

Supplementary material

1. Key data for quantification of ecosystem services and analysis of driving factors

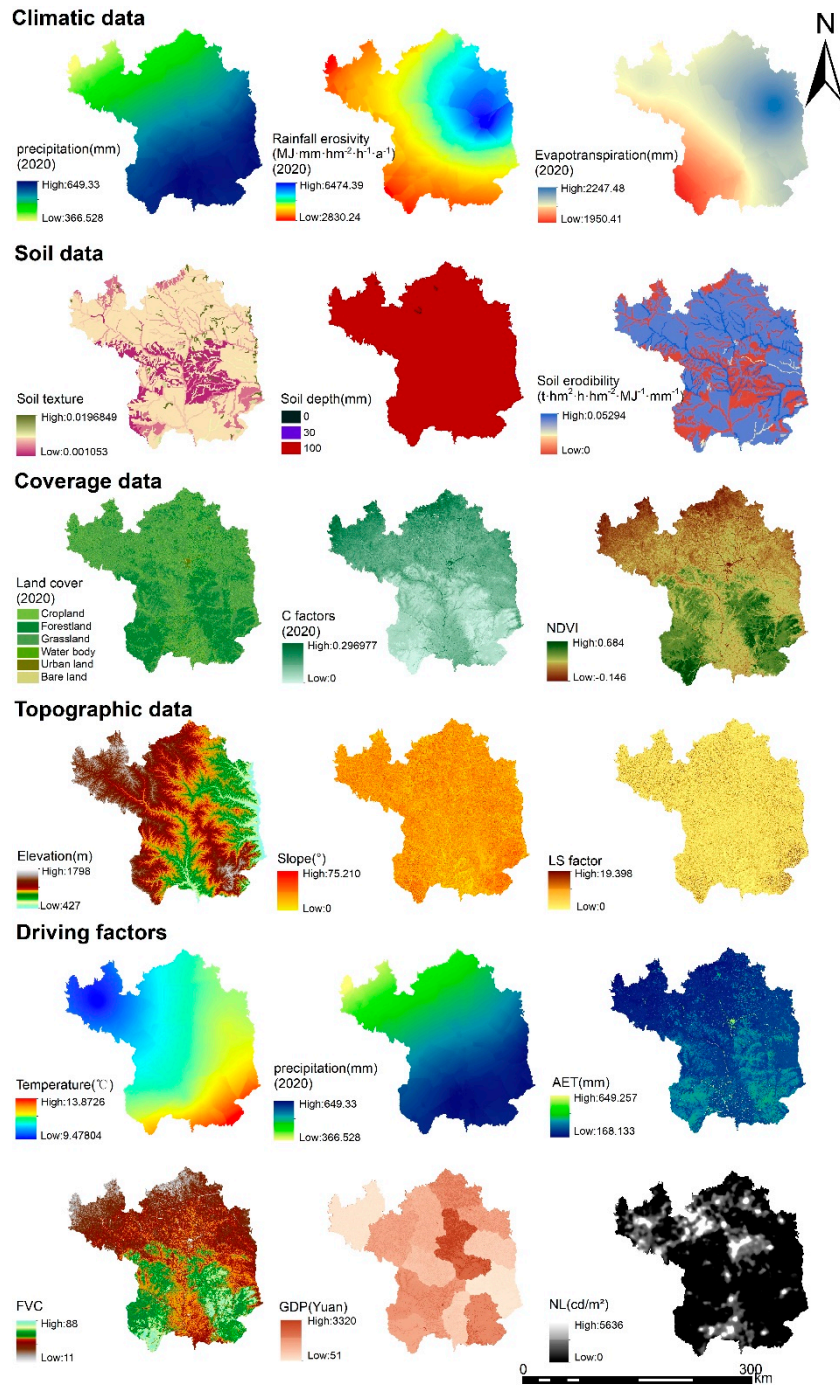


Figure S1. Key Data for quantification of ecosystem services and analysis of driving factors (exemplified by the year 2020).

2. Changes in ecosystem services (ESs) during 1990 to 2020

There were significant differences in the trends of the four ESs means in Yan'an (Table S1). Over the past 30 years, carbon sequestration and soil conservation showed an overall decreasing tendency followed by an increasing trend. After the implementation of vegetation

restoration, the two ESs have demonstrated positive improvement effects. Compared with 1990, the carbon sequestration in 2020 will be 444.83 g C/m², with an overall increase of 9%. The increase in soil conservation was even more significant by year 2020, being 2.2 times to year 1990.

However, over the past three decades, both water yield and baseflow regulation had fallen below their average values in 1990. By 2020, the annual average water yield and baseflow regulation has decreased by 3.40% and by 10.50%, respectively, compared to the values observed in 1990.

Table S1. Average values of the four ESs in Yan'an City from 1990 to 2020.

| ESs | 1990 | 2000 | 2010 | 2020 |
|--------------------------|---------|---------|---------|---------|
| CS (g C/m ²) | 407.725 | 289.358 | 395.153 | 444.829 |
| SC (t/hm) | 123.503 | 96.065 | 218.331 | 398.056 |
| WY (mm) | 313.843 | 216.287 | 258.971 | 303.171 |
| BR (mm) | 2.193 | 2.338 | 1.547 | 1.968 |

3. Significance tests for ES interactions

Table S2. Significance test standard.

| Moran's I | Z score | <i>p</i> value |
|-----------|---------|----------------|
| 90% | >1.65 | <0.10 |
| 95% | >1.96 | <0.05 |
| 99% | >2.58 | <0.01 |

Table S3. Global bivariate spatial autocorrelation results for each ES pair during 1990 to 2020.

| ES pairs | Year | 1990 | 2000 | 2010 | 2020 |
|----------|----------------|---------|---------|---------|---------|
| CS-WY | Moran's I | 0.154 | 0.541 | 0.544 | 0.412 |
| | Z score | 33.847 | 100.327 | 102.328 | 80.247 |
| | <i>p</i> value | 0.001 | 0.001 | 0.001 | 0.001 |
| BR- WY | Moran's I | -0.052 | -0.005 | -0.040 | -0.060 |
| | Z score | -10.183 | -1.037 | -8.316 | -12.009 |
| | <i>p</i> value | 0.001 | 0.164 | 0.001 | 0.001 |
| BR-CS | Moran's I | -0.066 | -0.012 | -0.046 | -0.028 |
| | Z score | -14.368 | -2.621 | -9.755 | -6.132 |
| | <i>p</i> value | 0.001 | 0.005 | 0.001 | 0.001 |
| SC-CS | Moran's I | 0.035 | 0.094 | 0.117 | 0.014 |
| | Z score | 7.383 | 19.570 | 24.655 | 3.015 |
| | <i>p</i> value | 0.001 | 0.001 | 0.001 | 0.002 |