	**	19	14	4	4	4	4	**
Aug/2006	Min	**	**	340	1,032	1,304	121.0	74.4	**	**	28	21	104	64.0	26.0	8.8	**
	Max	**	**	1,628	1,196	1,896	153.0	106.0	**	**	176	131	144	90.0	88.0	16.4	**
	Ave	**	**	622	1,114	1,568	136.0	89.8	**	**	72	65	129	73.3	50.2	12.7	**
	Samples	**	**	24	2	3	3	3	**	**	23	6	3	3	3	3	**
Sep/2006	Min	**	**	332	1,260	2,056	125.8	72.4	**	**	24	38	108	93.6	27.6	7.8	**
	Max	**	**	1,912	1,284	2,136	135.6	103.0	**	**	176	243	146	102.8	28.5	11.2	**
	Ave	**	**	707	1,272	2,096	130.7	87.7	**	**	81	109	127	98.2	33.1	9.5	**
	Samples	**	**	23	2	2	2	2	**	**	21	7	2	2	2	2	**
Oct/2006	Min	**	**	204	1,088	1,892	107.6	85.0	**	**	28	56	128	82.4	18.5	10.8	**
	Max	**	**	1,808	1,576	2,200	154.4	104.5	**	**	248	223	228	98.4	49.4	18.0	**
	Ave	**	**	684	1,305	1,979	136.3	93.8	**	**	123	145	192	89.0	38.3	13.7	**
	Samples	**	**	25	4	4	4	4	**	**	23	5	4	4	4	4	**
Nov/2006	Min	**	**	424	1,168	1,560	127.2	85.8	**	**	44	56	128	82.4	18.5	9.6	**
	Max	**	**	1,304	1,372	2,112	170.0	99.0	**	**	184	101	168	124.8	38.0	18.0	**
	Ave	**	**	687	1,245	1,726	142.4	92.8	**	**	99	83	146	99.5	31.2	13.5	**
	Samples	**	**	21	5	5	5	5	**	**	21	6	6	6	6	6	**
Dec/2006	Min	**	**	348	1,004	1,500	117.2	92.8	**	**	44	60	132	88.8	16.1	8.4	**
	Max	**	**	1,316	1,152	2,664	151.6	114.2	**	**	164	118	176	126.0	36.9	16.0	**
	Ave	**	**	680	1,085	2,158	140.2	101.6	**	**	86	85	159	114.6	27.1	12.5	**
	Samples	**	**	19	5	5	5	5	**	**	17	5	4	5	5	5	**

Appendix 6

Questionnaire for Village Authority (Awareness Survey)

Appendix 6 Awareness Survey

Questionnaire for Village Authority
(Sheik, Aqil, Amin, WUG/WUA president)

A) INFORMATION ABOUT THE SITE & THE RESPONDENT

1) Questionnaire No.: _____
2) Wadi: _____
   _____
3) Village: _____
4) District: _____
5) Sub - Basin: _____

6) Name of Respondent: _____
7) Address: _____
   _____
8) Sex (Male, Female): _____
9) Age: _____
   _____
10) Position in the village: _____ (Sheikh, Aqil, Amin, Imam, , WUG / WUA president)
11) Name of Investigator: _____

    Signature: _____
12) Date of Survey: _____

Data of this questionnaire is confidential and should be used only for the intended purpose.

B) GENERAL INFORMATION

1) Details of current population

	Name of community	No. of household	No. of children		No. of adults	
			male	female	male	female
1						
2						
3						
4						
5						
6						
7						

2) Details of occupations of the villagers

No.	Occupation	No. of persons
1	Government Service	
2	Private Service	
3	Agriculture	
4	Animal Husbandry	
5	Business	
6	Landless Laborer / daily laborer	
7	Rural Artisans	
8	Others	
	Total	

3) Demographic trends for the past 15 years (one option)

□ Dramatically increased due to influx of people with expansion of residential housing of the village.

□ Dramatically increased due to influx of people but the residential housing of the village remained unchanged.

□ Stable apart from natural population increase.

□ Dramatically decreased due to migration of people.

4) Available amenities/services and accessibility

4.1. What is the distance from village to nearest agricultural market?

4.2. What is the time taken to the nearest agricultural market?

4.3. What is the type of access road (Earthen, Asphalt, Gravel).

4.4. What type of telephone available in the village? (landline, mobile, none)

4.5. Is there bank in the village?

4.6. Is there electricity network available in the village?

□ Yes (Local, Public, Other).

□ No

5) Schools

5.1. Is there any school in the village?

□ Yes

□ No (move to 5.3)

5.2. What type of schools is available in the village?

(After asking this question Move to Q 6)

No	Classification of Schools	No. of Schools	No. of Boys Student	No. of Girls Students
1	Basic Education			
2	Secondary Education			
3	Basic & Secondary Education			
4	**Total**			

5.3. What is the distance to the nearest school? _____

6) Nearest Health Services

6.1. Is there any health facility available in the village?

□ Yes

□ No (move to 6.3)

6.2. What type of health facility available in the village? (After asking this question Move to Q 7)

No.	Type of Health Facility	Available medical Services	No. of Doctors	No. of primary health workers	No. of midwives	No. of Nurses
1	Health unit					
2	Health centre					
3	Hospital					

6.3. What is the Nearest Health Services to the village and how fare it is from the village?

_____

7) Morbidity for the past three years (2004 - 2006). Data should be obtained from the health facility in the village (if such facility exists). Where there is not health facility, the respondent should be prompted to identify the most common health problems in order or priority.

Diseases	No. of cases in each category			Occurrence in month
	Male	Female	Children	
Malaria				
Cholera				
Diarrhea				
Bilharzias				
Diphtheria				

8) Mortality for past three years (2004 - 2006)

Year	Category	No. of Cases	Reason, if known
2004	Infant		
	Maternal		
2005	Infant		
	Maternal		
2006	Infant		
	Maternal		

9) What are the most suited communication channels to give information for the community?

	Mosque Preaching	Television	Radio	News paper	Poster / Hoardings	face-to-face	School	Others (specify)
For men								
For women								
For children								

C) LAND USE AND AGRICULTURAL ACTIVITIES

1) What is the total area of land? ___ Libna

2) Land extension trends in the past 15 years

□ The reasons for the increase in the areas of lands _____

_____

□ The reasons of the decrease in the areas of lands _____

_____

□ There is no change

3) Details of land use

Distribution of land		Land use pattern	
Type of lands	Area of lands (libna)	Type of lands	Area of lands (libna)
Government owned lands		Waste lands	
Private owned lands		Grazing lands	
Public lands		Forest lands	
Endowment lands		Agricultural lands	
Total		Others	
		Total	

4) General cropping pattern of the village

No.	Crop	Sowing time (month)	Irrigated area (libna)	Unirrigated area (libna)	Harvesting time (month)
1	Grapes				
2	Qat				
3	Peach				
4	Gage				
5	Almond				
6	Prickly pear				
7	Pomegranate				
8	Onion				
9	Tomatoes				
10	Potatoes				
11	Cereal in general				
12					
13					
14					
15					
16					

D) WATER SUPPLY FOR DOMESTIC USE

1) Source and quality of drinking water to the community

Source	number of sources	No. of house holds	Quality of drinking water *	Seasonal availability
Deep well (artisans)				
Shallow well (dug well/hand dug)				
Dug bore				
Ponds				
Springs				
Others (specify)…..….				

* Quality of drinking water: Good, fair, bad

2) Quantity of available water for domestic use

☐ enough ☐ fair ☐ inadequate ☐ very inadequate

3) Average of daily household requirement of water _____ (liters/day)

_____ (Ave. no. of household members)

4) Average of water used by animals on each H/H level: _____ (liters/day)

_____ Average number of animals for each H/H

5) How many households having animals? _____

6) Is there piped network system available in the village?

☐ Yes (move to 8)

☐ No

7) Who is the responsible person usually fetching water in household?

☐ adult males ☐ adult females ☐ children

8) Has the village experienced drinking water scarcity in the last 10 years?

☐ Yes ☐ No (move to 10)

9) How many times the village has experienced drinking water scarcity in the last 10 years?

_____

10) Were the wells dried up in the village in the last 10 years?

☐ Yes ☐ No (move to 13)

11) How many wells were dried up in the village in the last 10 years?

_____

12) How did the community deal and cope with water scarcity?

_____

_____

_____

13) Details of water harvesting structures within the village

Type of structures	Total no. of structures	no. of structures working	no.. of structures not working	Date and reasons of not working
Collection tanks				
Recharge dams				
Subsurface dams				
Farm ponds				
Recharge wells				
Other (specify)……..				

E) IRRIGATION WATER REQUIREMENTS

1) Irrigation water sources (multiple options)

Type of Sources	No. of sources	Area of land irrigated (libna)	
		Rainy	Other seasons
Deep wells			
Shallow wells			
Ponds / reservoirs			
Rain – fed			
Others			

2) Network of irrigation water (multiple options)

Type of Irrigation Network	Length (m)	Area of land irrigated (libna)	
		Rainy	Other seasons
Canals			
Pipe networks			
Ditch drains			
Others			

3) Do the villagers experience the depletion of ground water level?

☐ Yes ☐ No (GOTO to F)

4) What are the reasons for the depletion of ground water level??

☐ Scarcity of rainfall ☐ Excessive use water for irrigation

☐ Uncontrolled drilling of wells ☐ Increase the depth of wells

☐ Unavailability of water dams ☐ Other (specify) _____

5) How do the people look at or feel about the depletion of ground water level?

☐ They are greatly concerned ☐ Are not aware of this problem (GOTO F)

6) What is the villagers' suggestion to address the depletion of ground water level?

_____

_____

_____

F) WATER USER GROUP (WUG) / WATER USER ASSOCIATION (WUA) IN THE VILLAGE

1) Is the use of water for irrigation organized around an association or a group in the village?
   ☐ Yes ☐ No (GOTO 8)

2) What type of organization available in the village?
   ☐ Water groups (WUG) at the level of the well
   ☐ Water groups (WUG) at the level of the well linked to the WUA at village level
   ☐ WUA at the village level, but there is no WUG at the level of the well

3) How many of WUGs that are available in the village?

_____

4) Is it a formal (registered) or informal (unregistered) organization?
   ☐ Formal (registered) ☐ Informal (unregistered)

5) Description of the existing WUA

   5.1 What is the fee for membership and monthly subscription in the WUA?

   Membership fees is (_____ YER) and monthly subscription (_____YER)

   5.2 Name of the organization or the WUA: _____

   5.3 Date of establishment: _____

   5.4 Executive members: _____

   5.5 Decision making process: _____

   5.6 Regulation in water distribution: _____

6) What are the roles and responsibilities of WUA?
   ☐ Equitable distribution of water among users
   ☐ Supervision of rotational water use
   ☐ Maintenance of field channel
   ☐ Collection of water dues
   ☐ Arrangement of support services
   ☐ Organizing processing and marketing of farm products
   ☐ Other (specify)_____

7) Specify the Perceived Benefit by WUA?
   ☐ Protecting the farmers rights
   ☐ The insurance of equitable distribution of water among the members
   ☐ Water Conservation
   ☐ Reducing the problems among the members
   ☐ Facilitating on having agricultural services for the members
   ☐ Other (specify)_____

8) Is the community in favor of collective sharing of water among the villagers?

☐ Yes ☐ No (move to 9)

8.1 Are you willing to give your services and / or contribution if needed to form the WUA / WUG in your village?

☐ Yes ☐ No

9) Are the villagers familiar with participatory irrigation management or with WUG / WUA?

☐ Yes ☐ No

10) Do the villagers think that the adoption of participatory irrigation management could improve water conservation?

☐ Yes ☐ No (GOTO to G)

11) Are the villagers prepared / willing to form a WUG / WUA? Among themselves?

☐ Yes ☐ No (GOTO to G)

12) If WUG/ WUA are formed, are the villagers willing to accept the decisions and regulations made by WUG / WUA?

☐ Yes ☐ No

13) If WUG / WUA are formed, are the villagers ready to pay membership fee of the WUG / WUA?

☐ Yes ☐ No

G) WATER RESOURCE MANAGEMENT AND WATER CONSERVATION

1) Will the villagers agree to register the well?

☐ Agree without conditions (GOTO to 2) ☐ Agree, but with conditions

☐ Disagree (GOTO to 1.2)

1.1. What are the conditions of agreements?

☐ The well should not be confiscated

☐ The pump should not be monitored

☐ They shouldn't prevent us from mobilizing the drilling machine

☐ Other (specify)_____

1.2 What are the reasons for disagreement?

☐ Fear of defining limited water abstraction

☐ Fear of monitoring the pump

☐ Fear of being confiscated the well

☐ Fear of being prohibited re-deepening the well

☐ Other (specify)_____

2) Will the villagers agree to install water meters on their pumps?

☐ Agree without conditions (move to 3) ☐ Agree, but with conditions

☐ Disagree (move to 2.2)

2.1. What are the conditions for agreeing to install the water meters?

- ☐ The well should not be confiscated
- ☐ The pump should not be monitored
- ☐ They shouldn't prevent us from mobilizing the drilling machine
- ☐ Other (specify)_____

2.2. What are the reasons for disagreement?

- ☐ Fear of defining limited water abstraction
- ☐ Fear of monitoring the pump
- ☐ Fear of being confiscated the well
- ☐ Fear of being prohibited re-deepening the well
- ☐ Fear of government penalties / sanctions
- ☐ Other (specify)_____

(After answering 2.2 move to 4)

3) Will the villagers agree to monitor the pump regularly by the concerned Project Authority?

- ☐ Agree without conditions (move to 4)
- ☐ Agree, but with conditions
- ☐ Disagree (move to 3.2)

3.1. What are the conditions to allow monitoring of the pump?

- ☐ The well should not be confiscated
- ☐ They shouldn't prevent us from mobilizing the drilling machine
- ☐ Other (specify)_____

3.2. What are the reasons of disagreement?

- ☐ Fear of identifying the water shares
- ☐ Fear of monitoring the pump
- ☐ Fear of being confiscated the well
- ☐ Fear of being prohibited re-deepening the well
- ☐ Fear of government penalties / sanctions
- ☐ Other (specify)_____

4) Will the rate of water abstraction change in future years?

- ☐ Yes, there will be increase in the rate of water abstraction (GOTO 4.3)
- ☐ Yes, there will be decreasing in the rate of water abstraction (GOTO 4.2)
- ☐ No, the rate of water abstraction will remain as it is.

4.1 Why will there not be future abstraction of water?

- ☐ Inability to increase the operational pumping capacity
- ☐ The water source is not sufficient
- ☐ The village does not have areas to expand agricultural lands
- ☐ People can not afford the cost of expansion of agricultural lands
- ☐ Other (specify)_____

(After answering 4.1 go to Q 5)

4.2 Why do you think the abstraction of water will decrease in future?

☐ Because of the depletion of water level ☐ Due to the high cost of fuel

☐ Due to the introduction of modern irrigation systems

☐ Recession of agricultural land ☐ Other (specify)_____

4.3 Why do you think the abstraction of water will increase in future?

☐ Due to the expansion in agricultural land ☐ Selling water to others

☐ Increase in number of partners for the well

☐ Other (specify)_____

5) Are the villagers agreeing to the prohibition of drilling new wells?

☐ Yes, we are with the idea of prohibiting the drilling of new well

☐ No, we are against this idea (move to 5.2)

5.1. Why are you with this idea?

☐ The fear from the depletion of water level or the dry up of the wells

☐ To abide with the Water Law / Government regulations

☐ The desire to solve the water problem ☐ Other (specify)_____

(After answering 5.1 go to Q 5)

5.2 Why you are against this idea?

☐ The current water source is insufficient

☐ people's desire to expand agricultural land

☐ The desire to have my own well

☐ Other (specify)_____

6) Will the villagers agree to the prohibition of expansion of irrigated land in their village?

☐ Yes, with the prohibition of expansion of irrigated land

☐ No, against the prohibition of expansion of irrigated land (move to 6.2)

6.1. Why are you with this idea?

☐ The fear from the depletion of water level

☐ The Water Law prohibits the expansion of agricultural land

☐ Other (specify)_____

(After answering 6.1 go to Q 7)

6.2 Why are you against the prohibition of expansion of irrigated land?

☐ The scarcity of rainfall

☐ It is the people's desire to expand agricultural land

☐ people want to utilize unused lands for agriculture

☐ people want o improve sources of income

☐ Other (specify)_____

7) Are the villagers aware or informed about water saving technology for irrigation?

☐ Yes ☐ No (GOTO H)

8) What are their preferences on water saving technology?

☐ improved piped irrigation ☐ pressurized irrigation system on farm

☐ wadi bank protection ☐ land leveling ☐ plastic cover techniques

☐ introduction of new variety of crops less water consuming

9) Why are the farmers not using any of these water saving technologies in their farms?

☐ The cost of purchase is too high

☐ Lack of skilled labors to install such technology

☐ Unsuccessful experience in the past

☐ Difficulties to maintain such system

☐ Each farmer sharing a well with a group wants to get full rotational share as agreed

☐ Other (specify)_____

H) AWARENESS ON WATER RIGHTS AND WATER LAW

1) Are the villagers aware of Water Rights?

☐ Yes ☐ No (GOTO 3)

2) What the common perception of villagers about the Water Rights?

_____

_____

3) Are the villagers aware of Water Law 2002?

☐ Yes ☐ No (GOTO 7)

4) What is the common perception of villagers about the Water Law is:

_____

_____

_____.

5) Are the villagers aware that the Water Law contains penalties / sanctions for those who do not abide by the law?

☐ Yes ☐ No (GOTO 7)

6) If "Yes", do the villagers think these penalties / sanctions are acceptable? Please explain.

_____

_____

_____

7) Do you have traditional customs to conserve the water rights?

☐ Yes ☐ No (END THE INTERVIEW)

8) What are the traditional customs?

Appendix 7

Questionnaire for Water Users
(Water Usage and Awareness Survey)

Appendix 7 **Water Usage and Awareness Survey**

Questionnaire for Water Users

A) Information about the Site & the Respondent

1) Questionnaire No.: _____

2) Site name: _____-

3) Wadi: _____
_____

4) Village: _____

5) District: _____

6) Sub - Basin: _____

7) Name of Respondent: _____

8) Address: _____
_____

9) Sex (Male, Female): _____

10) Age: _____
_____

11) Status of Respondent: _____ (sole farm owner, shared farm owner)

12) Educational Status: _____

13) Employment Status: _____

14) Name of Investigator: _____

Signature: _____

15) Date of survey:_____

Data of this questionnaire is confidential and should be used only for the intended purpose.

B) Family Structure

Age group	No. of household members	
	Male	Female
From 0 to five years		
From 6 years to 14 years		
From 15 years to 24 years		
From 25 years to 60 years		
From 60 years and above		

C) Farm Structure

1) Size of farm: _____ (libna)

Description of land	Total area (libna)	Area cultivated (libna)
Owned		
Rented		
Shared		

2) Recently changes in the farm size

Changes	Area (libna)
No change	
Decreased (libna)	
Increased (libna)	

2.3 Reasons for change in size:

_____

_____

_____

3) Crop budget in Yemeni Rial for various crops

No	Crops	Cost per crop in Yemeni Rial									
		Cultivated Area (libna)	Seed		Fertilizer		Crop chemicals (pesticides)		Irrigation cost / water abstraction cost	Machinery cost (including fuel for machineries)	Labor charges
			quantity	cost	quantity	cost	quantity	cost			
1	Grapes										
2	Qat										
3	Peach										
4	Gage										
5	Almond										
6	Prickly pear										
7	Pomegranate										
8	Onion										
9	Tomatoes										
10	Potatoes										
11	Cereal in general										
12											
13											
14											

Specify quantities of seed, pesticides, etc applied per libna

D) Farm Production

No	Crops	Source of Irrigation	Water provided in field (hrs/libna/day)	Sowing Period	Harvesting Period	Aprox. Yield in tons	Market price		Gross Income
							Unit	Unit price	
1	Grapes								
2	Qat								
3	Peach								
4	Gage								
5	Almond								
6	Prickly pear								
7	Pomegranate								
8	Onion								
9	Tomatoes								
10	Potatoes								
11	Cereal in general								
12									
13									
14									
15									

Source of irrigation: Canal, Deep well, Shallow well, Dug well, Pond/Reservoir, Rain-fed, Others

E) Irrigation System

1) Source of irrigation and quantity of source owned

Source of irrigation	Quantity			Average depth (m)	Ave. consumption per day (l / day)
	Total	Operating	Non operating		
Deep well (artisan well)					
Shallow well (dug well/hand dug)					
Dug well					
Ponds / reservoirs					
Rain fed					
Others (specify_____)					

2) Source of irrigation and percentage of land (multiple options):

Source of irrigation	% of land under various sources	
	Summer	Rainy
Deep well (artisan well)		
Shallow well (dug well/hand dug)		
Dug well		
Ponds / reservoirs		
Rain fed		
Others		

3) Currently adopted water conveyance technology (multiple options):

☐ Earthen channel ☐ Lined channel

☐ Pipe / Conduit ☐ Others (_____)

4) Currently adopted on-farm irrigation technology (multiple options):

Method of irrigation	Area (libna)	% of total farm
Furrow method		
Basin flooding		
Uncontrolled flooding		
Bubbler		
Drip		
Sprinkler		
Other		

F) Domestic Water Use

1) Source of drinking water, seasonal availability and quality (multiple options):

Source	No. of household	Seasonal availability	Water Quality (see options below)
Deep well (artisan well)			
Shallow well (dug well/hand dug)			
Dug well			
Ponds			
Rainwater harvesting			
Spring			
Other			

Water quality options: very good, good, fair, bad, very bad

2) Quantity of available water for domestic use

☐ Enough ☐ Fair ☐ Inadequate ☐ Very inadequate

3) Daily household requirement of water

_____ (Liters/day)

_____ (No. of household members)

4) Is the house connected to piped network system?

☐ Yes (move to 6) ☐ No

5) Who is usually responsible for fetching water from the source?

☐ men ☐ women
☐ children

6) Has the village experienced drinking water scarcity in the last 10 years?

☐ Yes ☐ No (move to 7)

6.1 How many times the village has experienced drinking water scarcity in the last 10 years?

_____

6.2 How many wells were dried up in the village in the last 10 years?

_____

6.3 How did the villagers cope with in water scarcity?

_____

_____

_____

7) Details of water harvesting structures within village premises

Type of structures	Total no. of structures	No. of structures working	No. of structures not working	Date and reasons of not working
Collection tanks				
Farm ponds				
Recharge wells				
Other				

G) Well Inventory

1) Well Parameter

Well No.		
Coordinates	Latitude	
	Longitude	
	Elevation	
Type of well (deep well, shallow well, hand dug or dug well)		
Year of construction and or commissioning of the well		
Diameter of the well (cm)		
Depth of the well (m)		
Static water level (m)		
Dynamic water level (m)		
Average discharge of the well (l / s)		
Pump type		
Diameter of pump discharge pipe (cm)		
Engine type		
Source of energy (diesel/ petrol/ human/ animal/ electricity)		
Distance from nearest operational wells (m)		

2) Is the ownership of the well shared?

☐ Yes ☐ No. (move to 4)

3) What is the sharing system?

_____

_____

_____

4) Irrigation water use purpose for the above well

No.	Details	
1	Total number of beneficiaries (no.)	
2	Total number of farms (no)	
3	Total area of above farms (libna)	
4	Average area irrigated by well in wet season (Feb to Sep) (libna)	
5	Average area irrigated by well in dry season (Oct to Jan) (libna)	
6	Average pumping hr/day in wet season (Feb. to Sep.) (hrs/day)	
7	Average pumping hr/day in dry season (Oct. to Jan.) (hrs/day)	
8	Average pumping days/week in wet season (days/week)	
9	Average pumping days/week in dry season (days/week)	

5) General Cropping pattern for the above well

Cropping Pattern		Cultivated area (libna)	Irrigation method
Cereals			
Vegetables			
Fruits			
Cash crops	Qat		
	Grape		
	Coffee		
	Total Area		

*Irrigation method: drip, sprinkler, canal, etc.…

6) Other water use purpose

6.1 Is the water being utilized other than irrigation purpose?

☐ Yes ☐ No. It is only for irrigation purpose. (GOTO 6.3)

6.2 What is the water being utilized other than irrigation purpose?

☐ Domestic (drinking) ☐ Animal

☐ Other (specify) _____

6.3 Is there other water users using this well water?

☐ Yes ☐ No (move to 6.5)

6.4 Who are the other users?

Users	number of users	Quantity of water used (l/day)
Families		
Animals		
Tankers		
Others		

6.5 Is the water sold?

☐ Yes ☐ No (Move to 7)

6.6 What are the price and quantity of sold water?

Consumers	Unit	Price per unit	total number of units sold	total amount of money collected day

Information for the enumerator: 1 m^3 = 5 barrels ; 1 barrel = 200 liters; 1 m^3 = 1,000 liter

7) Other information

7.1 Has any depletion occurred to water level after commissioning of the well?

☐ Yes ☐ No (move to 7.3)

7.2 What is the rate of water depletion per year?

The rate of depletion per year is _____ (in meter or no. of pipes)

7.3 Was the well re-drilled?

☐ Yes ☐ No. It was not re-drilled (move to 7.5)

7.4 What is the depth of well re-drilled? And when?

It was re-drilled _____meters in the year of : _____

7.5 What is the quality of water according to the users?

☐ Very good ☐ Good ☐ Fair ☐ Bad ☐ Very bad

7.6 If "Bad" or "Very bad", When the deterioration was started?

the deterioration was started from the year:_____

7.7 Is the quantity of well water enough to irrigate cultivated area?

☐ Yes ☐ No

7.8 Do you have future plans to increase cultivated area? When?

☐ Yes, within _____(years) ☐ No

7.9 Do you have plans to drill a new well?

☐ Yes ☐ No

H) Farmers Willingness

❖ Perception on groundwater situation

1) Are there any changes in currently using well capacity?

☐ Yes, there is increase in the well capacity

☐ Yes, there is decrease in the well capacity

☐ No, there is no change (GOTO 2)

1.1 What are the perceived reasons for the change in well capacity?

_____

_____

_____

2) Were any wells abandoned in the past due to dry-up:

☐ Yes ☐ No (GOTO 3)

2.1 What are the perceived reasons for dry-up of wells?

_____

_____

_____

❖ Water Saving Technology

3) What is the improved technology for water conveyance preferred by you?

(Multiple Options) (for the enumerator read the options)

☐ Earthen channel ☐ Pipe / Conduit

☐ Others (specify_____)

3.1. Do you use any of this improved technology?

☐ Yes (GOTO 4) ☐ No

3.2 What are the reasons for not introducing improved technology for water conveyance?

☐ The cost of procurement is too high ☐ The pipes get corroded

☐ The cost of maintenance is too high

☐ We got used to what we have ☐ Others (_____)

4) What is the preferred improved on-farm irrigation technology?

☐ Bubbler ☐ Drip ☐ Sprinklers ☐ Others (specify_____)

4.1. Do you use any of this improved technology?

☐ Yes (GOTO I) ☐ No

4.2 What are the reasons not to introduce improved on-farm irrigation technology?

☐ The cost of procurement is too high ☐ Lack of skill labors for installation

☐ Unsuccessful experience in the past ☐ Difficulties of maintenance

☐ I am sharing the well with a group and I want to get my full rotational share as agreed

☐ Others (_____)

I) PARTICIPATION IN WUG /WUA

1) Is there a water users group (WUG) to manage this well?

☐ Yes ☐ No

2) Is there any water users association (WUA) to manage irrigation water at village level?

☐ Yes ☐ No (move to 7)

3) Are you a member in the WUA at village level?

☐ Yes ☐ No (move to 6)

4) How much money do you pay for membership fee and monthly subscription in the WUA?

The membership fee is: (_____YER) and monthly subscription: (_____YER).

5) What are the roles and responsibilities of the WUA?

_____

_____

_____

(If there is a WUA at village level the enumerator should GOTO part J)

6) What are the reasons for not joining the WUA at the village level?

_____

_____

_____

7) If there is no WUA at village level, have you heard about Water irrigation committee in one of the nearest villages?

☐ Yes ☐ No (GOTO 9)

8) What do you know about WUAs?

_____

_____

_____

9) Are you willing to give your services and / or contribution if needed to form a WUA in your village?

☐ Yes ☐ No **(GOTO J**)

10) Do you agree that the management of the irrigation at the village level to be done by WUA?

☐ Yes ☐ No

11) Are you ready to pay membership fee and monthly subscription for the WUA?

☐ Yes ☐ No (**GOTO J)**

11.1 What is the amount of money you are willing to pay as a membership fee and the monthly subscription?

The membership fee is: (_____YER) and monthly subscription: (_____YER).

12) What are the preferred modes of participation in WUA?

☐ Equitable distribution of water among the members

☐ Supervision of rotational water ☐ Maintenance of field channel

☐ Collection of water dues ☐ Arrangement of support services

☐ Organizing processing and marketing of farm products

☐ Any other (_____)

13) What are the perceived/expected benefits by WUA?

☐ Protecting the farmers rights

☐ Ensure equitable distribution of water among the members

☐ Conservation of water level

☐ Solve problems among members

☐ Facilitating farmers access to agricultural services

☐ Other (specify)_____

14) Is the respondent willing to follow the decisions and regulations made by WUA?

☐ Yes ☐ No

J) Awareness of Water Right and Water Law 2002

1) Are you aware of Water Rights?

☐ Yes ☐ No (GOTO 2)

1.1 What is your perception about the Water Rights?

_____

_____

2) Are you aware of Water Law 2002?

☐ Yes ☐ No (move to k)

2.1 What is your perception about the Water Law is:

_____

_____

3) From the following provisions of the Water Law, will you agree to abide by Water Law (in the future)? (Please give reasons for each circumstance)

3.1 Licensing of rigs / Registering drilling rigs ☐ Agree ☐ Disagree

_____

_____

_____

3.2 Prohibiting the drilling of new wells ☐ Agree ☐ Disagree

_____

_____

_____

3.3 Maintaining the current abstraction rate (bylaw) ☐ Agree ☐ Disagree

_____

_____

_____

3.4 Imposing the non expansion of irrigated area ☐ Agree ☐ Disagree

_____

_____

_____

4) The respondent knows that Water Law contains penalties / sanctions for those who do not abide by the law?

☐ Yes ☐ No (move to k)

4.1 If "Yes", do you think these penalties / sanctions are acceptable? Please explain.

_____

_____

5) Is the respondent satisfied with current rate of water abstraction?

☐ Yes ☐ No

☐ Not aware of the abstraction rate referred to in the law

K) WATER CONSERVATION

1) Will you agree to register the well?

☐ Agree without conditions (GOTO to 2) ☐ Agree, but with conditions

☐ Disagree (GOTO to 1.2)

1.1. What are the conditions of agreements?

☐ The well should not be confiscated

☐ The pump should not be monitored

☐ They shouldn't prevent us from mobilizing the drilling machine

☐ Other (specify)_____

1.2. What are the reasons for disagreement?

☐ Fear of identifying the water shares

☐ Fear of monitoring the pump

☐ Fear of being confiscated the well

☐ Fear of being prohibited re-deepening the well

☐ Other (specify)_____

2) Will you agree to install water meters on their pumps?

☐ Agree without conditions (move to 3) ☐ Agree, but with conditions

☐ Disagree (move to 2.2)

2.1. What are the conditions for agreeing to install the water meters?

☐ The well should not be confiscated

☐ The pump should not be monitored

☐ They shouldn't prevent us from re-drilling

☐ Other (specify)_____

2.2. What are the reasons for disagreement?

☐ Fear of defining limited water abstraction

☐ Fear of monitoring the pump

☐ Fear of being confiscated the well

☐ Fear of being prohibited re-deepening the well

☐ Fear of government penalties / sanctions

☐ Other (specify)_____

(After answering 2.2 move to 4)

3) Will you agree to monitor the pump regularly by the concerned Project Authority?

☐ Agree without conditions (move to 4) ☐ Agree, but with conditions

☐ Disagree (move to 3.2)

3.1. What are the conditions to allow monitoring of the pump?

- ☐ The well should not be confiscated
- ☐ They shouldn't prevent us from mobilizing the drilling machine
- ☐ Other (specify)_____

3.2. What are the reasons of disagreement?

- ☐ Fear of identifying the water shares
- ☐ Fear of monitoring the pump
- ☐ Fear of being confiscated the well
- ☐ Fear of being prohibited re-deepening the well
- ☐ Fear of government penalties / sanctions
- ☐ Other (specify)_____

4) Will the rate of water abstraction change in future years?

- ☐ Yes, there will be an increases in the rate of water abstraction (GOTO 4.3)
- ☐ Yes, there will be decreasing in the rate of water abstraction (GOTO 4.2)
- ☐ No, the rate of water abstraction will remain as it is.

4.1 Why will there be no change in future abstraction of water?

- ☐ Inability to increase the operational pumping capacity
- ☐ The water source is not sufficient
- ☐ We do not have areas to expand agricultural lands
- ☐ I can not afford the cost of expansion of agricultural lands
- ☐ Other (specify) _____

(After answering 4.1 go to Q 6)

4.2 Why do you think the abstraction of water will decrease in future?

- ☐ Because of the depletion of water level
- ☐ due to the high cost of fuel
- ☐ Due to the introduction of modern irrigation systems
- ☐ Recession of agricultural land
- ☐ Other (specify)_____

4.3 Why do you think the abstraction of water will increase in future?

- ☐ Due to the expansion in agricultural land
- ☐ Selling water to others
- ☐ Increase in number of partners for the well
- ☐ Other (specify)_____

5) Will you agree to the prohibition of drilling new wells?

- ☐ Yes, with the idea of prohibiting the drilling of new well
- ☐ No, against this idea (move to 5.2)

5.1. Why are you with this idea?

☐ The fear from the depletion of water level or the dry up of the wells

☐ To abide with the Water Law / Government regulations

☐ The desire to solve the water problem

☐ Other (specify)_____

(After answering 5.1 go to Q 5)

5.2 Why you are against this idea?

☐ The current water source is insufficient

☐ I intend to expand agricultural land

☐ I intend to have my own well

☐ Other (specify)_____

6) Will you agree to the prohibition of expansion of irrigated land in the village?

☐ Yes, with the prohibition of expansion of irrigated land

☐ No, against the prohibition of expansion of irrigated land (move to 6.2)

6.1. Why are you with this idea?

☐ The fear from the depletion of water level

☐ The Water Law prohibits the expansion of agricultural land

☐ Other (specify)_____

(After answering 6.1 go to Q 7)

6.2 Why are you against the prohibition of expansion of irrigated land?

☐ The scarcity of rainfall

☐ I intend to expand agricultural land

☐ I intend to utilize unused lands for agriculture

☐ I want o improve sources of income

☐ Other (specify)_____

Appendix 8

Questionnaire for Industrial Water Usage Condition (Water Usage Survey)

Appendix 8 Water Usage Survey دراسة إستخدامات المياه

Questionnaire for Industrial Water Usage Condition in Sana'a city

إستبيان خاص بإستخدام المياه في الصناعة

يتم تعبئة هذا الإستبيان في المصانع أو الشركات المصنعة التي يوجد لديها بئر خاص بها. المدلي بالبيانات مدير الشركة أو المسئول المعني

The questionnaire should be used in factories or manufacturing companies that has its own well inside the factory. The respondent should be the company manager, the production manager or the person in charge

Wadiإسم الوادي: _____

Villageالقرية/neighborhood حارة:Street/ شارع _____

District: المديرية _____

_____

Sub - Basin: الحوض المائي الفرعي _____

Date of Survey: تاريخ الدراسة _____

Name of the Company / Factory: إسم الشركة / المصنع _____

Address: العنوان_____

Contact telephone number: _____

Contact facsimile number: _____

Date of Establishment: تاريخ التأسيس _____

Respondent: Name:إسم المدلي بالبيانات _____

Sex of Respondent (Male, Female): الجنس(ذكر ، أنثى)

Age: العمر_____

Position of the respondent:المنصب _____

Name of Investigator: اسم الباحث _____

Signature of the investigator: توقيع الباحث_____

Data of this questionnaire is confidential and should be used only for the intended purpose.

جميع البيانات سرية ويجب استخدامها في الأغراض المحددة لها

1. Current state of water use استخدامات المياه حالياً

(if there is more than one production facility within the factory/ company), then please use a separate sheet for each production facility) (يرجى جمع البيانات لكل وحدة إنتاج في صفحة خاصة عند وجود اكثر من خط انتاج)

a) Outline of the facility معلومات عن وحدة الانتاج

Main Product المنتج الرئيسي	Annual production حجم الإنتاج سنوياً	Unit الوحدة
1)		
2)		
3)		
4)		
5)		

b) Monthly variation in production التغيير الشهري في حجم الانتاج

Is there any monthly variation for each main?
هل في أي تغيير شهري في حجم الإنتاج أم الإنتاج ثابت طوال العام

☐ Yes there is a monthly variation for the whole production

☐ Yes there is a monthly variation for each main product

☐ No. It is constant in the year لا- الانتاج ثابت على مدار السنة

If yes, then can you tell me the variation for each month?

Month الشهر	Monthly production الانتاج الشهري	Month الشهر	Monthly production الانتاج الشهري
Jan.		Jul.	
Feb.		Aug.	
Mar.		Sep.	
Apr.		Oct.	
May		Nov.	
Jun.		Dec.	

c) Source of water and consumption الاستهلاك و مصدر المياه

1)Water consumption by the year 2005: الاستهلاك م3/سنة_____ m^3/year

2)Water consumption by the year 2006: الاستهلاك م3/سنة _____ m^3/year

3)**Actual** sources of raw water(multiple):مصدر المياه

☐ Own well بئر خاص

Characteristics of the Well(s) to be administered if there is a well:خصائص البئر يتم تعبئته في حالة وجود بئر

Well No.		البئر رقم 1	البئر رقم 2	البئر رقم 3	البئر رقم 4	البئر رقم 5
Coordinate	Latitude					
	Longitude					
	Elevation					
Type of well (dug well, borehole, dug bore)						
Year of construction						
Diameter of the well (cm)						
Depth of the well (m)						
Static water level (m)						
Dynamic water level (m)						
Average discharge (l / s)						
Pump type						
Pump setting depth (m)						
Number of working hours per day						
Working days per week						

☐ Network:شبكة مياه _____ m^3/day, _____ days/week

☐ Other اخرىm^3/day, (specify)_____ days/week

Is there any variation in the monthly water consumption in the production facility?
هل يوجد تغير في الاستهلاك الشهري

☐ Yes and they are نعم وهي كما يلي

Month الشهر	Monthly discharge التصريف الشهري (m^3/month)	Month الشهر	Monthly discharge التصريف الشهري (m^3/month)
Jan.		Jul.	
Feb.		Aug.	
Mar.		Sep.	
Apr.		Oct.	
May		Nov.	
Jun.		Dec.	

☐ No. It is constant in the year.لا- إستهلاك المياه ثابت على مدار السنة

d) Purpose of water use الغرض من استخدام المياه

(Brief explanation, for example, cooling water, process water, etc) شرح مختصر

_____

_____

e) Required water quality (e.g. drinking water, does not matter)

Does the Water have to follow specific quality standard (for example drinking water standard, there has to be quality standard of some sort ……or it is not important for the water to follow any specific standard)? Please explain:

_____

_____

f) Do you have water treatment facility? هل يوجد لديكم وحدة لتنقية للمياه

☐ Yes and they are نعم وهي

Process: طريقة المعالجة/التنقية_____

Quantity of water treated :

_____day/week عدد أيام المعالجة في الأسبوع_____m3/day كمية المياه التي يتم معالجتها في اليوم

☐ No

2. Future expansion of the facility

التوسعة المستقبلية لالمنشأة في المستقبل

a) Do you have expansion plan of the production facilities? هل يوجد خطط توسعية في المنشأة

☐ Yes and those plans are:نعم وهي

Current capacity: الطاقة الحالية _____ (2007)

By 2010: الطاقة بحلول _____

By 2015: الطاقة بحلول _____

By 2020: الطاقة بحلول _____

☐ No

b) Do you expect any increase in the water consumption?

هل يوجد خطط لزيادة استهلاك المياه في المستقبل

☐ Yes, and those plans are:نعم وهي

By 2010: الاستهلاك بحلول _____ m^3

By 2015: الاستهلاك بحلول _____ m^3

By 2020: الاستهلاك بحلول _____ m^3

And their sources are (multiple:مصادر المياه هي

☐ Own well بئر خاص

☐ Network شبكة مياه

☐ Other sources اخرى _____

☐ No, and:

Current consumption:الاستهلاك الحالي _____ m^3/year (2006)

☐ Future consumption expected to be on the same levelيتوقع ان لايتغير الاستهلاك

☐ Future consumption expected to be decreased يتوقع أن ينخفض الاستهلاك

to _____ m^3 or _____ %

by means من خلال _____

3. Disposal of wastewater طريقة التخلص من المياه العادمة

a) Is there any wastewater discharged from the facility to outside?

هل توجد مياه عادمة يتم تصريفها الى خارج المنشاة

☐ Yes. (Please go to "b") نعم (يرجى الانتقال الى

☐ No. (End of the Inquiry)لا

b) How much in volume is the wastewater discharged?

ماهي كمية المياه العادمة التي يتم تصريفها

volume in 2005: _____ m^3/year (2005) الكمية عام

volume in 2006: _____ m^3/year (2006) الكمية عام

Is there any monthly variation in the discharge of wastewater?

☐ Yes, and the monthly variation of discharge is as follow:

Month الشهر	Monthly discharge of 2006 الاستهلاك الشهري (m^3/month)	Month الشهر	Monthly discharge of 2006 الاستهلاك الشهري (m^3/month)
Jan.		Jul.	
Feb.		Aug.	
Mar.		Sep.	
Apr.		Oct.	
May		Nov.	
Jun.		Dec.	

☐ No. (End of the Inquiry) لا

c) Where is the wastewater discharged to إلى أين يتم تصريف المياه العادمة **(to the enumerator please observe method of discharge) (multiple choices)**

☐ Wadi وادي

☐ Public sewerage systemشبكة الصرف الصحي العامة

☐ Reuse in irrigation اعادة الاستخدام في الري

☐ Others

d) Is the water treated by the treatment facilities of the factory (pretreatment or primary treatment) before discharging into wadi or public sewerage system?

هل يتم معالجة المياه العادمة في وحدة معالجة داخل المنشأة قبل التصريف؟

☐ Yes, and the treatment process is: نعم وطريقة المعالجة المستخدمة هي

- ☐ Screening الغربلة/التصفية
- ☐ Sedimentation (settling) الترسيب
- ☐ Degreasing فصل الدهون
- ☐ Biological treatment معالجة بيولوجية
- ☐ Chemical treatment معالجة كيميائية
- ☐ Neutralization معادلة التأين
- ☐ Others أخرى _____

☐ No (End of the Inquiry)

e) What are the final qualities of wastewater at discharge point? (to the enumerator please prompt the respondent for any test that has been conducted to verify answer and observe the results)

ماهي نوعية المياه العادمة عند مخرج التصريف

☐ Quality according to Standard (please specify the standard): _____
_____

☐ Quality according to Regulation, Law: (please specify the standard):_____
_____ _____

☐ There is no standards and/or regulations and laws but the wastewater is treated as follow.(Please explain for which substance you are treating and why)?

_____

_____

_____

Appendix 9

Questionnaire for Touristic Water Usage Condition (Water Usage Survey)

Appendix 9 Water Usage Survey

Questionnaire for Touristic Water Usage Condition

Wadi: _____

Village: _____

District: _____

Sub - Basin: _____

Date of Survey: _____

Name of the Hotel and category: _____

Address: _____

Date of Establishment: _____

Respondent Name: _____

Sex (Male, Female): _____ Age: _____

Position: _____ Telephone No. _____

Signature: _____

Name of Investigator: _____

Signature: _____

Data of this questionnaire is confidential and should be used only for the intended purpose.

1. Current quantity of rooms: _____

2. Current quantity of beds: _____

3. Average monthly nights spent by tourists per year

	Nights spent by tourists (persons/month)					
	2001	2002	2003	2004	2005	2006
Jan.						
Feb.						
Mar.						
Apr.						
May						
Jun.						
Jul.						
Aug.						
Sep.						
Oct.						
Nov.						
Dec.						
Total						

4. Source of water consumption

Total water consumption in the year 2005: _____ m^3/year

Total water consumption in the year 2006: _____ m^3/year

Sources of raw water: ☐ Own well

Well quantity: _____

Specifications:

Well No.						
Coordinate	Latitude					
	Longitude					
	Elevation					
Type of well (dug well, borehole, dug bore)						
Year of construction						
Diameter of the well (cm)						
Depth of the well (m)						
Static water level (m)						
Dynamic water level (m)						
Average discharge (l / s)						
Pump type						
Pump setting depth (m)						
Working time and working days per week						

☐ Network: _____ m^3/day, _____ days/week

☐ Other _____ m^3/day, _____ days/week

Is there any monthly variation on water consumption (2006)?

☐ Yes and they are

Month	Monthly consumption (m^3/month)	Month	Monthly consumption (m^3/month)
Jan.		Jul.	
Feb.		Aug.	
Mar.		Sep.	
Apr.		Oct.	
May		Nov.	
Jun.		Dec.	

☐ No. It is constant in the year.

Is there any depletion of water level after commissioning of the well?

☐ Yes, it started in the year of _____ , and

the rate per year of depletion is _____ (in meter or no. of pipes)

☐ No

Was the well redrilled?

☐ Yes and it was redrilled _____meters in _____(years).

☐ No. It was not redrilled.

What is the quality of water according to the users

☐ Very good ☐ Good ☐ Fair ☐ Bad ☐ Very bad

If "Bad" or "Very Bad", when did it start? The year of _____

5. Do you have water treatment facility?

☐ Yes and they are

Process: _____

Capacity: _____

☐ No

6. Disposal of wastewater

a) Where is the wastewater discharged to?

☐ Public sewerage system and the volume is

_____ m^3/year for the year 2005

_____ m^3/year for the year 2006

☐ Other: _____

_____ m^3/year for the year 2005

_____ m^3/year for the year 2006

7. Future expansion plan

a) Do you have expansion plan for quantity of beds and rooms?

☐ Yes and those plans are:

year	beds	rooms
current year 2007		
2010		
2015		
2020		

☐ No

Appendix 10

Questionnaire for Water Usage Condition for Tankers (Water Usage Survey)

Appendix 10 Water Usage Survey

Questionnaire for Water Usage Condition for Tankers

Wadi: _____

Street:

Neighborhood: _____

District: _____

Sub - Basin: _____

Date of Survey: _____/ _____/2007

Name of the Company / Organization/Owner: _____

Address: _____

Date of Establishment: _____

Respondent:: Name _____

Sex (Male, Female): _____ Age: _____

Position: _____ Telephone No. _____

Signature: _____

Name of Investigator: _____

Signature: _____

Data of this questionnaire is confidential and should be used only for the intended purpose

1. Well Inventory

a) Well Parameter

Well No.		
Coordinate	Latitude	
	Longitude	
	Elevation	
Type of well (dug well, borehole, dug bore)		
Year of construction and or commissioning of the well		
Diameter of the well (cm)		
Depth of the well (m)		
Static water level (m)		
Dynamic water level (m)		
Average discharge of the well (l / s)		
Pump type		
Diameter of pump discharge pipe (cm)		
Engine type		
Source of energy (diesel/ petrol/ human/ animal/ electricity)		
Distance from nearest operational wells (m)		

b) Water Production

Average pumping hr/day in wet season (Feb. to Sep.) (hrs/day)	
Average pumping hr/day in dry season (Oct. to Jan.) (hrs/day)	
Average pumping days/week in wet season (days/week)	
Average pumping days/week in dry season (days/week)	
Average pumping days/season in wet season (days/season)	
Average pumping days/season in dry season (days/season)	
Average water pumped in a year (m^3) (to be done by investigator)	

2. Water Usage

a) Is the well owner, also owner of Tankers?

☐ Yes.

Number of Tankers	Capacity of Water (m3)

And the price and quantity for each consumer is:

Consumers*	Water Use**	Unit	Price per unit	Quantity sold per day in m3

*Consumers: private person, company, school, hospital, restaurant, building contractors, etc

**Water use: irrigation, water treatment station, Kawther, domestic, domestic, drinking, others etc.

☐ No.

b) Is the water sold to other tankers?

☐ Yes. And the capacity and quantity of tankers supplied per day are:

Tanker Capacity (m3)	number of tankers supplied per day	Price YR/ Tanker

Outline of the consumers for the other tankers

Consumers*	Unit	Price per unit	Quantity sold per day	Water Use**

*Consumers: private person, company, school, hospital, etc

**Water use: irrigation, private water supply, domestic etc. - if the respondent knows

☐ No.

3. Other information

Is there any depletion of water level after commissioning of the well?

☐ Yes, it started in the year of _____,

and the rate per year of depletion is _____ (in meter or no. of pipes)

☐ No

Was the well redrilled?

☐ Yes and it was redrilled _____ meters in _____ (years).

☐ No. It was not redrilled.

What is the quality of water according to the users (to be verified by the water tanker or the driver):

☐ Very good ☐ Good ☐ Fair ☐ Bad ☐ Very bad

If "Bad" or "Very Bad", when did it start to be bad? The year of ___

5. Awareness of Water Right and Water Law 2002

a) Is the respondent aware of Water Rights?

☐ Yes, and the common perception about the Water Rights is:

_____

_____

_____ .

☐ No

b) Is the respondent aware of Water Law 2002?

☐ Yes, and the common perception about the Water Law is:

_____

_____

_____

☐ No

c) From the following provisions of the Water Law, will you agree to abide by Water Law (in the future)? (Please give reasons for each circumstance)

- Licensing of rigs / Registering drilling rigs ☐ Agree ☐ Disagree

_____

_____

_____

- Prohibiting the drilling of new wells ☐ Agree ☐ Disagree

_____

_____

- Maintaining the current abstraction rate (bylaw) ☐ Agree ☐ Disagree

- Imposing the non expansion of irrigated area ☐ Agree ☐ Disagree

d) The respondent knows that Water Law contains penalties / sanctions for those who do not abide by the law?

☐ Yes ☐ No

If "Yes", do you think these penalties / sanctions are acceptable? Please explain.

e) Is the respondent satisfied with current rate of water abstraction?

☐ Yes ☐ No

4. Water Conservation

a) Will the well owner agree to register the well?

☐ Yes ☐ No

What are the conditions of the owner to agree or reasons not to agree well registration?

_____

_____

_____

b) Will the owner agree to install water meters in his well?

☐ Yes ☐ No

What are the conditions of the owner to agree or reasons not to agree installation of water meters in his well?

_____

_____

_____

c) Will the owner agree to monitor the pump regularly by the concerned Project Authority?

☐ Yes ☐ No

What are the conditions of the owner to agree or reasons not to agree monitoring of pump by concerned Project Authority?

_____

_____

_____

d) Will the owner maintain the current rate of abstraction or reduce the amount of water abstraction in the future years? What are the reasons for both cases?

☐ Yes ☐ No

Reason: _____

_____

_____

_____

e) Will the owner agree to the prohibition of new well drilling? What are the reasons?

☐ Yes ☐ No

What are the conditions of the owner to agree or reasons not to agree the prohibition of new well drilling?

_____

_____

_____

Appendix 11

Well Inventory

Appendix 11Well Inventory [Results of the Water Usage Survey in the Industrial Sector in Sana'a City]

					1. Current State of Water Use																					
Well ID No.	Wadi	District	Sub-Basin	Date of Establishment of the Company/ Factory	a) Outline of Factory									b) Monthly Variation in Production												
					Main Producut (1)	Annual Production (1)	Unit (1)	Main Producut (2)	Annual Production (2)	Unit (2)	Main Producut (3)	Annual Production (3)	Unit (3)	Monthly variation for main product	Monthly Production											
															Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
16-I-01	Wadi Al Mawrid	Sana'a	Wadi Al Mawrid		Light food			Bumpers			Garments			Yes, for the whole production												
16-I-02	Wadi Al Mawrid	Sana'a	Wadi Al Mawrid	1976	School books	12,000	Tone per year							No	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
16-I-03-A	Wadi Artel	Bani Matar	Wadi Artel	2005	Bricks	300,000	Brick	Stone	100,000	Stone				Yes, for the whole production	30000	10000	0	0	0	15000 - 36000	15000 - 36000	15000 - 36000	10000 - 36000	15000 - 36000	10000 - 36000	10000 - 36000
16-I-04	Wadi Al Mawrid	Sana'a	Wadi Al Mawrid	1975	Powder Soap	5	Tone/ Hour	Beautify Soap	220	Tone/Year				No												
16-I-05	Wadi Artel	Bani Matar	Wadi Artel	2004	Bricks	120,000	Brick							Yes, for the whole production	8000	8000	8000	8000	8000	8000	10000	10000	10000	8000	8000	8000
16-I-06	Wadi Al Mawrid	Sana'a	Wadi Al Mawrid		Differnet Texture and medical cotton	400,000	KG							No												
16-I-08	Wadi Dhahar	Sana'a	Wadi Al Mawrid	1979	Bottled Water	120,000	M3 per year							No												
16-I-07-A	Wadi Al Mawrid	Sana'a	Wadi Al Mawrid	1982	Ready mix concrete	27,500	M3 per year							Yes, for the whole production	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know

Appendix 11Well Inventory [Results of the Water Usage Survey in the Industrial Sector in Sana'a City]

Well ID No.	c) Source of Water and Consumption																				
	1) Water Consumption (2005)	2) Water Consumption (2006)	3) Source of Raw Water	Characteristics of Well (No.1)												Characteristics of Well						
	m3/year	m3/year	Own Water	Latitude	Longitude	Elevation	Type of Well	Year of Construction	Diameter (cm)	Depth (m)	S.W.L (m)	D.W.L (m)	Average Discharge (l/s)	Pump Type	Working Hours/Day	Working Days/Week	Latitude	Longitude	Elevation	Type of Well	Year of Construction	Diameter (cm)	Depth (m)
16-I-01	15,000	15,000	Yes	04 13 759	17 02 192	2278	Borehole	1978		800					3.5	6							
16-I-02	8,640	8,640	Yes	04 43 71	17 01 963		Borehole	2005		260			25		3	6							
16-I-03-A	900	1,300	Yes	04 14 355	16 89 354	2329	Deep well	2005	25.4	350	30	10	4	Caprari	10	6							
16-I-04	3,960	4,500	Yes	04 12 470	16 92 074	2327	Borehole	1975	120	300	260		3.3	Electrical	1.5	6							
16-I-05	1,000	1,200	Yes	04 14 362	16 89 241	2318	Deep well	2004	20.32	370	30	5	4	Caprari	12	6							
16-I-06	195,000	195,000	Yes	04 15 685	17 00 013	2275	Borehole		25.4	300	126	12-Sep		Franklin	24	6							
16-I-08	100,000	120,000	Yes	04 09 075	17 03 006	2325	Borehole	1991	20.32	300	205	216	9	Sp27.31	8	6	04 09 070	17 03 000	2325	borehole	1995	20.32	300
16-I-07-A	6,875	6,000	Yes	04 11 200	16 95 585	1318	Borehole	1982	25.4	500	Don't know	Don't know	Don't know	Ghatas	8	6	04 11 201	16 95 586	1318	borehole	1982	25.4	350

Appendix 11Well Inventory [Results of the Water Usage Survey in the Industrial Sector in Sana'a City]

Well ID No.	(No.2)						Monthly variation for main product	Monthly Discharge (m3/month)											d) Purpose of Water Use	e) Required Water Quality
	S.W.L (m)	D.W.L (m)	Average Discharge (l/s)	Pump Type	Working Hours/Day	Working Days/Week		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul	Aug.	Sep.	Oct.	Nov.	Dec.	
16-I-01																			Cleaning potatoes and the water is consumed by the people of the living complex	Drinking Water
16-I-02							Yes	720	720	720	720	720	720	720	720	720	720	720	720	For irrigating trees, for labors use and washing hand for labors of book press	For cleaning the water from oil to protect the machines from salt
16-I-03-A							Yes	90	90	90	90	90	100	100	100	100	100	90	90	For mixing and spraying it with cement and making wet stones	The water is light for stone
16-I-04							No												To dissolve some of the chemical materials, to generate steam, to cool machines and equipment, and for domestic use	Filtered water for the boiler and the remaining is water for drinking
16-I-05							No												For mixing and spraying it with cement and for labors use	There is no specified standard but the water is too clean and pure
16-I-06							No												For printing, dye, cooling and ventilation	Filtered water for cooling, Drinking water and hot water
16-I-08	205	216	10.15	Sp27.31	8	6	Yes	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Drinking pure water	PH conductivity TDS and mineral as per W.H.O standard and maintain biological control as guide linr of W.H.O
16-I-07-A	Don't know	Don't know	Don't know	Ghatas	8	6	No													Mix the water with the concrete	Doesn't matter

Appendix 11Well Inventory [Results of the Water Usage Survey in the Industrial Sector in Sana'a City]

					2. Future Expansion of the Facility																
Well ID No.	f) Existence of Water Treatment Facility				a) Expansion Plan of the Production Facilities					b) Expectation of Increase in Water Consumption											
		Process	Quantity of Water Treated			Current Capacity (2007)	By 2010	By 2015	By 2020	Increase is expected	Expected Consumption (By 2010)	Expected Consumption (By 2015)	Expected Consumption (By 2020)	Water Sources to be Used for Expansion		Increase is **not** expected	Current Consumption (2006)	Change in Future Consumption	Expected consumption decrease		Means to Decrease Consumption
			day/week	m3/day							m3	m3	m3	Type of Source	(specify "other")		m3/year		m3	%	
16-I-01	No				No					No											
16-I-02	Yes	Adding aqua water to protect the press machines	4.25	2	Yes	8,640	9,504	10,800	11,664	No				Our own well does not cover the need due to water scarcity so we have to search for an additional source							
16-I-03-A	Yes	Sedimentation	1	1	No					No								To be same lavel			
16-I-04	Yes	Ion exchanging softner	6	5.5	No					Yes	6,750	10,125									
16-I-05	No				No					No							1,200	To be same lavel			
16-I-06	Yes	Drip and filtering	168	6	Yes	400	4,800			No							25,200	To be decreased	Don't know	Unknown	Plans of transfering the printing and dying to Hodiedah which leads to decrease the water consumption inspite of increase of production
16-I-08	Yes	Filteration	1350	225	No																
16-I-07-A	Yes	Filteration and sedimentation	Don't know	Don't know	No	3,500				No							3,500	To be decreased	400	60	

Appendix 11Well Inventory [Results of the Water Usage Survey in the Industrial Sector in Sana'a City]

Well ID No.	3. Wastewater Disposal																					
	a) Any wastewater discharged from the facility to outside?	WasterWater Discharged		Monthly Variation in Discharge of Wastewater	Monthly Discharge of 2006 (m3/month)												c) Discharge Place of Wastewater	d) Treatmet of Wastewater before Discharged to Outside			e) Final Quality of Wastewater at Discharge Point		
		Year 2005	Year 2006		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul	Aug.	Sep.	Oct.	Nov.	Dec.			Treatment Process	Treatment Process (Others)	According to the Standard	According to Regulation, Law	No standard/regulation, but treated
		m3	m3																	(specify)	(Specify)	(Specify)	(specify)
16-I-01	Yes			No													Public sewerage system	No					
16-I-02	Yes	7,344	7,344	Yes	612												Public sewerage system	No					No need, because it does not have any checmicals
16-I-03-A	Yes	40	60	No																			
16-I-04	Yes	300	300	No													Others	No					Water description contains soluted soap
16-I-05	No																						
16-I-06	Yes	105	1,050	No													Public sewerage system	No					
16-I-08																							
16-I-07-A	Yes	Don't know	Don't know	Yes	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Others	Yes	Sedimentation				

Appendix 12

Result of PCM Workshop

Results of the PCM workshop of this project

1. Purpose of the workshop

The purpose of this workshop was to find out the main problems confronted in the Basin. This workshop was conducted in a participatory approach, so that each of the stakeholders relating to the water resources management in the Basin can think, express and understand the problems confronted.

2. Date, place, etc.

Date: 10 - 11 July 2007

Time: Both days, 9:00 AM to 14:00 PM

Place: Eagle Hotel, Sana'a

3. Participants

First day: 61 persons, Second day: 59 persons

4. Method

1) Explanation of the method, explanation of the project

2) Brain storming on the major problems faced by the participants in Sana'a Basin

3) The problems were sorted out into themes

4) The participants were grouped according to each theme

5) Each group discussed about their own themes to reach the consensus for a core problem (group session)

6) Problem analysis: direct causes and direct effects from the core problem was discussed. (group session)

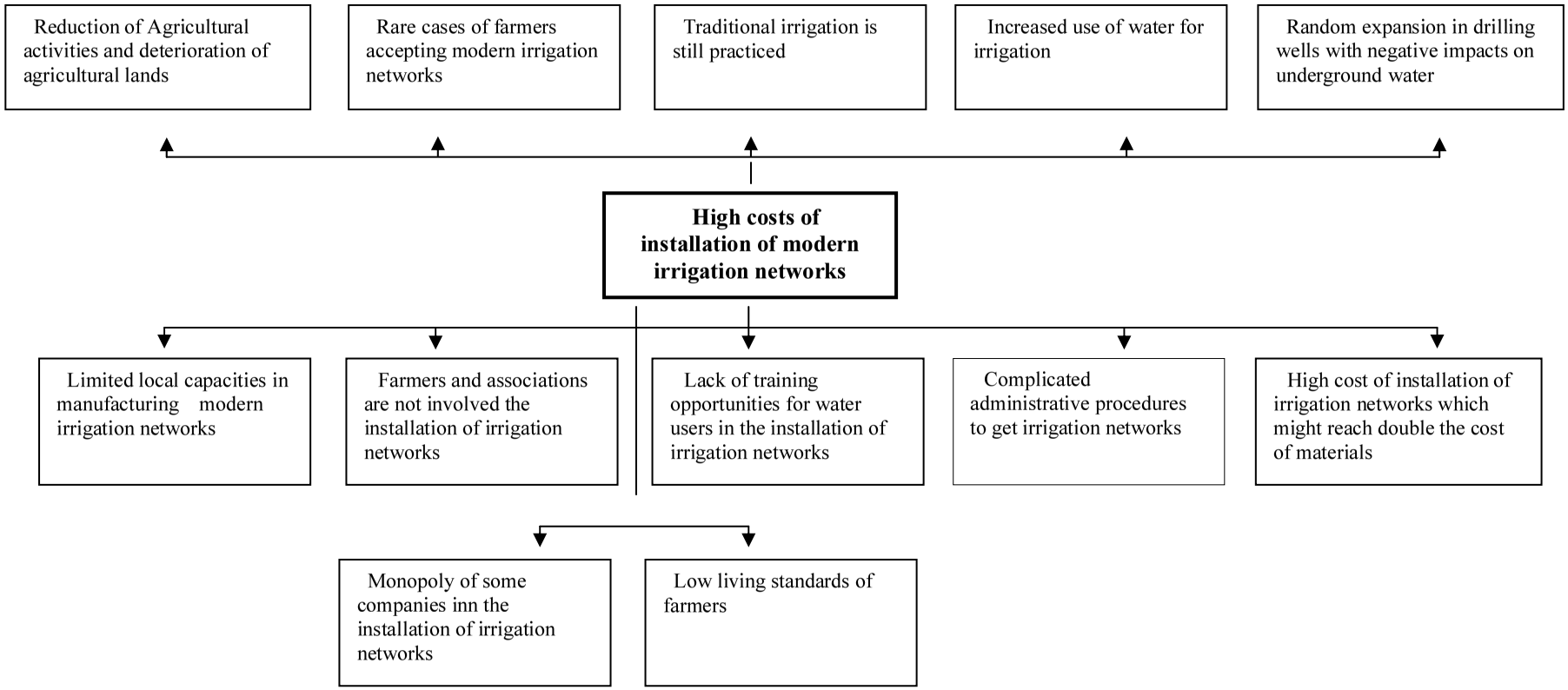
7) Solutions were discussed (group session)

8) Stakeholders were discussed (group session)

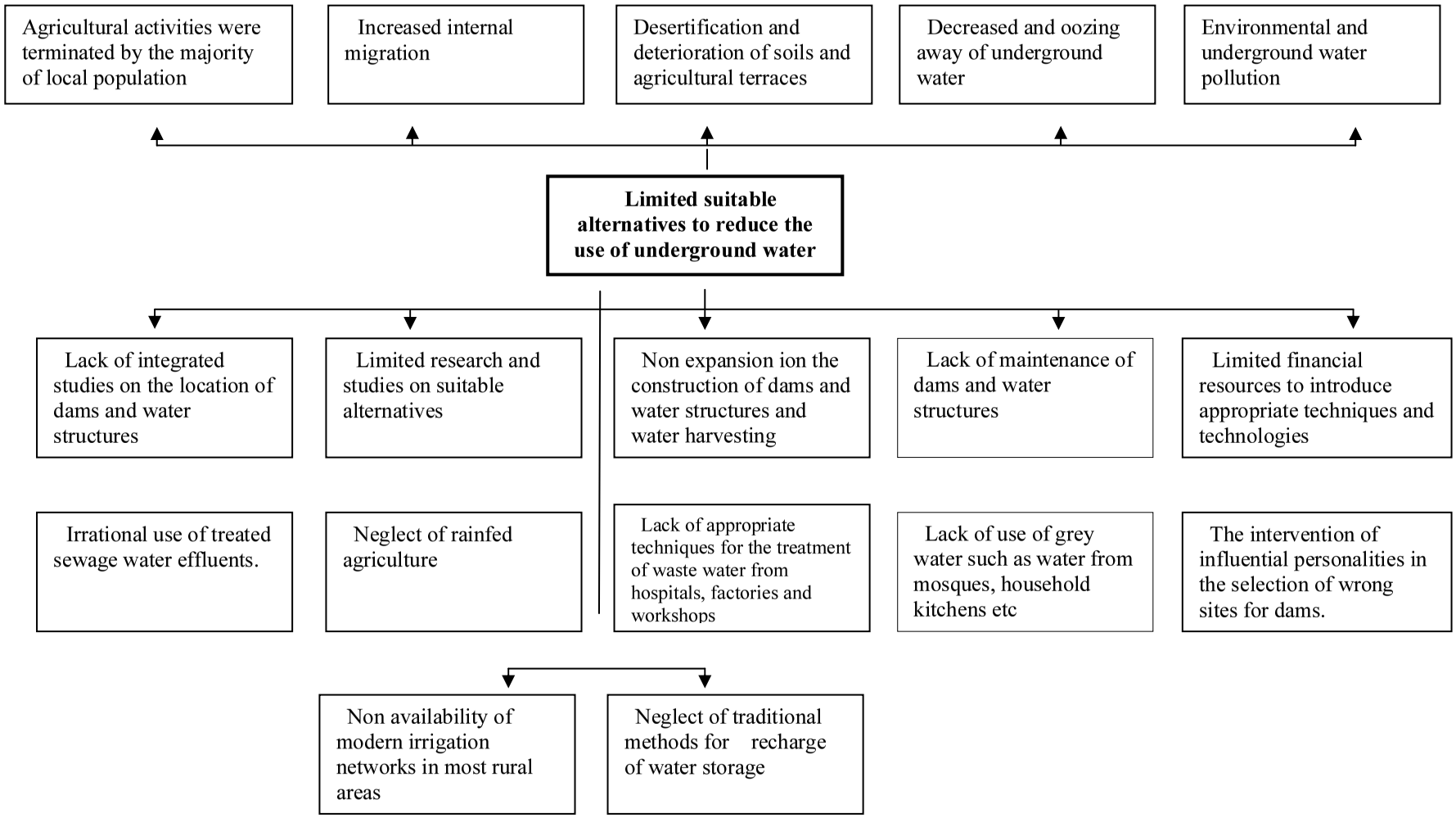
5. Summary of Results.

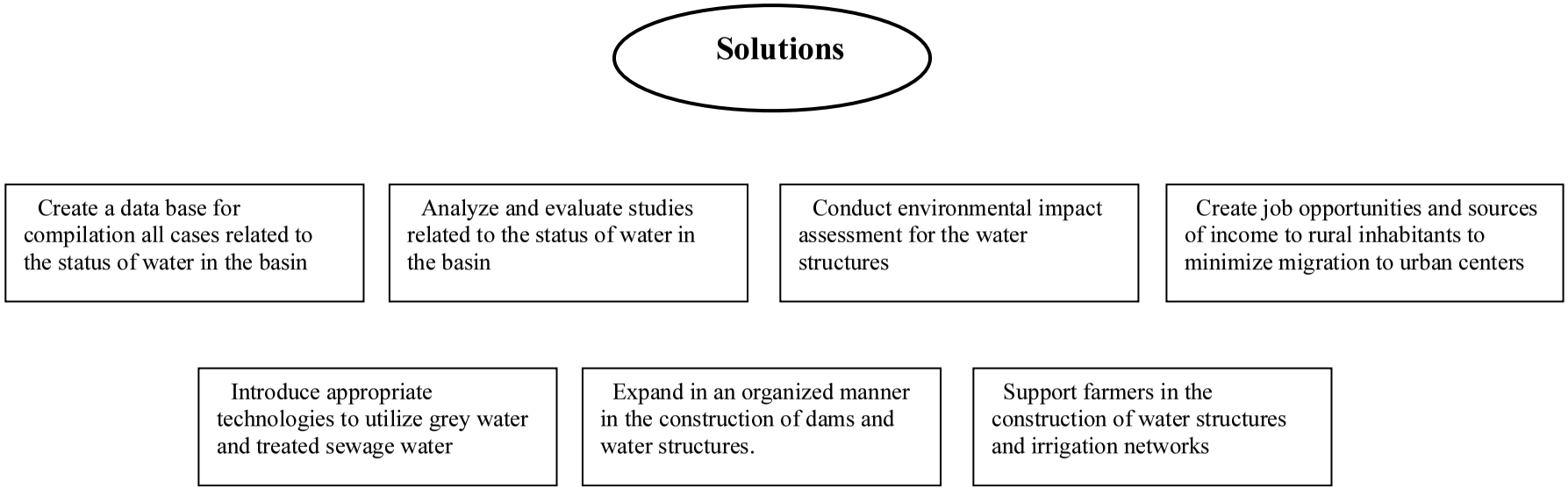
(next page)

Problem analysis and preparation of suggested solutions

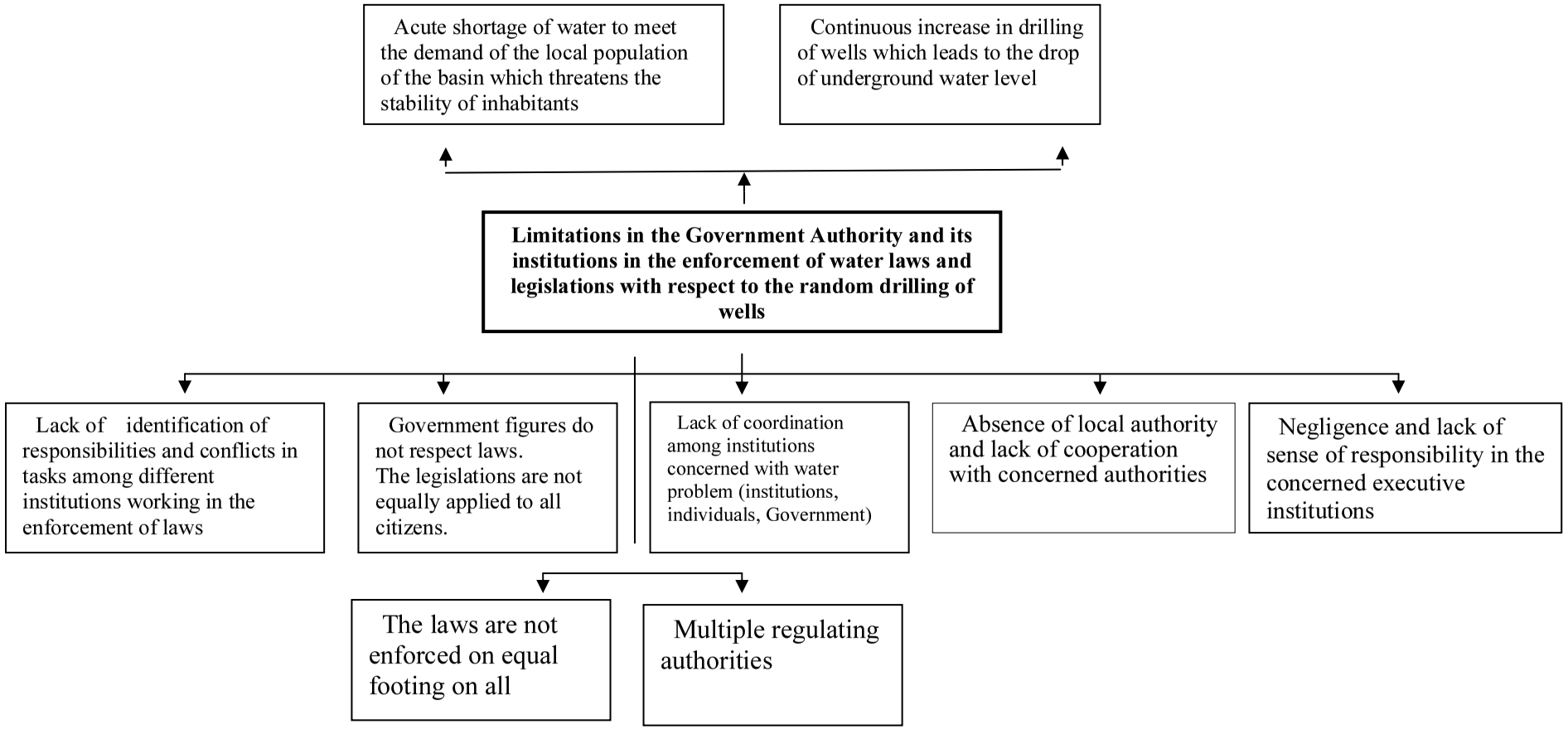


Conduct training programs and increase capacity of farmers in the installation and maintenance of irrigation networks	Support and promote local manufacturing of irrigation networks	Simplify procedures to get irrigation networks	Stop monopoly of companies in the erection of irrigation networks


Agricultural activities were terminated by the majority of local population
Increased internal migration
Desertification and deterioration of soils and agricultural terraces
Decreased and oozing away of underground water
Environmental and underground water pollution
Limited suitable alternatives to reduce the use of underground water
Lack of integrated studies on the location of dams and water structures
Limited research and studies on suitable alternatives
Non expansion ion the construction of dams and water structures and water harvesting
Lack of maintenance of dams and water structures
Limited financial resources to introduce appropriate techniques and technologies
Irrational use of treated sewage water effluents.
Neglect of rainfed agriculture
Lack of appropriate techniques for the treatment of waste water from hospitals, factories and workshops
Lack of use of grey water such as water from mosques, household kitchens etc
The intervention of influential personalities in the selection of wrong sites for dams.
Non availability of modern irrigation networks in most rural areas
Neglect of traditional methods for recharge of water storage


Solutions
Create a data base for compilation all cases related to the status of water in the basin
Analyze and evaluate studies related to the status of water in the basin
Conduct environmental impact assessment for the water structures
Create job opportunities and sources of income to rural inhabitants to minimize migration to urban centers
Introduce appropriate technologies to utilize grey water and treated sewage water
Expand in an organized manner in the construction of dams and water structures.
Support farmers in the construction of water structures and irrigation networks

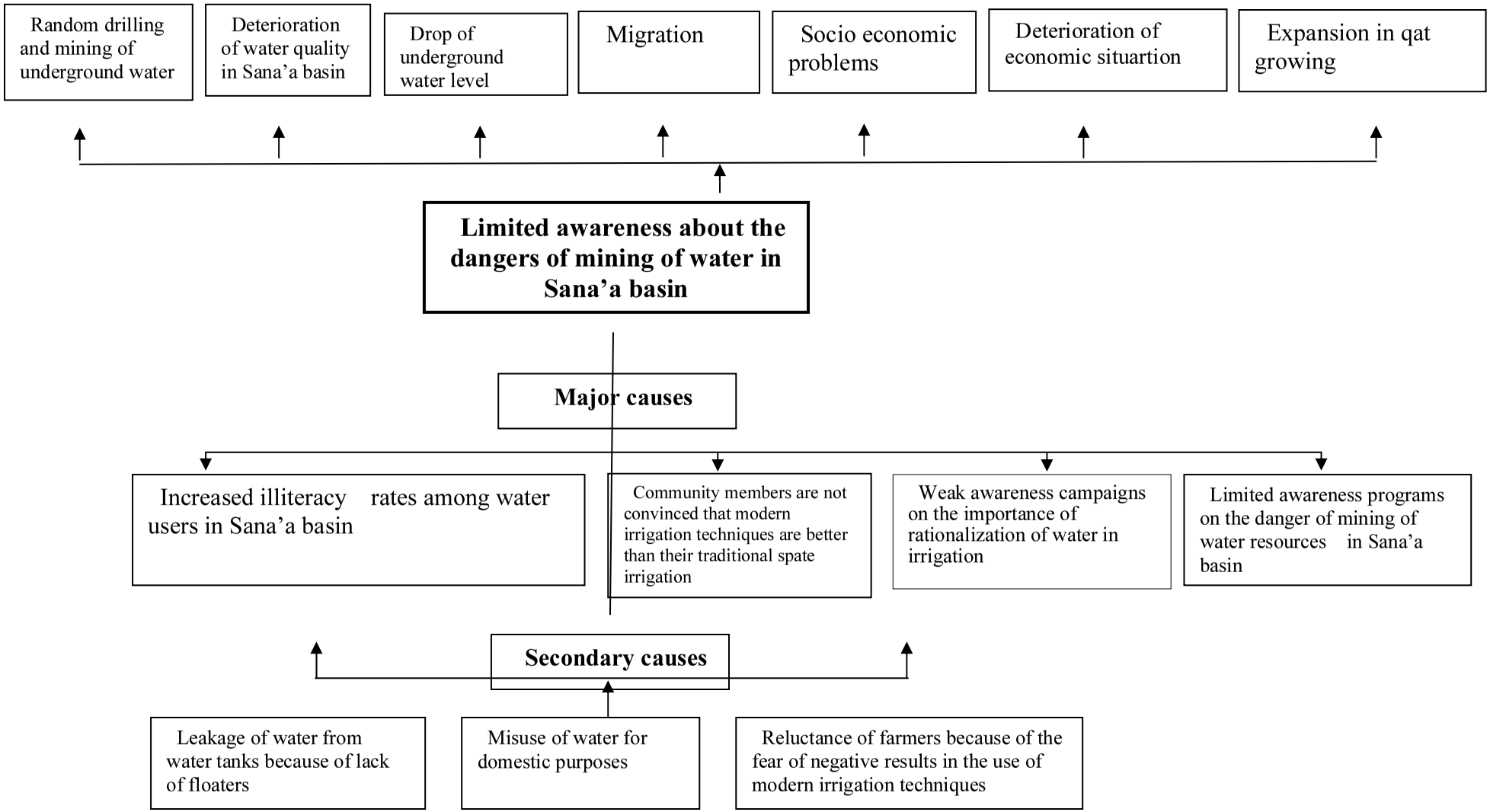
Analysis of problems and suggestions for solutions : Group number (2)

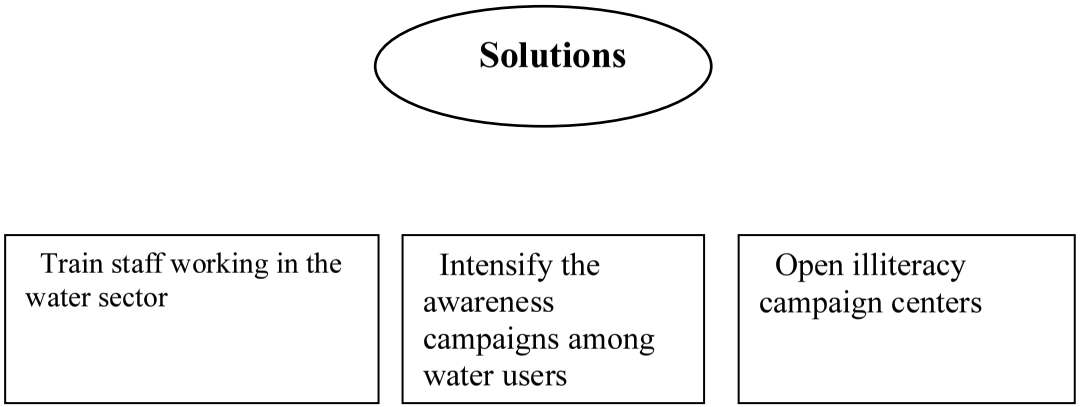


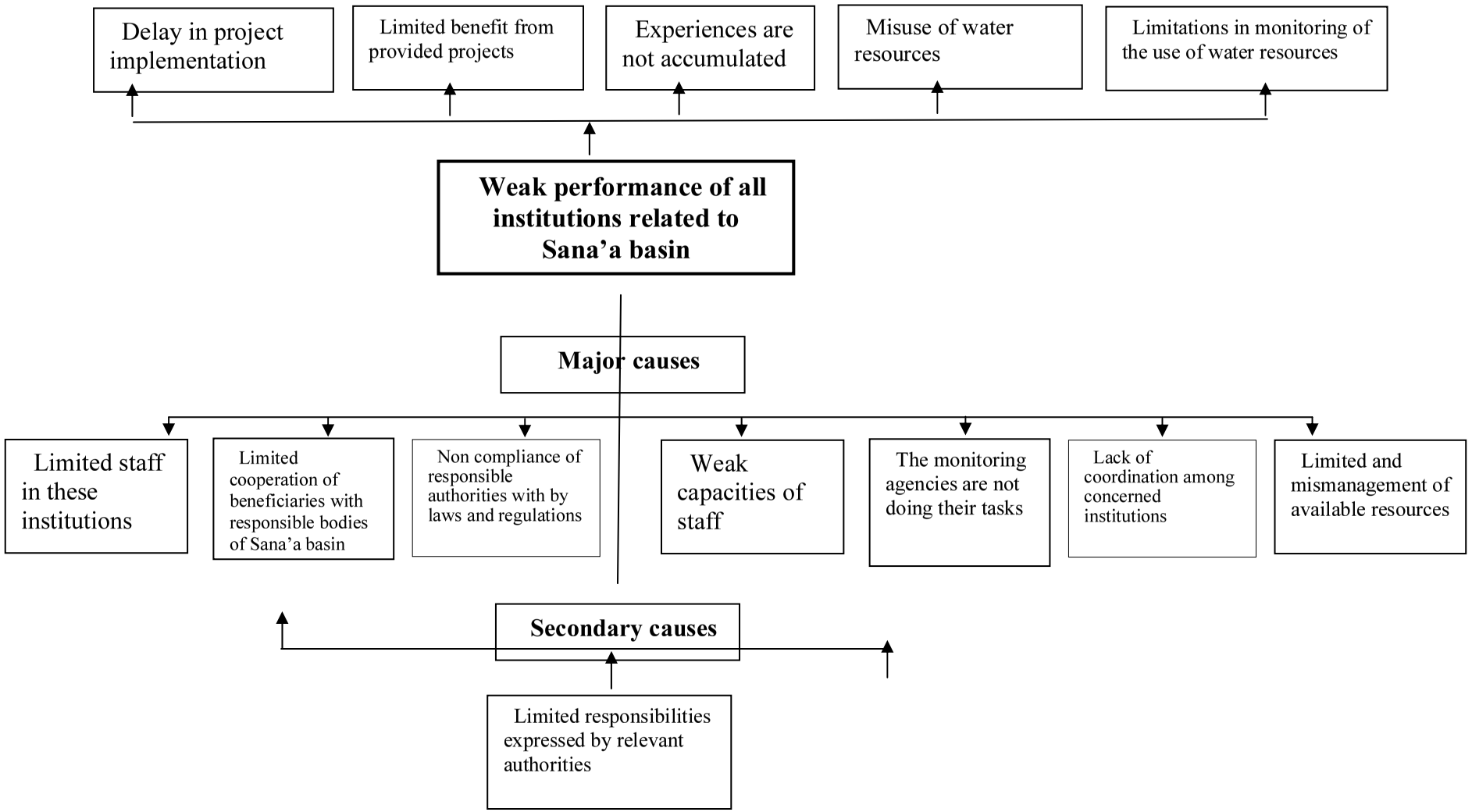
Solutions

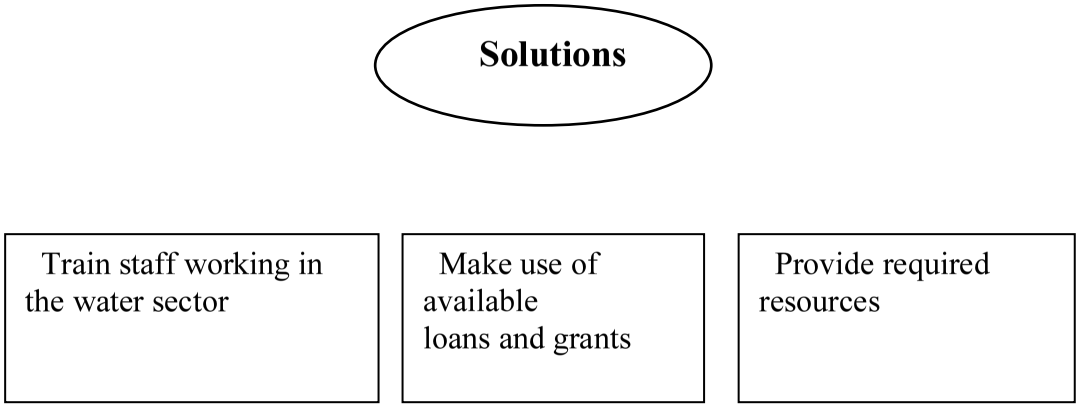
Give total authority to local councils for regulating and infracting actions related to random drilling of wells	Prohibit the import of drilling rigs to the country	Enforce government laws and regulations without hesitation and stop any interference by individuals which might affect the the laws and regulations with respect to random drilling of wells	Ensure that the owners of drilling rigs do not drill wells without proper certificates issued by concerned authorities.	Involve local communities in monitoring and enforcement of laws because they are equally responsible and they are the first to suffer

Analysis of problems and potential solutions : Group number (3)

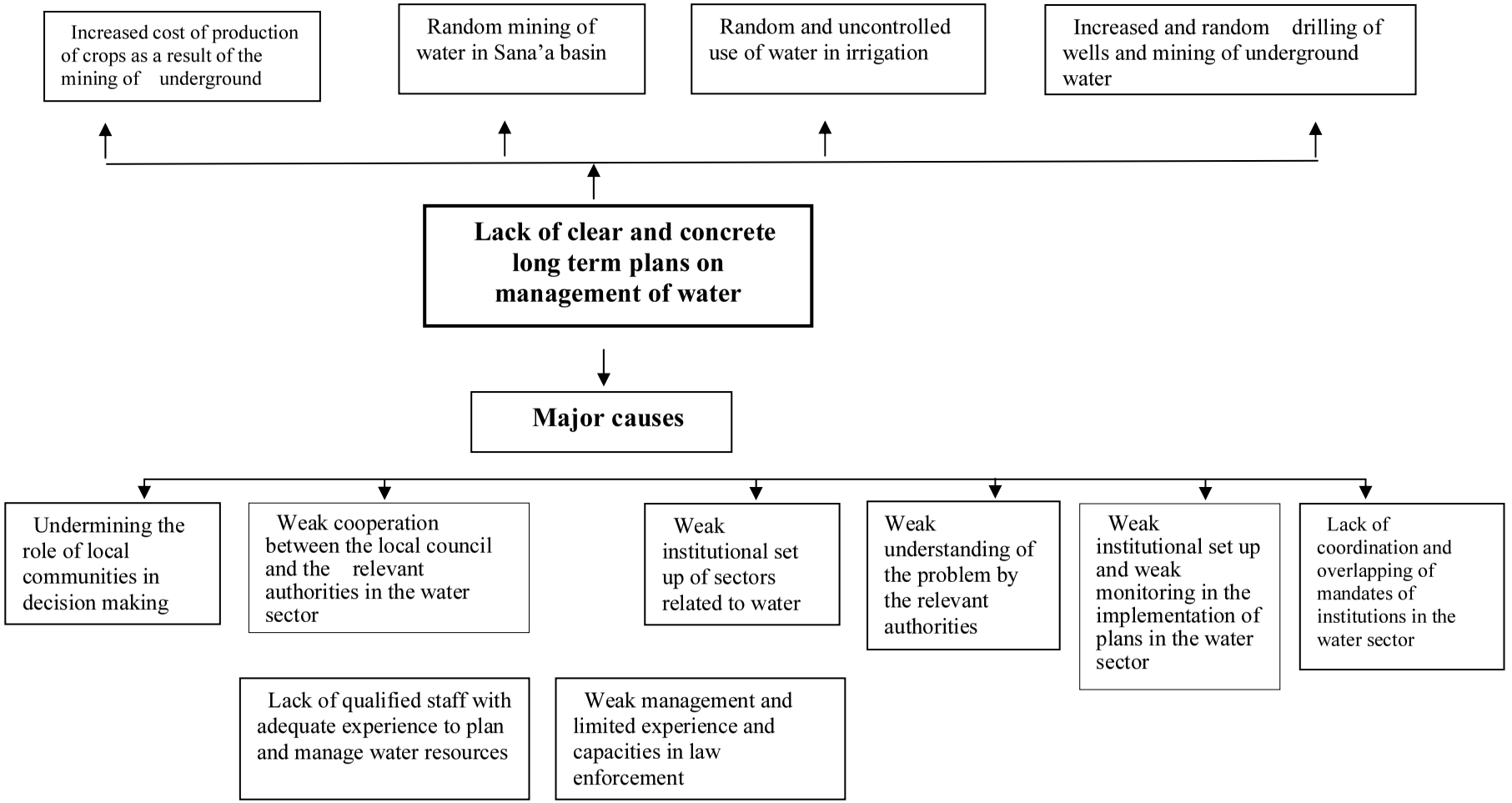


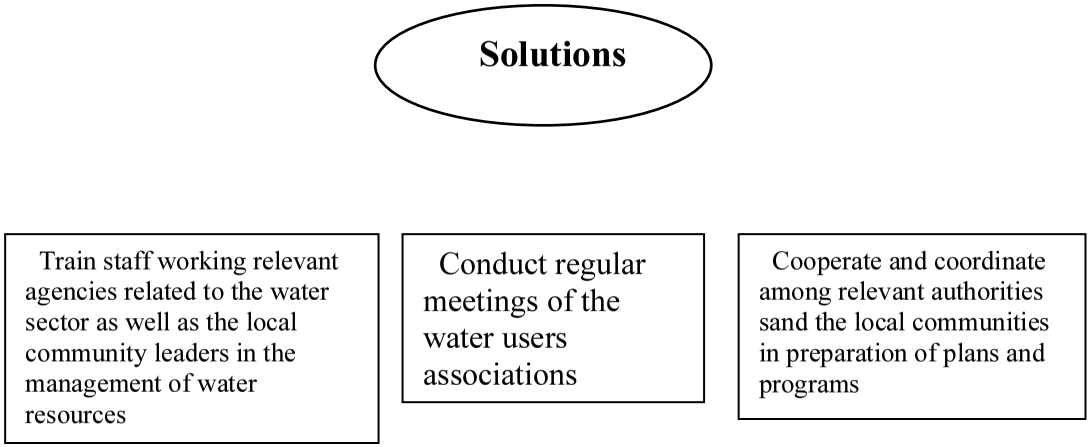

Solutions
Train staff working in the water sector
Intensify the awareness campaigns among water users
Open illiteracy campaign centers

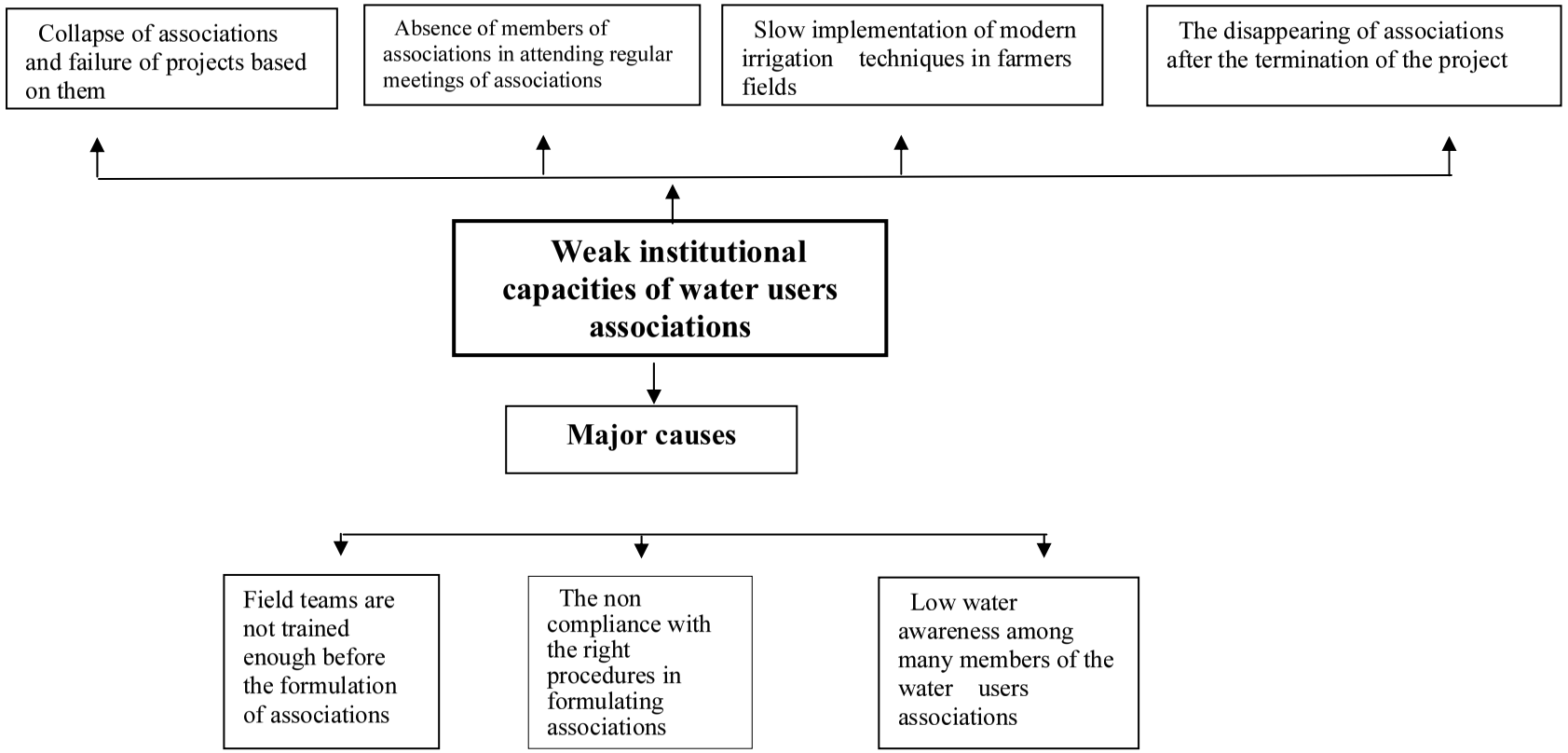

Delay in project implementation
Limited benefit from provided projects
Experiences are not accumulated
Misuse of water resources
Limitations in monitoring of the use of water resources
Weak performance of all institutions related to Sana'a basin
Major causes
Limited staff in these institutions
Limited cooperation of beneficiaries with responsible bodies of Sana'a basin
Non compliance of responsible authorities with by laws and regulations
Weak capacities of staff
The monitoring agencies are not doing their tasks
Lack of coordination among concerned institutions
Limited and mismanagement of available resources
Secondary causes
Limited responsibilities expressed by relevant authorities

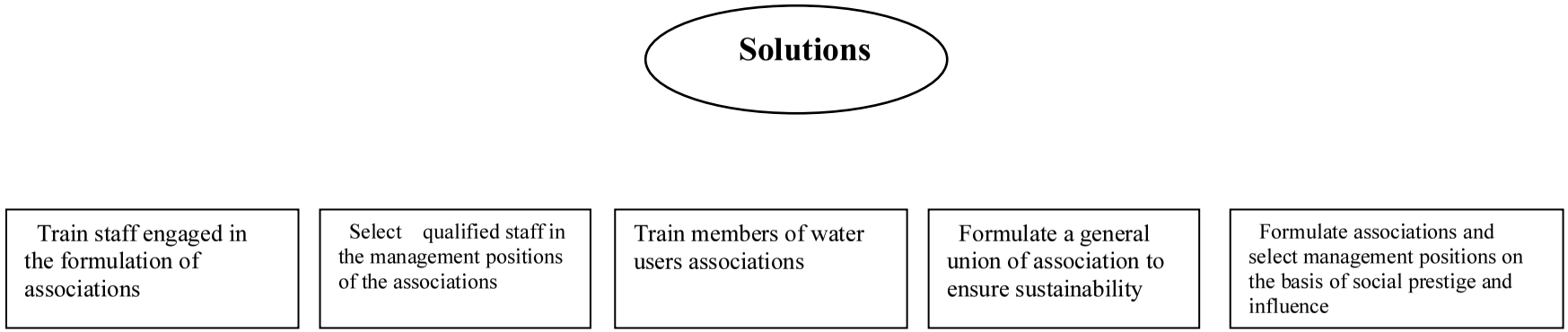

Solutions
Train staff working in the water sector
Make use of available loans and grants
Provide required resources

Problem analysis and potential solutions : Group number (4)




Solutions
Train staff working relevant agencies related to the water sector as well as the local community leaders in the management of water resources
Conduct regular meetings of the water users associations
Cooperate and coordinate among relevant authorities sand the local communities in preparation of plans and programs


Collapse of associations and failure of projects based on them
Absence of members of associations in attending regular meetings of associations
Slow implementation of modern irrigation techniques in farmers fields
The disappearing of associations after the termination of the project
Weak institutional capacities of water users associations
Major causes
Field teams are not trained enough before the formulation of associations
The non compliance with the right procedures in formulating associations
Low water awareness among many members of the water users associations


Solutions
Train staff engaged in the formulation of associations
Select qualified staff in the management positions of the associations
Train members of water users associations
Formulate a general union of association to ensure sustainability
Formulate associations and select management positions on the basis of social prestige and influence

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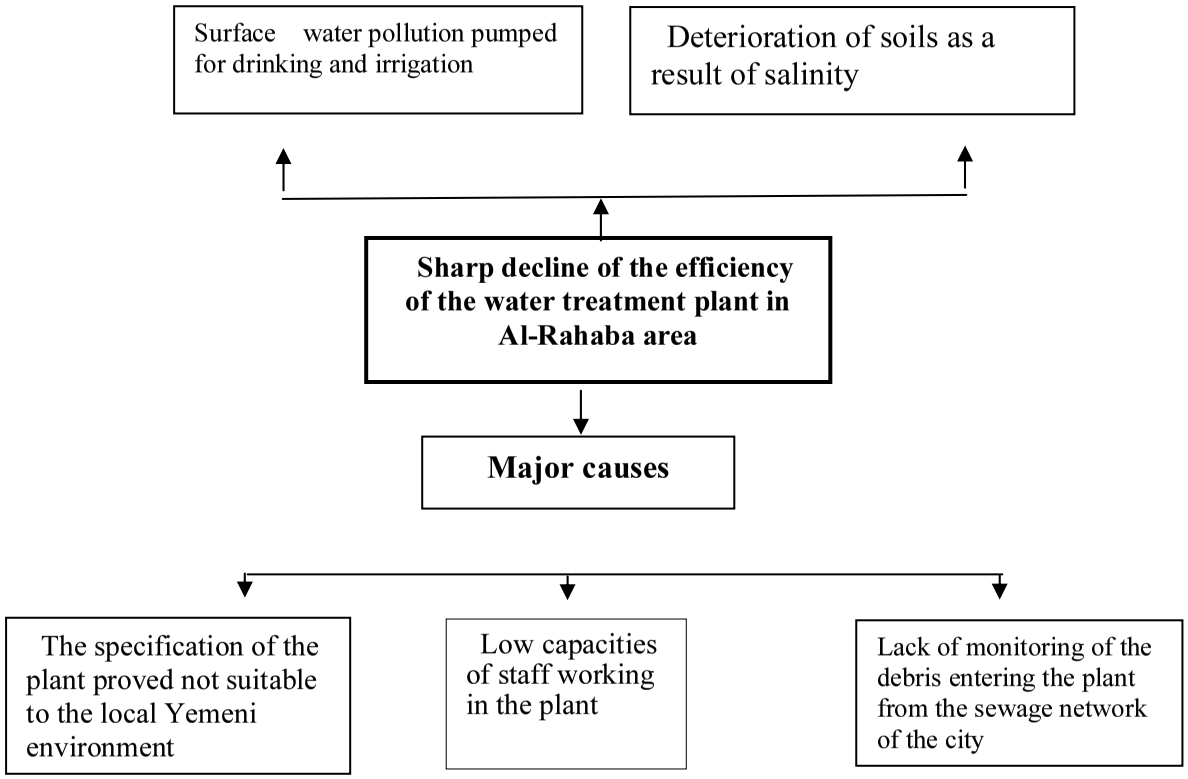
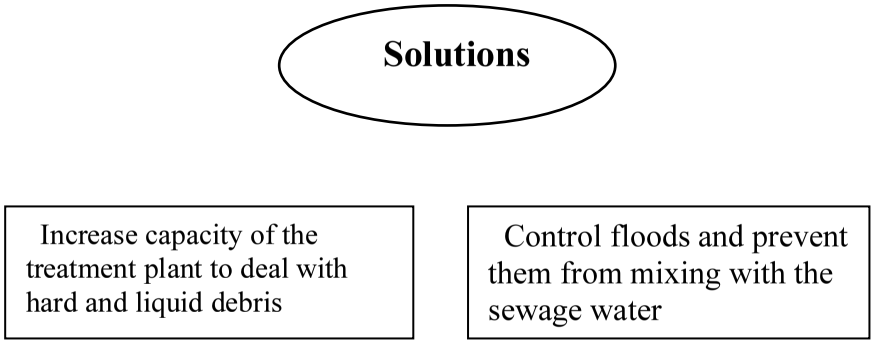
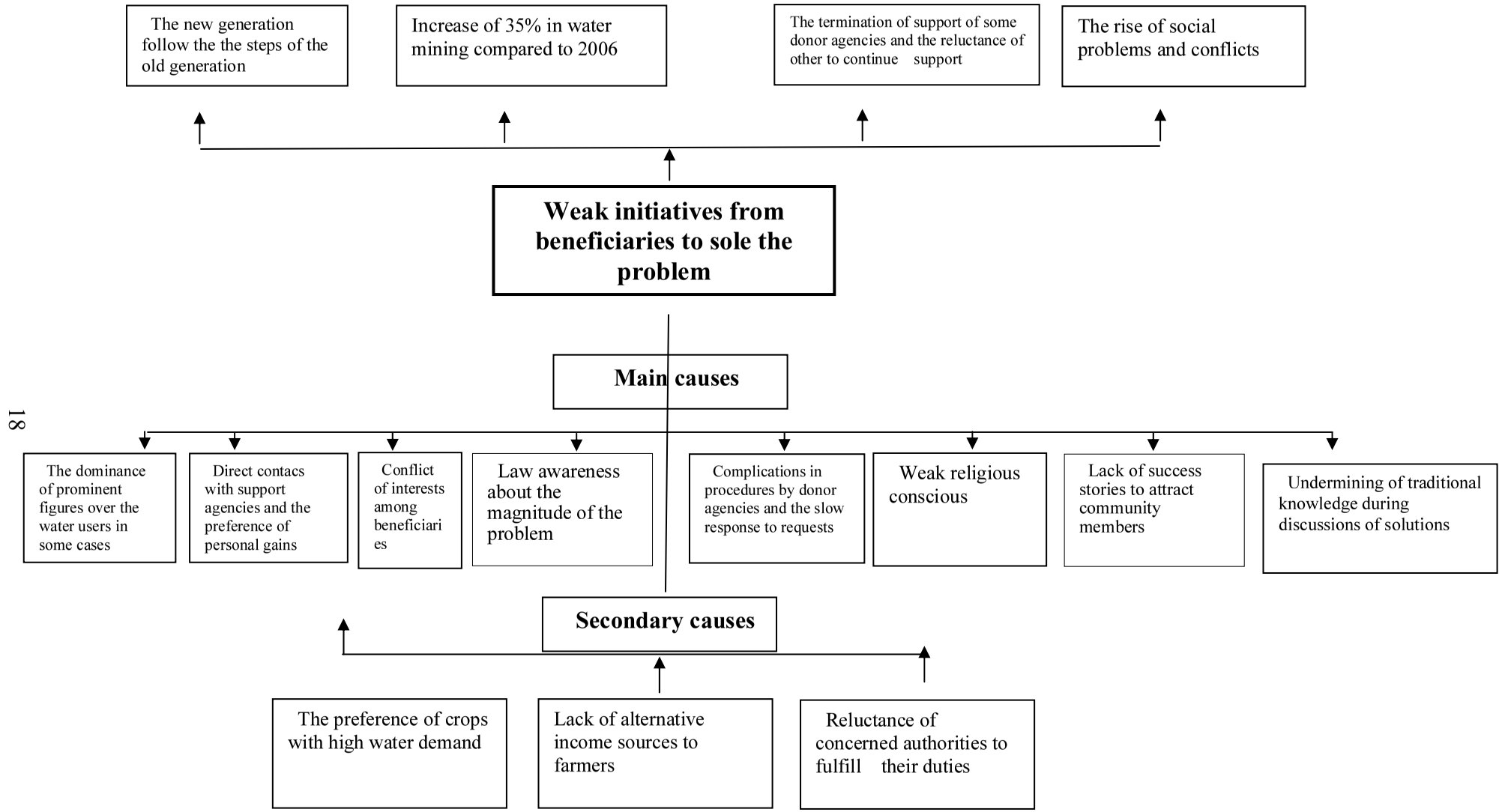
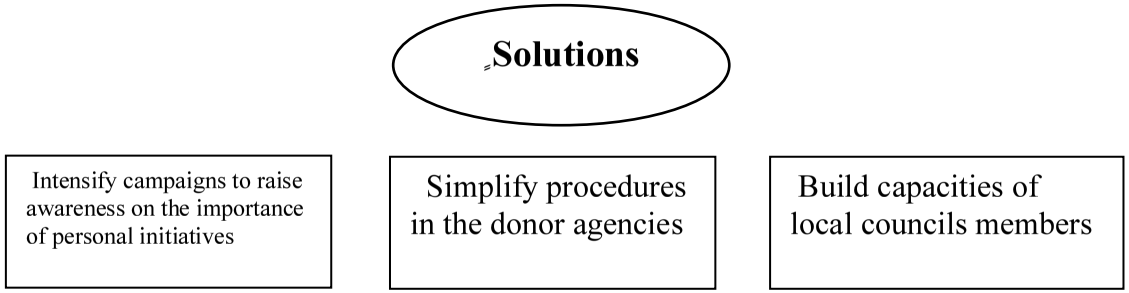
ت Analysis of problems and potential solutions : Group number (5)




Solutions
Increase capacity of the treatment plant to deal with hard and liquid debris
Control floods and prevent them from mixing with the sewage water


The new generation follow the the steps of the old generation
Increase of 35% in water mining compared to 2006
The termination of support of some donor agencies and the reluctance of other to continue support
The rise of social problems and conflicts
Weak initiatives from beneficiaries to sole the problem
Main causes
The dominance of prominent figures over the water users in some cases
Direct contacs with support agencies and the preference of personal gains
Conflict of interests among beneficiaries
Law awareness about the magnitude of the problem
Complications in procedures by donor agencies and the slow response to requests
Weak religious conscious
Lack of success stories to attract community members
Undermining of traditional knowledge during discussions of solutions
Secondary causes
The preference of crops with high water demand
Lack of alternative income sources to farmers
Reluctance of concerned authorities to fulfill their duties


Solutions
Intensify campaigns to raise awareness on the importance of personal initiatives
Simplify procedures in the donor agencies
Build capacities of local councils members

Appendix 13

Report of the Study on Water Resources Management in Jordan

Republic of Yemen
Ministry of Water and Environment
NWRA
Sana'a Branch

A Report of the visit to Jordan during the period between the 10th-14th /6/2007 Concerning Water Resources Management Action Plan

Prepared by

Ibrahim Rajeh Al-Zubairy **Mohammad Abdul Salam Salim** **Eng. / Saleh Abdullah Al-Dubby**
NWRA- Sana'a
General Manager of Sana'a Basin

June -2007

Appendix 13

Table of Content

In the Name of God Most gracious, Most Merciful

A Report of the visit to Jordan during the period between the 10th-14th /6/2007 Concerning Water Resources Management Action Plan

1. General background:

Sana'a basin, which the capital of Yemen falls in, is considered as one of the most critical underground water basin in the country. And it is threatened of drying. Also, it is one of the basins that were announced as protection water area according to the Cabinet decree no. (344) for 2002.

And until the current time, the basin lacks an implementation plan in order to manage its water resources which will be appropriate with its complications and different water circumstances socially and economically and go with the future plans and changes and to secure achieving a complete water resources management contributions on the society level, governmental and non- governmental, so as to decrease water crisis and reach a complete water development.

Through this, the Government of Yemen with the cooperation of the Government of Japan represented by JICA has signed a mutual cooperation agreement that includes preparing a drafting implementation plan for water resources management for the basin. The Japanese team from JICA is preparing it with the help of the Yemeni counterparts who are working in NWRA Headquarter and Sana'a Branch.

The visit of the Japanese and Yemeni team to Jordan falls under the program frame to prepare the plan and to benefit from the Jordanian experience in preparing and implementing the water resources management action plan in Jordan.

2. Arrangements and visits program:

1- **Arrangements :**

Preparing for this visit was made through the preparation of a group of inquiries and questionnaires, and then it was isolated according to the concerned administrations, as well as, preparing a timetable which shows the visits program in order to be sent in advance to the Ministry of Water and Irrigation, in Jordan. (Attached with a copy of the questionnaire and also a copy of visits programs)

2- **The program**

The program included a visit to many specialized authorities that belong to the Ministry of Water and Irrigation (Water Authority of Jordan and Jordan Valley Authority) and also to the JICA office in Jordan. Through the meetings with the Authorities a review of the full roles which are implemented by the concerned authorities in water resources management has been discussed. There was an exchange of discussions in order to understand the water policies, and the strategies in Jordan, so as to adopt a method according to the situation of Sana'a basin through a plan frame that must be prepared for the basin. The following is a summery of the visit according to the program:

3. First Day Visits (Monday 11 / 6/2007);

1- JICA office- Jordan

Host Names**:** Mr. Sato Takeaki Resident Representative
Ms**.** Fujiie Natsuko Assistant. Residential Representative

Meetings Topic:

- Explain the objectives of the visit to Jordan including the following elements:
- The Visits Goal
- The importance of benefiting from the Jordanian experience in water resources management.
- Training sessions in water resources management.

2- Training and Development Unit

Host names: Eng./ Basem Al-Zawaideh Director of Training and Development Unit –Water Authority of Jordan

Meetings Topic:

- Discuss the policy of training the water sectors crew in Jordan
- How to improve and develop the training procedures and mechanism
- To define the training priority's in training according to the work needs and necessity requirements to implement policies and strategies.
- Policy of suggested plans for University graduates and an employment system for the new staff.

The benefits from the lessons;

- A complete system of training exists and preparations in all fields concerning water are built on the necessary priorities.
- The application process should not be neglected and the interest in field work and transfer the theoretic scientific knowledge to operational knowledge and the ability the trainee will gain through this training policy.
- Follow a training policy for the new university graduates under the supervision of experienced engineers for a year. And through this direct contact office and field experience will be gained (100 new engineers will be trained annually).
- Follow the policy of connecting the employment degree with the training. With the least of training of 40 hours annually.
- Follow the policy of not limiting the specialization because the training may include a variety of specializations staring from operating and maintenance to planning and management.
- Follow the policy of before and after evaluation for the trainees and its effect on their performance level.

3- Underground Basins Management Directorate

Host: Dr. Khairi Al-Hadidi Director of Groundwater Basins Directorate – Water Authority of Jordan

Discussions;

- A background on the Ministry of water and irrigation in Jordan, and, the duties of the Basin directorate in implementing the requirements of the water resources management.
- Training the water basin programs and water information system (level, quantity, quality).
- Field survey, list the existing wells, collected information that concerned wells and modernize this information.
- The Government support in implementing water rules and legislations.
- The procedure that is being followed in order to control the digging of wells, seize illegal digging and the movement of rigs in the country.
- Digging licenses system, register wells and limit the quantity of water allowed to extract annually.
- Distribute the number of wells concerning its different uses.
- How convince the well owners of putting meters and impose water tariff system.
- Restructure the water sector and raise the irrigation ability concerning farm level.
- Rain water harvesting and artificial recharge.

Benefited lessons;

- The priority needed to build a complete water resources management and it include the following:

- List all the existing water resources, collect data and information concerning it and continue in modernize and monitoring the information as the first step to prepare a resources management plan.
- Qualified and provide the specialized staff in order to do field works.
- Provide equipments, machines and transportations and any necessary necessities, also, establish offices on regions level.
- Political support to apply water legislation and enhance field monitoring role and control the digging and rigs.
- Society awareness about the necessity of organizing and decreasing water uses and trying gradually to convince them to accept the new situation.

- considering water as a national property1 owned by the country is a good thing to help in controlling on digging wells and the extracted quantity of water.
- increase water awareness campaigns accompanied with setting meters on water wells in Jordan from 1994 till 2003.
- Existing private wells belong to the Ministry of Water and Irrigation to monitor the groundwater.
- obligate the requires of digging licenses for agricultural purposes to put meters and modern irrigation net.
- stop licenses issuing for digging wells that used for agricultural purposes and impose hard procedures to issue digging licenses for other purposes.
- mend the wells that are dug without license.
- improve irrigation capability, water harvest activities and artificial recharge for the ground basins.

4- Water Loss Directorate and the first indications of performance

Host: Eng./ Waleed Suker Directorate Manager - Water Authority of Jordan

Meeting subjects;

- The water situation in Jordan.
- Each person share of water in Jordan annually.
- The water cost according to the quality of water and the average crops
- Water providing system for the participants.
- The disadvantages of distributed pumping in the water net.
- The water loss in the net, the reasons and the precautionary procedures.
- The problems of illegal usage and connections.
- The precautionary procedures in order to stop the illegal usage.
- The role of the concerned authority in reducing the water loss.
- The procedures followed in order to reduce water loss.
- Information Waiba project.

Benefits from the meeting;

- the procedures and policies that followed in water loss management :

- Usage of minimum –night flow.

* The area is divided into a number of small and each area is isolated from the other.
* This area must be buried with water.
* A survey must be made in order to find the leakage.

- Setting water meters at the nets entrances in order to compare the quantity of water pumped with that in the bills.
- A complete and periodic survey must be made in order to discover the illegal usages.
- the procedures taken in order to implement the policies of water loss management :
- Establish numerous units and offices for water loss management in different areas in the governorates.
- These units are provided with experienced and qualified technicians.

These units are provided with developed vehicles in order to locate the loss and place of leakage.

- These developed equipments are:
- Ultrasonic flow meter.
- Noise data recorder equipment.
- Pressure and flow measurement equipment.
- Periodic training policy is made for the employees in loss water management with JICA help.
- Periodic awareness campaigns are made
- Distribute posters for the purpose of public awareness

- Policy of controlling violations:

- Punishments are implemented firmly according to the law.
- Reward to the employees to detect violation pipelines.
- The water supply network must be monitored and also the pipelines that transfer between the cities must also be monitored because these pipelines support Amman with water.
- The use of GIS program find out where the leakage and the loss.
- WAIBA project to provide water: Put special equipment on water faucets so as to reduce water consumption from it.

4. Second Day Visit (Tuesday 12/6/2007)

1- Water Systems Operation Directorate

Host: Dr. Mustafa Al-Assaf Director of Directorate of Water Authority of Jordan

Meetings subjects:

- Emergency plan to use private wells for domestic and municipality purposes.
- Improve the water type and observe pollution in nets and wells.
- How to face the demand on water because of increase in population.
- How to transfer water from rural areas to the cities with the agreement of the people and the treat the water rights.
- How to pump water through the nets and the type of nets used.

Lessons Benefited:

- Private Wells, when it is necessary, connect to water supply network system with the agreement of the wells owner by paying a specific amount.
- With the cooperation of the Ministry of Health, there should be a daily observation cycle for the quality of water coming out from the wells or when it flows to the net until reaching the final net and then analysed in laboratories.
- Interests in precaution procedures depending on the evaluation results of the quality of water.
- There are specific standards concerning drinking water nets and the importance of being distances away from sewage water nets.
- Find appropriate plans in order to cover the demand on water in areas where will be increase in population.
- Buy well with a circular area of 600 meters when the necessity comes to transfer water from areas that belong to locals.
- When digging wells with high salty water, there is no need to use developed irrigation system.

2- Water Resources and Planning Directorate

Host: Dr. Issa Al-Nasoor Directorate of Water Resources and Planning Directorate - Water Authority of Jordan

Meeting Topic:

- Planning for Water resources Management

Lessons Benefited:

Factors concerning the success of planning for the water resources management.

- The political support in preparing plans, programs, implementing laws, and water legislations.
- Find infrastructure and a good information basis.
- Prepare Water Observation programs for the basins.
- Prepare a map of areas where it is possible for the layers that easily become polluted and establish zone to protect water resources.
- Prepare a water strategy for the present and future.
- Prepare and implement awareness programs that are appropriate to the community and the participation of the water resources management and other authorities in these programs.
- Change the crops to less water consuming crops.
- Take strong actions against drillers and reduce the digging of wells.

3- Water Projects Directorate

Host; Dr. Othman Al-Kurdy Directorate Manager Water Authority of Jordan

Meeting Topic:

- There is no successful management for water resources in Yemen.

Lessons Benefited:

- There are crises because of unsuccessful management for water resources in Jordan.
- First, it is necessary to conserve the water uses in agricultural sector which is the most sector that consumes water and then the other.
- There should be water scenario and future predictions in order to take the necessary water resources management policies in Yemen.
- Improve the living circumstances for the employees of the water sectors, provide the necessary equipments and transportation which are basic condition for the success of the Water Resources management.

4- National Water Plan:

Host: Eng./ Susan Taha National Water Plan Manager – Ministry of Water and Irrigation

Meeting topics:

- General background concerning the National Digital Plan
-.General database system.
- General awareness and water users associations.
- Future water scenarios considering the increase in population.
- Re allocation of water for the purpose of reducing the gap and demand.
- Conditioning the existence of rainwater harvest system form the roofs of the houses (new buildings).

Benefits from the meeting;

- The digital plan is a mathematical patterns which are established in a GIS program (geographical information system) and it is formed from the following:
- Description of the quantity and the quality of surface and underground water resources as well as the alternative resources.
- Description of the current and future water necessity by different sectors.
- Description for the needed technical and operational procedures in order to reduce water deficiency in deferent areas of the country for the coming years, as well as , take in consideration the social, economical and environmental aspects.
- Knowing the water scenarios and the future meditations are important to put fit plans and policies to avoid water crisis or reduce it.
- The importance of school awareness and place the water awareness subjects as a part of the curriculums
- The necessity of connecting between the public awareness and reduce the average population growth through a developmental plans for the country with a concentration on the population growth on each persons annual share form water.
- The interesting in establishing rain water harvest institutions to benefit from the lost rainwater.
- Count the annual water budget, taking in consideration all available abilities to provide agricultural sector needs.
- Encourage the investments in neighboring areas where there are no buildings or people.

5. Third Day Visits (Wednesday. 13/6/2007)

1- surface water control unit – Deer Ula

Hosts Dr. Shafek manager of water department – Jordan Valley Authority

Meeting topics

- Rationalization surface water use and rain water harvest**.**
- Use treated water for irrigation and pure water for drinking.
- Improvement of the irrigation efficiency using drop irrigation system.
- The problem of marketing crops.
- Use computer control system in distributing surface water called SCADA system

Benefited lessons;
Consumption tactics concerning water uses:
-The use of sewage and treated wastewater in irrigation and provide the pure water for drinking.
- Interested in rainwater agricultural and encourage harvesting rainwater.
- Raise the irrigation qualification from the water resources to the farm and follow the drop irrigation system and reduce the evaporation.
-Support and encourage the farmers in following modern irrigation techniques.
- Notice the pumping stations distribution from king Abdullah channel to the capital Amman (supported by JICA).

2-The national center for agricultural researches and technology transformation- AlBaka'a- Jordan Wadi
Hosts; Dr/Mohammad AlDabas National Center Manager

Meeting topics:

-Training programs and manners in researches center.
- Discussion about the needed level for implementation of a successful training session for the representatives of water users associations.

3- JICA Office- Jordan:

Hosts	Sato Takeaki	Resident Representative
	Mr. Fujii Natsuko	Assistant Resident Representative
	Mr. Uskiki Hisao	JICA Advisor

Meeting topics:
- The benefit from the Jordanian's experience in order to compose an implementation plan for water resources management for Sana'a basin.
- The important of having a tax system for water consumption as a successful step to reduce the use of water.
- Awareness campaigns importance, and change the culture of the community concerning the consumption of water use and the monitoring system.
- Fasten the procedures of issuing wells digging license.
- Future programs in Sana'a basin.
- Raise the interest for the specialized staff for both quantity and quality in water resources management.
- How far the implementation of the monitoring system on extracts water in different sectors (in Sana'a basin for example) as in Jordan.
- Water property, the difficulty of registration wells, limits the quantity of extract water and the importance of monitoring the wells digging.
- Training sessions for the water sector staff (concentration on training and qualify the technical staff in the water sector so as to implement the water strategies and polices with high efficiency.

6. Notices on the visits:

We were pleasure to have chosen Jordan because its nature and water situation is similar to ours. There are few differences concerning experiences, scientific and practical, in water resources management. But there are some notes that should be mentioned so to not happen in the future when having such studies, there notes are:

- The visit was short; there were no field visits which enhance the theoretical information.
- The lack coordination for the visit and this led to difficulty of implementing the program because some administrations were busy.
- There was no break between the meetings which would ease the internal discussions of the team in order to put a plan to get benefit form the next meeting.

7. Summary:

1- the necessity that plan have a clear policy for training the water sector staff through :

- Put a complete training and qualifying system in all different fields concerning water according to the priorities and taking into consideration the variety of knowledge for all work fields that are related to water.
- The importance of training the new employees by the experienced employees.
- Put the regulations for the employment degrees which include personal development through training programs and scientific researches.
- Never neglect the evaluation of the training to get the concerned authorities benefit from the trainees according to their creative abilities.
- Provide the financial support for the training.

2- Improve the living situations for the water sector employees and provide the necessary equipments and transportation and all the necessary materials needed. And establish offices at water areas level.

3- Limit the existing water resources, collect data and information concerning it. Also prepare programs to monitor water basins using limited monitor wells and infrastructure, also locate infrastructure and a good information basis.

4- The importance of the political support to raise the following activities concerning the control of the underground water because it is a public property.

- The enforcement of water laws and implements the water legislations and raises the standards of field monitoring, and controls the illegal digging and the driller's violations.
- Stop the issuance of licenses for well digging for irrigation purposes and impose strict regulations in issuing licenses for other uses.
- Fill up (bury) the wells that are building illegally without a license and seize the unlicensed drillers and impose strict procedure concerning this matter.

- Impose on wells digging licenses for the purpose of agriculture to install meters on their wells and install developed irrigation net and limit the flow

area and the total amount pumped out with the coordination with the Ministry of Agriculture and Irrigation.
- Observe over the wells digging and trail digging.
- The management should be decentralization and the participation should be with local communities through the establishment and training of the waters users associations. Also the concerned authorities should participate in these trainings and workshops must also be made, conferences and there should be encouragement.
- Interest in raising the water awareness to the new generations through special school programs and put these programs as a main lesson in schools.
- Put an organizational frame in order to benefit from drinking wells in cities.

5- When putting the plan what must be taken into consideration are as follows:
- Follow up water and sewage water projects according to the increase population.
- Prepare protection zone to prevent the water resources from pollution.
- Study the possibility of changing the agriculture system and plant crops that are high in economically and low in water usage.
- It is necessary to conserve water uses in agricultural sector which it is the most sectors of water consumption and then the other.
- Understand the water scenario and the future predictions in order to take the necessary water policies so as not to face any crises.
- Establish collection facilities for rain water and artificial feeding for the underground basins. And also encourage agriculture through rain water irrigation.
- Raise and improve the irrigation abilities from the water source to the farms through the support of farmers to use developed irrigation systems like drop irrigation and reduce vaporization.
- Use treated sewage and waste water for agriculture and provide pure underground water for domestic and drinking.
- Encourage water investment in areas that has enough water resources..

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