Supplement file

Establishment of Model

Variables

Table S-1 Names, units and data sources of the variables included in the PLE space system dynamics model

No.	Subsystem	Variables	Abbreviations	Units
1	Population -Economy	Total Fixed-asset investment	FAI	10^9 RMB
2		Fixed-asset investment in primary industry	FAIP	10^9 RMB
3		Fixed-asset investment in secondary industry and tertiary-industry	FAII&T	10^9 RMB
4		The proportion of primary industry in total Fixed-asset investment	PPI	Dmnl
5		Gross Domestic Product	GDP	10^9 RMB
6		Gross product of primary industry	GDPP	10^9 RMB
7		Gross product of secondary industry	GDPS	10^9 RMB
8		Gross product of tertiary-industry	GDPT	10^9 RMB
9		Total population	TP	10000 people
10		Population growth rate	PGR	%
11		Population growth quantity	PGQ	10000 people/Year
12		Rural population	RP	10000 people
13		Urban population	UP	10000 people
14		Urbanization rate	UR	Dmnl
15	Land	Total land area	TLA	km^2
16		Land area of Production space	LAP	km^2
17		Land area of Ecological space	LAE	km^2
18		Land area of living space	LAL	km^2
19		Construction land area	CLA	km^2
20		Land area of Agriculture Production space	LAPA	km^2
21		Land area of Industry Production space	LAPI	km^2
22		Land area growth quantity of Agriculture Production space per year	LAGQPA	km^2
23		Garden area	GA	km^2
24		Cultivated area	CA	km^2
25		The proportion of cultivated land area of agricultural production space	PCAPA	Dmnl
26		Land area of urban living space	LALU	km^2
27		Land area of rural living space	LALR	km^2
28		The proportion of industrial production space land area of construction land area	PPICLA	%
29		Growth quantity of Construction land area per year	GQCLA	km^2

30	Gross product of primary industry per unit area of Agriculture Production space	GDPPA	10^9 RMB/km^2
31	Gross product of secondary industry per unit area of Industry Production space	GDPPI	10^9 RMB/km^2
32	Gross product of tertiary-industry per unit area of urban living space	GDPLU	10^9 RMB/km^2
33	living area of Rural per capita	LALRPer	km^2/10000 people

Equations

(01)CA=LAPA*PCAPA
(02)CLA= INTEG (GQCLA, 56.5182)
(03)FAI=IF THEN ELSE(GDP<650, (37.362*EXP(0.0044*GDP))*1.01, (1624*LN(GDP)-10032)*1.07)
(04)"FAII&T"=FAI*(1-PPI)
(05)FAIP=FAI*PPI
(06)GA=LAPA*(1-PCAPA)
(07)GDP=GDPP+GDPT+GDPS
(08)GDPLU = WITH LOOKUP (Time, ([(2005,0)-(2020,10)],(2010,3.197),(2011,4.1285),(2012,4.97),(2013,6.091),(2014,6.202),(2015,6.041),(2016,5.8191),(2017,5.2616)))
(09)GDPP=GDPPA*LAPA
(10)GDPPA = WITH LOOKUP (Time, ([(2005,0)-(2020,0.1)],(2010,0.0123),(2011,0.0152),(2012,0.0188),(2013,0.021),(2014,0.0226),(2015,0.0234),(2016,0.0249),(2017,0.0258)))
(11) GDPPI = WITH LOOKUP (Time, ([(2005,0)-(2020,20)],(2010,11.1072),(2011,10.43),(2012,10.46),(2013,9.285),(2014,9.488),(2015,9.4138),(2016,9.821),(2017,11.2744))
(12)GDPS=GDPPI*LAPI
(13)GDPT=GDPLU*LALU
(14)GQCLA=IF THEN ELSE("FAII&T"<535, (3.6268*LN("FAII&T")-19.121) *1.5, (7.0571*LN ("FAII&T")-38.928)*1.18)
(15)LAE=TLA-LAP-LAL
(16)LAGQPA=FAIP*(-0.6885)+0.7059
(17)LAL=LALR+LALU
(18)LALR = WITH LOOKUP (RP, ([(0,0)-(500,200)],(368.88,159.08),(375.1,158.04),(384.5,157.1),(390.6,156.25),(394.2,155.52),(397,154.87),(407,154.33),(415.186,153.89)))
(19)LALU=CLA-LAPI
(20)LAP=LAPA+LAPI
(21)LAPA= INTEG (LAGQPA,6016.95)
(22)LAPI=CLA*PPICLA
(23)PCAPA=0.9989
(24)PGQ=PGR*TP/100
(25)PGR = WITH LOOKUP (Time,([(2009,0)-

(2040,10)],(2010,0.75321),(2011,0.71313),(2012,0.86858),(2013,0.84238),(2014,0.79821),(2015, 0.82873),(2016,1.1324)))

(26)PPI = WITH LOOKUP (Time,([(2005,0)-(2020,1)],(2010,0.01197),(2011,0.014258),(2012,0.0077),(2013,0.01),(2014,0.016),(2015,0.017),(2016,0.0089),(2017,0.016)))

(27)PPICLA = WITH LOOKUP (Time,([(2005,0)-(2020,1)],(2010,0.2785),(2011,0.3694),(2012,0.4283),(2013,0.4556),(2014,0.4551),(2015,0.4324), (2016,0.3936),(2017,0.3443)))

(28)RP=TP*(100-UR)/100

(29)TLA= 22436.93

(30)TP= INTEG (PGQ,521.919)

(31)UP=TP*UR/100

(32)UR= 14.476*EXP(0.001*GDP), GDP<650

UR= 27.424*LN(GDP)-150.83), 650<GDP<2000

UR = 9.6679 ln(x) - 10.318, GDP>2000

(33) LALRPer = WITH LOOKUP (Time, ([(0,0)-(3000,10)], (2010, 0.37),(2011,0.38),(2012,0.39),(2013,0.39),(2014,0.40),(2015,0.41),(2016, 0.42),(2017, 0.43)))

Precision of System Dynamic Model

Table S-2 Comparison of simulated and real values of some key variables

Variables		2010	2011	2012	2013	2014	2015	2016	2017
	Actual value	521.92	525.85	529.60	534.20	538.70	543.00	547.50	553.70
TP	Simulated value	521.92	525.85	529.60	534.20	538.70	543.00	547.50	553.70
	Error%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Actual value	200.54	276.20	421.79	548.50	550.48	612.98	739.30	897.36
FAI	Simulated value	200.16	281.69	408.90	524.24	542.12	625.48	763.02	914.68
	Error%	-0.19	1.99	-3.06	-4.42	-1.52	2.04	3.21	1.93
	Actual value	21.03	22.60	25.04	26.21	27.50	29.19	31.49	33.38
UR	Simulated value	21.15	22.86	24.88	26.33	27.13	28.45	30.62	33.01
	Error%	0.59	1.15	-0.64	0.44	-1.33	-2.54	-2.77	-1.10
	Actual value	379.64	465.03	555.60	611.27	669.51	708.38	765.53	830.62
GDP	Simulated value	379.21	456.87	541.56	598.03	658.07	690.41	747.28	815.43
	Error%	-0.12	-1.76	-2.53	-2.17	-1.71	-2.54	-2.38	-1.83
	Actual value	74.46	91.59	113.35	126.47	135.76	140.65	149.44	154.55
GDPP	Simulated value	74.01	91.44	113.06	126.26	135.82	140.50	149.34	154.64
	Error%	-0.60	-0.17	-0.26	-0.17	0.04	-0.11	-0.06	0.06
	Actual value	174.82	222.87	270.61	271.78	299.39	308.13	322.06	357.94
GDP_S	Simulated value	174.83	218.07	262.20	264.47	292.97	298.48	312.59	349.85
	Error%	0.01	-2.16	-3.11	-2.69	-2.15	-3.13	-2.94	-2.26
	Actual value	130.37	150.56	171.64	213.02	234.36	259.60	294.04	318.13
GDPT	Simulated value	130.37	147.35	166.30	207.31	229.29	251.43	285.35	310.94
	Error%	0.00	-2.13	-3.11	-2.68	-2.16	-3.15	-2.95	-2.26
	Actual value	6016.95	6016.13	6013.79	6010.15	6005.09	5998.61	5990.76	5981.48
LAPA	Simulated value	6016.95	6016.01	6013.95	6012.49	6009.58	6004.32	5997.70	5993.73
	Error%	0.00	0.00	0.00	0.04	0.07	0.10	0.12	0.20
LAPI	Actual value	15.74	21.36	25.87	29.27	31.55	32.73	32.79	31.75

	Simulated value	15.74	20.91	25.07	28.48	30.88	31.71	31.83	31.03
	Error%	0.01	-2.12	-3.10	-2.68	-2.14	-3.13	-2.95	-2.26
	Actual value	40.78	36.47	34.53	34.97	37.78	42.97	50.53	60.46
LALU	Simulated value	40.78	35.69	33.46	34.03	36.97	41.62	49.04	59.10
	Error%	0.00	-2.13	-3.11	-2.68	-2.15	-3.14	-2.95	-2.26
	Actual value	153.89	154.33	154.87	155.52	156.26	157.10	158.04	159.08
LALR	Simulated value	154.09	154.40	154.83	155.65	155.86	156.54	157.56	158.74
	Error%	0.13	0.05	-0.03	0.09	-0.26	-0.36	-0.30	-0.22
	Actual value	16212.64	16211.71	16210.93	16210.10	16209.31	16208.59	16207.87	16207.22
LA_E	Simulated value	16212.40	16213.00	16212.70	16209.30	16206.70	16205.80	16203.90	16197.40
	Error%	0.00	0.01	0.01	0.00	-0.02	-0.02	-0.02	-0.06
	Actual value	6032.69	6037.49	6039.66	6039.41	6036.65	6031.34	6023.56	6013.23
LAP	Simulated value	6032.69	6036.91	6039.01	6040.97	6040.46	6036.02	6029.53	6024.76
	Error%	0.00	-0.01	-0.01	0.03	0.06	0.08	0.10	0.19
	Actual value	194.67	190.80	189.41	190.49	194.04	200.07	208.57	219.55
LAL	Simulated value	194.87	190.10	188.29	189.68	192.83	198.16	206.60	217.84
	Error%	0.10	-0.37	-0.59	-0.42	-0.63	-0.96	-0.94	-0.78
	Actual value	428.36	478.49	533.93	587.50	547.65	508.78	513.16	537.57
TEC	Simulated value	427.75	470.11	520.44	574.71	538.30	495.85	500.90	527.75
	Error%	-0.14	-1.75	-2.53	-2.18	-1.71	-2.54	-2.39	-1.83
	Actual value	7.77	8.43	8.62	9.65	8.92	9.40	9.99	12.03
TWC	Simulated value	7.78	8.32	8.54	9.32	9.26	9.44	10.01	11.71
	Error%	0.20	-1.27	-0.88	-3.42	3.83	0.46	0.13	-2.65

FLUS Model

Suitability Probability Calculation

The suitability probability of nine land classes in the PLE space was calculated by the ANN-based module in the FLUS model. The ANN used in the FLUS model is a multilayer neural network consisting of an input layer, an implicit layer, and an output layer. Input signals from multiple neurons are passed through connections with weights. The total input value received by the neuron is compared with the threshold of the neuron. The neuron's output is processed by an activation function if it is greater than the threshold. The activation function uses the sigmoid function with the following equation:

$$sp(p,k,t) = \sum_j \omega_{j,k} \times sigmoid\left(net_j(p,t)\right) = \sum_j \omega_{j,k} \times \frac{1}{1+e^{-net_j(p,t)}} \quad (1)$$

$sp(p,k,t)$ is the suitability probability of k types of land at time t and raster pixel p; $\omega_{j,k}$ is the weight between the output layer and hidden layer; $sigmoid(\ )$ is the activation function from hidden layer to output layer; $net_j(p,t)$ indicates the signal received by the j hidden layer at raster pixel p and time t. The total probability of suitability of each raster pixel output by the neural network algorithm is always 1.

$$\sum_k sq(p,k,t) = 1 \quad (2)$$

The ANN sampling mode to obtain training samples in the FLUS model is divided into uniform sampling and random sampling. In the uniform sampling mode, the number of sampling points for each type of land is the same. In the random sampling mode, the number of sampling points is related to the proportion of each site. In this paper, uniform sampling is chosen, and the sampling ratio is 0.1% of the effective pixels in the study area. According to experience, the number of hidden layers of the neural network is set to 14.

Based on the ANN suitability probability results, the accuracy can be evaluated by the RMSE and the AUC value associated with the ROC curve. Smaller RMSE values and larger AUC values indicate higher model accuracy.

Simulation and Validation

Land-use conversion not only depends on the suitability probability output from the neural network but is also affected by factors such as neighbourhood density, inertia coefficient, conversion cost and land class competition. The integrated land-use conversion probability is calculated by the formula:

$$TProb_{p,k}^t = sp(p,k,t) \times \theta_{p,k}^t \times I_k^t \times (1 - sc_{c \to k}) \quad (3)$$

where $TProb_{p,k}^t$ is the total probability after combining the influence of the above four aspects; $\theta_{p,k}^t$ is the neighbourhood influence, and the calculation formula is shown in equation (4); I_k^t is the inertia coefficient in the adaptive process, and the calculation formula is shown in equations (5)-(7); and $sc_{c \to k}$ is the cost of changing land type c to k. The costs of different types of conversion together form the cost matrix.

$$\theta_{p,k}^t = \frac{\sum_{N \times N} con(c_p^{t-1} = k)}{N \times N - 1} \times \omega_k \quad (4)$$

where $\sum_{N \times N} con(c_p^{t-1} = k)$ represents the total number of raster pixels of land type k after the end of the last iteration in the Moore neighbourhood window of N*N, and N=3 in this paper; ω_k is the neighbourhood weight of land type k.

The gap between current land quantity and future demand adaptively adjusts during the iterative process, determining the inertia factor for different types of sites. The adaptive inertia coefficient

I_k^tat moment t for land type k is:

$$I_k^t = I_k^{t-1} \qquad \left|D_k^{t-2}\right| \le \left|D_k^{t-1}\right| \tag{5}$$

$$I_k^t = I_k^{t-1} \times \frac{D_k^{t-2}}{D_k^{t-1}} \qquad 0 > D_k^{t-2} > D_k^{t-1} \tag{6}$$

$$I_k^t = I_k^{t-1} \times \frac{D_k^{t-1}}{D_k^{t-2}} \qquad D_k^{t-1} > D_k^{t-2} > 0 \tag{7}$$

where D_k^{t-1} and D_k^{t-2} are the differences between the demands and actual patches in land type k at moments t-1 and t-2, respectively.

Model Precision

Suitability Probabilities based on ANN

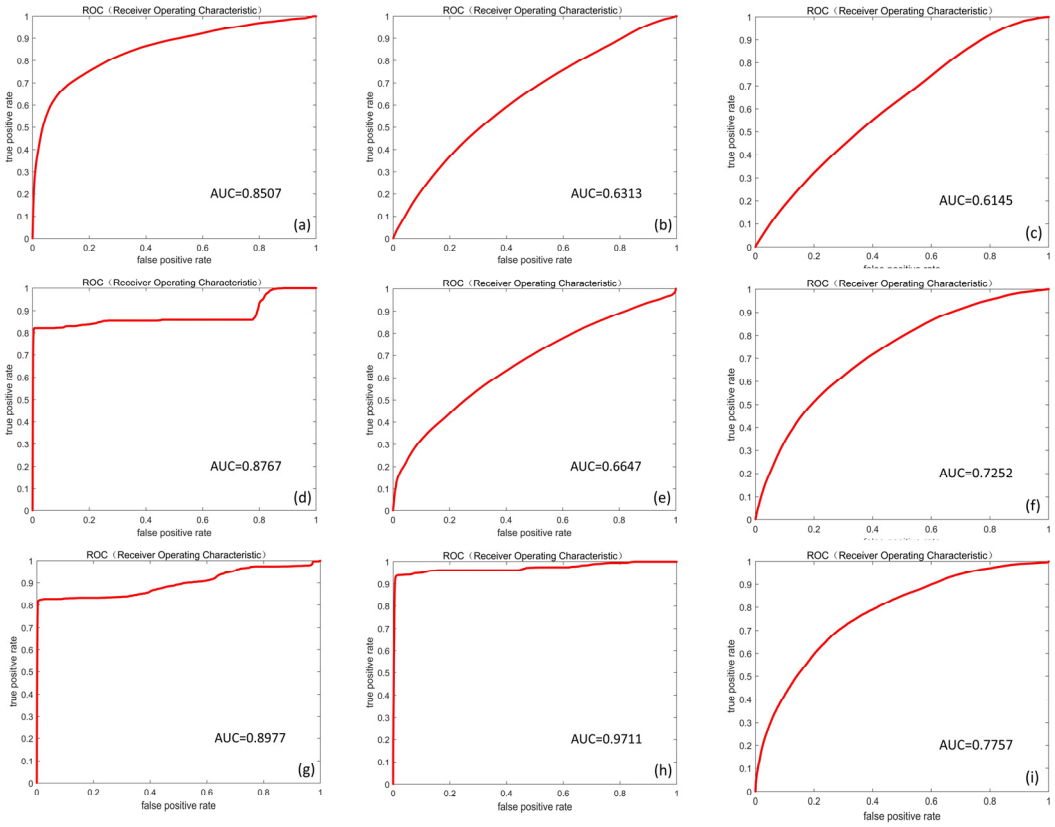

Figure S- 1 ROC curves and AUC values for 2010 suitability probability results based on ANN

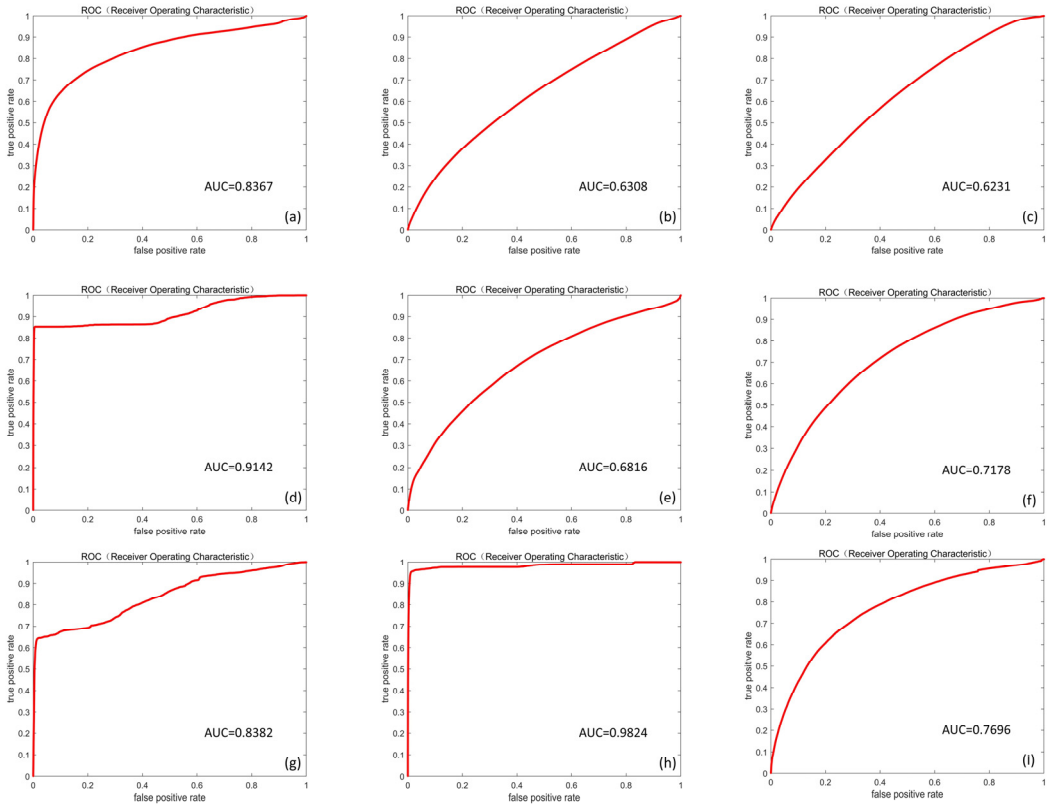

Figure S- 2 ROC curves and AUC values for 2015 suitability probability results based on ANN

Accuracy of Spatial Simulation

Table S-3 Cost Matrix for the 2015 simulation using 2010 PLE spatial distribution data

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	1	1	0	1	1	0	0	0
EP	1	1	1	0	1	1	0	0	0
EG	0	1	1	0	0	0	0	0	1
EA	0	0	0	1	0	0	0	0	0
PP	0	1	1	0	1	1	0	0	0
PG	0	1	1	0	1	1	0	0	0
PI	1	1	1	0	1	1	1	1	0
LU	0	0	1	0	1	1	0	1	0
LR	0	1	1	0	1	1	0	0	1

Note：0 means that it cannot be converted into another lands, 1 means that it can be converted

Table S-4 Cost Matrix for the 2015 simulation using 2010 PLE spatial distribution data

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	1	1	0	1	1	0	1	0
EP	1	1	1	1	1	1	1	0	1
EG	1	1	1	0	1	1	1	0	1
EA	1	1	1	1	0	0	0	1	0
PP	1	1	1	0	1	1	1	0	1

PG	1	1	1	1	1	1	0	0	1
PI	1	1	1	0	1	1	1	0	0
LU	1	1	1	0	1	1	1	1	0
LR	1	1	1	0	1	1	0	0	1

Table S-5 Confusion matrix between the actual and simulated values of PLE in 2015

	ER	EP	EG	EA	PP	PG	PI	LU	LR	Total
ER	15657	123	0	0	2	1	4	0	0	15787
EP	43	75757	71	0	256	222	62	0	0	76411
EG	27	23	83674	0	31	37	20	4	3	83819
EA	0	0	0	163	0	0	0	0	0	163
PP	56	298	0	0	30042	7165	98	13	42	37714
PG	10	210	0	0	7296	20242	8	5	13	27784
PI	0	0	0	0	0	0	153	0	0	153
LU	0	0	0	0	0	0	0	421	0	421
LR	0	0	78	0	0	0	0	0	1643	1721
Total	15793	76411	83823	163	37627	27667	345	443	1701	2439739

Table S-6 Confusion matrix between the actual and simulated values of PLE in 2018

Land-use types	ER	EP	EG	EA	PP	PG	PI	LU	LR	Total
ER	15555	115	82	5	289	90	4	5	14	16159
EP	160	71378	2505	7	1095	918	46	17	72	76198
EG	154	2403	78055	3	1416	1347	20	5	58	83461
EA	0	3	4	104	2	14	0	0	0	127
PP	140	1079	1394	3	27568	4861	40	191	102	35378
PG	104	1128	1418	3	4602	22491	37	13	193	29989
PI	0	16	10	0	19	0	176	145	5	371
LU	45	7	5	0	19	2	6	454	23	561
LR	1	61	56	0	149	114	3	3	1342	1729
Total	16159	76190	83529	125	35159	29837	332	833	1809	243973

Constrained Scenarios

Table S-7 Cost Matrix for Base Scenario

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	1	1	1	1	1	1	1	1
EP	1	1	1	1	1	1	1	1	1
EG	1	1	1	1	1	1	1	1	1
EA	1	1	1	1	1	1	1	1	1
PP	1	1	1	1	1	1	1	1	1
PG	1	1	1	1	1	1	1	1	1
PI	1	1	1	1	1	1	1	1	1
LU	0	0	0	0	0	0	0	1	0

LR	1	1	1	1	1	1	1	1	1

Table S-8 Cost Matrix for Scenario A1 and A2

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	0	0	0	0	0	0	0	0
EP	1	1	1	1	1	1	1	1	1
EG	1	1	1	1	1	1	1	1	1
EA	1	1	1	1	1	1	1	1	1
PP	0	0	0	0	1	0	0	0	0
PG	0	0	0	0	0	1	0	0	0
PI	1	1	1	1	1	1	1	1	1
LU	0	0	0	0	0	0	0	1	0
LR	1	1	1	1	1	1	1	1	1

Table S-9 Cost Matrix for Scenario A3

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	1	1	1	1	1	1	1	1
EP	1	1	1	1	1	1	1	1	1
EG	1	1	1	1	1	1	1	1	1
EA	1	1	1	1	1	1	1	1	1
PP	0	0	0	0	1	0	0	0	0
PG	0	0	0	0	0	1	0	0	0
PI	1	1	1	1	1	1	1	1	1
LU	0	0	0	0	0	0	0	1	0
LR	1	1	1	1	1	1	1	1	1

Table S-10 Cost Matrix for Scenario B1 and B2

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	0	0	0	0	0	0	0	0
EP	0	1	0	0	0	0	0	0	0
EG	0	0	1	0	0	0	0	0	0
EA	1	1	1	1	1	1	1	1	1
PP	1	1	1	1	1	1	1	1	1
PG	1	1	1	1	1	1	1	1	1
PI	1	1	1	1	1	1	1	1	1
LU	0	0	0	0	0	0	0	1	0
LR	1	1	1	1	1	1	1	1	1

Table S-11 Cost Matrix for Scenario B3

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	1	1	1	1	1	1	1	1
EP	0	1	0	0	0	0	0	0	0
EG	0	0	1	0	0	0	0	0	0
EA	1	1	1	1	1	1	1	1	1
PP	1	1	1	1	1	1	1	1	1
PG	1	1	1	1	1	1	1	1	1
PI	1	1	1	1	1	1	1	1	1

LU	0	0	0	0	0	0	0	1	0
LR	1	1	1	1	1	1	1	1	1

Table S-12 Cost Matrix for Scenario C1 and C2

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	0	0	0	0	0	0	0	0
EP	0	1	0	0	0	0	0	0	0
EG	1	1	1	1	1	1	1	1	1
EA	1	1	1	1	1	1	1	1	1
PP	0	0	0	0	1	0	0	0	0
PG	1	1	1	1	1	1	1	1	1
PI	1	1	1	1	1	1	1	1	1
LU	0	0	0	0	0	0	0	1	0
LR	1	1	1	1	1	1	1	1	1

Table S-13 Cost Matrix for Scenario C3

	ER	EP	EG	EA	PP	PG	PI	LU	LR
ER	1	1	1	1	1	1	1	1	1
EP	0	1	0	0	0	0	0	0	0
EG	1	1	1	1	1	1	1	1	1
EA	1	1	1	1	1	1	1	1	1
PP	0	0	0	0	1	0	0	0	0
PG	1	1	1	1	1	1	1	1	1
PI	1	1	1	1	1	1	1	1	1
LU	0	0	0	0	0	0	0	1	0
LR	1	1	1	1	1	1	1	1	1

Results

Spatiotemporal pattern analysis

Table S- 14 Ratio of land area for production, living and ecological space in 2010, 2015, and 2018

Year	2010		2015		2018	
PLE Space	Area (km^2)	Percentage (%)	Area (km^2)	Percentage (%)	Area (km^2)	Percentage (%)
Ecological Space	16210.36	72.25	16206.31	72.23	16203.87	72.22
Production Space	6031.90	26.88	6030.55	26.88	6000.09	26.74
Living Space	194.67	0.87	200.07	0.89	232.97	1.04
Total	22436.93	100.00	22436.93	100.00	22436.93	100.00

Table S-15 Land area and percentage of 9 subclasses in PLE space in 2010, 2015, and 2018

PLE space	2010		2015		2018	
	Area (km^2)	Percentage (%)	Area (km^2)	Percentage (%)	Area (km^2)	Percentage (%)
ER	1442.06	6.43	1453.9	6.48	1481.17	6.60

EP	7028.53	31.33	7018.83	31.28	7000.82	31.20
EG	7726.74	34.44	7720.56	34.41	7710.14	34.36
EA	13.03	0.06	13.03	0.06	11.74	0.05
PP	3166.14	14.11	3442.69	15.34	3218.38	14.34
PG	2850.02	12.70	2555.13	11.39	2752.14	12.27
PI	15.74	0.07	32.73	0.15	29.57	0.13
LU	40.78	0.18	42.96	0.19	72.76	0.32
LR	153.89	0.69	157.1	0.70	160.21	0.71
Total	22436.93	100	22436.93	100	22436.93	100

Table S-16 Land-use transition matrix from 2010 to 2015

	ER	EP	EG	EA	PP	PG	PI	LU	LR	2015 Total
ER	1441.91	5.91	2.7	0	2.28	1.1	0	0	0	1453.9
EP	0.03	7016.88	1.29	0	0.37	0.25	0	0	0	7018.82
EG	0	0.02	7720.42	0	0	0	0	0	0.11	7720.55
EA	0	0	0	13.03	0	0	0	0	0	13.03
PP	0	0.06	0.02	0	2659.35	783.26	0	0	0	3442.69
PG	0	0.42	0.06	0	491.92	2062.73	0	0	0	2555.13
PI	0.13	4.96	1.74	0	8.69	1.48	15.74	0.01	0	32.75
LU	0	0	0.22	0	1.47	0.51	0	40.77	0	42.97
LR	0	0.28	0.29	0	2.05	0.69	0	0	153.78	157.09
2010 Total	1442.07	7028.53	7726.74	13.03	3166.13	2850.02	15.74	40.78	153.89	22436.93

Table S-17 Land-use transition matrix from 2015 to 2018

Area (km^2)	ER	EP	EG	EA	PP	PG	PI	LU	LR	Total of 2018
ER	1435.43	15.04	11.80	0	12.55	6.13	0.02	0.04	0.15	1481.16
EP	2.64	6576.75	222.74	0.56	102.93	88.16	1.27	0.36	5.41	7000.82
EG	1.78	230.46	7220.44	0.29	134.50	116.53	0.53	0.31	5.30	7710.14
EA	0.08	0.55	0.32	10.36	0.34	0.11	0	0	0	11.74
PP	11.37	99.14	124.22	0.37	2646.69	322.83	1.77	1.41	10.57	3218.38
PG	0.78	85.20	132.87	1.44	513.09	2008.40	0.37	0.25	9.74	2752.13
PI	0.47	4.15	1.96	0	4.68	2.10	16.07	0.03	0.12	29.57
LU	0.87	1.56	0.42	0	16.74	1.52	12.36	38.87	0.41	72.76
LR	0.49	5.97	5.77	0	11.18	9.36	0.34	1.68	125.40	160.21
Total of 2015	1453.90	7018.83	7720.55	13.03	3442.69	2555.13	32.73	42.97	157.10	22436.92

Results of Multi-Scenarios

Future demand

Table S-18 Projections of the economy and population under different scenarios in 2030

Scenarios	GDP	Total population	Urbanization rate	GDP per capita
Planning	4100.00	615.00	55.00	6.70

target				
BS	3405.08	624.57	68.33	5.45
A1	4614.44	642.44	71.27	7.18
A2	3724.54	630.16	69.19	5.91
A3	3114.25	618.10	67.46	5.04
B1	4602.20	642.44	71.24	7.16
B2	3714.87	630.16	69.17	5.90
B3	3105.14	618.10	67.43	5.02
C1	4602.20	642.44	71.24	7.16
C2	3714.87	630.16	69.17	5.90
C3	3105.14	618.10	67.43	5.02

Spatial optimization

Table S-19 Difference between future demand and allocated values for different scenarios

		ER	EP	EG	EA	PP	PG	PI	LU	LR
	Demand	1625862	7712021	8491467	12913	3292757	2815742	155301	175127	116159
BS	Allocation	1616891	7712021	8491467	12913	3292757	2815742	120154	175127	160277
	Difference%	-0.55	0.00	0.00	0.00	0.00	0.00	-22.63	0.00	37.98
	Demand	1605507	7502478	8260746	12562	3499585	2992607	109825	233379	180660
A1	Allocation	1605507	7502478	8303348	12562	3499585	3009208	109825	174176	180660
	Difference%	0.00	0.00	0.52	0.00	0.00	0.55	0.00	-25.37	0.00
	Demand	1605507	7517681	8277486	12587	3498279	2994861	119142	213486	158320
A2	Allocation	1605507	7517898	8302920	12587	3498279	2994861	119140	187837	158320
	Difference%	0.00	0.00	0.31	0.00	0.00	0.00	0.00	-12.01	0.00
	Demand	1594955	7538630	8302441	12641	3498279	2994861	132419	191913	131210
A3	Allocation	1594961	7538637	8302442	12641	3498279	2994861	132418	190768	132342
	Difference%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.60	0.86
	Demand	1605507	7615472	8384894	12751	3371607	2883170	109801	233327	180820
B1	Allocation	1605507	7615472	8384894	12751	3371607	2934836	109801	181661	180820
	Difference%	0.00	0.00	0.00	0.00	0.00	1.79	0.00	-22.14	0.00
	Demand	1605507	7628344	8399333	12773	3374127	2885324	120057	213435	158449
B2	Allocation	1605507	7628344	8399333	12773	3374127	2923422	97049	194338	162456
	Difference%	0.00	0.00	0.00	0.00	0.00	1.32	-19.16	-8.95	2.53
	Demand	1619516	7654718	8430291	12837	3354736	2878482	117840	164066	164863
B3	Allocation	1619516	7654718	8430291	12837	3354736	2905995	90327	164066	164863
	Difference%	0.00	0.00	0.00	0.00	0.00	0.96	-23.35	0.00	0.00
	Demand	1605507	7615472	8384894	12751	3498279	2756498	109801	233327	180820
C1	Allocation	1605507	7615472	8384894	12751	3498279	2965739	29418	104468	180821
	Difference%	0.00	0.00	0.00	0.00	0.00	7.59	-73.21	-55.23	0.00
	Demand	1605507	7628344	8399333	12773	3498279	2761172	120057	213435	158449
C2	Allocation	1605507	7628344	8399333	12773	3498279	2950662	31375	111015	160061
	Difference%	0.00	0.00	0.00	0.00	0.00	6.86	-73.87	-47.99	1.02
	Demand	1619516	7654718	8430291	12837	3498279	2725199	133325	191859	131325
C3	Allocation	1619516	7654718	8430291	12837	3498279	2885302	30293	110898	155215
	Difference%	0.00	0.00	0.00	0.00	0.00	5.87	-77.28	-42.20	18.19