

Supporting Information

How do ecosystem service functions affect ecological health? Evidence from the Yangtze Economic Belt in China

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Text S1. Comprehensive index evaluation

1) Assume that there are m evaluation objects, and each object has n evaluation indexes. Based on this, the judgment matrix is constructed as Equation (1):

$$X = (x_{ij})_{m \times n} (i = 1, 2, \dots, m; j = 1, 2, \dots, n) \quad (1)$$

2) Standardize the judgment matrix:

The positive index and negative index are shown as follows:

$$x'_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (2)$$

$$x'_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})} \quad (3)$$

3) Calculate information entropy:

$$H_j = -k \sum_{i=1}^m p_{ij} \ln p_{ij} \quad (4)$$

where $p_{ij} = \frac{x'_{ij}}{\sum_{i=1}^m x'_{ij}}; k = \frac{1}{\ln m}$.

4) Determine the weight of index j :

$$w_j = \frac{1 - H_j}{\sum_{j=1}^n (1 - H_j)} \quad (5)$$

where $w_j \in [0, 1], \sum_{j=1}^n w_j = 1$. The weights of each index of the ecological health evaluation system are shown in the table S1.

5) Calculate the weighted matrix:

$$R = (r_{ij})_{m \times n}, r_{ij} = w_j \times x_{ij} (i = 1, 2, \dots, n) \quad (6)$$

6) Determine the optimal solution S_j^+ and worst solution S_j^- :

$$S_j^+ = \max(r_{1j}, r_{2j}, \dots, r_{nj}), S_j^- = \min(r_{1j}, r_{2j}, \dots, r_{nj}) \quad (7)$$

7) Calculate the Euclidean distance between the optimal solution and the worst solution of each scheme:

$$sep_i^+ = \sqrt{\sum_{j=1}^n (s_j^+ - r_{ij})^2}, sep_i^- = \sqrt{\sum_{j=1}^n (s_j^- - r_{ij})^2} \quad (8)$$

8) Calculate the comprehensive evaluation index:

$$C_i = \frac{sep_i^-}{sep_i^+ + sep_i^-}, C_i \in [0,1] \quad (9)$$

In the formula, when the value of C_i is larger, the evaluation object is better.

Table S1 Weights of ecological health evaluation index

Target Layer	Criterion Layer	Index Level	Weight relative to the criterion layer	Weight relative to the target layer
Ecosystem Health	Ecological Vitality (0.355)	NDVI	0.432	0.153
		NPP	0.135	0.048
		LST	0.433	0.154
		Spread index	0.212	0.053
	Ecological Organization (0.252)	Shannon uniformity	0.146	0.037
		Shannon Diversity	0.376	0.095
		Dispersion and juxtaposition index	0.266	0.067
	Ecological Restoration (0.393)	Ecological Resistance Index	0.543	0.213
		Ecological Resilience Index	0.457	0.180

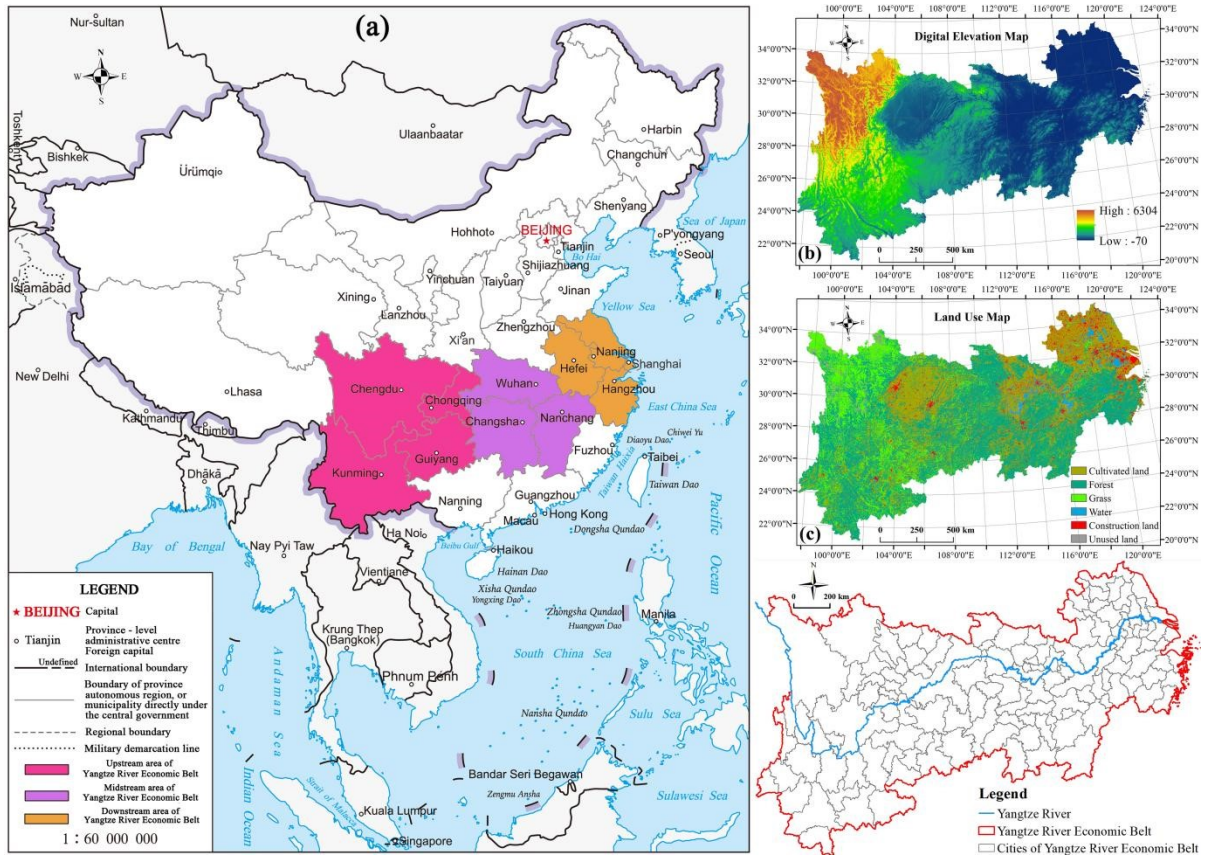


Figure. S1 Location and characteristics of the Yangtze River Economic Belt.

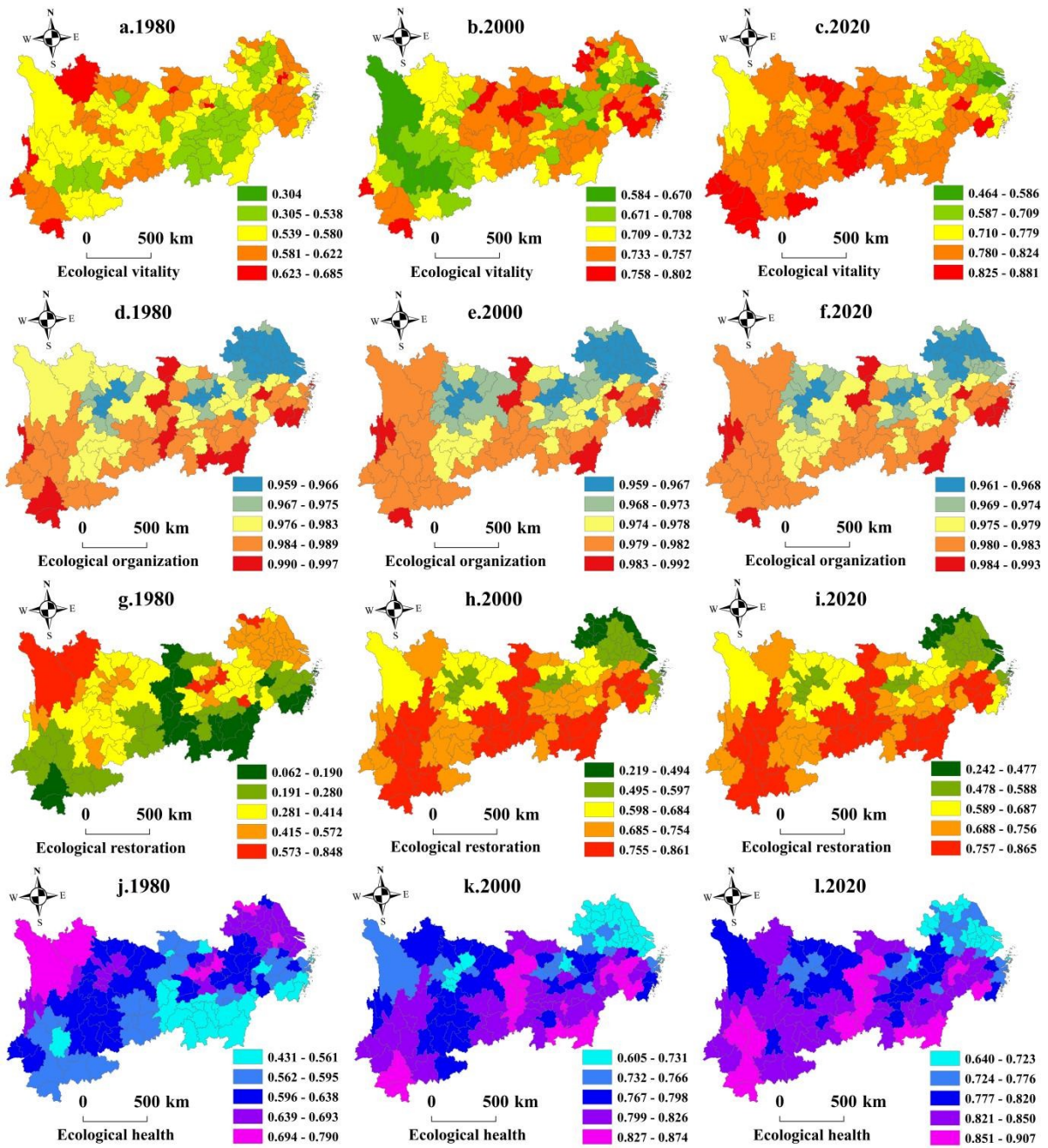


Figure. S2 Spatio-temporal distribution of ecological health index in the Yangtze River Economic Belt

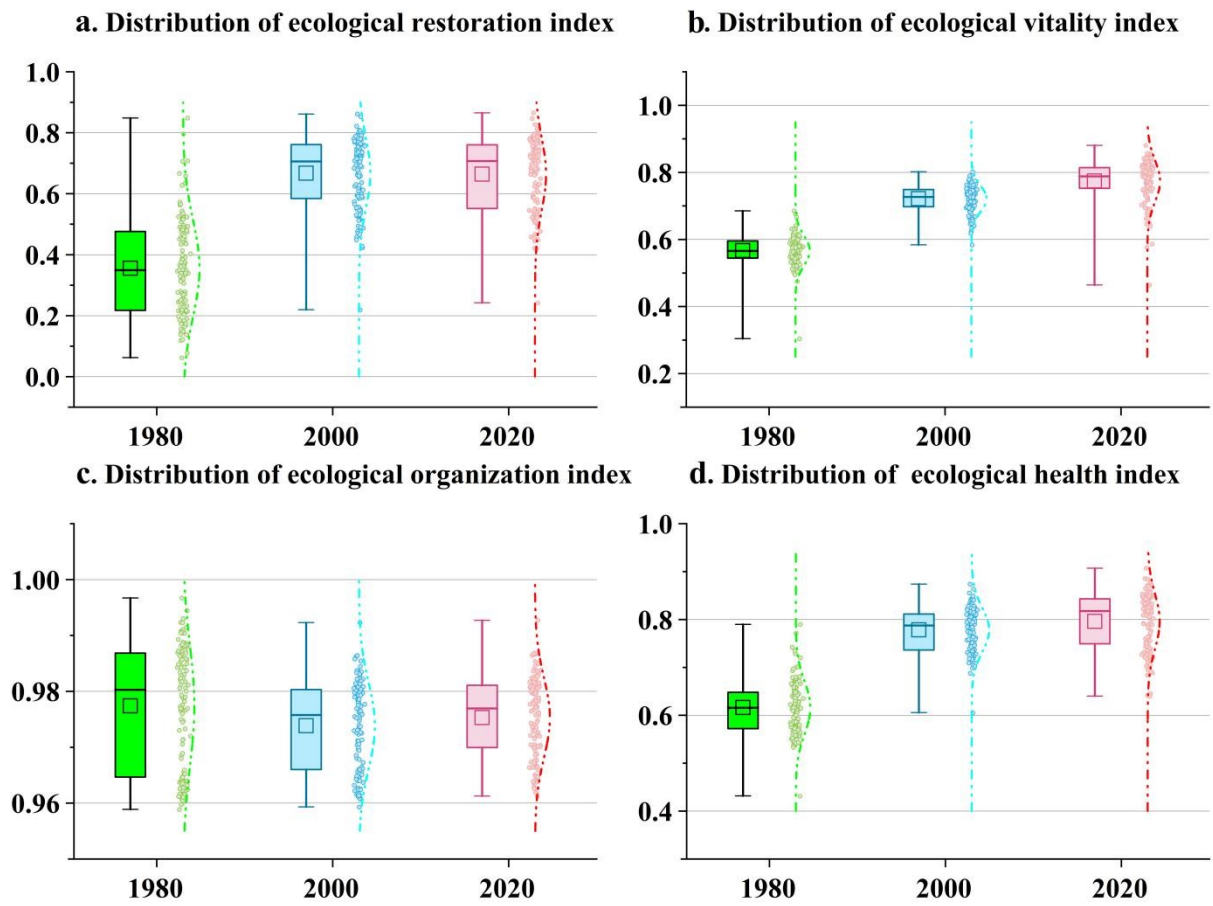


Figure. S3 Distribution of ecological health index in Yangtze River Economic Belt

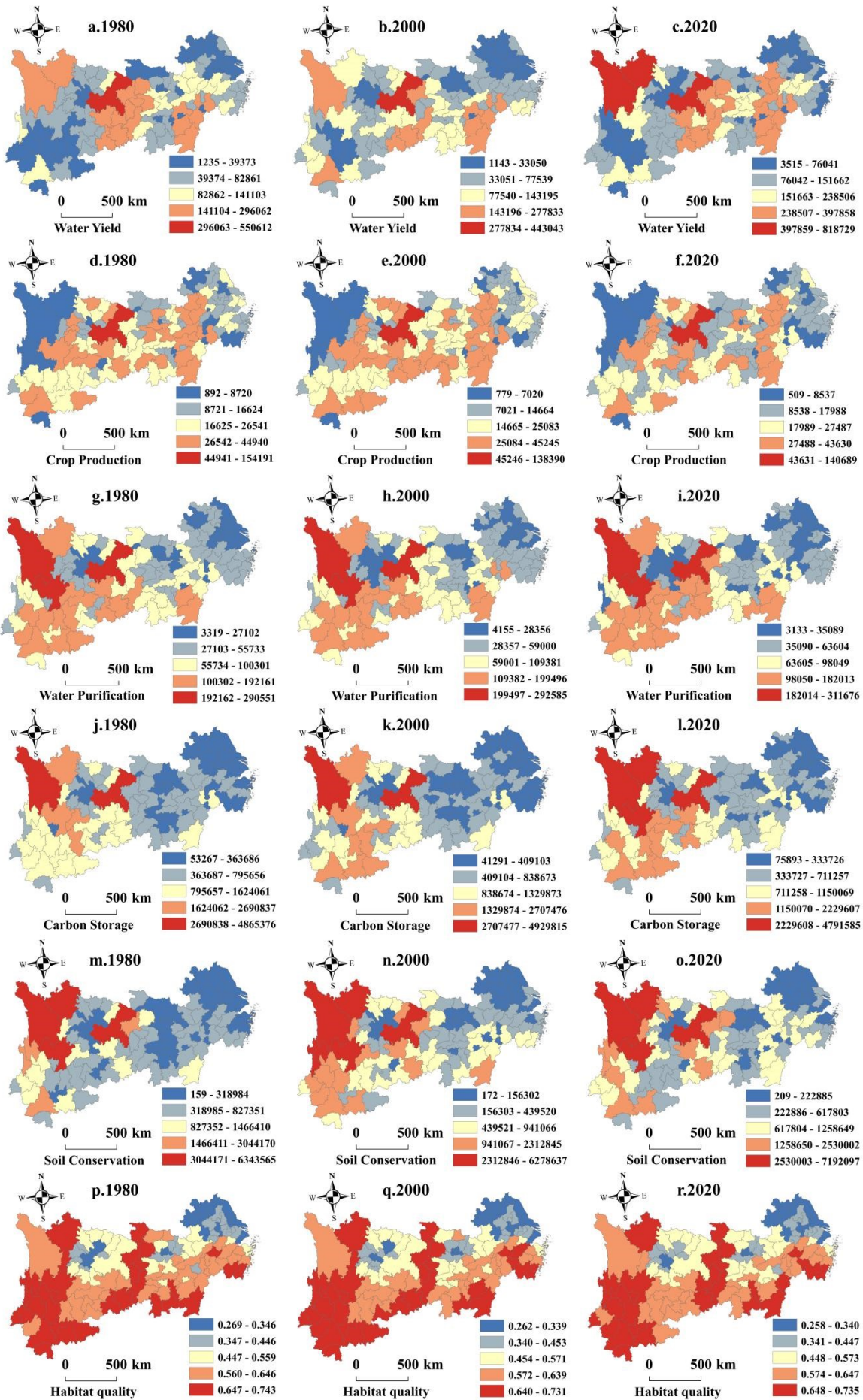


Figure. S4 Spatio-temporal distribution of ecosystem services in the Yangtze River Economic Belt

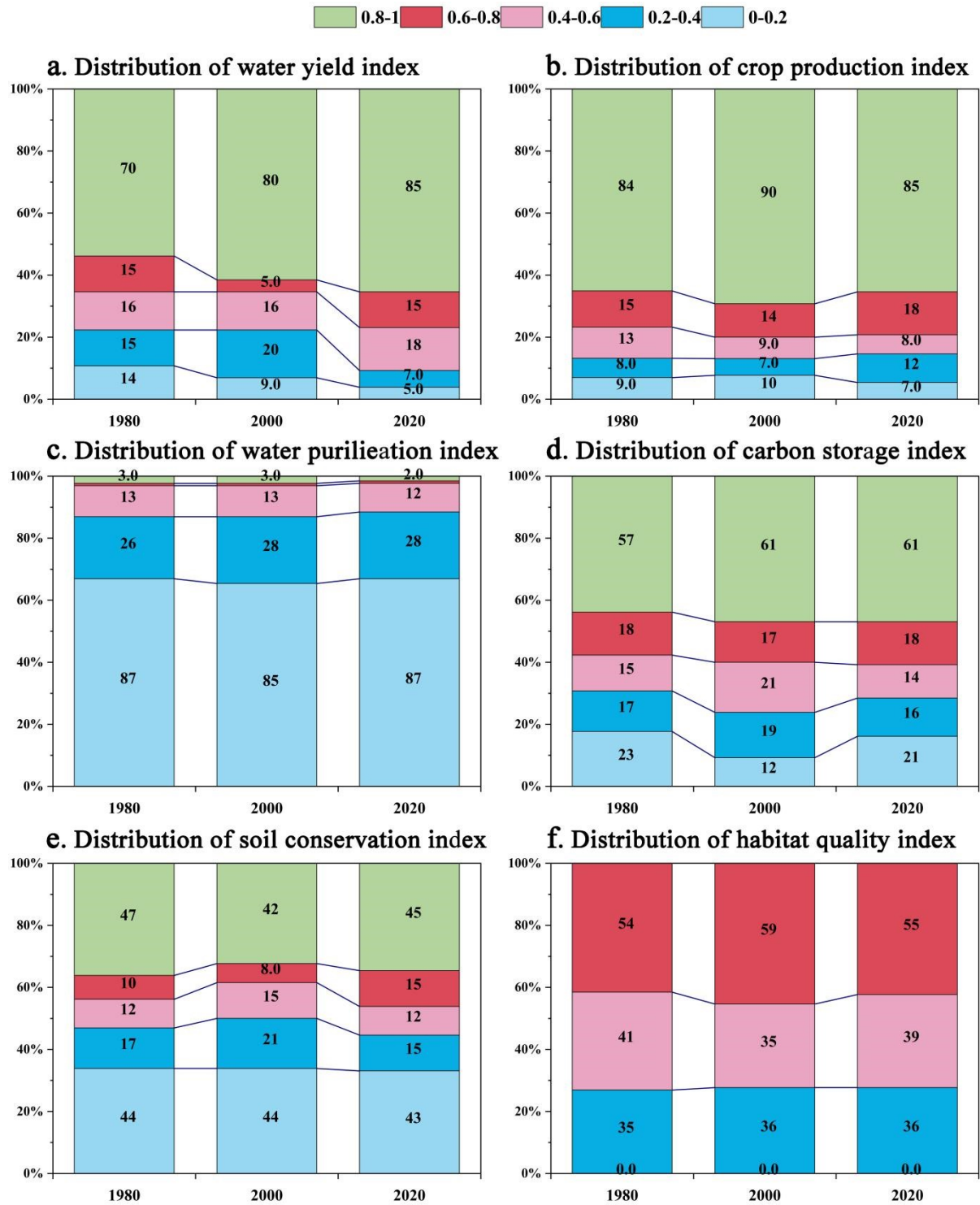


Figure. S5 Distribution of ecosystem service index in Yangtze River Economic Belt

Table S2 Estimated results of the OLS model from 1990 to 2020.

1980	Variable	Coefficient [a]	Standard deviation [t]	Statistic	Probability [b]	Robust_SE	Robust_t	Robust_Pr [b]	VIF [c]
	Intercept	0.774786	0.013879	55.824596	0.000000*	0.015497	49.994598	0.000000*	—

	Water yield	-0.001416	0.036146	-0.039172	0.96881	0.02623	-0.053981	0.95703	2.542308
	Crop production	-0.097423	0.047079	-2.069347	0.040603*	0.043293	-2.250344	0.026196*	2.72564
	Water purification	-0.094009	0.045232	-2.078364	0.039750*	0.045812	-2.052052	0.042282*	8.079755
	Carbon storage	0.194363	0.062055	3.132087	0.002176*	0.052545	3.698971	0.000332*	8.780968
	Soil conservation	0.123508	0.044856	2.75342	0.006790*	0.043375	2.847464	0.005167*	4.609552
	Habitat quality	-0.307848	0.028273	-10.888591	0.000000*	0.030595	-10.062151	0.000000*	1.843707
	Variable	Coefficient [a]	Standard deviation [t]	Statistic	Probability [b]	Robust_SE	Robust_t	Robust_Pr [b]	VIF [c]
	Intercept	0.625948	0.008737	71.639859	0.000000*	0.00658	95.125883	0.000000*	—
2000	Water yield	0.061606	0.024107	2.555476	0.011816*	0.014122	4.362327	0.000030*	3.114924
	Crop production	0.034894	0.027072	1.288922	0.199848	0.016835	2.072637	0.040290*	2.25875
	Water purification	0.001447	0.027999	0.05168	0.95886	0.020849	0.069403	0.944774	7.760864
	Carbon storage	-0.064065	0.039549	-1.619893	0.107825	0.030628	-2.091734	0.038514*	8.415929
	Soil conservation	-0.033746	0.028361	-1.189864	0.236391	0.026474	-1.27469	0.204825	4.365189
	Habitat quality	0.282249	0.017373	16.246207	0.000000*	0.015167	18.609721	0.000000*	1.721178
	Variable	Coefficient [a]	Standard deviation [t]	Statistic	Probability [b]	Robust_SE	Robust_t	Robust_Pr [b]	VIF [c]
	Intercept	0.598483	0.010018	59.739906	0.000000*	0.010863	55.094431	0.000000*	—
2020	Water yield	-0.004057	0.026292	-0.154294	0.877626	0.014859	-0.273005	0.785312	3.192898
	Crop production	0.094241	0.032477	2.901757	0.004400*	0.024005	3.925913	0.000149*	2.106182
	Water purification	-0.037101	0.041134	-0.901954	0.368835	0.037668	-0.984948	0.326575	9.220682
	Carbon storage	0.00587	0.055043	0.106636	0.915244	0.040234	0.145885	0.884245	10.658015
	Soil conservation	-0.010606	0.040584	-0.261335	0.794275	0.023388	-0.453477	0.651013	5.772952
	Habitat quality	0.368375	0.020243	18.198027	0.000000*	0.023149	15.913522	0.000000*	1.550545

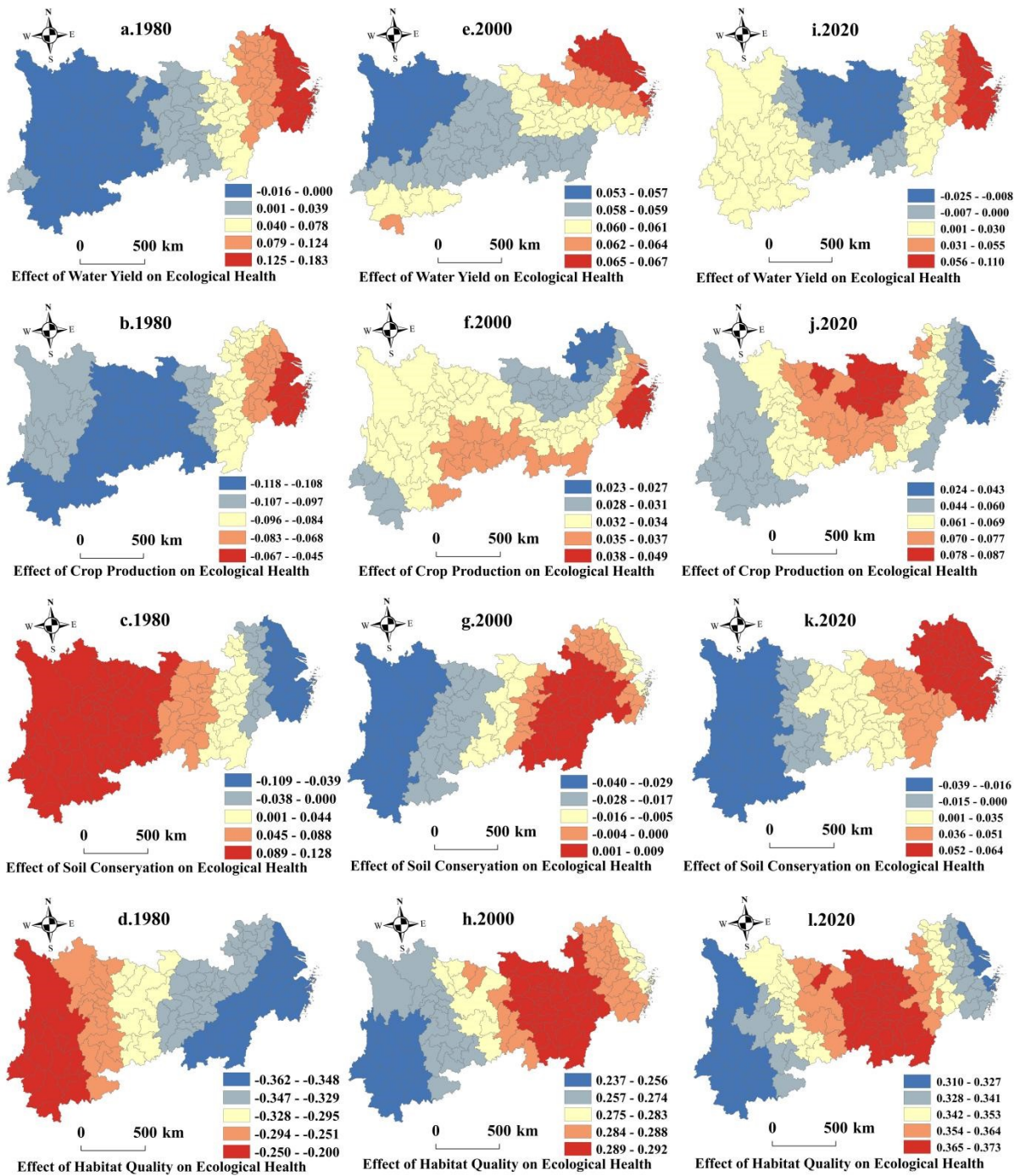


Figure. S6 Distribution of influence coefficient of ecosystem service index on ecological health index in Yangtze River Economic Belt