

Evaluation of Intensive Construction Land Use in the Emerging City Based on PSR-Entropy model

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Abstract. A comprehensive understanding of emerging city land utilization and the evaluation of intensive land use in the Emerging City will provide the comprehensive and reliable technical basis for the planning and management. It is an important node. According to the Han cheng from 2008 to 2016 years of land use, based on PSR-Entropy model of land use evaluation system, using entropy method to determine the index weight, the introduction of comprehensive index method to evaluate the degree of land use. The results show that the intensive land use comprehensive evaluation index of Han cheng increased from 2008 to 2015, but the land intensive use can not achieve the standards. The potential of further enhancing space is relatively large.

1. Introduction

Under the new urbanization, the urban landscape of China' is undergoing tremendous changes, and urban land use is rapidly transforming. China is currently in the stage of rapid economic and social development, industrialization, urbanization, so the construction land is extremely scarce resources [1]. The contradiction between the ever-expanding construction land area and the scarce land resources is increasing. On one hand, the nationwide construction land continued to grow rigidly [2-4]. On the other hand, most of the emerging cities of land use is still in the extensive expansion mode and construction land use level is still in the low stage of use [5, 6]. Therefore, it is necessary to solve the contradiction between land supply and demand in the rapid process of urbanization and realize the sustainable development of the land use efficiency and efficiency.

The evaluation of intensive use of construction land is complicated. Domestic and foreign scholars have done a lot of research, but indicators are often relatively simple, and the evaluation focused on large and medium-sized cities. Based on the land use situation of Han cheng City in Han cheng, Shaanxi Province in 2008-2015, this paper constructs the evaluation system of urban land use based on PSR model and uses the entropy weight method to determine the index weight, and introduces the



comprehensive index method to evaluate the urban construction land intensive degree, Which can provide reference for the intensive use of construction land and its evaluation standard in emerging cities.

2. Overview of research areas and data sources

2.1. Overview of research areas

Han cheng is located in the eastern part of Shaanxi Yellow River in the west bank, Guan zhong Basin northeast corner and strategic location. Han cheng was listed as the second batch of national new urbanization comprehensive pilot area in 2015. At the end of 2015 the city's resident population is 398, 600.

2.2. Data sources

The original data of this paper mainly comes from "Statistical Yearbook of Han cheng" (2008-2015), "Statistical Communiqué of National Economic and Social Development of Han cheng" (2008-2015), China Urban Statistical Yearbook (2008-2015) and some government websites Statistical data.

3. Research methods

3.1. PSR model

"PSR model" is the "pressure - state - response" model. OECD proposed the PSR model, the human pressure on the natural, the status of resources, management measures as a whole system to consider the response to the use of resources to reveal the relationship between man and land. PSR model is used by domestic scholars in the intensive use of land, and it is generally considered that it can better explain the connotation of intensive land use.

3.2. Entropy model

Entropy method is a kind of information according to the amount of information contained in each index element, through the mathematical statistical formula calculation method to calculate the weight of the objective method. The entropy weight method is as follows: (1) The original data is normalized. (2) Calculate the information entropy of each index. (3) Calculate the entropy weight of each index.

4. Establishment of PSR - entropy model

4.1. Establishment of PSR Evaluation Index System

Based on the PSR model analysis framework of urban construction land intensive use, combined with the economic and social development of the study area and the actual situation of land resources utilization, and considering the completeness and typicality of the existing data, we will build the evaluation system of intensive use of construction land in Hancheng City, which can be quantifiable, easy to obtain the principle of choice. This is divided into target layer, criterion layer and index layer, including the pressure index system, the state index system and the response index system three subsystems of 12 indicators (Table1). The construction sites in this article include residential land, industrial land and water conservancy facilities.

Table 1. Evaluation system of construction land intensive use.

Target layer	Criteria layer	Index layer	Index attribute	Indicator description
Comprehensive Value of Intensive Evaluation of Construction Land in Hangzhou	Pressure index	Population load (Million people/ km ²)	+	Resident population/Construction land area
		Secondary and tertiary industry GDP and construction land elasticity coefficient	+	Construction land growth rate/Second, the tertiary industry GDP growth rate
		Construction land and population annual growth rate	+	Construction land growth rate/Population growth rate
	Status indicator	Per capital road area (m ²)	+	Used to measure the integrity of the infrastructure
		Unit construction land two, three industry GDP(Million·km ²)	+	Second, the industry's GDP/Construction land area
		Construction land rate	+	Construction land area/Total land area
		Per capital construction land area(km ²)	-	Construction land area/Resident population
	Response indicator	Investment in fixed assets (Million·km ²)	+	Investment in fixed assets/Resident population
		Ground infrastructure inputs (Million·km ²)	+	Infrastructure inputs/Resident population

4.2. Entropy Method to Determine Index Weight

4.2.1. *Indicators of quantification and standards.* Firstly, the original data matrix is constructed. For the evaluation index system of n years, the original data matrix A can be constructed.

$$A = \begin{pmatrix} X_{11} & \cdots & X_{1m} \\ \vdots & \vdots & \vdots \\ X_{n1} & \cdots & X_{nm} \end{pmatrix}_{n \times m} \quad (1)$$

Which X_{ij} is the i year of the j index of the value.

Because the entropy method is used to calculate the ratio of the same index value of each index, it does not need to be standardized. If there is a negative number in the data, it needs to be non-negative. In addition, in order to avoid entanglement when the logarithmic meaningless, the need for data translation:

For the bigger the better indicators:

$$X'_{ij} = \frac{X_{ij} - \min(X_{1j}, X_{2j}, \dots, X_{nj})}{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - \min(X_{1j}, X_{2j}, \dots, X_{nj})} + 1, \quad i = 1, 2, \dots, n; j = 1, 2, \dots, m \quad (2)$$

For the smaller the better indicators:

$$X'_{ij} = \frac{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - X_{ij}}{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - \min(X_{1j}, X_{2j}, \dots, X_{nj})} + 1, i = 1, 2, \dots, n; j = 1, 2, \dots, m \quad (3)$$

For convenience, the data after non-negative treatment is kept X_{ij} . The standardized results are shown in Table2.

Table 2. The standard value on intensive use of the construction land of Han cheng.

	Index	Raw data normalized value							
		2008	2009	2010	2011	2012	2013	2014	2015
Press- ure	Population load	0.692	0.705	0.720	0.731	0.779	0.799	0.841	0.895
	Secondary and tertiary industry GDP and construction land elasticity coefficient	0.278	0.335	0.407	0.544	0.586	0.593	0.610	0.657
	Construction land and population annual growth rate	0.358	0.363	0.386	0.446	0.476	0.496	0.503	0.542
state	Per capital road area	0.394	0.420	0.630	0.756	0.751	0.765	0.794	0.800
	Unit construction land two, three industry GDP	0.278	0.335	0.407	0.544	0.586	0.634	0.654	0.674
	Construction land rate	0.694	0.705	0.713	0.724	0.736	0.744	0.750	0.772
	Per capital construction land area	0.782	0.718	0.704	0.694	0.685	0.672	0.643	0.628
respo- nse	Investment in fixed assets	0.147	0.223	0.295	0.331	0.45	0.560	0.663	0.695
	Ground infrastructure inputs	0.537	0.539	0.587	0.661	0.757	0.784	0.796	0.800

4.2.2. Calculate the information entropy of each index. Calculate the share of the index in the first year of the index:

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^n X_{ij}} \quad (j = 1, 2, \dots, m) \quad (4)$$

Calculate the entropy of the first indicator:

$$e_j = -k * \sum_{i=1}^n P_{ij} \log(P_{ij}), e_j \geq 0 \quad (5)$$

$$\text{the constant } k \text{ is related to the number of samples } m, k = \frac{1}{\ln m}, 0 \leq e \leq 1. \quad (6)$$

4.2.3. The entropy of each index. According to the index system, the entropy weight method is used to calculate the weight value of intensive use index of construction land in Han cheng (Table3). We will calculate the difference coefficient of the j indicator. For the j, the larger the difference of the index

value, the greater the role of the evaluation of the scheme, and the lower the entropy value. Utility value : $g_j = 1 - e_j$, then: the greater of the g_j , the more important indicators.

Table 3. Evaluation index weighting for the intensive use of construction land in Han cheng.

Evaluation factor	Information entropy	Utility value	Weights/%
Population load	0.2108	0.7892	11.08
Secondary and tertiary industry GDP and construction land elasticity coefficient	0.2074	0.7926	11.13
Construction land and population annual growth rate	0.2101	0.7899	11.09
Per capital road area	0.2081	0.7919	11.12
Unit construction land two, three industry GDP	0.2069	0.7931	11.13
Construction land rate	0.2111	0.7889	11.07
Per capital construction land area	0.2110	0.7890	11.08
Population load	0.2002	0.7998	11.23
Secondary and tertiary industry GDP and construction land elasticity coefficient	0.2099	0.7901	11.09

5. Evaluation process and result analysis

5.1. Estimation of Comprehensive Value of Intensive Use of Construction Land in Han cheng

To achieve the intensive use of urban construction land, it is necessary to coordinate the internal system of "pressure-state-response" system in urban land use to realize economic development and social progress within the moderate pressure of land. The comprehensive evaluation of the evaluation index of urban construction land takes into account the comprehensive effect of each evaluation index. The weights of the three sub-systems are obtained by constructing the two pairs of comparison matrix, and the weights of the pressure, the state and the response are obtained as follows: $r_1 = 0.284$, $r_2 = 0.417$, $r_3 = 0.299$. You can calculate the comprehensive utilization of urban construction land in Han cheng (Table4). Therefore, we get the urban construction land intensive use of comprehensive evaluation formula:

$$E = r_1 \sum_{i=1}^n W_i P_i + r_2 \sum_{j=1}^n W_j P_j + r_3 \sum_{k=1}^n W_k P_k \quad (7)$$

E is the comprehensive evaluation index of urban land intensive use, r is the weight of three subsystems of stress, state and response, W is the weight of each specific indicator to the respective subsystem, and P is the value of each specific index.

Table 4. The results of construction land intensive use evaluation of Han cheng.

Criteria layer	2008	2009	2010	2011	2012	2013	2014	2015
Pressure system	0.042	0.044	0.048	0.054	0.058	0.060	0.062	0.066
State system	0.099	0.101	0.114	0.126	0.128	0.130	0.132	0.133
Response system	0.023	0.025	0.029	0.033	0.040	0.045	0.049	0.050
Comprehensive evaluation index	0.164	0.171	0.191	0.213	0.226	0.235	0.242	0.249

5.2. Evaluation of the results

From the comprehensive evaluation results, from 2008 to 2015, the construction land intensive use of the comprehensive evaluation index showed an increasing trend, indicating that the intensive use of urban land is increasing.

5.2.1. Construction land use pressure. The pressure of construction land use mainly refers to the economic and social activities of human beings, including the development and unreasonable exploitation of construction land resources, which directly or indirectly affect the intensive use of construction land. Han cheng industrial industry developed and has the relative proportion of construction land as a traditional industrial city. The intensive use of construction land in Han cheng shows an increasing trend over time, from 2008 to 2015, showing a growth trend, which shows that due to population density, population and land growth flexibility, two, three industry GDP and land growth and elastic growth, the intensive use of construction land has achieved good results.

5.2.2. Construction land use status. Construction land use status refers to the construction land use system in the face of construction land use pressure, the construction land environment changes and the state, including nature, resources, environment, the status of human living standards and social coordination Degree. From 2008 to 2015, the construction land status index rose from 0.099 to 0.133, indicating that the intensive use of construction land in good condition.

5.2.3. Construction land use response. Construction land use response refers to the human takes appropriate measures to reduce, prevent, restore and prevent human activities on the negative impact of land use in the face of construction land pressure, the response to the use of land use response to reflect the problems. This promotes the intensive use of construction land and is conducive to economic and social development. The response index of urban construction land use in Han cheng increased from 0.023 in 2008 to 0.50 in 2015. On the whole, the response index showed a fluctuating trend, which also indicated that the response to urban land intensification was fully Claim.

6. Conclusion

(1) It is feasible to construct the evaluation index system based on the PSR model and to guide the practice of intensive use of urban construction land on the basis of the connotation of the intensive use of urban construction land.

(2) In urban construction land intensive use of the PSR system, the subsystems and their internal indicators from different levels and angles reflect the level of urban construction land intensive use. The comprehensive evaluation index of urban construction land intensive use can be used to measure the extent of urban construction land use.

(3) The evaluation of the intensive use of urban construction land should also be combined with practice to carry out dynamic evaluation in practice. This paper evaluates the problem but does not raise the corresponding countermeasures, and the latter research should be supplemented and perfected.

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