

Table S1. Physiochemical parameters of water quality analyses of Sanghar district (subdistrict Sangahr, Khipro and Jam Nawaz Ali)

Sample ID	pH	EC µs/cm	Salinity g/L	TDS mg/L	NO ₂ µg/L	NO ₃ mg/L	T.PO ₄ mg/L	O.PO ₄ mg/L	T.H mg/L	Cl mg/L	Alk mg/L	SO ₄ mg/L
S1	7.4	2176	1.1	1393	1.85	2.1	0.86	0.25	320	270	280	236
S2	7.44	1492	0.7	955	3.29	6.39	0.71	0.32	260	145	255	96
S3	7.5	5730	3.1	3667	3.47	2.49	0.57	0.26	788	750	360	762
S4	7.38	1203	0.6	770	3.19	1.11	0.63	0.24	240	130	235	90
S5	8.46	424	0.2	271	3.15	2.99	0.26	0.19	120	34	120	28
S6	7.47	2856	1.5	1828	3.33	2.14	0.29	0.22	430	350	352	448
S7	7.44	2161	1.1	1383	3.1	4.12	0.65	0.25	320	254	326	220
S8	7.48	2160	1.1	1383	3.38	1.43	1.07	0.46	320	260	301	234
S9	7.31	2576	1.3	1649	3.19	1.79	0.58	0.3	400	310	334	326
S10	7.84	1265	0.6	810	3.1	1.29	0.65	0.5	250	136	245	135
S11	7.54	1101	0.5	705	3.01	2.56	1.07	0.48	240	132	231	88
S12	7.9	531	0.3	340	3.15	0.69	0.6	0.41	160	48	158	27
S13	7.3	2495	1.3	1597	3.38	2.18	0.69	0.54	340	300	334	240
S14	7.66	2960	1.5	1894	2.96	3.94	0.54	0.32	440	378	362	454
S15	7.39	1252	0.6	801	3.24	2.49	0.72	0.37	260	142	248	136
S16	6.74	1251	0.6	801	3.24	1.82	0.71	0.35	250	135	244	134
S17	7.85	1813	0.9	1160	2.87	2.21	0.53	0.24	260	176	260	202
S18	7.67	1458	0.7	933	4.17	3.06	0.71	0.35	260	142	244	104
S19	8.61	789	0.4	505	2.64	5.22	0.53	0.42	180	74	208	53
S20	8.22	1763	0.9	1128	2.64	4.93	0.58	0.36	280	182	250	192
S21	7.54	1668	0.8	1068	2.5	2.99	0.66	0.56	270	176	248	178
S22	7.96	399	0.2	255	2.64	3.24	0.69	0.51	140	28	136	36
S23	7.69	2072	1.1	1326	4.75	1.68	0.62	0.7	310	260	272	226
S24	7.82	2066	1.1	1322	3.24	2.03	0.83	0.66	320	258	268	222
S25	8.03	2164	1.1	1385	3.47	0.65	0.6	0.39	340	268	276	230
S26	8.65	424	0.2	271	3.52	1.68	0.95	0.72	140	52	146	38
S27	7.45	962	0.5	616	2.69	1.79	1.08	0.48	220	124	226	82
S28	8.49	828	0.4	530	3.43	1.43	1.15	0.75	200	78	214	58
S29	8.02	2174	1.1	1391	3.15	1.68	0.72	0.68	320	272	290	248
S30	7.33	1318	0.7	844	3.52	1.72	0.65	0.59	240	140	252	138
S31	7.64	603	0.3	386	3.84	2.71	0.92	0.66	160	54	164	34
S32	7.32	2960	1.5	1894	4.12	2.21	0.99	0.87	380	384	362	448
K1	7.32	1321	0.7	846	4.07	2.92	0.61	0.4	260	152	258	88
K2	8.29	869	0.4	556	4.03	1.4	0.62	0.61	200	80	218	62
K3	7.57	1169	0.6	748	3.48	3.8	0.65	0.65	240	127	238	88
K4	7.62	1188	0.6	760	4.54	1.33	0.57	0.42	250	138	244	96
K5	8.27	2434	1.3	1558	4.58	1.29	0.73	0.72	300	280	306	218
K6	7.45	5520	3	3533	3.52	3.66	0.61	0.48	700	1144	790	1205
K7	7.41	5710	3.1	3654	4.58	3.56	1.17	1.14	800	1230	820	1319
K8	7.5	5500	3	3520	4.63	2.07	0.68	0.67	680	1122	785	1205
K9	7.71	1628	0.8	1025	4.17	1.43	1.91	0.58	280	178	248	174
K10	7.59	1628	0.8	1042	4.21	2.14	0.5	0.4	300	196	270	190
K11	7.63	2234	1.1	1430	4.26	2.32	0.55	0.32	360	278	284	218
K12	7.85	600	0.3	384	4.12	1.26	0.67	0.65	160	50	160	48
K13	7.83	613	0.3	392	4.9	1.5	1.08	0.43	180	66	168	62
K14	7.71	975	0.5	624	4.69	3.41	0.7	0.6	260	130	230	86
K15	7.7	1628	0.8	1042	3.52	3.63	0.81	0.14	280	218	276	194
K16	7.82	425	0.2	272	3.51	5.93	0.41	0.36	140	56	148	48
K17	7.84	450	0.2	288	3.2	4.86	0.34	0.3	160	66	162	62
K18	7.58	2335	1.2	1494	2.31	5.36	0.54	0.3	380	288	298	228
K19	8.01	385	0.2	246	3.15	1.5	2.46	0.26	140	40	138	32

K20	7.72	875	0.4	560	2.59	2.39	2.38	0.62	220	120	240	95
K21	7.95	823	0.4	527	4.63	4.79	2.85	1.15	200	108	220	80
K22	7.67	532	0.3	340	6.34	3.77	2.05	0.6	160	45	156	74
K23	8.08	730	0.4	467	3.66	3.13	3.98	0.53	180	66	216	76
K24	7.24	2569	1.3	1644	3.15	3.91	3.15	0.69	360	280	344	367
K25	7.73	1166	0.6	746	2.08	4.09	1.01	0.71	240	146	232	138
K26	7.86	877	0.4	561	2.78	3.7	0.9	0.57	220	124	202	101
K27	7.64	1002	0.5	641	2.04	3.63	2.48	0.7	240	120	245	128
K28	8.02	1104	0.5	707	0.09	2.88	4.47	0.72	240	118	173	136
K29	7.82	3540	1.9	2266	4.12	4.86	2.81	0.73	460	290	396	670
K30	7.96	2728	1.4	1746	3.66	3.8	3.47	0.73	370	253	301	411
J1	7.96	855	0.4	547	220	1.58	2.74	2.72	220	124	206	70
J2	7.86	2558	1.3	1637	350	3.29	7.76	3.07	350	246	298	357
J3	7.91	1616	0.8	1034	270	2.55	4.79	2.92	270	176	248	182
J4	7.6	2536	1.3	1623	340	3.19	3.95	3.02	340	244	296	346
J5	7.99	2798	1.5	1791	400	2.53	3.51	2.14	400	257	304	415
J6	7.45	399	0.2	255	140	2.64	4.19	0.9	140	44	148	48
J7	7.33	346	0.2	221	126	3.75	3.24	1.05	126	35	104	43
J8	7.21	1396	0.7	893	250	3.38	2.92	2.83	250	130	251	146
J9	7.84	1009	0.5	646	230	2.69	2.79	2.67	230	88	215	119
J10	7.88	1537	0.8	984	260	2.73	3.06	2.27	260	148	244	157
J11	8.03	454	0.2	291	130	2.58	4.86	2.61	130	56	150	48
J12	7.91	866	0.4	554	216	4.68	1.4	0.99	216	124	190	74

Table S2. Analyses of essential and trace elements of Sanghar district (subdistrict Sangahr, Khipro and Jam Nawaz Ali).

S ID	Na mg/L	K mg/L	Ca mg/L	Mg mg/L	Mn µg/L	As mg/L	Fe µg/L	Co µg/L	Cu µg/L	Ni µg/L	Pb µg/L	Cd µg/L	F mg/L	Cr µg/L
S1	218	50	116	30	47	0.005	20.7	37.9	4.9	12.9	7.7	4.7	1.88	37
S2	124	11	96	20	70	0	19.2	33.6	5.3	10.9	0	2.9	1.3	67
S3	390	102	272	102	79	0	115.8	14.6	0	96.9	6.9	24.7	8.89	0
S4	115	11	90	15	23	0	256.3	9.8	16.7	37.4	8.8	2.1	0.45	39
S5	26	5	44	10	45	0.025	62.8	15.9	88.5	0	7.1	1.1	0.22	45
S6	260	24	120	130	49	0	13.3	33.9	4.3	76.7	44	24.3	6.44	53
S7	210	18	108	50	14	0	28.9	42.8	5.9	86.9	10.8	11.9	4.1	0
S8	212	22	110	45	11	0	56.4	16.7	89.7	55.1	8.9	8.9	3.9	63
S9	244	23	129	78	17	0	90.3	27.1	1.7	112	0	2.3	4.8	55
S10	120	18	88	30	6	0.005	2.5	12.6	7.8	92.4	34.7	2.6	0.89	41
S11	105	9	86	25	25	0.01	1.9	13.2	0	15.3	12.4	1.8	0.57	71
S12	26	6	56	16	30	0.005	33	36.4	5.3	19.7	7.3	1.2	0.88	96
S13	226	34	116	50	103	0	50.9	23.7	4.2	55.7	6.4	11.4	6.7	0
S14	286	32	128	120	65	0	12.5	23.9	5.1	95.2	34.5	18.9	10.7	42
S15	112	14	89	38	45	0.005	26.4	40.4	5.8	11.6	7.8	2.5	0.75	48
S16	110	16	86	35	76	0.005	9.7	25.3	111.2	53.4	8.4	2.3	0.73	31
S17	201	26	98	15	35	0.005	4.2	17.9	97.2	45.7	29.5	9.8	2.2	52
S18	118	8	96	20	23	0	31.3	34.9	4.3	0	4.3	2.3	0.86	0
S19	62	8	66	15	11	0.025	11.8	33.9	5.3	155	27.9	1.1	0.32	0
S20	182	16	100	26	65	0.01	20	38.5	6.9	16	7.4	5.3	3.78	69
S21	174	15	98	25	16	0	8.5	16.4	4.3	12.6	5.9	4.2	2.1	0
S22	22	5	44	12	11	0.005	9.8	25.3	7.2	34.7	7.7	0.9	0.22	43
S23	212	32	106	45	21	0	20.1	35.2	0	14.7	63.4	12.5	3.9	35
S24	200	26	108	50	10	0	13.2	24.7	56.4	11.9	5.7	8.6	4	83
S25	216	38	110	28	65	0.005	153	28	102	56.4	0	7.3	5.3	63.6

S26	24	6	46	25	80	0.025	8.9	21.4	4.5	61.2	44.3	1.2	0.21	72
S27	86	16	80	20	19	0	4.4	13.5	0	24.8	7.8	1.3	0.42	58.3
S28	68	11	74	15	15	0	12.3	29.7	108.7	14.6	8.7	1.9	0.33	47
S29	219	28.5	112	40	9	0.005	6.9	22.3	3.6	12.4	15.4	6.8	2.7	87
S30	128	28	90	15	282	0.01	5.9	21	2.1	27.6	8.7	2.7	0.44	51.4
S31	32	5	58	14	77	0	103.6	29.8	103.7	63.2	0	1.1	0.32	44.5
S32	296	28	120	80	27	0.005	20.7	36.1	6.3	36.4	8.7	9.9	3.74	65
K1	128	11	96	20	87	0.005	2.4	13.6	0	16.3	7.3	0	1.7	0.87
K2	72	9	76	10	3	0	6.5	22.7	3.9	33.2	8.8	89	1.4	0.33
K3	106	8	86	25	14	0	11.8	32.9	6.4	89.6	3.1	0	1.7	0.56
K4	108	10	88	30	32	0	12.9	30.8	7.9	33.5	8.2	15.4	1.4	0.63
K5	216	18	104	40	8	0	3.9	14.6	11.8	89	0	53	4.9	3.7
K6	1345	101	244	90	14	0	1.2	11.9	7.3	93	38.9	9	26.2	16.9
K7	1349	103	260	149	88	0	38.1	35.3	6.7	33.8	7.9	46	22.5	18
K8	1342	99	240	80	15	0	18.5	42.3	7.3	92.6	33.6	25	18.9	16
K9	160	16	100	30	40	0	5.6	16.7	80.7	76.9	33.2	102	5.4	1.5
K10	162	18	102	45	29	0	18.1	23.8	4.2	13.8	66.2	80.6	3	1.3
K11	210	14	124	50	10	0	12.4	24.3	0	15.8	6.3	0	6.7	3.22
K12	30	11	58	15	15	0	1.9	10.9	9.6	135	8.3	77	1.7	0.73
K13	34	16	62	25	79	0	46.9	13.6	113.2	51.4	8.9	0	1.6	0.22
K14	98	10.5	96	20	23	0	10.2	26.4	6.6	88.9	32.4	0	2.5	0.98
K15	170	24	96	40	10	0	6.4	22.9	5.3	13.5	7.9	95	7.6	3.98
K16	26	6	46	25	6	0	2.5	21	2.9	22.4	7.1	107	0.45	0.12
K17	26	6	48	40	34	0.025	9.9	26.8	5.2	145	7.6	31	0.5	0.38
K18	212	16	130	55	40	0	17.2	48.3	7.5	34.5	8.7	49	11.2	5.1
K19	22	5	49	18	45	0.025	20	38.5	6.9	16	7.4	27	0.9	0.11
K20	73	34	78	25	3	0	8.5	16.4	4.3	12.6	5.9	40	2.2	0.45
K21	72	32	72	20	15	0	9.8	25.3	7.2	34.7	7.7	10	1.9	0.55
K22	48	7	58	15	30	0.005	20.1	35.2	0	14.7	63.4	39	1.3	0.23
K23	69	9	64	20	11	0.025	13.2	24.7	56.4	11.9	5.7	35	2.1	0.43
K24	240	13	128	40	103	0	153	28	102	56.4	0	44	9.2	8.1
K25	96	10	86	26	76	0.005	8.9	21.4	4.5	61.2	44.3	11	2.3	0.76
K26	64	8	79	22	3	0	4.4	13.5	0	24.8	7.8	21	1.6	0.56
K27	98	10.5	86	24	23	0	12.3	29.7	108.7	14.6	8.7	62	1.9	0.6
K28	86	9	85	28	76	0.005	6.9	22.3	3.6	12.4	15.4	38	2.8	0.72
K29	310	28	160	60	8	0	17.2	48.3	7.5	34.5	8.7	67	24.8	10.9
K30	266	18	130	45	7	0	1.9	13.2	0	15.3	12.3	0	10.1	6.8
J1	72	32	80	21	15	0	33	36.4	5.3	19.7	7.3	2.2	0.65	94
J2	240	14	125	38	7	0	50.9	23.7	4.2	55.7	6.4	8.1	6.7	0
J3	168	14	97	28	16	0	12.5	23.9	5.1	95.2	34.5	7.7	1.5	0
J4	238	11	121	38	7	0	26.4	40.4	5.8	11.6	7.8	7.2	4.3	62.8
J5	272	16	140	50	7	0	9.7	25.3	111.2	53.4	8.4	7.9	5.2	9
J6	40	11	50	14	11	0.005	4.2	17.9	97.2	45.7	29.5	0.71	0.21	36
J7	20	5	45	13	80	0.025	31.3	34.9	4.3	0	4.3	0.6	0.11	86
J8	101	11	87	32	87	0.005	11.8	33.9	5.3	155	27.9	1.7	0.89	78
J9	75	14	82	24	19	0	5.9	21	2.1	27.6	8.7	1.9	0.72	76
J10	147	12	94	26	23	0	103.6	29.8	103.7	63.2	0	2.3	1.2	87
J11	42	6	46	15	34	0.025	20.7	36.1	6.3	36.4	8.7	0.81	0.12	37
J12	64	8	77	23	3	0	2.4	13.6	0	16.3	7.3	2.1	0.34	67

Table S3. Water quality analyses foe irrigation of Sanghar district (subdistrict Sangahr, Khipro and Jam Nawaz Ali).

S ID	KI meq/L	SAR Meq/L	PI meq/L	Na% Meq/L
S1	1.1	1.6	94	65
S2	0.8	1.1	101	54
S3	0.8	1.2	67	57
S4	0.9	1.1	103	55
S5	0.4	0.5	101	36
S6	0.7	1.9	72	53
S7	1.0	1.7	94	59
S8	1.0	1.7	92	60
S9	0.8	1.6	81	56
S10	0.8	1.2	95	54
S11	0.7	1.1	96	51
S12	0.3	0.4	98	31
S13	1.0	1.7	93	61
S14	0.8	1.9	75	56
S15	0.6	1.1	90	50
S16	0.7	1.1	92	51
S17	1.4	1.8	103	67
S18	0.8	1.1	98	52
S19	0.6	0.8	111	46
S20	1.1	1.6	95	61
S21	1.1	1.5	96	61
S22	0.3	0.4	107	33
S23	1.0	1.7	89	62
S24	0.9	1.6	85	59
S25	1.2	1.7	96	65
S26	0.2	0.5	88	30
S27	0.7	0.9	101	50
S28	0.6	0.8	107	47
S29	1.1	1.7	92	62
S30	1.0	1.2	106	60
S31	0.3	0.5	103	34
S32	1.0	2.1	87	62
K1	47.5	1.2	101	55
K2	42.0	0.8	112	49
K3	43.0	1.1	97	51
K4	41.8	1.1	94	50
K5	53.6	1.8	96	62
K6	75.6	4.8	101	81
K7	70.6	4.5	95	78
K8	76.5	4.9	102	82
K9	49.6	1.4	92	58
K10	45.9	1.4	88	55
K11	47.8	1.5	84	56
K12	27.7	0.4	99	36
K13	26.7	0.5	87	36
K14	41.2	0.9	95	48
K15	49.6	1.5	93	59
K16	22.7	0.5	89	31

K17	18.3	0.5	77	27
K18	46.5	1.4	83	55
K19	21.6	0.4	92	29
K20	40.4	0.8	102	51
K21	42.9	0.9	104	53
K22	35.3	0.7	98	43
K23	39.9	0.9	109	48
K24	52.5	1.6	95	60
K25	40.7	1.0	95	49
K26	34.0	0.7	93	42
K27	41.8	1.0	100	50
K28	37.7	0.9	79	46
K29	52.2	1.7	89	61
K30	54.0	1.8	88	62
J1	34.0	0.8	95	51
J2	46.7	1.7	91	61
J3	44.7	1.5	94	59
J4	47.0	1.7	92	61
J5	46.3	1.7	85	60
J6	29.2	0.7	102	44
J7	18.4	0.4	84	30
J8	34.5	1.0	95	48
J9	31.0	0.8	94	46
J10	42.4	1.4	95	57
J11	30.2	0.8	106	44
J12	28.3	0.7	90	42