

Supplemental Table 1

Conversion matrix of land use in different time periods from 1990 to 2018.

Base year		Land use area in 2000 (Compared year) (km ²)								
Compared year		Crop land	Forest land	Grass land	Linear waters	Patchy waters	Tidal flats	Built-up land	Other land	Total
Land use area in 1990 (Base year) (km ²)	Crop land	104438.52	33.21	15.62	35.08	103.19	53.40	1017.16	0.68	105696.87
	Forest land	287.45	26552.42	112.47	2.73	3.33	0.52	21.31	0.34	26980.58
	Grass land	493.51	443.88	8820.01	5.22	12.31	2.43	30.10	0.34	9807.81
	Linear waters	191.36	4.34	6.18	1686.94	5.06	57.03	2.61	6.47	1959.99
	Patchy waters	101.18	1.19	5.24	1.18	1142.90	104.00	4.59	0.00	1360.29
	Tidal flats	270.76	9.69	20.65	162.94	67.27	342.96	6.85	15.69	896.81
	Built-up land	18.08	0.00	0.34	0.19	0.10	0.00	18468.26	0.00	18486.97
	Other land	92.91	3.10	3.80	1.17	8.51	0.01	4.49	28.75	142.72
Total		105893.77	27047.85	8984.31	1895.45↓	1342.67↓	560.35↓	19555.36	52.27	165332.03
Based year		Land use area in 2010 (Compared year) (km ²)								
Compared year		Crop land	Forest land	Grass land	Linear waters	Patchy waters	Tidal flats	Built-up land	Other land	Total
Land use area in 2000 (Base year) (km ²)	Crop land	104593.85	29.93	8.33	105.78	213.75	101.96	840.09	0.01	105893.69
	Forest land	35.73	26970.48	0.11	4.06	18.68	2.79	15.85	0.14	27047.85
	Grass land	8.60	1.80	8924.02	11.05	23.55	9.36	5.90	0.04	8984.31
	Linear waters	26.49	0.05	0.09	1812.87	13.98	41.79	0.11	0.00	1895.37
	Patchy waters	13.39	5.98	0.09	3.44	1300.11	9.62	9.97	0.00	1342.61
	Tidal flats	70.44	5.66	2.41	49.66	108.58	322.64	0.88	0.00	560.28
	Built-up land	15.88	0.00	0.01	1.23	1.33	0.00	19536.91	0.00	19555.36
	Other land	16.71	0.75		8.27	1.17	4.03	0.14	21.19	52.27
Total		104781.09	27014.65	8935.06	1996.37↑	1681.15↑	492.20↓	20409.85	21.37	165331.74
Based year		Land use area in 2018 (Compared year) (km ²)								
Compared year		Crop land	Forest land	Grass land	Linear waters	Patchy waters	Tidal flats	Built-up land	Other land	Total
Land use area in 2010 (Base year) (km ²)	Crop land	102078.76	439.02	144.72	87.79	118.46	22.57	1851.99	2.62	104745.92
	Forest land	550.73	26210.28	179.52	6.21	10.34	3.04	36.03	0.20	26996.35
	Grass land	130.39	296.48	8473.95	2.84	6.71	1.04	18.48	0.28	8930.17
	Linear waters	88.94	37.38	13.27	1699.69	53.09	69.14	5.76	5.12	1972.40
	Patchy waters	31.52	9.27	3.64	10.80	1610.96	5.91	7.52	0.04	1679.67
	Tidal flats	110.25	1.32	9.88	36.23	30.39	285.94	2.58	10.33	486.93
	Built-up land	581.98	19.32	15.56	5.33	5.07	0.43	19780.96	0.03	20408.68
	Other land	1.03	7.80	0.47	0.01	0.00	0.00	0.78	11.27	21.37
Total		103573.58	27020.87	8841.02	1848.91↓	1835.02↑	388.07↓	21704.10	29.90	165241.48
note:	changed waters	great changed waters		unchanged waters						

Supplemental Table 2

Correlation analysis between socioeconomic factors, precipitation, water area, landscape metrics, and graph metrics in the Henan Province region. (x1: total population, x2: per-capita GDP, x3: urbanization rate, x4: rainfall, x5: patchy-water area, x6: linear-water area, x7: tidal-flat area, x8: total surface water area, x9-x26: PD, LPI, CONTIG_AM, ENN_MN, COHESION and MESH of linear waters, patchy waters and tidal flats at the class level, respectively, x27-x32: PD, LPI, CONTIG_AM, ENN_MN, COHESION and MESH at the landscape level, respectively, x33-36: IIC, NC, SLC and EC at the global level, respectively).

		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
Total population	X1	1											
Per-capita GDP	X2	0.652	1										
Urbanization rate	X3	0.738	.989*	1									
Rainfall	X4	0.071	-0.517	-0.503	1								
Patchy-water area	X5	0.588	.958*	.966*	-0.71	1							
Linear-water area	X6	-0.512	-0.49	-0.444	-0.438	-0.221	1						
Tidal-flat area	X7	-.971*	-0.784	-0.861	0.166	-0.759	0.428	1					
Total surface water area	X8	-0.57	0.133	0.067	-0.856	0.306	0.556	0.358	1				
PD of linear waters	X9	-0.779	-0.843	-0.909	0.569	-0.919	0.119	0.903	-0.065	1			
PD of patchy waters	X10	-0.442	-0.874	-0.883	0.846	-.975*	0.007	0.643	-0.482	0.889	1		
PD of tidal flats	X11	-0.874	-0.754	-0.843	0.399	-0.817	0.145	.952*	0.133	.975*	0.766	1	
LPI of linear waters	X12	1.000**	0.656	0.743	0.049	0.6	-0.49	-.976*	-0.553	-0.793	-0.459	-0.886	1
LPI of patchy waters	X13	0.325	0.922	0.856	-0.589	0.865	-0.466	-0.485	0.377	-0.611	-0.810	-0.458	0.326
LPI of tidal flats	X14	-.975*	-0.632	-0.735	0.076	-0.633	0.312	.975*	0.451	0.856	0.529	0.945	-.980*
IJI of linear waters	X15	0.785	0.492	0.615	-0.335	0.616	0.12	-0.839	-0.167	-0.875	-0.608	-0.94	0.802
IJI of patchy waters	X16	-0.177	0.499	0.461	-.986*	0.668	0.388	-0.062	0.909	-0.469	-0.802	-0.277	-0.157
IJI of tidal flats	X17	0.867	0.21	0.34	0.297	0.202	-0.205	-0.771	-0.724	-0.543	-0.098	-0.715	0.868
ENN of linear waters	X18	0.7	0.852	0.908	-0.663	0.945	-0.06	-0.847	0.184	-.993**	-0.935	-0.944	0.715
ENN of patchy waters	X19	0.625	0.948	.966*	-0.697	.998**	-0.203	-0.790	0.272	-.943	-.972*	-0.853	0.637
ENN of tidal flats	X20	0.675	0.711	0.793	-0.647	0.85	0.12	-0.811	0.165	-.971*	-0.868	-0.949	0.694
COHESION of linear waters	X21	0.902	0.814	0.892	-0.364	0.844	-0.264	-.977*	-0.166	-.973*	-0.771	-.992*	0.912
COHESION of patchy waters	X22	0.251	0.849	0.82	-0.883	0.93	-0.028	-0.468	0.625	-0.748	-.967*	-0.583	0.265
COHESION of tidal flats	X23	-.974*	-0.805	-0.866	0.077	-0.734	0.569	.987*	0.421	0.845	0.59	0.893	-.974*
MESH of linear waters	X24	0.844	0.836	0.908	-0.475	0.89	-0.191	-0.945	-0.045	-.994**	-0.838	-.990*	0.856
MESH of patchy waters	X25	0.432	.965*	0.918	-0.611	0.924	-0.443	-0.592	0.333	-0.716	-0.868	-0.578	0.435
MESH of tidal flats	X26	-.986*	-0.623	-0.724	0.019	-0.606	0.363	.974*	0.501	0.829	0.49	0.924	-.990**
PD at landscape level	X27	-0.69	-0.871	-0.921	0.672	-.958*	0.081	0.842	-0.200	.990*	0.945	0.934	-0.706
LPI at landscape level	X28	0.325	0.922	0.856	-0.589	0.865	-0.466	-0.485	0.377	-0.611	-0.81	-0.458	0.326
IJI at landscape level	X29	0.876	0.444	0.573	-0.113	0.515	-0.037	-0.877	-0.393	-0.809	-0.463	-0.915	0.887
ENN_MN at landscape level	X30	0.706	0.902	0.946	-0.65	.970*	-0.146	-0.854	0.179	-.987*	-0.946	-0.928	0.72
COHESION at landscape level	X31	0.707	0.917	.957*	-0.644	.977*	-0.176	-0.855	0.177	-.982*	-0.947	-0.92	0.72
MESH at landscape level	X32	0.519	.984*	.959*	-0.644	.971*	-0.382	-0.683	0.305	-0.813	-0.92	-0.69	0.526
IIC at global level	X33	-0.767	-0.403	-0.425	-0.569	-0.175	0.89	0.636	0.826	0.261	-0.046	0.373	-0.748
NC at global level	X34	0.521	0.745	0.684	0.083	0.523	-0.932	-0.524	-0.262	-0.346	-0.341	-0.304	0.505
SLC at global level	X35	-0.805	-0.897	-0.893	0.085	-0.75	0.792	0.835	0.293	0.695	0.583	0.681	-0.798
EC at global level	X36	-0.768	-0.359	-0.388	-0.601	-0.136	0.866	0.628	0.857	0.243	-0.084	0.366	-0.750

Continued

		X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24
LPI of patchy waters	X13	1											
LPI of tidal flats	X14	-0.284	1										
IJI of linear waters	X15	0.151	-0.904	1									
IJI of patchy waters	X16	0.632	0.052	0.183	1								
IJI of tidal flats	X17	-0.180	-0.885	0.798	-0.439	1							
ENN_MN of linear waters	X18	0.655	-0.788	0.836	0.572	0.444	1						
ENN_MN of patchy waters	X19	0.832	-0.676	0.667	0.645	0.261	.964*	1					
ENN_MN of tidal flats	X20	0.472	-0.800	0.920	0.530	0.527	.973*	0.881	1				
COHESION of linear waters	X21	0.533	-0.948	0.893	0.255	0.695	0.939	0.875	0.916	1			
COHESION of patchy waters	X22	0.886	-0.317	0.385	0.881	-0.149	0.816	0.911	0.714	0.603	1		
COHESION of tidal flats	X23	-0.529	0.942	-0.741	0.008	-0.735	-0.784	-0.759	-0.718	-0.937	-0.436	1	
MESH of linear waters	X24	0.579	-0.906	0.889	0.370	0.619	.973*	0.917	.951*	.993**	0.684	-0.895	1
MESH of patchy waters	X25	.990**	-0.407	0.288	0.631	-0.056	0.752	0.899	0.585	0.645	0.909	-0.623	0.688
MESH of tidal flats	X26	-0.275	.998**	-0.876	0.105	-0.895	-0.756	-0.649	-0.761	-0.933	-0.279	.950*	-0.885
PD at landscape level	X27	-0.686	0.774	-0.814	-0.587	-0.417	-.999**	-.974*	-.964*	-0.933	-0.835	0.783	-.969*
LPI at landscape level	X28	1.000**	-0.284	0.151	0.632	-0.18	0.655	0.832	0.472	0.533	0.886	-0.529	0.579
IJI at landscape level	X29	0.069	-.956*	.972*	-0.04	0.915	0.745	0.57	0.823	0.881	0.222	-0.803	0.848
ENN_MN at landscape level	X30	0.724	-0.776	0.788	0.572	0.407	.995**	.984*	0.945	0.936	0.842	-0.806	.969*
COHESION at landscape level	X31	0.747	-0.769	0.769	0.57	0.394	.990**	.989*	0.932	0.933	0.849	-0.812	.965*
MESH at landscape level	X32	.958*	-0.518	0.429	0.639	0.063	0.843	.955*	0.701	0.744	0.925	-0.694	0.786
IIC at global level	X33	-0.208	0.607	-0.216	0.59	-0.618	-0.163	-0.188	-0.065	-0.458	0.141	0.737	-0.358
NC at global level	X34	0.755	-0.356	-0.017	-0.029	0.088	0.319	0.496	0.112	0.422	0.385	-0.646	0.386
SLC at global level	X35	-0.764	0.708	-0.412	-0.069	-0.411	-0.657	-0.747	-0.502	-0.768	-0.531	0.903	-0.736
EC at global level	X36	-0.152	0.612	-0.228	0.629	-0.649	-0.141	-0.152	-0.055	-0.446	0.187	0.724	-0.343

Continued

		X25	X26	X27	X28	X29	X30	X31	X32	X33	X34	X35	X36
MESH of patchy waters		X25	1										
MESH of tidal flats	X25	1											
PD at landscape level	X26	-0.395	1										
LPI at landscape level	X27	-0.778	0.742	1									
IJI at landscape level	X28	.990**	-0.275	-0.686	1								
ENN_MN at landscape level	X29	0.207	-0.942	-0.721	0.069	1							
COHESION at landscape level	X30	0.812	-0.747	-.998**	0.724	0.702	1						
MESH at landscape level	X31	0.832	-0.742	-.994**	0.747	0.686	.999**	1					
IIC at global level	X32	.988*	-0.501	-0.864	.958*	0.344	0.891	0.906	1				
NC at global level	X33	-0.242	0.657	0.166	-0.208	-0.409	-0.213	-0.231	-0.244	1			
SLC at global level	X34	0.735	-0.391	-0.347	0.755	0.065	0.411	0.443	0.678	-0.749	1		
EC at global level	X35	-0.804	0.726	0.673	-0.764	-0.471	-0.719	-0.74	-0.812	0.764	-0.904	1	
MESH of patchy waters	X36	-0.189	0.662	0.142	-0.152	-0.427	-0.186	-0.203	-0.196	.998**	-0.708	0.731	1

Note: ** Extremely significant correlation

* Significant correlation