Future impacts of land use change on ecosystem services under different scenarios in the ecological conservation area, Beijing, China

Supplementary Figures

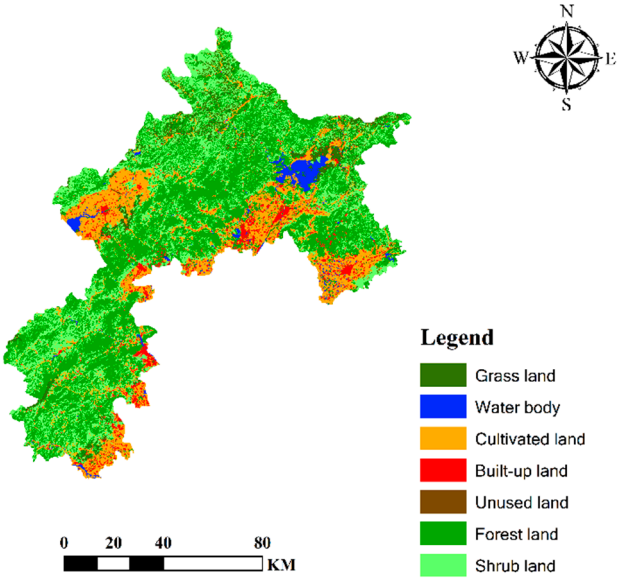

Figure S1. Land use maps of 2000 for the ecological conservation area in Beijing.

Supplementary Tables

Table S1. Description of land use types

Type	Description
Forest land (FL)	Evergreen coniferous forests, deciduous coniferous forests, deciduous broad-leaf forests, and mixed broadleaf conifer forests
Built-up land (BL)	Urban and rural settlements, commercial areas, industrial areas, construction areas, and transport facility areas
Shrub land (SL)	Mix of small trees (< 5m tall) and other natural covers
Cultivated land (CL)	Irrigated and dry croplands, orchards
Grass land (GL)	Mainly grass fields (dense, moderate, and low coverage grasses)
Water body (WB)	Rivers, lake/ponds, canals, and reservoirs
Unused land (UL)	Cliffs/small landslide, bare rocks, other permanently abandoned rock stony land, sand areas, other unutilized lands

Table S2. Driving factors of land use change

Data	**Year**	**Resolution**	**Data resource**
DEM	2000	30 m	Resources and Environmental Data Cloud Platform (http://www.resdc.cn/)
Slope	2000	30 m	Calculated from DEM
Aspect	2000	30 m	Calculated from DEM
Relief	2000	1 km	National Earth System Science Data Center

amplitude			(http://www.geodata.cn/)
GDP	2000, 2015	1 km	Resources and Environmental Data Cloud Platform (http://www.resdc.cn/)
Population	2000, 2015	1 km	Resources and Environmental Data Cloud Platform (http://www.resdc.cn/)
Annual precipitation	2015	1 km	National Earth System Science Data Center (http://www.geodata.cn/)
Annual mean temperature	2015	1 km	National Earth System Science Data Center (http://www.geodata.cn/)
Distance from road	2017	1 km	National Geomatic Center of China (http://www.ngcc.cn/)
Distance from residential area	2017	1 km	National Geomatic Center of China (http://www.ngcc.cn/)
Traffic station	2017	1 km	National Geomatic Center of China (http://www.ngcc.cn/)
Distance from river	2017	1 km	National Geomatic Center of China (http://www.ngcc.cn/)
Distance from landslide and collapse point	2015	1 km	China Geological Survey (http://www.cgs.gov.cn/)
Soil attributes	2012	1 km	Harmonized World Soil Database (http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/)

Table S3. Conversion cost matrix from 2000 to 2015 (km^2)

Land use types	Grass land	Water body	Cultivated land	Built-up land	Unused land	Forest land	Shrub land	Total
Grass land	488.63	26.05	186.49	8.30	5.54	25.99	52.62	793.63
Water body	1.09	169.42	16.51	1.19	0.30	4.41	2.27	195.18
Cultivated land	21.70	34.07	812.64	16.78	2.64	18.19	25.23	931.25
Built-up land	18.61	4.69	170.06	462.87	6.02	20.51	27.70	710.47
Unused land	1.28	0.42	3.99	0.31	9.72	0.92	1.64	18.28
Forest land	60.48	9.43	413.65	10.71	3.27	4122.92	297.63	4918.09
Shrub land	70.77	14.24	84.49	8.09	1.97	275.15	3121.83	3576.54
Total	662.58	258.32	1687.83	508.24	29.46	4468.09	3528.92	11143.45

Table S4. Input data on carbon stored in each of the four fundamental pools for each LULC class in the InVEST 3.8.0 model (Mg/ha)

Land use/land cover type	**Aboveground biomass**	**Belowground biomass**	**Soil**	**Dead organic matter**
Grassland	3.46	0	30.17	0
Water body	0	0	0	0
Cultivated land	17.29	0	22.5	0
Built–up land	0	0	0	0

Unused land	0	0	0	0
Forest land	24.45	4.51	93.85	12.53
Shrub land	5.72	0.36	63.05	3.49

Table S5. Input data for each LULC class in the InVEST 3.8.0 water yield model

Land use/land cover type	**Max root depth (mm)**	**Evapotranspiration coefficient**
Grassland	1400	0.591
Water body	0	1
Cultivated land	1500	0.683
Built–up land	0	0.3
Unused land	0	0.2
Forest land	3000	0.9
Shrub land	2000	0.5

Table S6. Input data for each LULC class in the InVEST 3.8.0 sediment delivery ratio model

Land use/land cover type	**Cover and management factor**	**management practice factor**
Grassland	0.01	0.2
Water body	0.001	0.001
Cultivated land	0.5	0.4
Built–up land	0.001	0.001
Unused land	0.25	0.01
Forest land	0.003	0.2
Shrub land	0.01	0.2

Table. S7. Carbon storage (CS) for each land-use type from baseline, in 2030 under the BAU, ELP, and RED scenarios (Tg).

	Grassland	Water body	Cultivated land	Built–up land	Unused land	Forest land	Shrub land
2015	2.67	0	3.77	0	0	65.53	26.39
BAU	3.01	0	2.71	0	0	65.42	26.70
ELP	2.53	0.00	3.52	0.00	0.00	66.80	26.67
RED	2.67	0.00	3.22	0.00	0.00	63.75	26.66

Table. S8. Water yield (WY) for each land-use type from baseline, in 2030 under the BAU, ELP, and RED scenarios (million m^3).

	Grassland	Water body	Cultivated land	Built–up land	Unused land	Forest land	Shrub land
2015	28.62	0.28	31.32	26.83	0.80	155.86	117.36
BAU	30.51	0.83	24.41	30.04	0.65	158.52	114.74
ELP	27.03	0.19	28.56	27.54	0.60	161.13	116.46
RED	28.60	0.19	26.95	36.81	0.40	152.23	117.32

Table. S9. Soil conservation (CS) for each land-use type from baseline, in 2030 under the BAU, ELP, and RED scenarios (million ton).

	Grassland	Water body	Cultivated land	Built−up land	Unused land	Forest land	Shrub land
2015	110.87	6.88	27.43	62.98	0.52	1281.42	971.17
BAU	115.01	3.99	22.66	56.42	0.97	1289.21	972.54
ELP	89.79	3.91	23.57	88.35	0.49	1409.78	879.38
RED	110.90	6.30	24.96	75.20	0.18	1274.38	988.22

Table. S10. Correlation among three ecosystem services for each scenario.

**denote significant correlation at significant level of 0.01

Scenarios	Block samples	Ecosystem services		
	N=11145	Carbon storage	Flood regulation	Soil conservation
BAU	Carbon storage	1	0.079**	0.336**
	Flood regulation		1	-0.014
	Soil conservation			1
ELP	Carbon storage	1	0.022*	0.642**
	Flood regulation		1	-0.034**
	Soil conservation			1
RED	Carbon storage	1	0.063**	0.441**
	Flood regulation		1	-0.014
	Soil conservation			1

* $p < 0.05$. ** $p < 0.01$.

Supplementary Table. S11. Ecosystem service (ES) change matrix driven by per-unit land use transitions of the main land use types from 2015 to 2030 under the BAU, ELP, and RED scenarios.

	Conversions	Area (km^2)	Carbon storage (10^4 Mg)	Water yield (10^6 m^3)	Soil conservation (10^5 t)
2015-BAU	CL to GL	48.98	0.34	0.27	1.19
	CL to BL	133.99	-44.18	4.45	8.69
	CL to FL	39.49	0.09	-0.09	1.69
	FL to SL	78.56	-1.30	0.03	-0.56
	SL to FL	77.04	1.25	-0.02	0.14
2015-ELP	GL to FL	179.49	163.45	-8.74	96.46
	CL to FL	100.19	85.71	-3.25	15.47
	CL to SL	56.62	17.29	-1.06	8.28
	BL to GL	132.36	43.43	-2.41	-24.79
	BL to FL	82.39	107.55	-5.97	-0.12
	FL to GL	102.89	-92.79	4.94	-47.29
	FL to BL	164.25	-200.22	10.61	0.43
	SL to GL	146.41	-48.76	4.89	-55.47

	SL to FL	1121.00	595.18	-14.55	305.56
2015-RED	CL to BL	133.95	-46.41	4.59	8.61
	FL to BL	130.86	-150.42	8.01	0.30