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Retraction

Retracted: Coupling Coordination Degree between New Urbanization and Eco-Environment in Shaanxi, China, and Its Influencing Factors

Discrete Dynamics in Nature and Society

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope

(2) Discrepancies in the description of the research reported

(3) Discrepancies between the availability of data and the research described

(4) Inappropriate citations

(5) Incoherent, meaningless and/or irrelevant content included in the article

(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] L. Guo, "Coupling Coordination Degree between New Urbanization and Eco-Environment in Shaanxi, China, and Its Influencing Factors," *Discrete Dynamics in Nature and Society*, vol. 2021, Article ID 1555362, 8 pages, 2021.

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Research Article

Coupling Coordination Degree between New Urbanization and Eco-Environment in Shaanxi, China, and Its Influencing Factors

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Taking northwestern China's Shaanxi Province as the object, this paper constructs a comprehensive evaluation system (CES) for new urbanization and a CES for eco-environment. On this basis, the coordination coupling between new urbanization and eco-environment in Shaanxi and its key factors were evaluated and analyzed, using composite index method, relative development level model, coupling degree model, and coordination coupling degree (CCD) model. The results show that the development level of new urbanization in the province increased linearly, while that of eco-environment rose slowly; the relative development between the two systems gradually changed from the development lag of eco-environment to the development lag of new urbanization; the CCD between the two shifted from medium incoordination to high coordination; the coordinated development between the two systems is greatly driven by per-capita gross domestic product (GDP) in the new urbanization system, and the park area in the eco-environment system.

1. Introduction

New urbanization is an urbanization process featured by the overall planning and integration of urban and rural areas, the interaction between various industries, an economical, intensive, and harmonious model of development, as well as an ecological and livable environment. Through new urbanization, large, medium, and small cities will develop in coordination with small towns and new rural communities, and their developments will promote each other. In fact, new urbanization is an important symbol of China's modernization.

In 2015, the Chinese Government clearly stated in its Work Report that it will provide more funds and policies to support the comprehensive piloting of new urbanization. The pilot program covers many places in Shaanxi Province, including Yan'an City, Shenmu County of Yulin City, Shanyang County of Shangluo City, and Caijiapo Town, Qishan County of Baoji City. New urbanization calls for constant improvement of the quality of urban construction. Compared with traditional notions of urbanization, new urbanization highlights the comprehensive improvement of intrinsic quality, that is, shifting from quantity-first to quality-first.

For a long time, Chinese people have been used to extensive utilization of land and energy. Since the proposal of new urbanization, it is a must to recognize the importance of pursuing resource-saving and environmentally friendly development. In the past, the urbanization process is mainly driven by central cities. Under the concept of new urbanization, it is inevitable to enhance the coordinated and synergistic development between city clusters, large, medium, and small cities, and small towns. Rather than proportional expansion of urban population and scale, new urbanization stresses the transformation from rural to urban in terms of industrial support, living environment, social security, and lifestyle. Focusing on ecological infrastructure and livable environment, new urbanization eyes the overall planning and sustainable development of rural and urban areas and pursues the ultimate goal of undifferentiated development of all people.

Nevertheless, the fast advancement of new urbanization will surely cause problems like air and water pollution, and eco-environment deterioration, which in turn overload the resources and environment [1]. In this background, it is of practical significance to study the coupling coordination effect

between new urbanization and eco-environment and pinpoint the key factors of this effect.

So far, many scholars have discussed the relationship between new urbanization and eco-environment. Their studies generally concentrate in two aspects: some scholars theoretically expounded the inner mechanism of new urbanization and eco-environment through literature review, pointing out the outstanding problems and challenges of the coordinated development between the two systems [1]. Some scholars empirically evaluated the coupling state and coordination level between new urbanization and eco-environment in Henan, Chongqing, and many other regions of China through empirical analysis [2–8]. However, there are few scholars that analyzed the factors affecting the coordinated development between the two systems from the perspective of coupling coordination degree (CCD).

To make up for the gap, this paper explores the coupling coordinated development of new urbanization and eco-environment in Shaanxi Province, China, and pinpoints the key factors of the development process with grey correlation model. The results show that the development level of new urbanization in the province increased linearly, while that of eco-environment rose slowly; the relative development between the two systems gradually changed from the development lag of eco-environment to the development lag of new urbanization; the CCD between the two shifted from medium incoordination to high coordination; the coordinated development between the two systems is greatly driven by per-capita gross domestic product (GDP) in the new urbanization system, and the park area in the eco-environment system. The research results provide a reference for government decision-making.

The remainder of this study is structured as follows. Section 2 describes methodology. Section 3 describes index selection and data sources. Empirical results and analysis are provided in Section 4. Finally, Section 5 concludes this study.

2. Methodology

2.1. Comprehensive Evaluation Model

2.1.1. Data Normalization. The original data on evaluation indices are incomparable, due to the differences in dimension and direction [8, 9]. To eliminate the errors induced by unit difference, the extremum method [10] was adopted to remove the dimensionality, i.e., to normalize the index data. The normalization process is detailed below:

The data on positive indices (the greater the value, the better the score) can be processed by [9]

$$X'_{ij} = \frac{X_{ij} - \min X_j}{\max X_j - \min X_j}. \quad (1)$$

The data on negative indices (the smaller the value, the better the score) can be processed by [9]

$$X'_{ij} = \frac{\max X_j - X_{ij}}{\max X_j - \min X_j}, \quad (2)$$

where X_{ij} is the data of index j in year i, X'_{ij} is the normalized value, $maxX_j$ is the maximum of index j, and $minX_j$ is the minimum of index j. All normalized values fall between zero and one.

2.1.2. Weight Determination. It is very important to determine the weight, as it measures the importance of the corresponding index. In this paper, the indices are weighed by the coefficient of variation method [6]. This objective weighting method directly calculates the weight of each index according to the information contained in that index. The coefficient of variation [11, 12], also called the relative standard deviation, can overcome the difficulty in comparing index data with different units or means. The indices were weighed in the following steps:

(1) Calculate the coefficient of variation, i.e., the ratio of standard deviation to mean [12]:

$$V_j = \frac{\sigma_j}{\overline{X}_j}, \quad (3)$$

where V_j is the coefficient of variation of index j, σ_j is the standard deviation of index j, and $\overline{X}_j$ is the mean of index j.

(2) Calculate the weight of each index [12], i.e., the coefficient of variation of the index as a proportion of the sum of the coefficients of variation for all indices [12]:

$$\omega_j = \frac{V_j}{\sum_{j=1}^{n} V_j}, \quad (4)$$

where ω_j is the weight of index j, V_j is the coefficient of variation of index j, and $\sum_{j=1}^{n} V_j$ is the sum of the coefficients of variation for all indices.

2.1.3. Composite Indices. After determining the weights of all indices, linear weighted summation was carried out to compute the composite indices of new urbanization and eco-environment [3, 4]:

$$P_1 = \sum_{j=1}^{m} X'_{ij}\omega_j, \quad (5)$$

$$P_2 = \sum_{j=1}^{n} Y'_{ij}\omega_j, \quad (6)$$

where X'_{ij} and Y'_{ij} are the normalized values of eco-environment and new urbanization, respectively, ω_j is the weight of index j, and P_1 and P_2 are the composite indices of eco-environment and new urbanization, respectively. The greater the values of P_1 and P_2, the better the composite evaluation.

2.1.4. Model of Relative Development Level. Relative development level intuitively compares the development level of new urbanization with that of eco-environment [1]:

$$A = \frac{P_2}{P_1}, \tag{7}$$

where A is the relative development level and P_1 and P_2 are the composite indices of new urbanization and eco-environment, respectively. If $0 < A \leq 0.9$, then the development of eco-environment lags that of the new urbanization; if $0.9 < A \leq 1.1$, then the development of eco-environment is in sync with that of the new urbanization; if $A > 1.1$, then the development of eco-environment leads that of the new urbanization [1].

2.2. CCD Model

2.2.1. Coupling Degree Model. Borrowed from physics, the term coupling [5] describes the interrelationship and the degree of mutual constraint between two or more systems. The fast advancement of new urbanization will surely cause problems like air and water pollution, and eco-environment deterioration, Therefore, this paper regards new urbanization and eco-environment as two different systems and introduces the term "coupling" to study the relationship between them. The coupling between two systems refers to the closeness between them. The closer the two systems, the higher the coupling degree between them. Hence, the coupling degree between systems can be evaluated by [5]

$$C = \frac{2\sqrt{P_1 \cdot P_2}}{P_1 + P_2}, \tag{8}$$

where C is the coupling degree and P_1 and P_2 are the composite indices of new urbanization and eco-environment, respectively. The C value falls in [0, 1]. If the C value approximates 0, the two systems are completely uncoupled, belonging to the disordered phase; if the C value approximates 0, the two systems achieve the perfect coupling state. Table 1 divides the coupling degree into four levels.

As shown in Table 1, when the coupling value falls in (0, 0.3], new urbanization and eco-environment is in a low stage coupling. At this stage, the degree of the interaction of the two is small, the development of new urbanization basically will not affect the development of eco-environment, and on the other hand, the development of eco-environment basically will not influence the development of new urbanization; when the coupling value falls in (0.3, 0.5], new urbanization and eco-environment are in the antagonistic stage. At this stage, the degree of interaction between the two increases. The development of new urbanization will cause damage to eco-environment, and the development of eco-environment will weaken the carrying capacity of new urbanization. When the coupling value falls in (0.5, 0.8], new urbanization and eco-environment are in the run-in stage. At this stage, the interaction between the two is relatively strong, which belongs to a benign development state. When the coupling value falls in (0.8, 1], new urbanization and eco-environment are in a high level coupling stage. At this stage, the interaction between the two is very strong, and at the same time, new urbanization and eco-environment are in an orderly development state.

2.2.2. CCD Model. The coupling degree cannot truthfully demonstrate the level of coordinated development between the two systems. For instance, the coupling degree remains high, when the composite indices of new urbanization and eco-environment are both low [6]. To solve the problem, the CCD model was introduced to reflect the system trend from disorderliness to orderliness and mirror the coupled and coordinated development between the two systems. The CCD model can be used to analyze the coordination development level between two systems, and it can be established as [13]

$$\begin{aligned} P &= \alpha P_1 + \beta P_2, \\ D &= \sqrt{C \cdot P}, \end{aligned} \tag{9}$$

where P is the overall development level of the two systems, D is the CCD, and α and β are the weights reflecting the importance of new urbanization and ecosystem to the entire system, respectively. In general, the two factors have the same importance, that is, $\alpha = \beta = 0.5$.

To better characterize the coordinated development of new urbanization and eco-environment, the CCD was divided into multiple categories [13], in reference to the research of predecessors and the development state of Shaanxi (Table 2).

2.3. Grey Correlation Model. Grey correlation is a method to analyze the grey system containing both known and unknown information. The essence of grey correlation degree model is to calculate the correlation degree and then use the magnitude of the correlation degree to accurately identify the key factors. The coupling between new urbanization and eco-environment is interactive, complex, and sequential in time. Therefore, grey correlation can characterize the correlation degree between the indices of new urbanization and eco-environment and facilitate the identification of the key factors in the coupled and coordinated development between the two systems. Grey correlation [14] can be calculated in the following steps:

(1) Calculate the correlation coefficient based on the data on new urbanization and eco-environment [14]:

$$\xi_{ij}(t) = \frac{\min_i \min_j \left|X_i(t) - Y_j(t)\right| + \rho \max_i \max_j \left|X_i(t) - Y_j(t)\right|}{\left|X_i(t) - Y_j(t)\right| + \rho \max_i \max_j \left|X_i(t) - Y_j(t)\right|}, \tag{10}$$

where t is the year; $X_i(t)$, $(i = 1, 2, \ldots, 14)$ is the normalized value of new urbanization in year t; $Y_j(t)$, $(j = 1, 2, \ldots, 9)$ is the normalized value of eco-environment in year t; $\xi_{ij}(t)$ is the correlation coefficient between $X_i(t)$ and $Y_j(t)$ in year t; and ρ is the identification coefficient. The value of ρ is normally set to 0.5.

Table 1: Classification of coupling degree.

C value	Phase	System development trend
(0, 0.3]	Low coupling	Eco-environment is not severely damaged and can carry the load of urbanization
(0.3, 0.5]	Antagonist phase	Eco-environment is severely damaged, and its carrying capacity of urbanization load weakens
(0.5, 0.8]	Run-in phase	Urbanization development enters the phase of benign coupling
(0.8, 1]	High coupling	The two systems move toward orderly development

Table 2: Classification of CCD.

D	(0, 0.2]	(0.2, 0.4]	(0.4, 0.6]	(0.6, 0.8]	(0.8, 1]
Levels	High incoordination	Medium incoordination	Low coordination	Medium coordination	High coordination

(2) Calculate the arithmetic mean of $\xi_{ij}(t)$ in each year; i.e., obtain the correlation degree r_{ij} between X_i and Y_j [14]:

$$r_{ij} = \frac{1}{n}\xi_{ij}(t), \tag{11}$$

where r_{ij} falls between [0, 1]. If r_{ij} approximates 1, the degree of correlation is strong; otherwise, the degree of correlation is weak. Referring to the research by other scholars, the correlation intensity was defined as follows: $r_{ij} < 0.45$ means low correlation; $0.45 \le r_{ij} \le 0.65$ means medium correlation; $r_{ij} > 0.65$ means high correlation.

3. Index Selection and Data Sources

3.1. Construction of Evaluation System. Drawing on the existing results, this paper establishes a comprehensive evaluation system (CES) for new urbanization from 4 dimensions: population urbanization, economic urbanization, social urbanization, and spatial urbanization [10]. The 14 indices in the CES are listed in Table 3. Another CES was created for eco-environment, which covers 9 indices in three dimensions (Table 4).

3.2. Data Sources. Since new urbanization was conceptualized in 2007; this paper defines the sample period as 2007–2018. The data were mainly collected from *China Urban Construction Statistical Yearbooks*, *Shaanxi Statistical Yearbooks*, *China Statistical Yearbooks*, *Shaanxi Regional Statistical Yearbooks*, Statistical Bulletin on National Economic and Social Development of Shaanxi Province, Shaanxi Provincial Bureau of Statistics, and various information websites.

4. Empirical Results and Analysis

4.1. Development Levels of New Urbanization and Eco-Environment. The indices of the CESs for new urbanization and eco-environment were weighed by formulas (3) and (4). The results are recorded in Table 5.

The index weights and normalized data were subjected to weighted summation by formulas (5) and (6), producing the composite indices of new urbanization and eco-environment in Shaanxi (Table 6).

As shown in Table 6, the composite index of new urbanization in Shaanxi increased linearly from 0.036 in 2017 to 0.961 in 2018, with a large growth each year. Since the proposal of new urbanization in 2007, Shaanxi Province has actively responded to the national policy and attached great importance to the development quality of urbanization. While pursuing the growth of urbanization rate, Shaanxi has paid more attention to the sustainability of urbanization, continuously enhanced the overall bearing capacity of urban areas, and implemented government regulation under the dominance of market mechanism. Therefore, the quality of new urbanization has been drastically improved. From 2007 to 2018, the composite index of eco-environment in Shaanxi slowly increased from 0.128 to 0.773. Although the development of eco-environment was initially higher than that of new urbanization (0.036), the eco-environment has been developing slowly at a small annual growth rate.

4.2. Relative Development Level. The relative development level of new urbanization and eco-environment in Shaanxi was calculated by formula (7). The results are displayed in Figure 1.

As shown in Figure 1, from 2007 to 2012, the relative development level A was greater than 1.1, indicating that the development of new urbanization lags that of eco-environment. The lag is particularly obvious in 2007, when the A value reached 3.556. In the start-up phase of new urbanization, the eco-environment of Shaanxi developed well and could withstand the two pressures brought by urbanization, namely, resource shortage and environmental pollution.

When it comes to 2008, the A value nosedived to 1.817. Lacking the relevant experience, Shaanxi blindly pursued the rapid growth of new urbanization, failing to consider the coupling and coordination between new urbanization and other systems, especially the eco-environment system. To a certain extent, the neglection of the coupling and coordination damages the eco-environment, posing a huge challenge to the sustained healthy development of eco-environment.

From 2013 to 2017, the A value basically remained between 0.9 and 1.1. New urbanization and eco-environment realized coordinated development, despite slight fluctuations. After several years of exploration, the development of new urbanization began to take shape and kept the same pace with eco-environment development.

Table 3: CES of new urbanization.

Goal layer	Criteria layer	Alternative layer	Index property
New urbanization	Population urbanization	Registered urban unemployment rate X_1 (%)	Negative
		Natural population growth rate X_2 (%)	Positive
	Economic urbanization	Per-capita gross domestic product (GDP) X_3 (yuan)	Positive
		Proportion of tertiary industry output X_4 (%)	Positive
		Fixed asset investment X_5 (100 million yuan)	Positive
		Per-capita disposable income of urban residents X_6 (yuan)	Positive
	Spatial urbanization	Urban area X_7 (km^2)	Positive
		Built-up area X_8 (km^2)	Positive
		Per-capita urban road area X_9 (m^2)	Positive
		Proportion of urban construction land in urban area X_{10} (%)	Positive
	Social urbanization	Consumer price index (CPI) X_{11}	Positive
		Total retail sales of consumer goods X_{12} (100 million yuan)	Positive
		Number of hospital beds per 10,000 people X_{13} (each)	Positive
		Gas penetration rate X_{14} (%)	Positive

Table 4: CES of eco-environment.

Goal layer	Criteria layer	Alternative layer	Index property
Eco-environment	Eco-environment stress	Industrial wastewater emissions Y_1 (10,000 tons)	Negative
		Industrial solid waste emissions Y_2 (10,000 tons)	Negative
		Urban sewage emissions Y_3 (10,000 m^3)	Negative
	Eco-environment state	Green coverage of built-up area Y_4 (%)	Positive
		Per-capita park and green area Y_5 (m^2)	Positive
		Park area Y_6 (hectares)	Positive
	Eco-environment response	Harmless treatment rate of domestic garbage Y_7 (%)	Positive
		Clean-up amount of domestic garbage Y_8 (10,000 tons)	Positive
		Sewage treatment rate Y_9 (%)	Positive

Table 5: Index weights.

Goal layer	Criteria layer	Index weight	Alternative layer	Index weight
New urbanization	Population urbanization	0.0568	X_1	0.0287
			X_2	0.0281
	Economic urbanization	0.4454	X_3	0.1338
			X_4	0.0252
			X_5	0.1747
			X_6	0.1117
	Spatial urbanization	0.2489	X_7	0.1024
			X_8	0.0837
			X_9	0.0309
			X_{10}	0.0319
	Social urbanization	0.2489	X_{11}	0.0062
			X_{12}	0.1529
			X_{13}	0.0789
			X_{14}	0.0109
Eco-environment	Eco-environment stress	0.3611	Y_1	0.1101
			Y_2	0.1271
			Y_3	0.1239
	Eco-environment state	0.3703	Y_4	0.0163
			Y_5	0.0854
			Y_6	0.2686
	Eco-environment response	0.2686	Y_7	0.0572
			Y_8	0.1087
			Y_9	0.1027

However, the A value was merely 0.804 in 2018, smaller than 0.9. The development of eco-environment now lagged that of new urbanization. The government and the public should pay high attention to eco-environment protection during the construction of new urbanization, trying to make the two systems consistent in development level.

Table 6: Composite indices.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
P_1	0.036	0.104	0.146	0.214	0.294	0.403	0.499	0.559	0.667	0.746	0.882	0.961
P_2	0.128	0.189	0.317	0.401	0.447	0.464	0.511	0.543	0.562	0.740	0.783	0.773

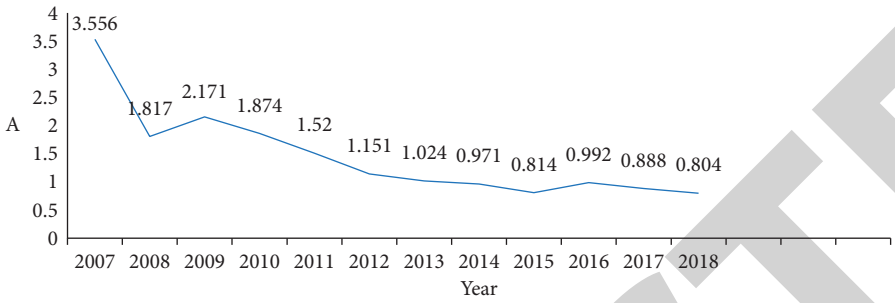

Figure 1: Relative development levels.

4.3. CCD Analysis. The composite indices of new urbanization and eco-environment were substituted into the coupling degree model and the CCD model to compute the coupling degrees and CCDs of the two systems in Shaanxi. Then, the results in 2007–2018 were divided by the classification standards for coupling degree and CCD (Table 7).

As shown in Table 7, the coupling degree between new urbanization and eco-environment in Shaanxi increased with oscillations from 0.829 in 2007 to 0.994 in 2018. Throughout the sample period, the coupling degree was always greater than 0.8, a sign of high coupling phase. This means that new urbanization system and eco-environment system belong to orderly development state. They are interrelated and interdependent in the process of development, but they are independent and nonconflicting. Meanwhile, in the 12 years, the CCD between the two systems in the province rapidly grew from 0.261 in 2007 to 0.928 in 2018. The coupling and coordination between them changed from medium incoordination to high coordination. To ensure the sustainable development of the two systems, during the development of new urbanization, eco-environment must be both highly coupled and highly coordinated with new urbanization.

Table 7: Coupling degrees, CCDs, and their levels.

Year	Coupling degree	Coupling phase	CCD	Coordination levels
2007	0.829	High coupling	0.261	Medium incoordination
2008	0.957	High coupling	0.374	Medium incoordination
2009	0.929	High coupling	0.464	Low coordination
2010	0.953	High coupling	0.541	Low coordination
2011	0.978	High coupling	0.602	Medium coordination
2012	0.997	High coupling	0.658	Medium coordination
2013	1.000	High coupling	0.711	Medium coordination
2014	1.000	High coupling	0.742	Medium coordination
2015	0.995	High coupling	0.776	Medium coordination
2016	1.000	High coupling	0.862	High coordination
2017	0.998	High coupling	0.912	High coordination
2018	0.994	High coupling	0.928	High coordination

4.4. Key Factors. The correlations between the 14 new urbanization indices and the 9 eco-environment indices were calculated by formulas (10) and (11). The values of each row were averaged to obtain the correlation of each new urbanization index with the eco-environment system. Similarly, the authors derived the correlation of each eco-environment index with the new urbanization system. The resulting correlation matrix is shown in Table 8.

As shown in Table 8, the correlations between most indices in the two systems were greater than 0.45. The only exceptions are the correlations of industrial solid waste emissions and industrial wastewater emissions with a few indices in new urbanization system (<0.45). Overall, the two systems of Shaanxi have a strong correlation. The strongest correlation exists between the built-up area of new urbanization system and the park area of eco-environment system. The correlation was as high as 0.920, a sign of high correlation.

Horizontally, the correlations of new urbanization indices with eco-environment system were all greater than 0.45. But the correlations mostly concentrated in the interval of 0.565 and 0.703. Therefore, the new urbanization indices interact closely with eco-environment, but the interactions could be further improved. The highest correlation (0.703) was observed between per-capita GDP of economic

Table 8: Coupling effect matrix between the two systems.

	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	Mean
X_1	0.796	0.459	0.441	0.789	0.778	0.730	0.760	0.710	0.812	0.697
X_2	0.604	0.505	0.497	0.575	0.575	0.710	0.563	0.635	0.540	0.578
X_3	0.882	0.503	0.483	0.743	0.706	0.807	0.688	0.803	0.713	0.703
X_4	0.654	0.473	0.473	0.619	0.614	0.717	0.645	0.658	0.646	0.611
X_5	0.838	0.491	0.475	0.739	0.687	0.834	0.674	0.826	0.698	0.696
X_6	0.846	0.502	0.489	0.753	0.693	0.826	0.677	0.832	0.703	0.702
X_7	0.716	0.440	0.434	0.637	0.628	0.838	0.616	0.766	0.644	0.635
X_8	0.795	0.488	0.492	0.663	0.628	0.920	0.621	0.878	0.643	0.681
X_9	0.784	0.524	0.500	0.759	0.788	0.711	0.777	0.707	0.778	0.701
X_{10}	0.586	0.661	0.695	0.627	0.586	0.513	0.578	0.599	0.563	0.601
X_{11}	0.517	0.700	0.766	0.473	0.507	0.530	0.508	0.593	0.486	0.565
X_{12}	0.816	0.480	0.487	0.718	0.667	0.877	0.654	0.875	0.679	0.695
X_{13}	0.849	0.483	0.477	0.722	0.682	0.852	0.669	0.848	0.693	0.697
X_{14}	0.725	0.521	0.498	0.802	0.796	0.666	0.819	0.667	0.796	0.699
Mean	0.743	0.516	0.515	0.687	0.667	0.752	0.661	0.743	0.671	

urbanization subsystem and eco-environment system, followed by per-capita disposable income of urban residents of the same subsystem. By contrast, the CPI of social urbanization subsystem and natural population growth rate of population urbanization subsystem had relatively weak correlations with eco-environment system (0.565 vs. 0.578). This means that the resource endowment of eco-environment creates a favorable space and carrier for the construction and promotion of new urbanization; with the gradual development of new urbanization, especially economic urbanization, lots of funds are diverted to the improvement and maintenance of eco-environment.

Vertically, the correlations of eco-environment indices with new urbanization system were above 0.65, except two indices: industrial solid waste emissions and industrial wastewater emissions of eco-environment stress subsystem. Thus, the eco-environment indices have a high correlation with new urbanization system. The strongest correlation was observed between park area and new urbanization system (0.752). It can be seen that, during the construction of urbanization, people care much about spiritual enjoyment. The growing size and number of parks help improve the overall development quality of urbanization.

5. Conclusions and Prospects

According to the connotations of new urbanization and the actual situation of Shaanxi, this paper constructs the CESs for new urbanization and eco-environment. Based on the data of the province in 2007–2018, the weight of each index was determined by coefficient of variation method, and the development levels of the two systems were measured by composite index method. Afterwards, the relative development levels of the two systems were evaluated by the relative development level model. Then, the coupling degree model and CCD model were called to determine the coupling phase and coordinated level between the two systems. Finally, the grey correlation model was adopted to analyze the correlation between the indices of the two systems and identify the key factors. The main conclusions are as follows:

(1) The development level of new urbanization in Shaanxi increased linearly, while that of eco-environment increased slowly. In 2007, when new urbanization was conceptualized, the composite level of eco-environment was above that of the new urbanization. In 2018, however, the composite level of new urbanization was far beyond that of eco-environment and approximated 1.

(2) The relative development level decreased year by year, with slight fluctuations. In 2007–2012, the relative development level was above 1.1, and the development of new urbanization lagged that of eco-environment; but the gap gradually narrowed. In 2013–2017, the relative development level stabilized between 0.9 and 1.1, indicating the coordinated development between the two systems with oscillations. In 2018, the relative development level was smaller than 0.9, suggesting that the development of eco-environment lagged that of new urbanization.

(3) From 2007 to 2018, the new urbanization and eco-environment in Shaanxi were highly coupled. In these 12 years, the CCD between the two systems in the province changed significantly, improving from medium incoordination to high coordination.

(4) Overall, the new urbanization system of Shaanxi is strongly correlated with the eco-environment system. The highest correlations belong to the built-up area of new urbanization system and the park area of the eco-environment system. Specifically, the per-capita GDP of the economic urbanization subsystem has the strongest correlation with the eco-environment system, while the park area of the eco-environment state subsystem has the strongest correlation with the new urbanization system.

According to the results on the CCD of new urbanization and eco-environment in Shaanxi and its influencing factors, several countermeasures were proposed:

(1) Step up eco-environment protection and improve the awareness of eco-environment protection. In recent

years, eco-environment development lagged severely in Shaanxi Province, which hinders the development of new urbanization. The province should carry out environmental education through various networks and channels and continuously enhance the citizen awareness of eco-environment protection. Firstly, the leaders at all levels should learn the importance of environmental protection, and the government departments must actively implement environmental supervision. Secondly, the environmental awareness of enterprise management should be reinforced, and the relevant laws and regulations must be in place. In particular, the management should improve their ability to properly handle industrial waste and establish the consciousness of resource conservation.

(2) Reasonably use local fiscal revenue to improve urban infrastructure. The province should construct better public roads and facilities and provide some intangible services. To improve the urbanization quality, the infrastructure quality should match the development level of urbanization. The improvement of infrastructure encourages residents to migrate from rural areas to cities and attracts investment from developers. In addition, public investors should be encouraged to invest in public construction projects. The government needs to formulate some incentive policies, opening new channels to diverse the financing means.

(3) Improve eco-environment carrying capacity during the rapid development of new urbanization. The government should control the expansion of energy-inefficient enterprises and support the development of energy-efficient ones instead. This strategy could promote green consumption and drive the development of environmental-friendly industries, thereby improving our living quality and resource utilization. In this way, both new urbanization and eco-environment can achieve benign development.

However, although this paper has carried out a lot of studies on the coupling coordination and influencing factors of new urbanization and eco-environment in Shaanxi, China, there are still the following deficiencies:

(1) Due to the availability of data, this paper only studied the overall situation of Shaanxi, China, and did not go into each prefecture-level city, so the research was not in-depth enough.

(2) Due to limited space, this paper does not compare Shaanxi China with other provinces of China.

Therefore, in future research, relevant data will be collected to conduct a more in-depth study on the relationship between new urbanization and eco-environment in Shaanxi, China.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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