

Supplementary Material

Table S1. Habitat quality threats factors impact weight analysis (2018)

No	Kebele/district	Name	HABITAT	so	wa	pop	ur	pr	unpr	Agri	pol	Is
1	Ambeli	Bare land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13	0.00	0.23	0.01	0.20
		Shrubland	1.00	0.25	0.06	0.39	0.28	0.05	0.04	0.56	0.06	0.09
		Cultivated land	0.35	0.23	0.03	0.42	0.28	0.09	0.07	0.57	0.19	0.14
		Forest land	1.00	0.05	0.07	0.52	0.29	0.82	0.16	0.85	0.10	0.04
		Grazing land	0.50	0.15	0.10	0.79	0.33	0.20	0.24	0.52	0.04	0.31
		Waterbody	1.00	0.10	0.40	0.19	0.26	0.13	0.00	0.80	0.03	0.21
		Woodland	1.00	0.05	0.04	0.49	0.29	0.18	0.14	0.34	0.00	0.01
2	Shebraden	Bare land	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13	0.00	0.37	0.05	0.20
		Shrubland	0.34	0.17	0.13	0.58	0.30	0.29	0.22	0.34	0.08	0.10
		Cultivated land	0.23	0.11	0.10	0.71	0.32	0.46	0.35	0.76	0.19	0.13
		Forest land	1.00	0.05	0.10	0.75	0.33	0.51	0.29	0.84	0.03	0.07
		Grazing land	0.50	0.11	0.03	0.48	0.29	0.16	0.12	0.41	0.04	0.00
		Water body	1.00	0.05	0.40	0.19	0.26	0.13	0.00	0.56	0.05	0.21
		Woodland	0.75	0.10	0.13	0.58	0.30	0.29	0.22	0.32	0.00	0.10
3	Derbo	Bare land	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.52	0.13	0.00
		Built up	0.00	0.05	0.40	0.19	0.26	0.13	0.00	0.86	0.04	0.20
		Shrubland	65.00	0.16	0.10	0.80	0.33	0.58	0.45	0.98	0.07	0.02
		Cultivated land	0.25	0.41	0.10	0.66	0.31	0.40	0.31	0.97	0.19	0.18
		Forest land	1.00	0.05	0.10	0.75	0.33	0.51	0.36	0.93	0.07	0.10
		Grazing land	0.56	0.16	0.20	0.65	0.31	0.13	0.30	0.52	0.04	0.17
		Waterbody	1.00	0.10	0.30	0.19	0.26	0.26	0.10	0.80	0.08	0.21
		Woodland	0.32	0.16	0.24	0.69	0.32	0.44	0.34	0.00	0.00	0.21
		Bare land	0.00	0.05	0.00		0.26	0.00	0.00	0.52	0.00	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13		0.82	0.08	0.20

4	Jembor	Shrubland	0.32	0.27	0.10	0.73	0.32	0.48	0.37	0.86	0.10	0.10
		Cultivated land	0.12	0.07	0.01	0.81	0.34	0.60	0.46	0.87	0.10	0.13
		Forest land	1.00	0.10	0.10	0.83	0.34	0.61	0.47	0.83	0.02	0.15
		Grazing land	0.67	0.17	0.10	0.74	0.33	0.50	0.39	0.76	0.04	0.04
		Water body	1.00	0.05	0.40	0.19	0.26	0.13	0.00	0.77	0.04	0.21
		Woodland	0.56	0.07	0.08	0.53	0.30	0.22	0.17	0.00	0.00	0.05
5	Werbeche	Bare land	0.00	0.05	0.00	0.00	0.26	0.00	0.00	0.52	0.13	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13		0.69	0.03	0.20
		Shrubland	1.00	0.25	0.01	0.46	0.29	0.13	0.10	0.77	0.10	0.03
		Cultivated land	0.35	0.36	0.03	0.43	0.28	0.09	0.07	0.72	18.90	0.35
		Forest land	1.00	0.06	0.18	0.53	0.30	0.22	0.17	0.68	0.02	0.05
		Water body	0.50	0.18	0.03	0.43	0.28	0.09	0.07	0.72	0.04	0.06
		Grazing land	1.00	0.28	0.08	0.53	0.30	0.22	0.17	0.52	0.00	0.05
		Waterbody	1.00	0.10	0.40	0.19	0.00	0.26	0.00	0.60	0.01	0.21
		Woodland	1.00	0.08	0.01	0.23	0.26	0.03	0.07	0.00	0.00	0.01
6	Dakune	Bare land	0.00	0.05	0.00	0.00	0.26	0.00	0.00	0.52	0.13	0.00
		Built up	0.00	0.05	0.40	0.19	0.26	0.13	0.00	0.82	0.02	0.20
		Shrubland	1.00	0.15	0.03	0.42	0.28	0.09	0.07	0.72	0.04	0.06
		Cultivated land	0.35	0.26	0.07	0.52	0.29	0.21	0.16	0.80	0.07	0.04
		Forest land	1.00	0.09	0.10	0.68	0.32	0.42	0.32	0.72	0.04	0.20
		Grazing land	0.50	0.08	0.07	0.52	0.29	0.21	0.16	0.82	0.04	0.04
		Water body	1.00	0.18	0.40	0.72	0.32	0.47	0.36	0.70	0.01	0.24
		Woodland	1.00	0.07	0.04	0.26	0.26	0.07	0.15	0.52	0.00	0.05
7	Gonchebet	Bare land	0.00	0.05	0.00	0.19	0.26	0.00	0.00	0.52	0.00	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13	0.00	0.77	0.13	0.21
		Shrubland	1.00	0.35	0.17	0.62	0.31	0.34	0.26	0.72	0.04	0.14
		Cultivated land	0.35	0.57	0.07	0.52	0.29	0.21	0.16	0.90	0.12	0.04
		Forest land	1.00	0.23	0.10	0.89	0.35	0.70	0.54	0.77	0.06	0.01
		Grazing land	0.50	0.21	0.17	0.62	0.31	0.34	0.26	0.52	0.04	0.14
		Waterbody	1.00	0.10	0.40	0.19	0.26	0.26		0.24	0.04	0.21

		Woodland	1.00	0.41	0.07	0.52	0.29	0.21	0.16	0.21	0.00	0.04
8	Achewede	Bare land	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.52	0.13	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13	0.00	0.77	0.02	0.20
		Shrubland	1.00	0.31	0.03	0.42	0.28	0.09	0.07	0.55	0.04	0.06
		Cultivated land	0.35	0.53	0.09	0.54	0.30	0.24	0.19	0.67	0.06	0.06
		Forest land	1.00	0.06	0.16	0.61	0.31	0.33	0.26	0.79	0.07	0.13
		Grazing land	0.50	0.17	0.21	0.66	0.31	0.40	0.31	0.52	0.04	0.18
		Waterbody	1.00	0.10	0.40	0.19	0.26	0.13	0.10	0.64	0.07	0.21
		Woodland	1.00	0.08	0.19	0.64	0.31	0.37	0.29	0.52	0.00	0.16
9	Kumishe	Bare land	0.00	0.05	0.00	0.19	0.26	0.00	0.00	0.52	0.13	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13	0.00	0.79	0.07	0.21
		Shrubland	1.00	0.61	0.21	0.66	0.31	0.40	0.31	0.92	0.07	0.18
		Cultivated land	0.35	0.65	0.01	0.44	0.28	0.11	0.09	0.56	0.05	0.16
		Forest land	1.00	0.08	0.12	0.57	0.30	0.28	0.22	0.68	0.02	0.09
		Grazing land	0.50	0.33	0.01	0.44	0.28	0.11	0.09	0.52	0.04	0.04
		water body	1.00	0.05	0.10	0.19	0.26	0.26	0.10	0.64	0.04	0.21
		Woodland	1.00	0.07	0.09	0.54	0.30	0.24	0.19	0.43	0.00	0.06
10	Bankewet	Bare land	0.00	0.05	0.00	0.19	0.00	0.00	0.00	0.52	0.00	0.00
		Built up	0.00	0.05	0.00	0.19	0.26	0.13	0.00	0.68	0.02	0.21
		Shrubland	1.00	0.27	0.01	0.44	0.28	0.37	0.09	0.92	0.02	0.04
		Cultivated land	0.35	0.51	0.01	0.44	0.28	0.11	0.09	0.90	0.03	0.04
		Forest land	1.00	0.20	0.44	0.89	0.35	0.50	0.54	0.68	0.02	0.01
		Grazing land	0.50	0.21	0.01	0.44	0.28	0.50	0.09	0.52	0.04	0.04
		waterbody	1.00	0.10	0.40	0.19	0.26	0.26	0.10	0.64	0.07	0.20
		Woodland	1.00	0.07	0.19	0.64	0.31	0.37	0.29	0.52	0.00	0.16
11	Yafter	Bare land	0.00	0.00	0.00	0.19	0.10	0.00	0.00	0.52	0.13	0.00
		Built up	0.00	0.05	0.00	0.10	0.26	0.13	0.10	0.21	0.07	0.20
		Shrubland	1.00	0.24	0.01	0.44	0.28	0.11	0.09	0.78	0.02	0.16
		Cultivated land	0.35	0.51	0.01	0.44	0.28	0.38	0.09	0.67	0.07	0.04
		Forest land	1.00	0.05	0.19	0.64	0.31	0.50	0.29	0.78	0.02	0.10

		Grazing land	0.50	0.21	0.01	0.44	0.28	0.37	0.19	0.52	0.04	0.04
		Waterbody	1.00	0.10	0.40	0.19	0.26	0.26	0.10	0.69	0.07	0.10
		Woodland	1.00	0.21	0.10	0.65	0.31	0.38	0.30	0.23	0.00	0.10
12	Abeke	Bare land	0.00	0.05	0.00	0.19	0.10	0.00	0.00	0.00	0.13	0.00
		Built up	0.00	0.05	0.00	0.10	0.26	0.13	0.10	0.12	0.03	0.20
		Shrubland	1.88	0.22	0.07	0.38	0.27	0.03	0.03	0.73	0.04	0.00
		Cultivated land	1.00	0.26	0.09	0.54	0.30	0.50	0.19	0.76	0.03	0.06
		Forest land	0.50	0.05	0.10	0.86	0.34	0.50	0.51	0.74	0.05	0.02
		Grazing land	1.00	0.26	0.10	0.55	0.30	0.38	0.20	0.65	0.04	0.00
		Waterbody	1.00	0.10	0.40	0.19	0.26	0.26	0.10	0.69	0.07	0.10
		Woodland	1.00	0.06	0.10	0.25	0.31	0.25	0.30	0.24	0.32	0.10
		Average factors impact weight		0.16	0.11	0.40	0.31	0.24	0.23	0.59	0.25	0.10

Table S2. Habitat quality threats factors impact weight analysis (1988)

	Kebele/district	Name	HABITAT	so	wa	pop	ur	pr	unpr	Agri	pol	Is
1	Ambeli	Shrubland	1.00	0.03	0.01	0.03		0.00	0.01	0.01	0.01	0.02
		Cultivated land	0.35	0.01	0.00	0.03	0.00	0.01	0.03	0.03	0.04	0.03
		Forest land	1.00	0.00	0.01	0.04	0.00	0.08	0.07	0.07	0.03	0.01
		Grazing land	0.50	0.01	0.05	0.08	0.00	0.06	0.09	0.09	0.07	0.06
		Woodland	1.00	0.00	0.01	0.04	0.01	0.02	0.05	0.05	0.02	0.00
2	Shebraden	Shrubland	0.34	0.02	0.02	0.05	0.00	0.03	0.09	0.09	0.04	0.02
		Cultivated land	0.23	0.01	0.04	0.07	0.01	0.05	0.14	0.14	0.05	0.03
		Forest land	1.00	0.00	0.04	0.07	0.01	0.05	0.12	0.12	0.03	0.01
		Grazing land	0.50	0.01	0.00	0.04	0.01	0.02	0.05	0.05	0.02	0.00
		Woodland	0.75	0.01	0.02	0.05	0.00	0.03	0.09	0.09	0.04	0.02
3	Derbo	Shrubland	65.00	0.02	0.02	0.08	0.01	0.06	0.18	0.18	0.02	0.00
		Cultivated land	0.25	0.05	0.03	0.06	0.01	0.04	0.12	0.12	0.05	0.04
		Forest land	1.00	0.00	0.04	0.07	0.01	0.05	0.14	0.14	0.06	0.05
		Grazing land	0.56	0.02	0.03	0.06	0.01	0.04	0.12	0.12	0.05	0.03
		Woodland	0.32	0.02	0.03	0.07	0.01	0.04	0.13	0.13	0.05	0.04
4	Jembor	Shrubland	0.32	0.03	0.04	0.07	0.01	0.05	0.15	0.15	0.06	0.05
		Cultivated land	0.12	0.00	0.00	0.08	0.01	0.06	0.18	0.18	0.07	0.03
		Forest land	1.00	0.01	0.05	0.08	0.01	0.06	0.19	0.19	0.07	0.03
		Grazing land	0.67	0.02	0.04	0.07	0.01	0.05	0.15	0.15	0.02	0.01
		Woodland	0.56	0.00	0.01	0.04	0.01	0.02	0.07	0.07	0.03	0.01
5	Werbeche	Shrubland	1.00	0.03	0.00	0.04	0.01	0.01	0.04	0.04	0.02	0.01
		Cultivated land	0.35	0.04	0.00	0.03	0.00	0.01	0.03	0.03	0.07	0.07
		Forest land	1.00	0.00	0.03	0.04	0.00	0.02	0.07	0.07	0.03	0.01
		Grazing land	0.50	0.02	0.00	0.03	0.01	0.01	0.03	0.03	0.01	0.01
		Woodland	1.00	0.03	0.01	0.04	0.00	0.02	0.07	0.07	0.03	0.01

6	Dakune	Shrubland	1.00	0.01	0.00	0.03	0.01	0.01	0.03	0.03	0.01	0.01
		Cultivated land	0.35	0.03	0.01	0.04	0.00	0.02	0.07	0.07	0.03	0.01
		Forest land	1.00	0.01	0.03	0.07	0.00	0.04	0.13	0.13	0.05	0.04
		Grazing land	0.50	0.00	0.01	0.04	0.01	0.02	0.07	0.07	0.03	0.01
		Woodland	1.00	0.02	0.04	0.07	0.00	0.05	0.15	0.15	0.06	0.05
7	Gonchebet	Shrubland	1.00	0.04	0.02	0.06	0.01	0.04	0.11	0.11	0.04	0.03
		Cultivated land	0.35	0.07	0.01	0.04	0.01	0.02	0.07	0.07	0.03	0.01
		Forest land	1.00	0.03	0.06	0.09	0.00	0.07	0.21	0.21	0.08	0.00
		Grazing land	0.50	0.02	0.02	0.06	0.01	0.04	0.11	0.11	0.04	0.03
		Woodland	1.00	0.05	0.01	0.04	0.01	0.02	0.07	0.07	0.03	0.01
8	Achewede	Shrubland	1.00	0.04	0.00	0.03	0.00	0.01	0.03	0.03	0.01	0.01
		Cultivated land	0.35	0.07	0.01	0.05	0.00	0.02	0.07	0.07	0.03	0.01
		Forest land	1.00	0.00	0.02	0.06	0.01	0.03	0.10	0.10	0.04	0.03
		Grazing land	0.50	0.02	0.03	0.06	0.01	0.04	0.12	0.12	0.05	0.04
		Woodland	1.00	0.00	0.03	0.06	0.01	0.04	0.11	0.11	0.04	0.03
9	Kumishe	Shrubland	1.00	0.08	0.03	0.06	0.01	0.04	0.12	0.12	0.05	0.04
		Cultivated land	0.35	0.09	0.00	0.03	0.01	0.01	0.03	0.03	0.04	0.03
		Forest land	1.00	0.00	0.02	0.05	0.00	0.03	0.09	0.09	0.03	0.02
		Grazing land	0.50	0.04	0.00	0.03	0.01	0.01	0.03	0.03	0.02	0.01
		Woodland	1.00	0.00	0.01	0.05	0.00	0.02	0.07	0.07	0.03	0.01
10	Bankewet	Shrubland	1.00	0.03	0.00	0.03	0.01	0.04	0.03	0.03	0.02	0.01
		Cultivated land	0.35	0.07	0.00	0.03	0.00	0.01	0.03	0.03	0.02	0.01
		Forest land	1.00	0.02	0.06	0.09	0.00	0.04	0.21	0.21	0.02	0.00
		Grazing land	0.50	0.02	0.00	0.03	0.01	0.05	0.03	0.03	0.02	0.01
		Woodland	1.00	0.00	0.03	0.06	0.00	0.04	0.11	0.11	0.04	0.03
11	yafter	Shrubland	1.00	0.03	0.00	0.03	0.01	0.01	0.03	0.03	0.04	0.03
		Cultivated land	0.35	0.07	0.00	0.03	0.00	0.01	0.03	0.03	0.02	0.01
		Forest land	1.00	0.00	0.03	0.06	0.00	0.04	0.11	0.11	0.04	0.03
		Grazing land	0.50	0.02	0.00	0.03	0.01	0.04	0.07	0.07	0.02	0.01

		Woodland	1.00	0.02	0.03	0.06	0.00	0.04	0.12	0.12	0.05	0.03
12	Abeke	Shrubland	1.5	0.02	0.01	0.03	0.01	0.00	0.01	0.01	0.02	0.00
		Cultivated land	1.00	0.03	0.01	0.05	0.00	0.02	0.07	0.07	0.03	0.01
		Forest land	0.50	0.00	0.06	0.09	0.01	0.03	0.20	0.20	0.02	0.00
		Grazing land	1.00	0.03	0.01	0.05	0.01	0.04	0.08	0.08	0.03	0.00
		Woodland	1.00	0.00	0.03	0.06	0.01	0.03	0.12	0.12	0.05	0.03
	Average factors impact weight			0.023	0.020	0.053	0.006	0.033	0.092	0.092	0.035	0.020

Table S3. The maximum distance (d-max) of the threat affect the habitat quality

Expert Number	Maximum Distance impact habitat quality								
	Soil erosion (so)	Water abstraction (wa)	Population (pop)	Urbanization (ur)	Paved road (pr)	unpaved road (unpr)	Agriculture (agr)	Pollution (pol)	Invasive species (Is)
1	1	28	1.5	5	1	0.5	0.5	10	0.5
2	1.5	21	3.5	1.3	0.25	0.25	1	9	1
3	1	23	1	1	1.5	1	1.75	15	1.75
4	1.5	34	3.5	2.5	2	0.5	0.5	22	0.5
5	0.5	30	1.5	4	2.5	0.5	1.25	32	1.25
6	0.25	21	1.5	1.5	3	0.75	1.5	31	1.5
7	1.5	45	2.5	0.5	1	0.5	0.5	21	0.5
8	1	12	2	2.75	0.5	0.25	1	29	1
9	1	32	2	2.75	0.75	1.5	0.5	12	0.5
10	0.5	36	1.5	2.25	2	0.25	1	15	1
11	0.24	21	1	1.75	1	0.5	1.25	30	1.25
12	1.5	32	2.5	3.25	1.5	0.75	1.5	20	0.25
13	1	21	2	2.75	1.5	0.25	1	26	0.75
14	0.5	44	2	2.75	0.75	0.25	1	12	1.5
15	1	32	3	6	2	0.5	0.5	4.5	0.25
16	0.5	26	1.5	2.3	2.5	0.25	1	5	1
17	2	18	2	2	3	0.75	1.5	5.5	1.25
18	1	21	2	3.5	1.5	0.25	1	5	0.25
19	1.5	23	2.5	5	1.5	0.25	1	5	0.75
20	0.5	34	1.5	2.5	1	0.75	1.5	5.5	0.25
21	0.25	30	1	1.5	1.25	1	0.5	4.5	0.75
22	1.5	21	2.5	3.05	2.5	0.25	1	5	1
23	1.5	45	2.5	3.05	1.5	1.25	2	6	0.25
24	1	12	2	2.55	2	0.25	0.5	4.5	0.75
25	0.5	32	1.5	2.29	2	1.75	2.5	6.5	1.5
26	0.24	36	1	3.55	1.25	1	0.5	4.5	0.25
27	1.5	21	2.5	3.05	2.5	0.25	1	13	1

28	1	32	2	2.55	3	0.25	1	36	1.25
29	0.5	21	1.5	3	1.5	1.25	0.5	14	0.25
30	1	44	1.5	3	4	0.25	1	13	0.75
31	1.4	37	2.5	4	2	0.25	1	19	0.25
32	2	27	3	4.5	1.5	0.25	1	26	0.75
33	0.5	23	1	2.5	1.75	1.5	0.5	36	1
34	1.5	26	2.5	4	3	0.25	1	35	0.75
35	0.5	28	1.5	3	2	1.75	2.5	25	1.25
36	0.5	39	1.5	3	2.5	0.25	1	33	2
37	0.5	35	1.5	3	2.5	0.25	1	16	0.75
38	2	26	3	4.5	1.75	0.5	0.5	19	1.5
39	0.5	50	1.5	3	3	0.75	1.5	34	1.75
40	0.5	17	1	2.5	1.5	1.25	0.5	24	0.75
41	0.24	37	1	2.5	4	0.25	1	30	1.25
42	2	41	2	3.5	2.5	0.5	0.5	16	0.75
43	1	26	2	3.5	2.5	0.25	1	15	1.25
44	1	37	2	3.5	2	0.75	0.5	14	1.5
45	0.25	26	1	2.5	2.25	0.25	1	20	0.5
46	1	49	2	3.5	1.5	0.25	0.5	27	1
47	2	37	3	4.5	2.5	0.25	1	37	1.75
48	1	27	2	3.5	3	0.5	1.25	36	0.5
49	1.5	24	2.5	4	0	1	0.5	26	1.25
50	0.5	27	1.5	3	0.75	0.25	1	34	1.5
51	0.25	29	1	2.5	0.5	0.25	1	17	0.5
52	3	30	4	5.5	1	0.25	1	20	1
53	2	36	3	4.5	1.5	0.5	0.5	35	0.5
54	1	27	2	3.5	2	1	1.75	25	1
55	0.5	51	1.5	3	0	0.25	0.5	31	1.25
56	0.24	18	1.5	3	0.5	0.25	1	17	0.5
57	1.3	38	2	4.8	0.25	0.25	0.5	9.5	1
58	0.5	42	1.5	3.8	1	0.75	1.5	11.5	1.75
59	1	27	2	3.8	0	0.75	0.5	9.5	0.5
60	0.5	38	1.5	3.05	0.5	0.25	1	10	1.25

61	1	27	2	3.8	0.5	0.25	0.5	10	1.5
62	2	30	3	4.8	0.25	0.75	1.5	19	0.5
63	1	38	2	3.8	1	0.25	1	18	1
64	1.5	28	2.5	4.3	1.5	0.75	0.5	24	0.5
65	0.5	24	1	3.3	2	0.75	1.5	31	1
66	0.25	27	1.5	3.05	0.5	0.25	0.5	20	1.25
67	0.5	27	1.5	5.8	0.5	0.5	1.25	40	0.75
68	2	23	3	4.8	0	0.75	0.5	30	1
69	1	36	2	3.8	0.25	0.75	1.5	38	1.5
70	0.5	27	1.5	3.5	1.5	0.25	1	21	0.25
71	0.24	32	1.5	3.04	0.5	0.5	0.5	24	2
72	2	18	3	2	1	1	1.75	39	1.5
Average	1.0	30.0	2.0	3.3	1.5	0.6	1.0	20.0	1.0

Table S4. Threats impact distance decay function

	Decay Distance function								
Expert number	Soil erosion (so)	Water abstraction (wa)	Population (pop)	Urbanization (ur)	Paved road (pr)	uppaved road	Agriculture (agr)	Pollution (pol)	Invasive species (Is)
1	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
2	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
3	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
4	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
5	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
6	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
7	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
8	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
9	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
10	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
11	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
12	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
13	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
14	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
15	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
16	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
17	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
18	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
19	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
20	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
21	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
22	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
23	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear
24	Exponential	Linear	Exponential	Exponential	Linear	Linear	Linear	Exponential	Linear

[illegible]

[illegible]

Table S5. The habitat threats, their weight, maximum distance and decay for 1988,1998, 2008 and 2018.

2018				1998			
MAX DIST	WEIGHT	THREAT	DECAY	MAX DIST	WEIGHT	THREAT	DECAY
1	0.7	so	linear	1	0.4	so	linear
30	0.6	wa	exponential	0	0	wa	exponential
2	1	pop	exponential	2	0.6	pop	exponential
7	0.5	ur	exponential	0	0	ur	exponential
1	1	pr	linear	0	0	pr	linear
0.5	0.7	unpr	linear	0.5	0.7	unpr	linear
1	0.6	agr	linear	0.5	0.6	agr	linear
20	0.5	pol	exponential	0	0	pol	exponential
2008				1988			
MAX DIST	WEIGHT	THREAT	DECAY	MAX DIST	WEIGHT	THREAT	DECAY
1	0.6	so	linear	0.5	0.2	so	linear
0	0	wa	exponential	0	0	wa	exponential
2	0.8	pop	exponential	1.5	1	pop	exponential
0	0.4	ur	exponential	0	0	ur	exponential
0	0	pr	linear	0	0	pr	linear
0.5	0	unpr	linear	0.5	0.7	unpr	linear
1	0.5	agr	linear	1	0.6	agr	linear
0	0	pol	exponential	0	0	pol	exponential

Questionnaire S6. Survey data gathering questionnaires

Modeling of Habitat quality at Winike Watershed, Omo Gibe, south western Ethiopia

Investigator: Abreham Berta

QUESTIONNAIRE AND DATA FORMAT

Objectives to identify

- Habitat types
- Threat types
- Distance threat and the habitat
- Sensitivity of the threat for the habitat

Data Collection and tools used

Data collection will be gathered using tools such as key interviews, focus group discussion and local indigenous ecological knowledge from each sampling kebeles. Semi-structured questionnaire (close and open ended) will be used to seek information from respondents especially those who have local indigenous ecological knowledge. Leaders and members of cooperatives, expert (expert of natural resource, forestry and ecologist officer will be our data sources. Information includes the habitat types in which the wildlife occupied, the major threat that affect the biodiversity, their effect status on the habitat, the distance between the habitat and the threat. The questionnaire basically prepared for three major data sources (KII, FGD and local indigenous ecological knowledge participants). After compressive review of literature, data analysis will be done by requesting the questionnaire for each data sources. Intensity of the threat information also gathered by comparing which one is more affect the habitat quality.

The method of sampling is purposive and 72 experts will be participated for gathering the data. The standard sampling size for FGD is 7 to 10 in one cluster and 24 cluster of FGD will be undertaken in the watershed from the total villages. Local indigenous ecological knowledge will be participated in the FGD to grasp their indigenous local ecological knowledge and information of the area.

Part I. Expert (KII)---Fulfill by 72 experts

A. General Information

A. Name _____ Age _____ Sex ____ Education-----

- B. Village _____
- C. Major occupation _____
- D. How long have you lived in the area? _____

b. Basic data

- a. Number of land use types _____
- b. Mention the land use types _____
- c. Total forest in hectare _____
- d. Total agricultural land in hectare _____
- e. Woodland area in ha _____
- f. Others _____

1. What are the challenges for your land management?

2. What are the types of habitat types in your locality?

3. Mention the threat types for each land use

- I. -----
- II. -----
- III. -----
- IV. -----
- V. -----
- VI. -----

4. The possible method for mitigation of threat impact on the habitat?

5. What is the effect of occurring these threats in your locality?

- I. -----
- II. -----
- III. -----
- IV. -----
- V. -----
- VI. -----

6. Mention the maximum distance between habitat between the threat

7. Which threat is distributed quickly to the surround habitat/ecosystem? (linear)

8. Which threat is slowly disturbed that bring huge long-term effect on the ecosystem? (exponential)

9. Wah do you think the contribution of pristine habit quality?

10. All the necessary information will be fulfilling by the expert

No.	Habitat types	Types of threat	Distance b/n habitat that the threat	Maximum distance affected	Distance decay*	Remarks
1						
2						
3						
4						
5						
6						
7						

**Distance decay = is the threat has long and short-term effect?*

This table should be fulfilling by 72 experts in 12 villages (6 experts in each village)

11. Sensitivity analysis of the threats using APH model --- *pairwise comparison matrix*

(Identification and knowing the threats type is mandatory to analyze APH model)

A pairwise comparison matrix, with 1 to 5 preference scale using Likert scale was done.

Based on Likert scale, a threat may be impact to the habitat quality as 5 (very high), 4 (pose a high threat), 3 (pose a medium threat), 2 (pose a low threat), 1 (poses no threat) and 0 (do not know).

Example: what is the intensity of **soil erosion**?

(very high) --5

(pose a high threat) --4

(pose a medium threat) --3

(pose a low threat) --2

(poses no threat) --1

(do not know) --0

- Comparison between soil erosion and population pressure. From these two threats, which one is more affect the habitat
- Which one is more severely affected to the habitat? Soil erosion Vs urbanization, water abstraction Vs soil erosion etc. this will be used for comparison of the threats in table 1 then drive table 2

Table 1. Expert judgment matrix format. *This value will be provided by expert judgment based on professional experience by comparison one form the other (comparing two threat impact)*

Factors	so	wa	pop	ur	pr	unpr	agr	wa	Is
so	so/so	so/wa	so/pop	...	...	...			
wa	1/(wa/so)								
pop	pop/so								
ur	ur/so								
pr	pr/so								
unpr	,,,								
agr	,,								
wa	wa/so								
Is	Is/so								
Sum	sum								

Table 2. Weight matrix format..... Each threat value in the table 1 divided by the total **sum** of the column each threat in the table 1. Finally, average of each threat value in row is threat weight/intensity (average in table 2)

Factors	so	wa	pop	ur	pr	unpr	agr	wa	Is	Average
so	$(so/so)/sum$									
wa	$(1/(wa/so))/sum$									
pop	$(pop/so)/sum$									
ur	$(pr/so)/sum$									
pr	$(pr/so)/sum$									
unpr	""""									
agr	""""									
wa	$(wa/so)/sum$									
Is	$(ls/so)/sum$									

Part II: Focus Group Discussions (FGD) and Key Informant Interview (KII)

A. General information

District _____ Group _____ Date _____

Name of Participant	village	Sex	Age	Religion	Educ.	Occupation	Organization

--	--	--	--	--	--	--	--

B. Basic data

- How do you define and use habitat quality in your locality?

- What are the major threats in your locality?

- Do you think that habitat quality is increased? If you say “yes” what are indicator in your locality?

10. Fill the following table concerning the habitat quality

No.	Types of threat	Habitat existence	Habitat types	Distance b/n habitat that the threat	Maximum distance affected	Distance decay	Remark
1							
2							
3							
4							
5							
6							

This table is fulfilling in 12 village and have 12 cluster of discussion with a combination of different participants

4. From your experience, how do you conserve habitat quality? Which types of conservation is best appropriate in your locality?

5. Which threat is more severely affect the habitat in your area?

6. What is the maximum distance between each habitat and threat? (distance the threat and forest and another habitat)

7. Which threat is quickly distributed in your area? which one is slowly affecting the ecosystem but long-term effect?

8. What is your recommendation for conservation of habitat quality for sustainability of the watershed?

9. Do you recognize the habitat quality contribution in your locality?

A. Social contribution _____ -

B. Economic contribution _____ -

C. Environmental contribution _____ -

Thank you!