Supplementary S1. Data requirements

Table S1. Six datasets were used to estimate four ESs.

Data name	Resolution	Data sources
Land-use	30 m	(https://zenodo.org/record/8176941)
DEM	30 m	Geospatial data cloud (http://www.gscloud.cn)
Soil data	250 m	World Soil Database (https://webarchive.iiasa.ac.at)
Precipitation	1000 m	A Big Earth Data Platform for Three Poles (http://poles.tpdc.ac.cn/zh-hans/)
Potential evapotranspiration	1000 m	A Big Earth Data Platform for Three Poles (http://poles.tpdc.ac.cn/zh-hans/)
Road network distribution	1000 m	Open Street Map (http://www.openstreetmap.org)

Table S2. Description of the drivers of land-use change.

Driving force	Driving factor	Factor description
Natural factors	DEM	Raster cell elevation
	SLOPE	Elevation data calculation
	AAR	Average 2000–2020
	PET	Average 2000–2020
	NDVI	2020 data
Socioeconomic factors	Distance to highway	Road network data are calculated using Euclidean distance
	Distance to provincial highway	Road network data are calculated using Euclidean distance
	Distance to railway	Road network data are calculated using Euclidean distance
	POP	2020 data
	GDP	2020 data

Table S3. Basin Land-Use Type Conversion Matrix.

	ND					CP					EP					CD				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
a	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	0	0	0
b	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1
c	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	0
d	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1
e	1	1	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1

Note: a, b, c, d, and e denote agriculture, forest, grass, water, and the constructed areas, respectively.

Columns indicate transfers in and rows indicate transfers out.

Table S4. Neighbourhood weights.

Types of land	Agriculture	Forest	Grass	Water	Constructed
Weights	0.7	0.4	0.4	0.4	0.8

Supplementary S2. Introduction to Formulas

In our study, we selected the water yield module, the carbon storage and sequestration module and the habitat quality module of the InVEST model to evaluate the corresponding ecosystem services, Soil conservation was estimated using the USLE equation.

Water yield

$$Y(x) = (1 - AET(x)/P(x)) \times P(x) \tag{S1}$$

$$AET(x)/P(x) = 1 + PET(x)/P(x) - [1 + (PET(x)/P(x))^{\omega}]^{1/\omega} \tag{S2}$$

$$PET(x) = K_c(\partial x) \cdot ET_0(x) \tag{S3}$$

$$\omega(x) = Z \cdot AWC(x)/P(x) + 1.25 \tag{S4}$$

$$AWC(x) = Min(rest.layer.depth, root.depth) \cdot PAWC \tag{S5}$$

$$AET(x) = Min(Kc(\partial x) \cdot ET_0(x), P(x)) \tag{S6}$$

Where AET(x) is pixel x actual transpiration, P(x) is the amount of precipitation across x pixels, PET(x) is potential evapotranspiration, AWC(x) is a volume of effective plant water content, ET_0 (x) is reference evapotranspiration from pixel x, and K_c (∂x) is evapotranspiration factor for each LULC. ω(x) is an empirical parameter. PAWC has an effective plant water content.

Carbon storage

$$S_{cs} = C_{above} + C_{below} + C_{soil} + C_{dead} \tag{S7}$$

Where S_{cs} is a supply of ESs carbon sequestration services; C_{above} is aboveground carbon stock; C_{below} is belowground carbon stock; C_{soil} is soil organic carbon; and C_{dead} is dead organic matter carbon stock.

Soil conservation

$$A = R \cdot K \cdot LS - USLE \tag{S8}$$

$$USLE = R \cdot K \cdot LS \cdot C \cdot P \tag{S9}$$

Where A is the amount of SC; USLE is soil erosion per unit area; R is the rainfall element; K is the soil erodibility element; LS is the topographic element; C is the surface cover element; and P is the soil and water conservation measures element.

Correlation recognition

Based on the Pearson factor scores, the synergistic effects of trade-offs of ESs were measured and mapped.

$$P_{X,Y} = \left(n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i\right) \Big/ \left(\sqrt{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}\sqrt{n\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)^2}\right) \tag{S10}$$

When $P_{X,Y} = 0$, X and Y are not linearly correlated. When $P_{XY} > 0$, the correlation coefficient between two ESs is positive and the two are considered to be synergistically correlated, and vice versa for trade-offs. The closer $P_{X,Y}$ is to ± 1, the higher the correlation.

The Pareto efficiency guidelines are as follows:

$$\left\{\forall_i \in \{1,2\}, ES_i(R) \geq ES_i(R^{'}); \exists_j \in \{1,2\}, ES_j(R) \geq ES_j(R^{'})\right\} \tag{S11}$$

Synergy potential

$$S = \int_a^b f(x)dx \tag{S12}$$

Where a and b are the minimum and maximum values of the option points, respectively.

Trade-off intensity

$$D_{\min} = \min\left\{\sqrt{(x_0 - x)^2 + (y_0 - y)^2}\right\} \tag{S13}$$

The larger the value of D_{min}, the stronger the resulting trade-off; the smaller D_{min}, the weaker this trade-off.

Supplementary S3. Spatial and temporal changes in the four ESs

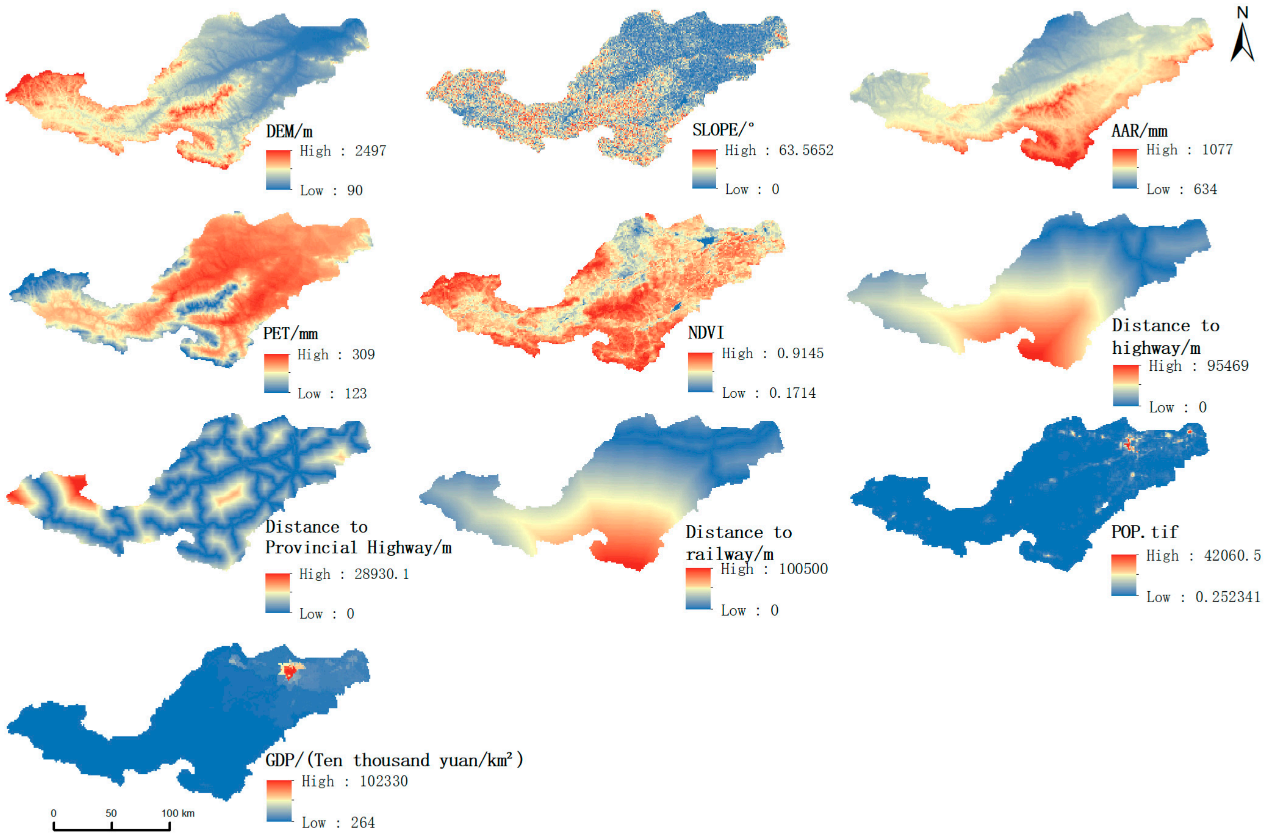

Figure S1. Drivers of land-use change.

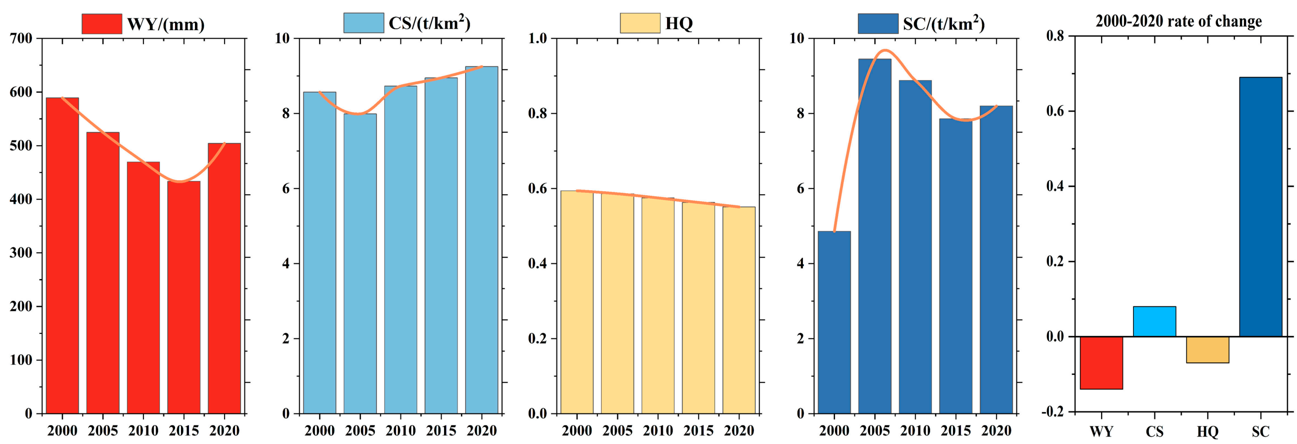

Figure S2. Changes in the mean value of ecosystem service provisioning.

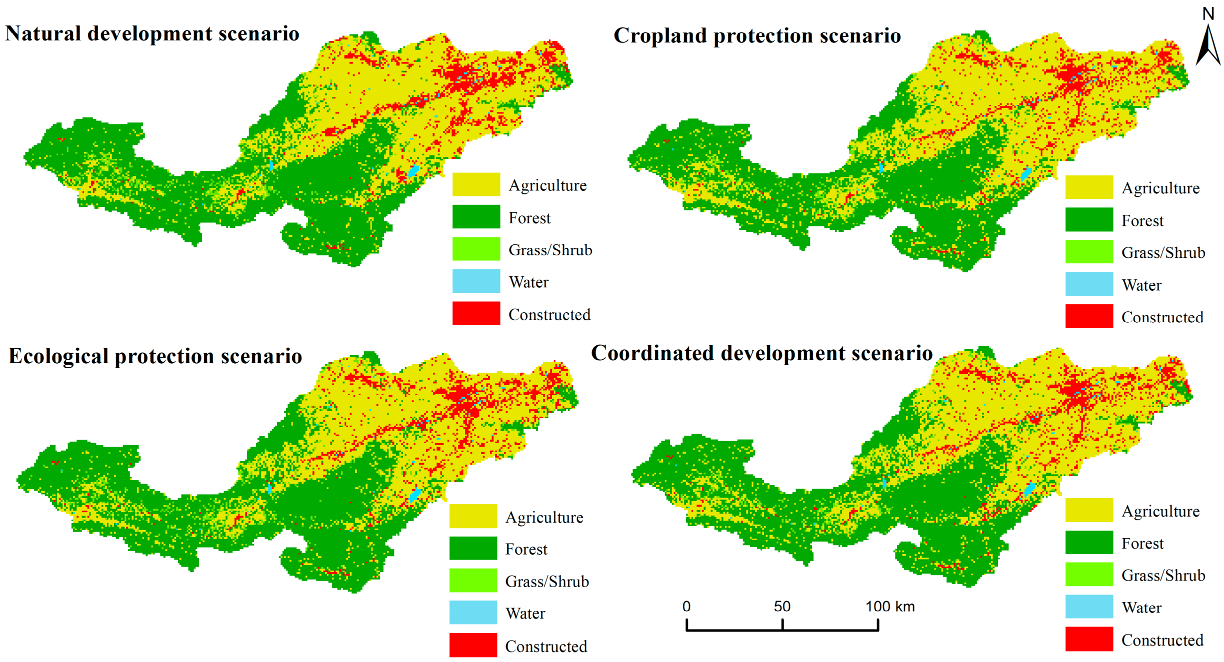

Figure S3. Land use in 2030.

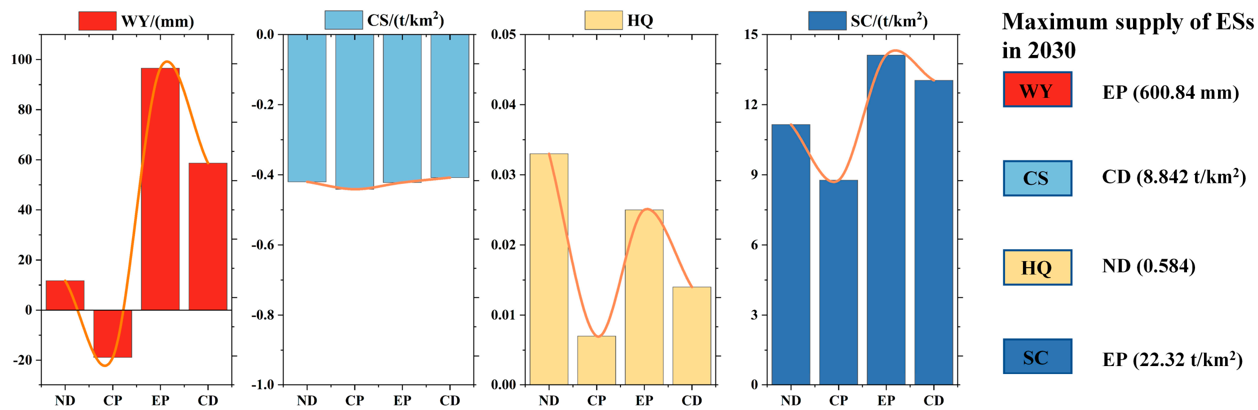

Figure S4. Changes in ESs provisioning capacity under different scenarios, 2020–2030.

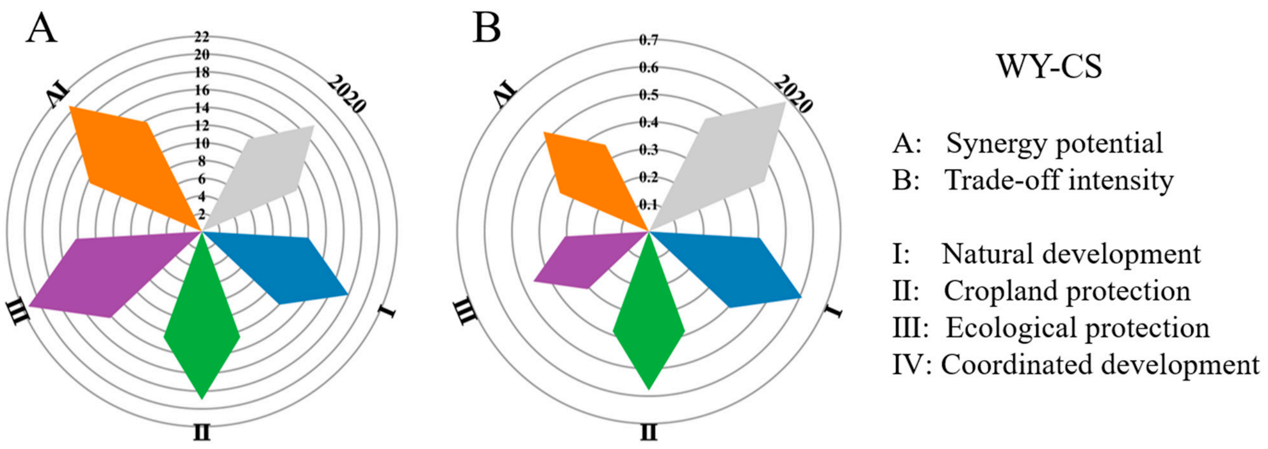

Figure S5. Comparison of scenarios of changes in synergy potential and trade-off intensity.

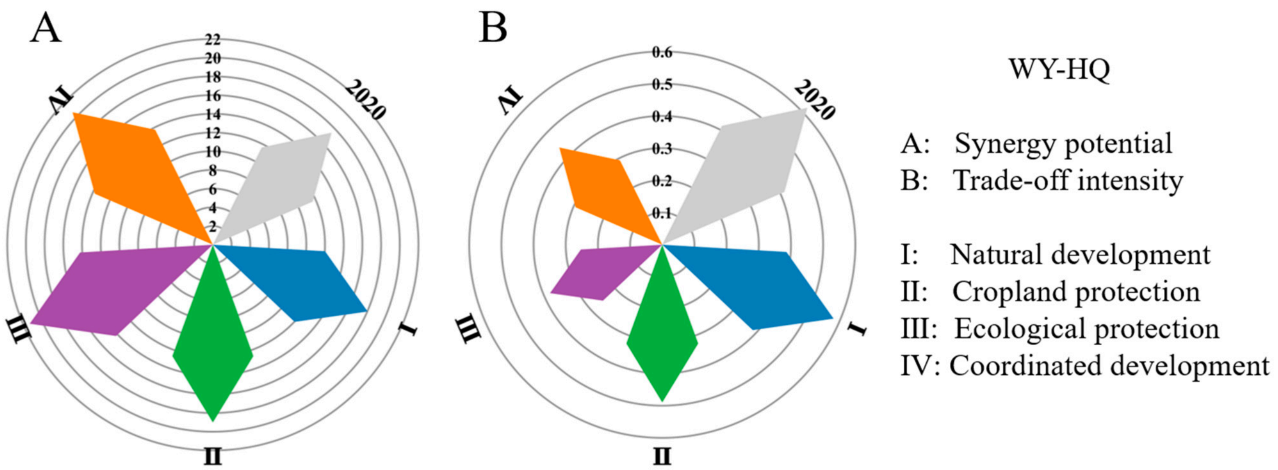

Figure S6. Comparison of scenarios of changes in synergy potential and trade-off intensity.