Urban Land Use Intensity and Efficient Evaluation in X City: Based on Principal Component Analysis

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Abstract

In order to assess the performance of urban land use in X City and to identify the problems in land use, principal component analysis is used in this paper to assess urban land use intensive and efficient. By seeking to local Statistical Yearbook, the local government work report, the local government budget and its implementation report and other related information on X City, the study collects land use performance indicators data from 2002 to 2008. Analysis results show that the first principal component score is quite close to the composite score sort, which indicates that the first principal component explains most information of the overall level. Empirical results show that X City urban land use efficiency is increased year by year from 2002 to 2008. That is to say, along with increasing input of urban land use, land-use intensity enhanced, and the continuous optimization of urban land use structure, X City efficient and intensive urban land use has become increasingly prominent. Therefore, we should pay more attention to the development of tertiary industry in aspects of urban land productivity, to further improve the output level of urban land in the future. It should be noted that idle land rate up to 30.7% in 2008 is due to the international financial crisis.

Keywords: principal component analysis, land use, performance evaluation

1. Introduction

Land use intensive and efficient assessment is looked as a composite system, and its performance level depends on the inputs and outputs levels of land use, land-use intensity, land use structure and other factors. These factors is not only related with intensive and efficient land use, but also interrelated between themselves, so a simple correlation analysis does not resolve the redundancy error.

The principal component analysis, to simplify land use evaluation system structure, can play a significant role in the correlation between the variables. Principal component analysis can also make many indicators linear combination by reducing the original variables to a few new and represented variables, so performance evaluation indicators Change for a few indicators to replace the multiple indicators. On the other hand, principal component analysis could objectively determine the weights to avoid subjective and arbitrary. Moreover, it not only focuses on typical characteristics of land intensive and efficient use, but also can avoid a lot of duplication of work. Thus the principal component analysis is a comprehensive evaluation method of intensive and efficient land use assessment. That is to say, by principal component analysis, we can have full understanding of the X city urban land use level and its gap in recent years.

Based on urban land intensive and efficient evaluation index system built, by principal component analysis method, used spss16.0 statistical analysis software, this paper selects the X City land intensive and efficient use to establish evaluation and analysis model from 2002 to 2008, and carries out comprehensive analyzes the performance situation in order to improve land intensive and efficient utilization levels and provide the basis for decision making.

2. Data Collection And Analytical Methods

2.1. Data Collection of Land Use Intensive Efficiency Indicator

The main source of indicators data in this article is the following channels, such as *x city statistical yearbook (1998 ~ 2009), x city land use analysis report, x city land use planning text (1997 ~ 2010), the overall x city plan, data sets of the land situation in the province of fujian province 2003, x city urban planning, china city statistical yearbook, environment report on fujian province in 2008* and other online resources data.

Urban land use performance changes in the determination of the time series often have a large impact on empirical results. The same indicators selected time series often yield different results.

The raw data time series on land use in this article is from 2002 to 2008 as the overall analysis of the intensive and efficient indicators. (Shown in Table 1)

Evaluation Dimensions	Evaluation Indicators	Indicator Values						
		2002	2003	2004	2005	2006	2007	2008
Land Investment And Utilization Degree	per unit of land fixed assets investment	10599	12575	16353	22530	29769	40177	43360
	per capita urban maintenance and construction funds	599	281	406	364	300	452	874
	per capita urban construction land area	53.49	68.12	69.63	73.94	78.89	84.96	92.4
	city's comprehensive plot ratio	0.92	0.96	1	1.09	1.18	1.27	1.37
	building density	28.5	29	29.5	30	30.5	31	31.5
Land Use Efficiency	per unit land revenue	2743	2038	2145	2927	3479	4115	4903
	total sales of social consumer goods	22367	17694	21178	24007	25600	28121	32058
	urban per capita disposable income	8326	8948	10231	11026	12274	14351	16554
	industrial land output rate	262419	239287	295475	355379	491646	540565	723583
	per unit area output value of the secondary industry	37583	32166	36795	44199	50024	55060	61361
	per unit area output growth rate of the three industrial	28787	23049	25654	26816	28352	32382	33810
Land Use Structure Rationality	the proportion of construction land area accounted for urban area	0.2	0.25	0.26	0.28	0.2	0.21	0.23
	the proportion of industrial land	0.21	0.21	0.2	0.22	0.19	0.2	0.19
	the proportion of residential land	0.51	0.47	0.46	0.47	0.3	0.3	0.28
	the proportion of roads and squares land	0.11	0.11	0.11	0.11	0.15	0.14	0.13
	the proportion of public facilities land	0.039	0.069	0.068	0.067	0.22	0.23	0.23
	land idle rate	14.3	11.8	5.7	10	7.8	8	30.7

Table 1. Raw Data On Land Use Intensive And Efficient Indicators

2.2. Principal Component Analysis Application Steps

In this paper, the SPSS16.0 system software, as an analytical tool, selects the "Analyze-Date Reduction -Factor" methods as principal component analysis. The specific application steps is as following:

Firstly, the original sample matrix is standardized, for a standardization processing to eliminate the dimensionless inconsistent trend in the indicators and magnitude difference phenomenon, then to establish the correlation matrix R of the variables. By using SPSS collinearity diagnostics, the correlation coefficient matrix R line results show that there is no strong collinearity between variables and it fits for principal component analysis.

Secondly, to calculate the eigenvalues, the contribution rate and the cumulative contribution rate of R. The variance or the eigenvalues of each principal component can be seen from Table II. It is the size of the corresponding composition which can describe how much the original information is. In accordance with the principle that cumulative contribution rate is greater than 80-85%, the first three characteristics values is greater than 1 and the cumulative contribution rate is 95.257%: The first principal component eigenvalues is 12.831, which explains 75.478% of the total variance; the second principal component eigenvalues is 1.943, explaining 11.432% of the total variance; the third principal component eigenvalues is 1.419 and 8.346% of the total variance explained. This indicates that it only needs to extract the three main ingredients, which has been able to explain most of the information and plays a dimensionality reduction. Therefore, the extraction of three principal components is as the first, second and third principal components respectively (Shown in Table 2).

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.831	75.478	75.478	12.831	75.478	75.478	9.746	57.328	57.328
2	1.943	11.432	86.911	1.943	11.432	86.911	3.691	21.711	79.039
3	1.419	8.346	95.257	1.419	8.346	95.257	2.757	16.218	95.257
4	.544	3.201	98.458						
5	.202	1.189	99.647						
6	.060	.353	100.000						
7	4.28E-16	2.517E-15	100.000						
8	2.75E-16	1.619E-15	100.000						
9	1.60E-16	9.425E-16	100.000						
10	1.04E-16	6.170E-16	100.000						
11	5.52E-17	3.247E-16	100.000						
12	-3.79E-18	-2.234E-17	100.000						
13	-1.28E-16	-7.565E-16	100.000						
14	-1.91E-16	-1.124E-15	100.000						
15	-3.24E-16	-1.908E-15	100.000						
16	-5.38E-16	-3.168E-15	100.000						
17	-8.25E-16	-4.856E-15	100.000						

Extraction Method: Principal Component Analysis.

Table 2. Principal Components Explained The Total Variance Of The Original Variables

Thirdly, according to the principal component loading matrix (Component Matrix before and after), the rotation of the original variables can be seen from Table. The first principal component includes the following indicators: per unit of land fixed assets investment, per capita urban construction land area, city's comprehensive plot ratio, building density, per unit land revenue, total sales of social consumer goods, urban per capita disposable income, industrial land output rate, per unit area output value of the secondary industry, the proportion of residential land, the proportion of roads and squares land and the proportion of land for public facilities. These indicators reflect land investment and utilization degree, land use efficiency, land use structure rationality and other aspects of comprehensive development in X City. Among them, per unit of land fixed assets investment, per capita urban construction land area, city's comprehensive plot ratio, building density and urban per capita disposable income are greater than 0.9, which are the key indicators of X City land intensive and efficient use. We also find that the proportion of industrial land, the proportion of residential land and other indicators are negative, indicating that the X City urban land intensive and efficient use exists room for improvement in some aspects, such as industrial land and residential land, thus affecting the urban land intensive and efficient utilization levels. On the other hand, the second and third principal components is land development growth and land continues to grow respectively [1].

Finally, based on principal component analysis, we choose three main ingredient Factor 1, Factor 2 and Factor 3 to construct comprehensive evaluation index, taking their variance contribution rate of 75.478%, 11.432%, 8.346% as their weights, as follows: $Z = 0.75478 \times \text{Factor 1} + 0.11432 \times \text{Factor 2} + 0.08346 \times \text{Factor 3}$. The principal component score, the composite score and ranking are shown in Table 3.

Year	The First Principal Component Score	Ranking	The Second Principal Component Score	Ranking	The Third Principal Component Score	Ranking	The Composite Score	Ranking
2002	-1.74	7	0.92	2	0.86	2	0.04	4
2003	-0.67	6	-0.67	6	-0.54	6	-1.88	7
2004	-0.36	5	-0.53	5	-0.52	5	-1.41	6
2005	0.18	4	-0.19	3	-1.60	7	-1.61	5
2006	0.58	3	-1.02	7	1.33	1	0.89	3
2007	0.97	2	-0.31	4	0.59	3	1.25	2
2008	1.04	1	1.81	1	-0.11	4	2.74	1

Table 3. Each Principal Component Score And Composite Score

3. The Analysis of Assessment Results and Conclusions

3.1. Assessment Results

As shown in Table 3, the first principal component score is quite close to the composite score sort, which indicates that the first principal component explains most information of the overall level. That is to say, the second and third principal components play a supplemented and amended role in the composite score.

Firstly, urban land investment and the degree of utilization in X City, per unit of land fixed assets investment and per capita urban maintenance and construction funds have a significant growth in the past seven years. Moreover, X City per unit of land fixed assets investment is 433.6 million yuan in 2008, which is four times in 2002. At the same time, according to the data of per capita urban construction land area, city's comprehensive plot ratio, building density and other indicators, we find that X City land has been utilized more reasonable and fully, such as urban construction land area per capita increased from 53.49 square meters in 2002 to 92.4 square meters [2].

Secondly, from the relevant index data, it can be seen that X City land output level has been improved by leaps and bounds in the aspects of urban land productivity. Such as per unit land revenue and total sales of social consumer goods have both been steady growth. Especially in the last three years, the annual growth rate of these two indicators are more than 20%. Urban per capita disposable income and per unit area output value of the secondary industry are up to two times in 2008. Furthermore, industrial land output rate increases from 2.62419 billion yuan per k m^2 in 2002 to 7.23583 billion yuan per k m^2 in 2008, an increase nearly 3 times. Comparatively speaking, per unit area output growth rate of the three industrial is relatively low, annual growth rate about 5%. Therefore, in the emphasis on fiscal revenue, the secondary industry, industrial output at the same time, we should pay more attention to the development of tertiary industry in aspects of urban land productivity, to further improve the output level of urban land in the future [3].

Finally, in aspects of urban land use structure in X City from 2002 to 2008, the relevant data show that the indexes, namely the proportion of construction land area accounted for urban area, the proportion of industrial land and the proportion of roads and squares land, were fluctuated respectively 20% to 28%, 19% to 22%, and 11% to 15%. However, residential land proportion is significant downward trend. Residential land accounts for the construction area by 51% in 2002 down to 28% in 2008. The proportion of X City land for public facilities in 2002 and 2005 were 3.9 % and 6.7 % respectively. From the data in the two years, we can see that before 2005, in the process of urban land use, a very small proportion of land for public facilities in X City, but from 2006, the proportion of land for public facilities has been greatly improved, rising to 22%. It means that X City land has been more fully utilized, idle land decreased year by year, by 2002 the land idle rate of 14.3% to 8% in 2007. It should be noted that idle land rate up to 30.7% in 2008 is due to the international financial crisis.

3.2. Research Conclusions

In this paper, principal component analysis is used to assess the efficiency and intensity of X City urban land use. The findings indicate that X City urban land use efficiency is increased year by year from 2002 to 2008. That is to say, along with increasing input of urban land use, land-use intensity enhanced, and the continuous optimization of urban land use structure, X City efficient and intensive urban land use has become increasingly prominent, so the overall level was a linear increase trend.

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