

Table S1. The characteristics of vegetation.

Site	Vegetation types	Afforestation years (a)	Understory herbs				Forest and shrub biomass (Mg/ha)	Total vegetation biomass (Mg/ha)	Dominant species
			Shannon index	Simpson index	Pielou Index	Herb biomass (Mg/ha)			
1	forest	40	0.93	0.55	0.85	11.51	48.32	59.83	<i>Picea asperata</i> Kom.
2	forest	40	1.62	0.79	0.94	12.08	29.28	41.35	<i>Picea asperata</i> Kom.
3	shrub	40	1.88	0.81	0.87	11.45	17.39	28.84	<i>Caragana korshinskii</i> Kom.
4	shrub	40	2.02	0.84	0.89	19.68	11.14	30.82	<i>Caragana korshinskii</i> Kom.
5	grass	40	2.02	0.86	0.97	7.6	0	7.6	<i>Tribulus terrestris</i> L., <i>Agropyron cristatum</i> L., <i>Artemisia capillaris</i> Thunb.
6	grass	40	1.77	0.8	0.91	5.39	0	5.39	<i>Aster hispidus</i> Thunb., <i>Eleusine indica</i> L., <i>Tribulus terrestris</i> L.
7	grass	40	1.79	0.8	0.86	9.34	0	9.34	<i>Aster hispidus</i> Thunb., <i>Poa sphondylodes</i> Trin., <i>Potentilla chinensis</i> Ser.
8	forest	25	1.46	0.72	0.9	17.83	15.29	33.12	<i>Picea asperata</i> Kom.
9	forest	25	1.9	0.8	0.86	9.44	17.62	27.06	<i>Picea asperata</i> Kom.
10	forest	25	1.63	0.75	0.84	9.26	19.08	28.33	<i>Picea asperata</i> Kom.
11	forest	25	1.8	0.79	0.87	16.85	34.67	51.52	<i>Picea asperata</i> Kom.
12	shrub	25	1.95	0.85	0.96	11.35	4.31	15.66	<i>Caragana korshinskii</i> Kom.
13	shrub	25	1.91	0.83	0.91	12.94	3.95	16.89	<i>Caragana korshinskii</i> Kom.
14	grass	25	2.22	0.87	0.92	8.76	0	8.76	<i>Sonchus wightianus</i> DC, <i>Aster hispidus</i> Thunb., <i>Anaphalis sinica</i> Hance
15	grass	25	2.51	0.91	0.95	16.76	0	16.76	<i>Medicago falcata</i> L., <i>Artemisia capillaris</i> Thunb.
16	forest	10	1.74	0.79	0.9	14.9	14.38	29.28	<i>Picea asperata</i> Kom.
17	forest	10	1.15	0.6	0.79	10.64	7.16	17.81	<i>Picea asperata</i> Kom.
18	shrub	10	2.13	0.86	0.93	6.87	3.74	10.61	<i>Caragana korshinskii</i> Kom.
19	shrub	10	1.38	0.72	0.92	18.91	12.12	31.03	<i>Caragana korshinskii</i> Kom.
20	shrub	10	0.78	0.44	0.66	31.58	6.02	37.6	<i>Caragana korshinskii</i> Kom.
21	grass	10	2.18	0.87	0.91	11.45	0	11.45	<i>Psathyrostachys splendens</i> Trin., <i>Sporobolus fertilis</i> Steud., <i>Elsholtzia ciliata</i> Thunb.
22	grass	10	2.24	0.87	0.9	13.21	0	13.21	<i>Dracocephalum heterophyllum</i> Benth., <i>Elsholtzia ciliata</i> Thunb., <i>Artemisia capillaris</i> Thunb.
23	grass	10	1.83	0.82	0.88	12.51	0	12.51	<i>Aster hispidus</i> Thunb., <i>Sonchus wightianus</i> DC., <i>Agropyron cristatum</i> L.

Table S2. The Source of variance and multiple comparisons of soil nutrient characteristics.

Soil layer		STN		STP		SAP		SAN		SNN	
		F	η^2	F	η^2	F	η^2	F	η^2	F	η^2
0-20cm	Ref	1.50	—	0.12	—	0.35	—	0.25	—	2.67	—
	Red	10.12**	0.36	2.07	—	1.14	—	2.17	—	2.97	—
	Ref×Red	6.31**	0.45	1.10	—	0.75	—	0.37	—	1.12	—
20-40cm	Ref	0.90	—	1.25	—	0.71	—	1.30	—	3.30	—
	Red	3.55	—	0.77	—	0.77	—	5.78*	0.18	7.90**	0.35
	Ref×Red	5.69**	0.53	0.70	—	1.95	—	8.54***	0.55	3.30*	0.3
40-60cm	Ref	1.88	—	0.92	—	1.83	—	6.35**	0.25	0.84	—
	Red	2.49	—	0.29	—	0.03	—	3.76*	0.15	4.04*	0.31
	Ref×Red	9.59**	0.64	0.70	—	1.32	—	3.78*	0.30	0.69	—
60-80cm	Ref	2.28	—	0.06	—	0.83	—	0.24	—	3.37	—
	Red	1.40	—	5.11*	0.35	1.25	—	6.83**	0.38	4.71*	0.26
	Ref×Red	7.54**	0.59	0.91	—	0.98	—	1.82	—	2.11	—
80-100cm	Ref	2.00	—	0.23	—	0.03	—	0.70	—	11.57***	0.28
	Red	5.84*	0.2	1.52	—	0.96	—	1.38	—	11.69***	0.28
	Ref×Red	7.24**	0.5	1.73	—	0.14	—	1.76	—	7.97***	0.38

Table S3. Soil nutrient characteristics.

Soil layer	Revegetation types	Years	STN(g/kg)	STP(g/kg)	SAP(mg/kg)	SAN(mg/kg)	SNN(mg/kg)
0-20cm	Forestland	10a	0.7±0.09b	0.77±0.03a	9.07±0.61a	14.31±1.94a	0.44±0.05a
		25a	1.11±0.17b	0.78±0.18a	7.15±1.77a	15.28±2.06a	0.52±0.06a
		40a	1.53±0.33ab	0.64±0.02a	6.71±0.27a	15.54±1.27a	0.53±0.12a
	Shrubland	10a	1.03±0.32b	0.8±0.1a	7.06±3.19a	12.84±1.56a	0.4±0.06a
		25a	1.49±0.78ab	0.64±0.03a	7.64±1.05a	17.15±2.61a	0.49±0.11a
		40a	1.35±0.39b	0.68±0.07a	5.78±0.17a	19.52±2.08a	0.8±0.2a
	Grassland	10a	1.06±0.08b	0.72±0.06a	6.73±1.52a	11.86±0.67a	0.56±0.08a
		25a	2.24±0.07a	0.78±0.04a	8.7±3.07a	17.43±1.67a	0.83±0.03a
		40a	0.83±0.11b	0.67±0.04a	6.78±1.3a	21.62±13.72a	0.7±0.38a
20-40cm	Forestland	10a	0.62±0.05bc	0.81±0.01a	6.4±2.98ab	16.16±0.67b	0.36±0.14c
		25a	0.6±0.09bc	0.73±0.15a	3.24±0.79b	15.78±1.5b	0.46±0.05bc
		40a	1.21±0.67ab	0.65±0.06a	6.28±1.4ab	14.74±2.41b	0.54±0.16abc
	Shrubland	10a	0.66±0.04bc	0.78±0.09a	4.79±1.49ab	11.26±2.09b	0.41±0.02bc
		25a	1.15±0.75ab	0.7±0.1a	6.77±2.11ab	12.75±0.4b	0.67±0.14a
		40a	1.29±0.06ab	0.76±0.11a	5.29±0.7ab	23.54±2.55a	0.6±0.05ab
	Grassland	10a	0.8±0.28bc	0.66±0.03a	6.11±1.37ab	12.27±0.38b	0.52±0.09abc
		25a	1.66±0.5a	0.68±0.04a	5.53±2.46ab	16.72±0.94b	0.72±0.06a
		40a	0.44±0.1c	0.68±0.03a	7.19±1.5a	13.35±4.44b	0.44±0.11bc
40-60cm	Forestland	10a	0.67±0.23b	0.68±0.11a	7.39±1.93ab	12.65±0.27bc	0.44±0.02ab
		25a	0.6±0.2b	0.74±0.16a	4.67±2.51ab	16.3±1.23b	0.46±0.06ab
		40a	0.72±0.21b	0.6±0.06a	6.78±1.41ab	14.17±1.61bc	0.53±0.11ab
	Shrubland	10a	0.61±0.06b	0.76±0.08a	7.19±3.44ab	12.71±1.34bc	0.42±0.05ab
		25a	0.69±0.2b	0.68±0.04a	9.63±3.33a	14.73±2.14bc	0.63±0.18a
		40a	1.3±0.3a	0.74±0.03a	5.91±1.22ab	20.8±6.97a	0.58±0.05ab
	Grassland	10a	0.61±0.22b	0.64±0.16a	4.79±1.97ab	11.26±0.22bc	0.39±0.1b
		25a	1.26±0.28a	0.67±0.03a	4.17±2.28b	14.07±0.13bc	0.57±0ab
		40a	0.36±0.05b	0.64±0.03a	6.36±2.24ab	10.12±2.2c	0.5±0.18ab
60-80cm	Forestland	10a	0.58±0.03b	0.69±0.07ab	4.54±0.01a	12.56±0.4b	0.41±0.01b
		25a	0.57±0.14b	0.74±0.09ab	5.97±4.83a	17.86±5.68ab	0.45±0.04b

80-100cm	Shrubland	40a	0.58±0.11b	0.61±0.04b	6.03±0a	13.22±0.81b	0.48±0.06b
		10a	0.57±0.14b	0.77±0.12a	5.78±1.38a	12.08±0.5b	0.4±0.08b
		25a	0.58±0.05b	0.68±0.02ab	14.34±14.21a	16.44±5.62ab	0.53±0.07b
	Grassland	40a	1.07±0.37a	0.62±0.01ab	5.04±1.41a	16.16±2.28ab	0.56±0.02b
		10a	0.55±0.18b	0.76±0.05a	5.2±0.62a	14.8±1.37ab	0.46±0.05b
		25a	0.93±0.01a	0.66±0.04ab	5.78±0.7a	21.55±0.27a	0.81±0.07a
		40a	0.35±0.04b	0.64±0.03ab	6.86±0.51a	10.63±1.42b	0.51±0.26b
	Forestland	10a	0.58±0.05bc	0.71±0.07ab	7.27±1.75a	14.36±0.54ab	0.31±0.13c
		25a	0.57±0.18bc	0.72±0.13ab	10.5±10.21a	16.68±7.2ab	0.45±0.04bc
		40a	0.44±0.04cd	0.62±0.02b	6.16±1.93a	14.45±2.55ab	0.44±0.07bc
	Shrubland	10a	0.47±0.03cd	0.67±0.05ab	7.44±3.33a	10.82±0.11b	0.38±0.03bc
		25a	0.66±0.04abc	0.71±0ab	11.24±2.46a	17.67±3.35ab	0.56±0.12b
		40a	0.79±0.04ab	0.67±0.05ab	4.92±0.18a	21.37±6.43a	0.98±0.06a
	Grassland	10a	0.53±0.14cd	0.8±0.07a	8.26±6.47a	14.48±3.89ab	0.44±0.05bc
		25a	0.82±0.09a	0.62±0b	7.64±0.18a	15.87±0.8ab	0.55±0.01b
		40a	0.33±0.02d	0.69±0.05ab	5.95±1.12a	11.58±1.8b	0.42±0.19bc

Notes: The differences of these soil parameters were analyzed by two-way ANOVA and Tukey' s HSD test. Lower case letters indicate significant differences between various treatments at $p < 0.05$.

Table S4. The Source of variance and multiple comparisons of soil water-holding capacity.

Soil layer		Saturated water capacity		Capillary water capacity		Field capacity	
		F	η^2	F	η^2	F	η^2
0-20cm	Ref	0.98	—	1.13	—	1.26	—
	Red	0.29	—	1.39	—	3.67*	0.15
	Ref×Red	7.54**	0.6	9.67**	0.59	5.59**	0.46
20-40cm	Ref	2.19	—	2.48	—	1.14	—
	Red	0.13	—	0.84	—	2.75	—
	Ref×Red	6.19**	0.53	5.36**	0.46	2.05	—
40-60cm	Ref	1.33	—	2.24	—	0.37	—
	Red	0.1	—	0.55	—	6.60**	0.3
	Ref×Red	1.36	—	1.53	—	3.91*	0.36
60-80cm	Ref	6.68**	0.3	6.67**	0.3	0.09	—
	Red	1.89	—	2.34	—	7.73**	0.37
	Ref×Red	2.16	—	1.99	—	2.21	—
80-100cm	Ref	2.36	—	1.55	—	1.44	—
	Red	3.34	—	5.27*	0.28	6.96**	0.33
	Ref×Red	1.11	—	1.08	—	2.46	—

Table S5. Soil moisture characteristics.

Soil layer	Forestation types	Duration	Saturated water capacity	Capillary moisture capacity	Field moisture capacity
0-20cm	Forestland	10a	0.41±0.05ab	0.38±0.04abc	0.28±0.02ab
		25a	0.35±0.03b	0.30±0.02c	0.21±0.03ab
		40a	0.54±0.04a	0.49±0.04a	0.37±0.04a
	Shrubland	10a	0.47±0.09ab	0.44±0.09ab	0.34±0.09a
		25a	0.44±0.09ab	0.39±0.07abc	0.33±0.14a
		40a	0.43±0.02ab	0.39±0.02abc	0.13±0.03ab
	Grassland	10a	0.50±0.03ab	0.45±0.03ab	0.27±0.16ab
		25a	0.53±0.03a	0.47±0.02a	0.33±0.03a

20-40cm	Forestland	40a	0.38±0.03ab	0.33±0.02bc	0.07±0.03b
		10a	0.41±0.03ab	0.39±0.03ab	0.28±0.03ab
		25a	0.29±0.05b	0.26±0.04b	0.17±0.05ab
	Shrubland	40a	0.41±0.08ab	0.37±0.05ab	0.26±0.02ab
		10a	0.37±0.07ab	0.35±0.08ab	0.25±0.07ab
		25a	0.40±0.13ab	0.36±0.13ab	0.17±0.23ab
	Grassland	40a	0.46±0.02ab	0.39±0.02ab	0.06±0.03b
		10a	0.46±0.01ab	0.44±0.02a	0.22±0.17ab
		25a	0.52±0.07a	0.47±0.05a	0.34±0.06a
40-60cm	Forestland	40a	0.33±0.02b	0.3±0.02ab	0.09±0.03ab
		10a	0.38±0.02a	0.34±0.01ab	0.23±0.01a
		25a	0.33±0.03a	0.27±0.03b	0.16±0.01ab
	Shrubland	40a	0.39±0.04a	0.33±0.01ab	0.24±0.01a
		10a	0.39±0.11a	0.36±0.11ab	0.24±0.08a
		25a	0.44±0.18a	0.40±0.17ab	0.28±0.15a
	Grassland	40a	0.44±0.02a	0.38±0.02ab	0.05±0.03b
		10a	0.46±0.07a	0.43±0.06a	0.22±0.09a
		25a	0.44±0.02a	0.39±0.01ab	0.24±0.02a
60-80cm	Forestland	40a	0.35±0.03a	0.31±0.02ab	0.08±0.01b
		10a	0.34±0.04abc	0.32±0.04abc	0.23±0.03ab
		25a	0.29±0.03c	0.26±0.04c	0.16±0.02abc
	Shrubland	40a	0.35±0.04abc	0.30±0.03bc	0.19±0.02abc
		10a	0.40±0.09ab	0.37±0.09ab	0.29±0.09a
		25a	0.33±0.04bc	0.29±0.03bc	0.19±0.02abc
	Grassland	40a	0.44±0.01a	0.39±0.01ab	0.10±0.07bc
		10a	0.44±0.02a	0.41±0.01a	0.22±0.11ab
		25a	0.43±0.06ab	0.39±0.06ab	0.25±0.03a
80-100cm	Forestland	40a	0.37±0.01abc	0.32±0.01abc	0.07±0.01c
		10a	0.35±0.01ab	0.33±0.01ab	0.24±0.01a
		25a	0.30±0.07b	0.26±0.05b	0.16±0.03abc
	Shrubland	40a	0.38±0.03ab	0.34±0.02ab	0.22±0.02a
		10a	0.40±0.04ab	0.34±0.04ab	0.25±0.03a
		25a	0.35±0.11ab	0.29±0.04b	0.20±0.02ab
	Grassland	40a	0.44±0.03a	0.34±0.08ab	0.13±0.04bc
		10a	0.43±0.04a	0.39±0.02a	0.21±0.09ab
		25a	0.37±0.01ab	0.32±0.01ab	0.20±0.03ab
		40a	0.36±0.02ab	0.32±0.02ab	0.11±0.02c

Notes: The differences of these soil parameters were analyzed by two-way ANOVA and Tukey' s HSD test. Lower case letters indicate significant differences between various treatments at $p < 0.05$.